IBM Visual Insights

Version 1.2.0

IBM Visual Insights Guide

Note

Before using this information and the product it supports, read the information in "Notices" on page 199.

This edition applies to IBM® Visual Insights Version 1.2.0 and to all subsequent releases and modifications until otherwise indicated in new editions.

Contents

About this document

This document provides you with information about installing and using IBM Visual Insights to create a dataset that contains images or videos.

Highlighting

The following highlighting conventions are used in this document:

Bold	Identifies commands, subroutines, keywords, files, structures, directories, and other items whose names are predefined by the system. Bold highlighting also identifies graphical objects, such as buttons, labels, and icons that the you select.
Italics	Identifies parameters for actual names or values that you supply.
`Monospace`	Identifies examples of specific data values, examples of text similar to what you might see displayed, examples of portions of program code similar to what you might write as a programmer, messages from the system, or text that you must type.

ISO 9000

ISO 9000 registered quality systems were used in the development and manufacturing of this product.

Chapter 1. IBM Visual Insights overview

The IBM Visual Insights (formerly named IBM PowerAI Vision) platform, built on cognitive infrastructure, is a new generation of video/image analysis platforms. The platform offers built-in deep learning models that learn to analyze images and video streams for classification and object detection.

IBM Visual Insights includes tools and interfaces for anyone with limited skills in deep learning technologies. You can use IBM Visual Insights to easily label images and videos that can be used to train and validate a model. The model can then be validated and deployed in customized solutions that demand image classification and object detection.

The following are the main features of IBM Visual Insights:

Streamlined model training
You can use existing models that are already trained as starting point to reduce the time required to train models and improve trained results.

Single-click model deployment
After you create a training model, you can deploy an API with one click. You can then develop applications based on the model that you deployed.

Data set management and labeling
You can manage both raw and labeled data.

Video object detection and labeling assistance
Videos that you import can be scanned for objects and the objects can be automatically labeled.

Architecture overview

The architecture of IBM Visual Insights consists of hardware, resource management, deep learning computation, service management, and application service layers. Each layer is built around industry-standard technologies.

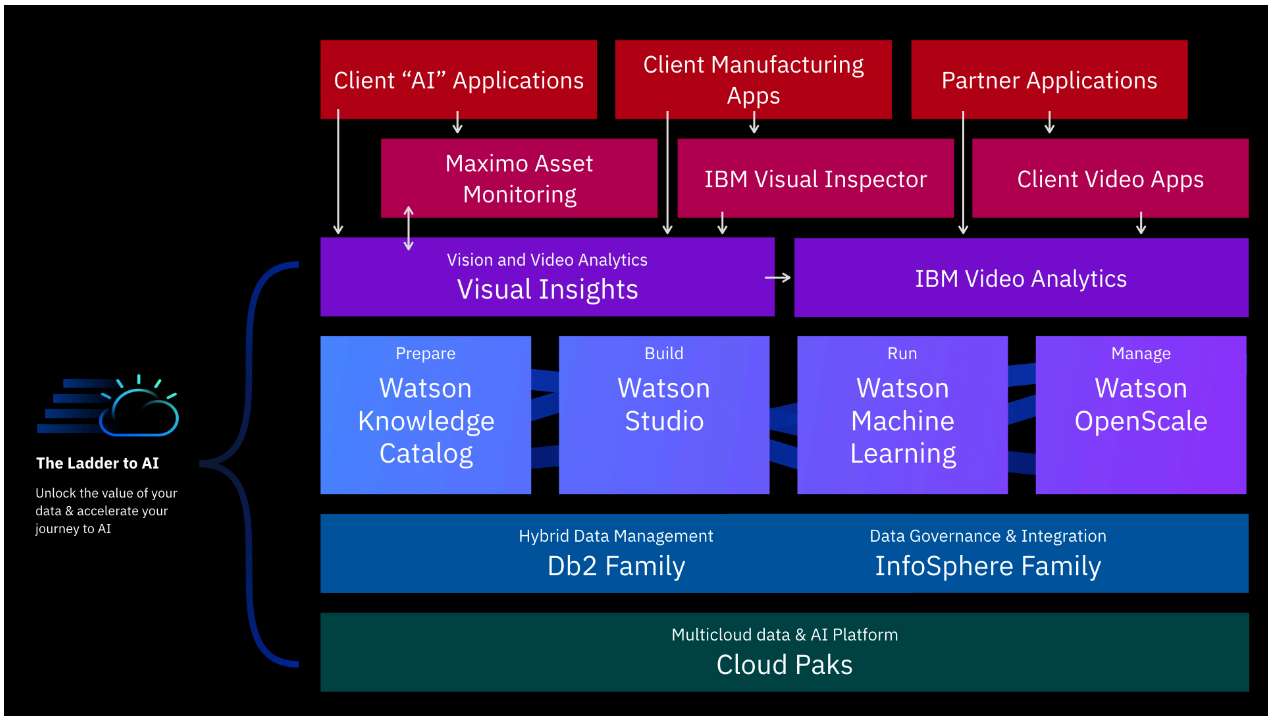


Table 1. Overview of the architecture layers

Architectural Layer	**Description**
Infrastructure Layer	Consists of hardware systems that support IBM Visual Insights, including virtu (containers), accelerators (GPUs/FPGAs), storage systems, networks, and so o
Resource Management Layer	Coordinates and schedules all computing resources.
Deep Learning Calculation Layer	Consists of deep learning algorithms, including data processing modules, mod and prediction modules.
Service Management Layer	Manages user projects in a graphical interface, including image preprocessing, management, data set management, training task management, model manag management.
Application Service Layer	Located on the top of the IBM Visual Insights platform, it is responsible for ma application-related services, including image labeling and preprocessing servi services, customized image classification services, and customized object dete

Use cases

IBM Visual Insights includes these main use cases to demonstrate its capabilities:

Static image classification
Determine whether an image belongs to one or more classes of images based on overall image contents. For example, determining the species of bird in an image.

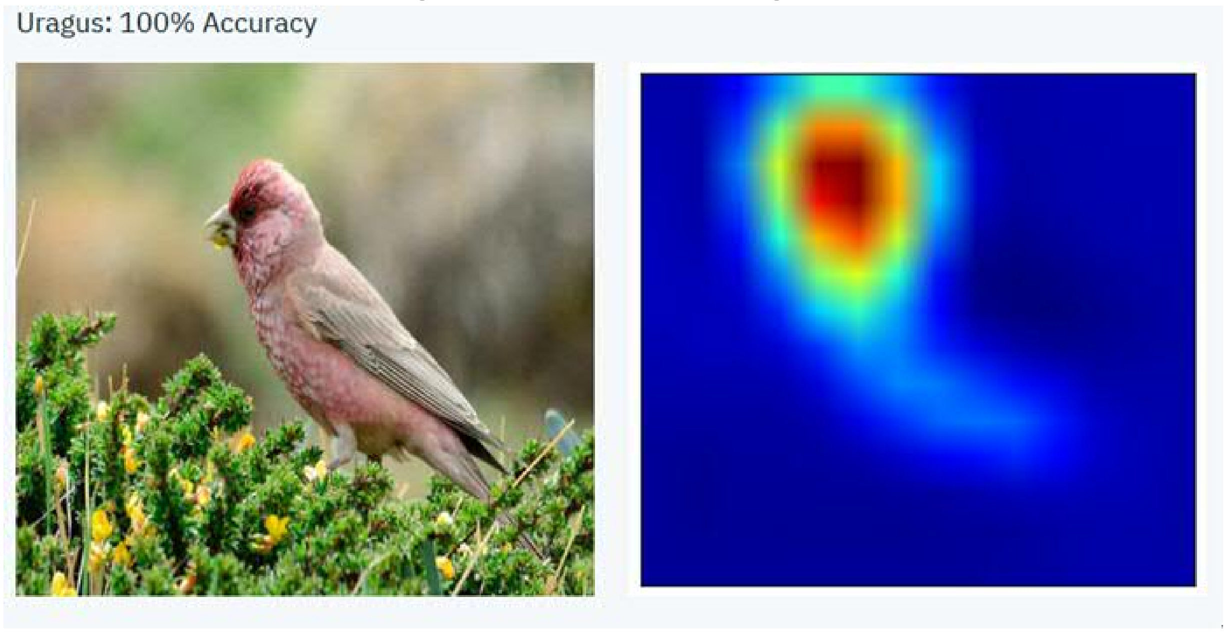


Figure 1. Detecting the overall contents of an image, based on custom training data

Static image object detection
Determine and label the contents of an image based on user-defined data labels. For example, finding and labeling all black cars in an image.

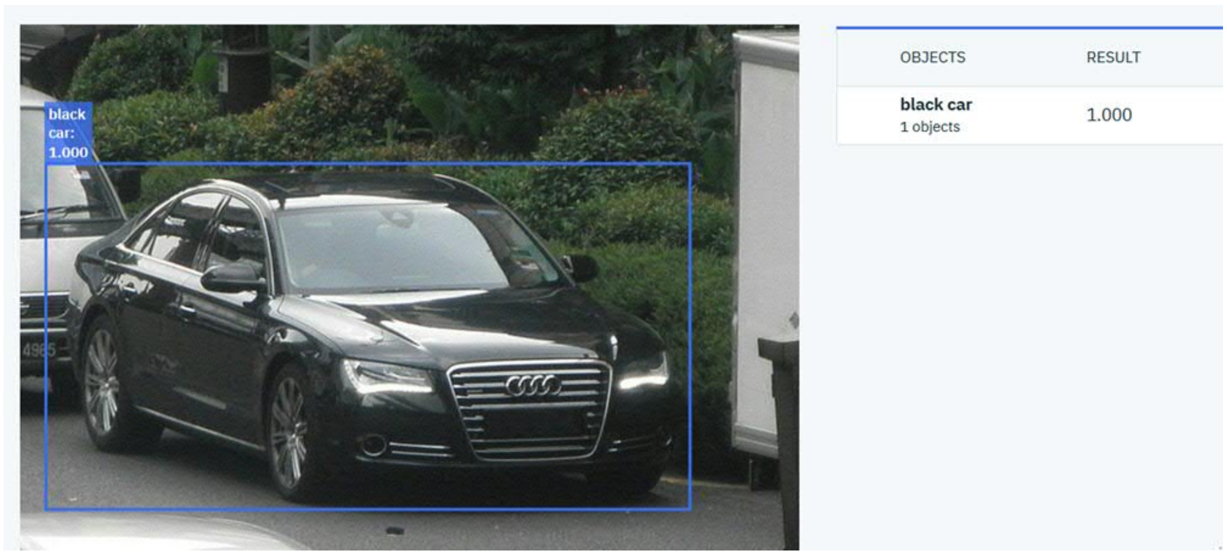


Figure 2. Detecting and labeling instances of objects within an image based on custom training data

Video object detection
Determine and label the contents of an uploaded video or live video stream based on user-defined data labels. For example, finding and labeling all white cars in a video.

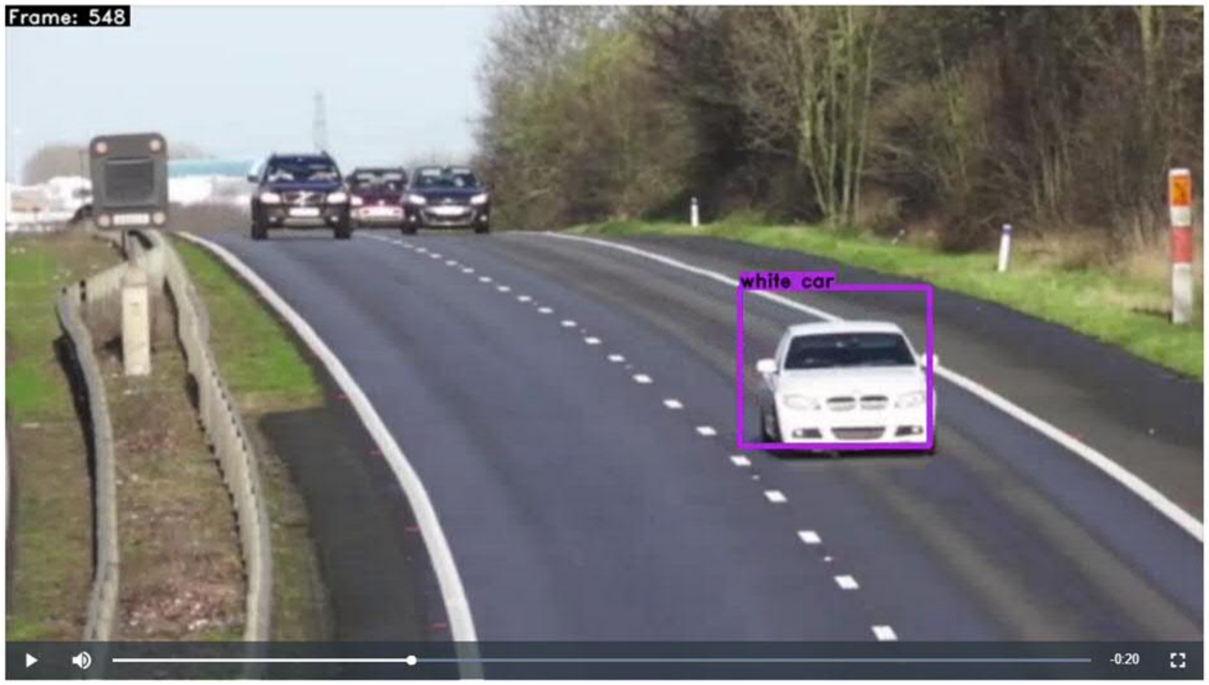


Figure 3. Detecting and labeling instances of objects within captured video frames based on custom training data

Static image segmentation
Determine and label the precise location of objects in an image based on user-defined data labels and arbitrary shapes. For example, find and label the precise boundary of all leaves in an image.

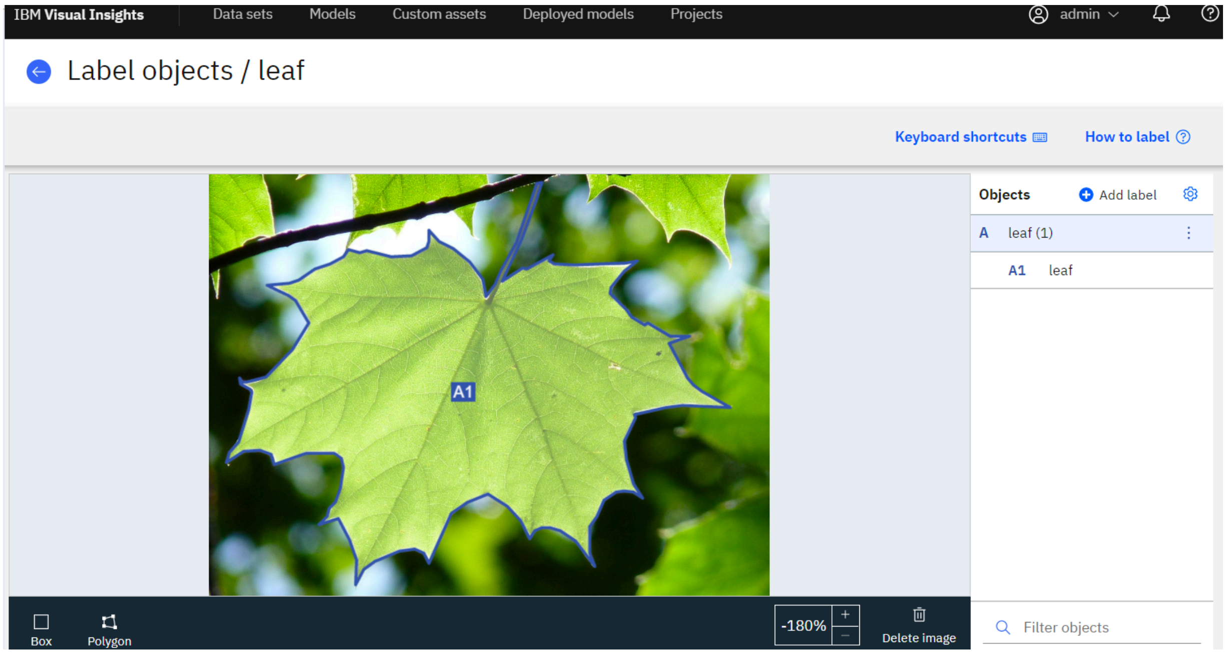


Figure 4. Detecting and labeling the precise edges of an object within an image based on custom training data

Video action detection
Annotate the parts of the video where a specific action is taking place. For example, detect a forehand or backhand stroke in a tennis game.

Auto label an image or video
After deploying a model for object detection, you can improve its accuracy by using the Auto label function. This function uses the labels in the deployed model to generate new labels in the data set; increasing the number of images that are labeled in the data set. The updated data set can be used to train a new, more accurate model.

By default, auto labeled tags are pink, while manually added tags are blue.

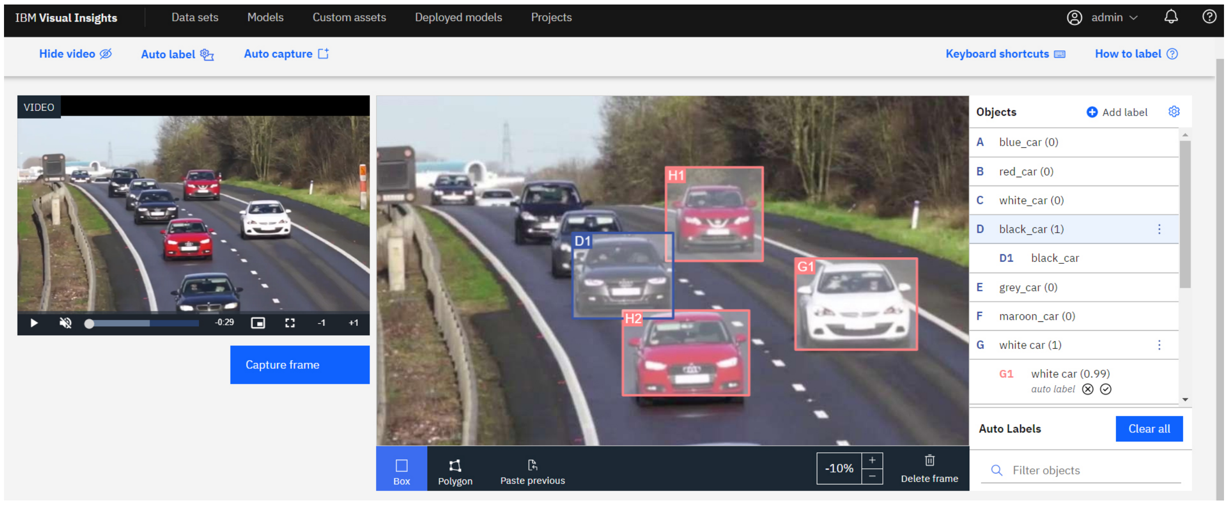
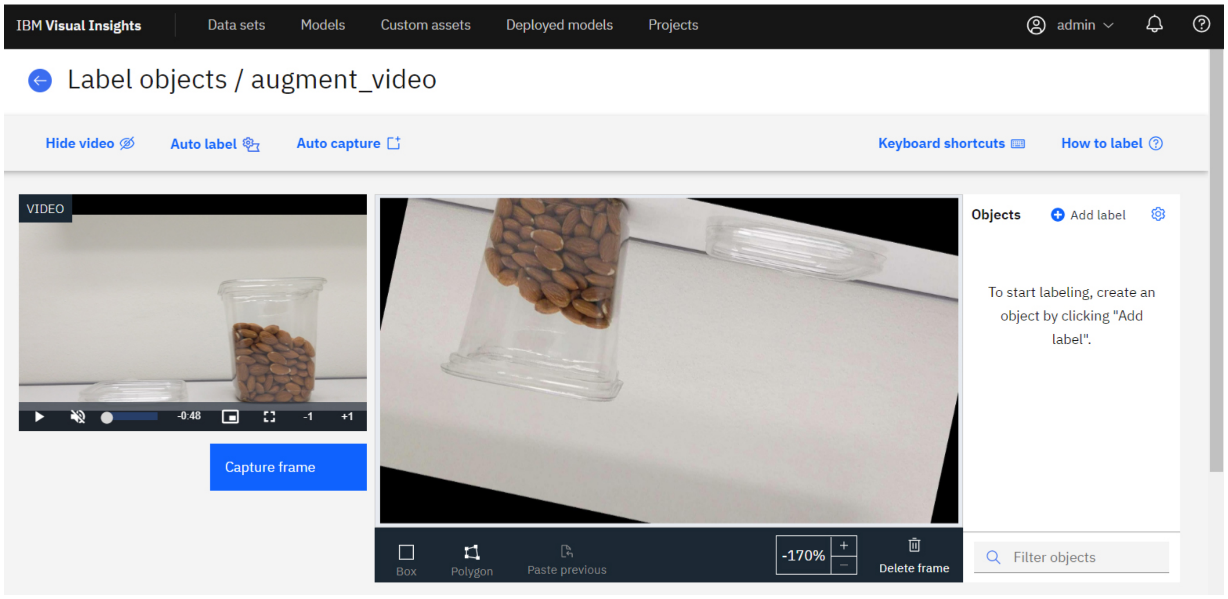


Figure 5. Auto labeled video

Data augmentation
After deploying a model, you can improve the model by using data augmentation to add modified images to the data set, then retraining the model. *Data augmentation* is the use of filters, such as blur and rotate, to create new versions of existing images or frames. Augmentation does not apply to full videos. It can be applied to a video's captured frames just as it is applied to images. When you use

data augmentation, a new data set is created that contains all of the existing images, plus the newly generated images, which are marked as augmented.



To start labeling, create an object by clicking "Add label".

Figure 6. Augmented video

What's new

The following functions, features, and support have been added for IBM Visual Insights Version 1.2.0:

Included with fix pack 1

After installing Version 1.2.0, it is recommended that you install all available fix packs. Fix pack 1 includes the following functional enhancements. In the documentation, functions that are only available with fix pack 1 are marked with these tags.

YOLO V3

Models optimized for speed can be run anywhere, but might not be as accurate as those optimized for accuracy. These models use "you only look once" (YOLO) V3 and will take several hours to train.

A CoreML asset is generated when you train a model using YOLO V3.

Queue for training jobs

When you submit a job for training, if there are not enough resources available for immediate training, the job is added to a queue. For details, see "Training a model" on page 78.

Move and copy between data sets

You can now move and copy videos and images between data sets. See "Creating and working with data sets" on page 67 for details.

Mark deployed models as "production"

The Production tag helps you track which models are ready for production use. You can now mark models as Production on the Deployed models page. Additionally, the Production and Rejected tags are now visible on the Deployed models page. See Chapter 11, "Production work flow," on page 107 for more information.

Find assets based on metadata

You can now search for images and videos based on their Exchangeable image file format (Exif) metadata. For details, see "Search for assets in a data set" on page 72.

You can view the metadata associated with an image by opening the image and clicking the Show metadata icon ( ).

View labels added by inferencing

When you deploy a model, if you specify to save inference results to a data set, those results are labeled as "Inferred". You can accept or reject the inferred labels. See "Refining a model" on page 95 to learn more.

Included with Version 1.2.0

The following functional enhancements are included with Version 1.2.0:

x86 support

Support for Training and Inference product on the x86 platform with Nvidia GPUs.

Product rename

IBM PowerAI Vision has been renamed to IBM Visual Insights. Additionally:

- The installation location has changed from `/opt/powerai-vision` to an IBM standard location: `/opt/ibm/vision`.
- Runtime tools have removed `powerai-` from the tool names. For example, `vision-start.sh`.
- Runtime Docker container and Kubernetes pod names have removed `powerai-` from the name.

Updated URL

After upgrading to Version 1.2.0, use the updated URL to access IBM Visual Insights:

IBM Visual Insights stand-alone URL

`https://`*`hostname`*`/visual-insights/`, where *hostname* is the system on which you installed IBM Visual Insights.

IBM Visual Insights with IBM Cloud® Private URL

`https://`*`proxyhost`*`/visual-insights-`*`RELEASE`*`/`, where *proxyhost* is the host name of your IBM Cloud Private proxy server, and *RELEASE* is the name you specified in the Release name field when you deployed the Helm chart.

Pre and post inferencing updates

When deploying a model, you can specify that inference results for images are saved to the data set. See "Preprocessing and post-processing" on page 92 for details.

User interface improvements

The user interface has an updated look and feel.

- The toolbar buttons have been replaced by icons with hover text.
- The Select checkbox now includes a dropdown menu to let you select all images on the current page.
- Improved support for working with the user interface on an iPad or small browser window.

IBM Visual Insights REST APIs

You can use REST APIs to work with IBM Visual Insights data sets and models, such as performing training and deployment. You can also use them to perform administrative tasks, such as monitoring events. These APIs allow you to bypass the user interface and automate IBM Visual Insights processes or solutions.

For information about using the APIs see Vision Service API documentation.

There are also examples of using the APIs for different actions, published here.

IBM Visual Insights editions

Each edition of IBM Visual Insights has different functionality.

Note: All editions are made available when the product is generally available.

Table 2. IBM Visual Insights editions

Edition	Can be installed on IBM Cloud Private	Can be installed as standalone	Model limit	Watermarked images	Can create additional users	Time limit	Renewable
Trial	Y	Y	5	Y		90 days	No - must reinstall
Non-production	Y	Y	5	Y		1 year	Y
Full	Y	Y	N/A		Y		N/A

IBM Visual Insights Trial

IBM Visual Insights offers a trial version of the product. It has full functionality, but is not licensed for production use.

The timed trial expires 90 days after you first **start** the application. The time remaining in the time trial is displayed in the user interface as **Days remaining**.

- "Limitations" on page 7
- "Installing the trial version" on page 7
- "What happens when the trial expires?" on page 9
- "Upgrading to the full version of IBM Visual Insights" on page 10

Limitations

This edition of IBM Visual Insights works the same as the standard install, with the following exceptions:

- Only five trained models can be on the system at any time. You can, however, export trained models if you want access to them later. See "Importing, exporting, and downloading IBM Visual Insights information" on page 98 for instructions.
- Only five models can be deployed at any time. To undeploy a model, click **Deployed Models**. Next, select the model that you want to undeploy and click the **X** (undeploy) in the header bar. The trained model is not deleted from IBM Visual Insights.
- Additional users cannot be used with the product. Only the admin user can log in to the user interface and use the product APIs.
- When using a trained model for inference, the resultant images are watermarked.

Installing the trial version

Attention: You cannot install IBM Visual Insights stand-alone on the same system that has the following software installed:

- IBM Data Science Experience (DSX)
- IBM Cloud Private
- IBM Watson Studio Local Edition
- Any other Kubernetes based applications

1. You must complete the following installation prerequisites steps before you install IBM Visual Insights.
   a. Complete all steps in the "Prerequisites for installing IBM Visual Insights" on page 25 topic.
   b. Your system must have a proper subscription and repository that provides you with updated packages. For information, see the Red Hat Subscription Manager documentation.

   c. Turn on Extra Packages for Enterprise Linux (EPEL). For information, see the EPEL website.
   d. If there was a previous version of PowerAI Vision installed but you do **NOT** wish to migrate the data, delete or move `/opt/powerai-vision/volume`. This will ensure that data for the previous install, such as data sets and trained models, will not appear in the newer version of the product.
2. Go to the IBM Visual Insights Trial download site, then download the .tar file and the .rpm files as instructed.
3. Unzip and untar the product tar file, and run the installation command for the platform you are installing on.

   RHEL

   ```
   sudo yum install ./<file_name>.rpm
   ```

   Ubuntu

   ```
   sudo dpkg -i ./<file_name>.deb
   ```

   The install files are extracted to `visual-insights-`*`arch`*`-1.2.0.0-`ppa, where *arch* is x86 or ppc, depending on your platform.
4. Load the IBM Visual Insights images from the directory that contains the extracted tar file. The user running the script must have Docker privileges:

   ```
   sudo /opt/ibm/vision/bin/load_images.sh -f ./file_name.tar
   ```

   Note: The installation process can take some time to complete.
5. (RHEL only) Open ports for the firewall to access IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/sbin/firewall.sh
   ```

6. After the installation is complete, you can start IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

   A user named `admin` is created with a password of `passw0rd`. For instructions to change these values, see "Managing users" on page 145.

   Note: The startup script will modify ownership and permissions on `/opt/ibm/vision/volume` so that the containers can run under a non-root ID and access the data.

   You must read and accept the license agreement that is displayed before you can use IBM Visual Insights.

   It can take several minutes to start IBM Visual Insights. To check the status of the startup process, run this script:

   ```
   sudo /opt/ibm/vision/bin/helm.sh status vision
   ```

   In the output from the **`helm.sh status vision`** script, you can verify which IBM Visual Insights components are available by locating the Deployment section and identifying that the AVAILABLE column has a value of 1 for each component. The following is an example of the output from the **`helm.sh status vision`** script that shows all components are available:

```
user@system:~$ /opt/ibm/vision/bin/helm.sh status vision
LAST DEPLOYED: Mon Feb 17 19:25:40 2020
NAMESPACE: default
STATUS: DEPLOYED
RESOURCES:
==> v1beta1/Ingress
NAME        HOSTS  ADDRESS  PORTS  AGE
vision-ing  *      80       6d21h
==> v1/Pod(related)
NAME                                      READY  STATUS   RESTARTS  AGE
vision-elasticsearch-777f6bcc6c-5xvlg     1/1    Running  0         17h
vision-fpga-device-plugin-bm8qx           1/1    Running  0         17h
vision-keycloak-f57979785-fpw8q           1/1    Running  0         17h
vision-logstash-f8cc6fcc6-rhqtc           1/1    Running  0         17h
vision-mongodb-79b9d7977c-2twtb           1/1    Running  0         17h
vision-postgres-6f4788c594-gxcjp          1/1    Running  0         17h
vision-service-799c94f575-2cr48           1/1    Running  0         4h34m
vision-taskanaly-67745bc59f-qd225         1/1    Running  0         17h
vision-ui-774d989b47-2swvb                1/1    Running  0         17h
vision-video-microservice-6fc86b5866-s8x44  1/1    Running  0         17h
==> v1/Secret
NAME            TYPE    DATA  AGE
vision-secrets  Opaque  4     6d21h
==> v1/ConfigMap
NAME           DATA  AGE
vision-config  53    6d21h
==> v1/PersistentVolumeClaim
NAME             STATUS  VOLUME       CAPACITY  ACCESS MODES  STORAGECLASS  AGE
vision-data-pvc  Bound   vision-data  40Gi      RWX           6d21h
==> v1/Service
NAME                       TYPE       CLUSTER-IP   EXTERNAL-IP  PORT(S)            AGE
vision-elasticsearch       ClusterIP  10.10.0.169  <none>       9200/TCP,9300/TCP  6d21h
vision-keycloak            ClusterIP  10.10.0.30   <none>       8080/TCP,8443/TCP  6d21h
vision-logstash            ClusterIP  10.10.0.198  <none>       9600/TCP           6d21h
vision-mongodb             ClusterIP  10.10.0.173  <none>       27017/TCP          6d21h
vision-postgres            ClusterIP  10.10.0.201  <none>       5432/TCP           6d21h
vision-service             ClusterIP  10.10.0.85   <none>       9080/TCP           6d21h
vision-taskanaly           ClusterIP  10.10.0.44   <none>       5000/TCP           6d21h
vision-ui                  ClusterIP  10.10.0.41   <none>       8080/TCP           6d21h
vision-video-microservice  ClusterIP  10.10.0.216  <none>       38080/TCP          6d21h
==> v1beta1/DaemonSet
NAME                       DESIRED  CURRENT  READY  UP-TO-DATE  AVAILABLE  NODE SELECTOR  AGE
vision-fpga-device-plugin  1        1        1      1           1          <none>         17h
==> v1/Deployment
NAME                       DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE
vision-elasticsearch       1        1        1           1          17h
vision-keycloak            1        1        1           1          17h
vision-logstash            1        1        1           1          17h
vision-mongodb             1        1        1           1          17h
vision-postgres            1        1        1           1          17h
vision-service             1        1        1           1          17h
vision-taskanaly           1        1        1           1          17h
vision-ui                  1        1        1           1          17h
vision-video-microservice  1        1        1           1          17h
NOTES:
Find the Visual Insights UI URL by running the following commands:
export NODE_IP=$(kubectl get ing vision-ing --namespace default -o
jsonpath="{.status.loadBalancer.ingress[0].ip}")
echo https://${NODE_IP}/vision/
```

After the application startup has completed and the user interface is available, it can be accessed at `https://`*`hostname`*`/visual-insights/`, where *hostname* is the system on which you installed IBM Visual Insights.

What happens when the trial expires?

You can see how much time is left in the trial by reviewing the countdown in the header of the user interface. When the timed trial expires, the product will cease to work, including any running training, inference, import, or export operations. However, if you purchase a license, you will automatically regain access to all of your data sets, models, and so on. When the trial expires, you can upgrade to the full version or remove the trial version. The trial cannot be extended.

If the trial expires and you want to purchase IBM Visual Insights, follow the instructions in "Upgrading to the full version of IBM Visual Insights" on page 10.

If the trial expires and you do not decide to purchase IBM Visual Insights, follow these steps:

1. Remove previously installed images by running the following script:

   ```
   sudo /opt/ibm/vision/bin/purge_image.sh 1.2.0.0
   ```

   Optionally remove all product data by running the following script. This will remove data sets, models, and so on:

   ```
   sudo /opt/ibm/vision/bin/purge_data.sh
   ```

2. Remove IBM Visual Insights by running the following command:
   - For RHEL:

     ```
     sudo yum remove visual-insights
     ```

   - For Ubuntu:

     ```
     sudo dpkg --remove visual-insights
     ```

3. Delete the data directory by running the following command:

   ```
   sudo rm -rf /opt/ibm/vision/
   ```

Upgrading to the full version of IBM Visual Insights

When you are ready to purchase IBM Visual Insights, you can buy a license from IBM Visual Insights Marketplace. Use one of these methods to upgrade to the full version. Your data is not deleted when the product is uninstalled. You will automatically regain access to all of your data sets, models, and so on.

1. Stop the current instance of IBM Visual Insights by running the following script:

   ```
   sudo  /opt/ibm/vision/bin/vision-stop.sh
   ```

2. Obtain and install IBM Visual Insights:

   Install IBM Visual Insights from IBM Passport Advantage

   a. Download the product tar file from the IBM Passport Advantage website.

   b. Unzip and untar the product tar file, and run the installation command for the platform you are installing on.

      RHEL

      ```
      sudo yum install ./<file_name>.rpm
      ```

      Ubuntu

      ```
      sudo dpkg -i ./<file_name>.deb
      ```

      The install files are extracted to `visual-insights-`*`arch`*`-1.2.0.0-ppa`, where *arch* is x86 or ppc, depending on your platform.

   c. Load the IBM Visual Insights images from the directory that contains the extracted tar file. The user running the script must have Docker privileges:

      ```
      sudo /opt/ibm/vision/bin/load_images.sh -f ./file_name.tar
      ```

      Note: The installation process can take some time to complete.

   d. After the installation is complete, you can start IBM Visual Insights by running this script:

      ```
      sudo /opt/ibm/vision/bin/vision-start.sh
      ```

   Install IBM Visual Insights from AAS

a. Download the product tar.gz file from Advanced Administration System (AAS). This system is also called Entitled Software Support (ESS).
b. Untar the tar.gz file by running this command.

```
gunzip -c file_name.tar.gz | tar -xvf
    -
```

c. Unzip and untar the visual-insights-aas-*arch*-1.2.0.0.tar.gz file (where *arch* is x86 or ppc depending on the installation platform) by running this command:

```
gunzip -c file_name.tar.gz | tar -xvf -
```

The install files are extracted to `visual-insights-aas-arch-1.2.0.0/`, where *arch* is x86 or ppc, depending on your platform.

d. Load the IBM Visual Insights images from the directory that contains the extracted tar file. The user running the script must have Docker privileges:

```
sudo /opt/ibm/vision/bin/load_images.sh -f ./file_name.tar
```

Note: The installation process can take some time to complete.

e. After the installation is complete, you can start IBM Visual Insights by running this script:

```
sudo /opt/ibm/vision/bin/vision-start.sh
```

Related concepts

Uninstalling IBM Visual Insights stand-alone
You must uninstall IBM Visual Insights stand-alone on your system, before you can install IBM Cloud Private, IBM Data Science Experience Local, or other Kubernetes-based applications.

IBM Visual Insights Non-production edition

This edition of IBM Visual Insights lets you try out the product for one year, with limited functionality.

IBM Visual Insights Non-production edition functionality

This edition of IBM Visual Insights works the same as the standard install, with the following exceptions:

- Only five trained models can be on the system at any time. You can, however, export trained models if you want access to them later. See "Importing, exporting, and downloading IBM Visual Insights information" on page 98 for instructions.
- Only five models can be deployed at any time. To undeploy a model, click **Deployed Models**. Next, select the model that you want to undeploy and click the **X** (undeploy) in the header bar. The trained model is not deleted from IBM Visual Insights.
- Additional users cannot be used with the product. Only the admin user can log in to the user interface and use the product APIs.
- When using a trained model for inference, the resultant images are watermarked.

Installing or upgrading

Follow the "Install IBM Visual Insights from IBM Passport Advantage" instructions in "Installing IBM Visual Insights stand-alone" on page 31.

If you have a previous version of IBM Visual Insights installed, you can upgrade it by following these instructions: "Upgrading IBM Visual Insights" on page 40.

What happens after the license expires?

When your license expires, your trained models and labeled data sets are preserved. To continue working with IBM Visual Insights, follow these steps:

1. Contact your IBM sales representative to obtain an extended license key.
2. Input the licence key:
   - From the user interface, click the arrow by your user name and select **Edition information**. Paste the license extension token in the text box by **Extend license** and click **Submit**.
   - From the API, run PUT `/system/trial-ext`, JSON Payload `{ "token" : "`*`token_value`*`" }` For example:

     ```
     curl -X PUT -H "Content-Type: application/json" \
     -H "X-Auth-Token:<paiv-token>"  \
     -d '{"token": "<token-from-ibm>"}' \
     https://<paiv-host>:<paiv-port>/vision[-release-name]/api/system/trial-ext
     ```

Model functionality

You can train these types of models in IBM Visual Insights.

Table 3. Types of models and model functionality

Model type	**GoogLeNet**	**Faster R-CNN**	**tiny YOLO V2**	**YOLO V3**	**Detectron**	**Single Shot Detector (SSD)**	**Structured segment network (SSN)**	**Custom model**
Description	System default when training for image classification	Optimized for accuracy	Optimized for speed. These models use "you only look once" (YOLO) V2 and will take longer to train than other models in this product. You can choose the accelerator to deploy to.	Optimized for speed. These models use "you only look once" (YOLO) V3 and will take longer to train than other models in this product. Generates a CoreML asset.	Detectron Mask R-CNN models can use objects labeled with polygons for greater training accuracy. You can disable segmentation for a shorter training time.	Used for real-time inference and embedded devices. It is almost as fast as YOLO but not as accurate as Faster R-CNN.	Used for video action detection	Imported model used for training.
Image classification	Yes	No	No	No	No	No	No	Yes
Object detection	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Action detection	No	No	No	No	No	No	Yes	No

Table 3. Types of models and model functionality (continued)

Model type	**GoogLeNet**	**Faster R-CNN**	**tiny YOLO V2**	**YOLO V3**	**Detectron**	**Single Shot Detector (SSD)**	**Structured segment network (SSN)**	**Custom model**
Model processing								
Deploy multiple models to one GPU	Yes	Yes	No	No	No	No	No	No
Deploy to CPU (Standard install)	No	No	Yes	No	No	No	No	No
Deploy to TensorRT	No	Yes	No	No	No	Yes	No	No
Enable Core ML	Yes	No	Yes	Yes	No	No	No	No
Import / Export model	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Supported on Inference Server	Yes (default)	Yes (default)	Yes	Yes (If fix pack 1 is not installed) No	Yes	Yes	No	Yes - TensorFlow, Keras, and PyTorch
Use for transfer learning	Yes	Yes	No	No	No	Yes	No	No
Deploy to CPU (Inference Server)	Yes	Yes	Yes	No	No	No	No	No
Model type	**GoogLeNet**	**Faster R-CNN**	**tiny YOLO V2**	**YOLO V3**	**Detectron**	**Single Shot Detector (SSD)**	**Structured segment network (SSN)**	**Custom model**

Chapter 2. IBM Visual Insights concepts

IBM Visual Insights provides an easy to use graphical user interface (GUI) that you can use to quickly create computer vision-related artificial intelligence (AI) solutions.

You must be familiar with the following concepts before you can start using IBM Visual Insights:

Data set
A data set is a collection of images and videos that you uploaded to IBM Visual Insights. An example of a data set would be images of cars.

Category
A category is used to classify an image. The image can belong to only a single category. An example of a category for a data set that contains cars would be car manufacturers (Toyota, Honda, Chevy, and Ford).

Custom asset
Custom assets are certain assets that are created outside of IBM Visual Insights but that can be used by IBM Visual Insights.

Custom model
Also known as a *custom network*. This is a model that was trained outside of IBM Visual Insights. For information about what is supported by custom models, see "Model functionality" on page 12.

Custom inference script
Contains files that specify actions to be done outside of IBM Visual Insights. For example, to be used with preprocessing, post-processing, or Maximo Asset Monitor. For more information, see "Preprocessing and post-processing" on page 92 and "Integrating IBM Visual Insights Training and Inference with Maximo Asset Monitor" on page 125.

Object
An object is used to identify specific items in an image or specific frames in a video. You can label multiple objects in an image or a frame in a video. An example of objects in an image of cars might be wheel, headlights, and windshield.

Project
Project groups allow you to group trained models with the data sets that were used for training. This grouping is optional but is a useful way to organize related data sets. For example, project groups would be useful with a workflow that clones data sets as you refine labels and work toward a more accurate model. For more information about projects, see Chapter 10, "Creating and working with project groups," on page 105.

Model
A model is a set of tuned algorithms and that produces a predicted output. Models are trained based on the input that is provided by a data set to classify images or video frames, or find objects in images or video frames.

Neural network
A model implementation using a deep learning framework with nodes and weights.

Training concepts

Iteration
A full forward and backward pass using a set of images in the training of the neural network.

Batch
The set of images used in a full forward and backward pass in training of the neural network.

Batch size
The size of the batch of images used in an iteration.

Epoch
The measure for an entire data set passed forward and backward through the neural network one time. Usually the batch size is smaller than the full data set, so an epoch consists of multiple iterations of "Batch size".

Chapter 3. Planning for IBM Visual Insights

You must meet the software and hardware requirements and understand the supported file types before you can install IBM Visual Insights.

- "Hardware requirements" on page 17
- "Software requirements" on page 17
- "Networking requirements" on page 18
- "Disk space requirements" on page 18
- "Supported web browsers" on page 19
- "Image support" on page 19
- "Supported video types" on page 20
- "Deep learning frameworks" on page 20
- "Limitations" on page 21

Hardware requirements

IBM Visual Insights requires the following hardware:

Hardware

The following devices are supported:

- POWER8 S822LC (8335-GTB) or POWER9 AC922 with at least one NVIDIA NVLink capable GPU
- POWER9 IC922 with at least one NVIDIA T4 GPU
- x86 system with at least one NVIDIA Pascal, Volta, or Turing-architecture GPU

Required specifications

Your device must meet these minimum requirements:

- 64 GB of memory
- Ethernet network interface
- 75 GB of storage for installation, and at least 40 GB of storage for runtime. See "Disk space requirements" on page 18 for details.
- The Nvidia GPU must be configured in the "Default" compute mode. The "Exclusive Process" mode will cause trainings to fail. See nvidia-smi usage for details on compute modes.
- There are multiple options for deploying the model for testing. Deploying a model to a Xilinx FPGA requires the Xilinx Alveo U200 Accelerator card.

Software requirements

You must install the following software before you install IBM Visual Insights:

Linux

- Red Hat Enterprise Linux (RHEL) RHEL 7.6 ALT (little endian) for POWER9™
- RHEL 7.7 for x86
- Ubuntu 18.04

  Note: The Ubuntu Hardware Enablement (HWE) kernel is not supported. Kubernetes services do not function correctly, preventing IBM Visual Insights from starting successfully.

NVIDIA CUDA

10.1 Update 1 (if fix pack 1 is not installed) or later drivers. If fix pack 1 is installed, 10.2 or later drivers are required. For information, see the NVIDIA CUDA Toolkit website.

Docker

- RHEL: docker-1.13.1
- Ubuntu: Docker CE or EE 18.06.01

Networking requirements

Your environment must meet the following networking requirements:

- A default route must be specified on the host system.
  - For instructions to do this on Ubuntu, refer to the IP addressing section in the Ubuntu Network Configuration. Search for the steps to configure and verify the default gateway.
  - For instructions to do this on Red Hat Enterprise Linux (RHEL), refer to 2.2.4 Static Routes and the Default Gateway in the Red Hat Customer Portal.
- For RHEL, docker0 must be in a trusted firewall zone. If it is not in a trusted firewall zone, modify the RHEL settings as follows:

```
sudo nmcli device set docker0 managed yes
sudo nmcli connection modify docker0 connection.zone trusted
sudo systemctl stop NetworkManager.service
sudo firewall-cmd --permanent --zone=trusted --change-interface=docker0
sudo systemctl start NetworkManager.service
sudo nmcli connection modify docker0 connection.zone trusted
sudo systemctl restart docker.service
```

- IPv4 port forwarding must be enabled.

  If IPv4 port forwarding is not enabled, run the **`/sbin/sysctl -w net.ipv4.conf.all.forwarding=1`** command. For more information about port forwarding with Docker, see UCP requires IPv4 IP Forwarding in the Docker success center.
- IPv6 must be enabled.

Disk space requirements

IBM Visual Insights has the following storage requirements for the initial product installation and for the data sets that will be managed by the product.

Standalone installation

- `/var` - The product installation requires at least 75 GB of space in the `/var` file system for the product Docker images. IBM Visual Insights also generates log information in this file system. The installation process requires additional space because all Docker images are extracted to disk requiring about 40 GB of space, then the images are loaded by Docker. When the image is loaded, the extracted image is deleted but while images are being extracted and loaded, space is needed for both copies. All application Docker images are extracted and loaded in parallel.

  Recommendation: If you want to minimize the root (/) file system, make sure that `/var` has its own volume.
- `/opt` - IBM Visual Insights data sets, models, and runtime data are stored in this file system. This file system must have at least five GB of free space, in addition to any data sets, models or other runtime data for IBM Visual Insights to operate successfully. The storage needs will vary depending on the data sets and the contents. For example, video data can require large amounts of storage.

  Recommendation: If you want to minimize the root (/) file system, make sure that `/opt` has its own volume. The `/opt` file system should have at least 40 GB of space, although this value might be more depending on your data sets.

IBM Cloud Private installation

IBM Visual Insights will use the configured persistent storage for the deployment, the requirements are documented in “Installing IBM Visual Insights with IBM Cloud Private” on page 38.

Supported web browsers

The following web browsers are supported:

- Google Chrome Version 60, or later
- Firefox Quantum 59.0, or later

Image support

- The following image formats are supported:
  - JPEG
  - PNG
  - DICOM
- Images with COCO annotations are supported. For details, see “Importing images with COCO annotations” on page 71.
- IBM Visual Insights has limited support for Pascal VOC annotations. Annotations for multiple files residing in a common XML file are not supported. In other words, each annotation XML file can only contain annotations for a single image, identified by the `filename` attribute.

  If you have a single XML annotation file containing annotations for multiple images in the data set to be imported, the annotations need to be split out into separate XML files before IBM Visual Insights can import the annotations successfully.
- The models used by IBM Visual Insights have limitations on the size and resolution of images. If the original data is high resolution, then the user must consider:
  - If the images do not need fine detail for classification or object detection, they should be down-sampled to 1-2 megapixels.
  - If the images do require fine detail, they should to be divided into smaller images of 1-2 megapixels each.
  - There is a 24 GB size limit per upload session. This limit applies to a single .zip file or a set of files. You can, however upload 24 GB of files, then upload more after the original upload completes.
  - Large images will be scaled to the appropriate dimensions for the model as follows:
    - SSD: 512 x 512 pixels

      The original aspect ratio is maintained. If necessary, black bands are added to the image to make it fit.
    - tiny YOLO V2: 416 x 416 pixels

      The longest edge is scaled to 416 pixels and, if necessary, black bands are added to the shorter side to make it 416 pixels.
    - YOLO V3: 608 x 608 pixels
    - Faster R-CNN: 1000 x 600 pixels

      The original aspect ratio is maintained. If necessary, black bands are added to the image to make it fit.
    - Detectron: 1333 x 800 pixels
    - GoogLeNet: 224 x 224 pixels
    - Action detection: 224 x 224 pixels

Supported video types
The following video formats are supported:

Can be played in the IBM Visual Insights GUI:

- Ogg Vorbis (.ogg)
- VP8 or VP9 (.webm)
- H.264 encoded videos with MP4 format (.mp4)

Supported by API only:

- Matroska (.mkv)
- Audio Video Interleave (.avi)
- Moving Picture Experts Group (.mpg or .mpeg2)

Not supported:
Videos that are encoded with the H.265 codec.

Deep learning frameworks

The following frameworks are included with IBM Visual Insights.

Table 4. Included frameworks

Framework	Version	Python 2.7 support	Python3.6 support	Notes
Caffe 2	1.0.0 (If fix pack 1 is not installed.) 1.3.1 (If fix pack 1 is installed.)	Yes	No	Supported for Detectron models
IBM Caffe	1.0.0	Yes	No	Supported for GoogLeNet, Faster R-CNN, and tinyYOLO V2 models
Keras	2.2.4 (If fix pack 1 is not installed.) 2.3.1 (If fix pack 1 is installed.)	No (If fix pack 1 is not installed.) Yes (If fix pack 1 is installed.)	Yes	Supported for custom models
TensorFlow	1.14 (If fix pack 1 is not installed.) 2.1.0 (If fix pack 1 is installed.)	No	Yes	Supported for custom models

Table 4. Included frameworks (continued)				
Framework	**Version**	**Python 2.7 support**	**Python3.6 support**	**Notes**
TensorRT	5.1.3 (If fix pack 1 is not installed.) 7.0.0.11 (If fix pack 1 is installed.)	Yes	Yes	Supported for SSD models
PyTorch	1.1.0 (If fix pack 1 is not installed.) 1.3.1 (If fix pack 1 is installed.)	Yes	Yes	Supported for custom models

Limitations

Following are some limitations for IBM Visual Insights 1.2.0:

- IBM Visual Insights uses an entire GPU when you are training a dataset. Multiple GoogleNet or Faster R-CNN models can be deployed to a single GPU. Other types of models take an entire GPU when deployed. For details about other differences between model types, see "Model functionality" on page 12.

  The number of active GPU tasks (model training and deployment) that you can run at the same time depends on the number of GPUs on your server. You must verify that there are enough available GPUs on the system for the desired workload. The number of available GPUs is displayed on the user interface.
- You cannot install IBM Visual Insights stand-alone on a system that already has any of these products installed:
  - IBM Data Science Experience (DSX)
  - IBM Cloud Private
  - IBM Watson Studio Local Edition
  - Any other Kubernetes based applications

Chapter 4. License Management in IBM License Metric Tool

The IBM Visual Insights product is licensed per *Virtual Server* ("Learn about software licensing - Virtual Server"). When the product is installed, a software license metric (SLM) tag file is created to track usage with the IBM License Metric Tool.

The license metric tag is an XML file, with extension `.slmtag`. The IBM License Metric Tool discovers the license metric tag file and provides license consumption reports that, compared with license entitlements, allow IBM to verify license compliance. The tag file is human-readable and can therefore be interpreted by individuals for audit purposes.

The license metric tag file has a standard format and consists of two parts:

Header information

Contains:

SchemaVersion

Identifies the schema version of the license metric tag file.

SoftwareIdentity

Identifies the software identity instance that provides license metric data. Contains:

- **Name**

  Name of the software identity - *IBM Visual Insights Training and Inference* or *IBM Visual Insights Inference for Servers*

- **PersistentId**

  Unique identifier of the software identity. For IBM Visual Insights 1.2.0, the assigned **PersistentId** is:

  - **IBM Visual Insights Training and Inference** - `ebb8d2e1bd62488c8c196f568857ae38`
  - **IBM Visual Insights Inference for Servers** - `297aaa94baa441e0ad91a609b24083b7`
  - **IBM Visual Insights Training and Inference-Basic Edition for Non-Production** - `c92f7273a4854ce496e09245c50702a6`

- **InstanceId**

  Identifies the instance of the software identity that provides metrics by the path of the software for which *SLMTag* is generated - `/opt/ibm/vision`.

Metrics information

IBM Visual Insights 1.2.0 is licensed per Virtual Server, so the values are:

- **Type** - *VIRTUAL_SERVER*
- **Period** - **StartTime** is the time of install/deploy, **EndTime** is set to date '9999-12-31' so that the IBM License Metric Tool will understand that it as a perpetual license.

Chapter 5. Installing, upgrading, and uninstalling IBM Visual Insights

Use the information in these topics to work with the product installation. You can install IBM Visual Insights by using the command line (stand-alone) or by using IBM Cloud Private.

Only the most current level of each release of IBM Visual Insights should be installed, where version numbers are in the format *version.release.modification*.

After installing IBM Visual Insights, you can optionally change the SSL certificate by following the steps in this topic: "Installing a new SSL certificate in IBM Visual Insights stand-alone" on page 147.

Prerequisites for installing IBM Visual Insights

Before you can install either IBM Visual Insights stand-alone or IBM Visual Insights with IBM Cloud Private, you must configure Red Hat Enterprise Linux (RHEL), enable the Fedora Extra Packages for Enterprise Linux (EPEL) repository, and install NVIDIA CUDA drivers.

Note: Neither IBM Watson® Machine Learning Community Edition nor IBM Watson Machine Learning Accelerator are required for running IBM Visual Insights.

See Chapter 3, "Planning for IBM Visual Insights," on page 17 to ensure that your environment meets all software and hardware requirements.

- "Red Hat Enterprise Linux operating system and repository setup" on page 25
- "Ubuntu operating system and repository setup" on page 26
- "NVIDIA Components: IBM POWER9 specific udev rules (Red Hat only)" on page 27
- "Remove previously installed CUDA and NVIDIA drivers" on page 27
- "Install the GPU driver (RHEL)" on page 28
- "Install the GPU driver (Ubuntu)" on page 28
- "Verify the GPU driver" on page 29
- "Install Docker and nvidia-docker2 (RHEL)" on page 30
- "Install Docker and nvidia-docker2 (Ubuntu)" on page 30

Red Hat Enterprise Linux operating system and repository setup

1. Enable `common`, `optional`, and `extra` repo channels.

   IBM POWER8®:

   ```
   sudo subscription-manager repos --enable=rhel-7-for-power-le-optional-rpms
   ```

   ```
   sudo subscription-manager repos --enable=rhel-7-for-power-le-extras-rpms
   ```

   ```
   sudo subscription-manager repos --enable=rhel-7-for-power-le-rpms
   ```

   IBM POWER9:

   ```
   sudo subscription-manager repos --enable=rhel-7-for-power-9-optional-rpms
   ```

   ```
   sudo subscription-manager repos --enable=rhel-7-for-power-9-extras-rpms
   ```

   ```
   sudo subscription-manager repos --enable=rhel-7-for-power-9-rpms
   ```

   x86:

```
sudo subscription-manager repos --enable=rhel-7-server-optional-rpms
```

```
sudo subscription-manager repos --enable=rhel-7-server-extras-rpms
```

```
sudo subscription-manager repos --enable=rhel-7-server-rpms
```

2. Install packages needed for the installation.

   ```
   sudo yum -y install wget nano bzip2
   ```

3. Enable the Fedora Project Extra Packages for Enterprise Linux (EPEL) repository:

   ```
   wget https://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rpm
   ```

   ```
   sudo rpm -ihv epel-release-latest-7.noarch.rpm
   ```

4. Load the latest kernel or do a full update:

   - Load the latest kernel:
     - For x86:

       ```
       sudo yum install kernel-devel
       sudo yum update kernel kernel-devel kernel-tools kernel-tools-libs
       reboot
       ```

     - For POWER:

       ```
       sudo yum install kernel-devel
       sudo yum update kernel kernel-devel kernel-tools kernel-tools-libs kernel-bootwrapper
       reboot
       ```

   - Do a full update:

     ```
     sudo yum install kernel-devel
     sudo yum update
     sudo reboot
     ```

5. Install Docker and configure it so that IBM Visual Insights containers can use NVIDIA GPUs. For instructions, see “Install Docker and nvidia-docker2 (RHEL)” on page 30.

   Note: docker-1.13.1-108.git4ef4b30.el7 has a known issue with the Nvidia GPUs. The docker-1.13.1-104.git4ef4b30.el7 version can explicitly be installed, or newer versions of RHEL Docker work as well. Ensure that docker-1.13.1-108.git4ef4b30.el7 is NOT installed.

Ubuntu operating system and repository setup

1. Install packages needed for the installation

   ```
   sudo apt-get install -y wget nano apt-transport-https ca-certificates curl software-
   properties-common
   ```

2. Ensure the kernel headers are installed and match the running kernel. Compare the outputs of:

   ```
   dpkg -l | grep linux-headers kernel-package kernel-headers
   ```

   and

   ```
   uname -r
   ```

   Ensure that the `linux-headers` package version *exactly* match the version of the running kernel. If they are not identical, bring them in sync as appropriate:

   - Install missing packages.
   - Update down level packages.

- Reboot the system if the packages are newer than the active kernel.

3. Alternatively, do a full update:

```
sudo apt-get update
sudo apt-get dist-upgrade
sudo reboot
```

NVIDIA Components: IBM POWER9 specific udev rules (Red Hat only)

1. Copy the `/lib/udev/rules.d/40-redhat.rules` file to the directory for user overridden rules:

```
sudo cp /lib/udev/rules.d/40-redhat.rules /etc/udev/rules.d/
```

2. Edit the `/etc/udev/rules.d/40-redhat.rules` file:

```
sudo nano /etc/udev/rules.d/40-redhat.rules
```

3. Comment out the entire "Memory hotadd request" section and save the change:

```
# Memory hotadd request
#SUBSYSTEM!="memory", ACTION!="add", GOTO="memory_hotplug_end"
#PROGRAM="/bin/uname -p", RESULT=="s390*", GOTO="memory_hotplug_end"

#ENV{.state}="online"
#PROGRAM="/bin/systemd-detect-virt", RESULT=="none", ENV{.state}="online_movable"
#ATTR{state}=="offline", ATTR{state}="$env{.state}"

#LABEL="memory_hotplug_end"
```

4. Optionally, delete the first line of the file, since the file was copied to a directory where it cannot be overwritten:

```
# do not edit this file, it will be overwritten on update
```

5. Restart the system for the changes to take effect:

```
sudo reboot
```

Remove previously installed CUDA and NVIDIA drivers

Before installing the updated GPU driver, uninstall any previously-installed CUDA and NVIDIA drivers. Follow these steps:

1. Remove all CUDA Toolkit and GPU driver packages.

   You can display installed CUDA and driver packages by running these commands:

```
rpm -qa | egrep 'cuda.*(9-2|10-0|10-1)'
```

```
rpm -qa | egrep '(cuda|nvidia).*(396|410|418)\.'
```

   Verify the list and remove with **`yum remove`**.

2. Remove any CUDA Toolkit and GPU driver repository packages.

   These should have been included in step 1, but you can confirm with this command:

```
rpm -qa | egrep '(cuda|nvidia).*repo'
```

   Use **`yum remove`** to remove any that remain.

3. Clean the yum repository:

```
sudo yum clean all
```

4. Remove cuDNN and NCCL:

```
sudo rm -rf /usr/local/cuda /usr/local/cuda-9.2 /usr/local/cuda-10.0 /usr/local/cuda-10.1
```

5. Reboot the system to unload the GPU driver:

```
sudo shutdown -r now
```

Install the GPU driver (RHEL)

Install the driver by following these steps:

Note: These instructions are intended for installation on a single Red Hat instance. If the GPU driver must be installed on many Red Hat instances, follow the instructions in this article: NVIDIA and Red Hat: Simplifying NVIDIA GPU Driver Deployment on Red Hat Enterprise Linux.

1. Download the NVIDIA GPU driver:
   - Go to NVIDIA Driver Download.
   - Select Product Type: **Tesla**.
   - Select Product Series: **P-Series** (for Tesla P100) or **V-Series** (for Tesla V100).
   - Select Product: **Tesla P100** or **Tesla V100**.
   - Select Operating System, click **Show all Operating Systems**, then choose the appropriate value:
     – **Linux POWER LE RHEL 7** for Power®
     – **Linux 64-bit RHEL7** for x86
   - Select CUDA Toolkit: **10.2**.
   - Click **SEARCH** to go to the download link.
   - Click **Download** to download the driver.

     Important: An rpm file should be downloaded. If a different type of file is downloaded, verify that you chose the correct options and try again.
2. Install CUDA and the GPU driver.

   Note: For AC922 systems: OS and system firmware updates are required before you install the latest GPU driver.

   ```
   sudo rpm -ivh nvidia-driver-local-repo-rhel7-440.*.rpm
   ```

   ```
   sudo yum install nvidia-driver-latest-dkms
   ```
3. Set nvidia-persistenced to start at boot (required for ppc64le, recommended for x86):

   ```
   sudo systemctl enable nvidia-persistenced
   ```
4. Restart to activate the driver.
5. Verify the setup:

   IBM Power

   ```
   docker run --rm nvidia/cuda-ppc64le nvidia-smi
   ```

   x86_64

   ```
   docker run --rm nvidia/cuda nvidia-smi
   ```

Install the GPU driver (Ubuntu)

Many of the deep learning packages require the GPU driver packages from NVIDIA.

Install the GPU driver by following these steps:

1. Download the NVIDIA GPU driver.
   - Go to NVIDIA Driver Download.
   - Select Product Type: **Tesla**
   - Select Product Series: **P-Series** (for Tesla P100) or **V-Series** (for Tesla V100).
   - Select Product: **Tesla P100** or **Tesla V100**.
   - Select Operating System, click **Show all Operating Systems**, then choose the correct value:
     - **Linux POWER LE Ubuntu 18.04** for POWER
     - **Linux 64-bit Ubuntu 18.04** for x86
   - Select CUDA Toolkit: **10.2**
   - Click **SEARCH** to go to the download link.
   - Click **Download** to download the driver.

     Important: A deb file should be downloaded. If a different type of file is downloaded, verify that you chose the correct options and try again.
2. The driver file name is `NVIDIA-Linux-ppc64le-440.87.01.run`. Give this file execute permission and execute it on the Linux image where the GPU driver is to be installed.

   When the file is executed, you are asked two questions. It is recommended that you answer "Yes" to both questions. If the driver fails to install, check the `/var/log/nvidia-installer.log` file for relevant error messages.
3. Install the GPU driver repository and cuda-drivers:

   ```
   sudo dpkg -i nvidia-driver-local-repo-ubuntu1804-440.*.deb
   ```

   ```
   sudo apt-key add /var/nvidia-driver-local-repo-440.*/*.pub
   ```

   ```
   sudo apt-get update
   ```

   ```
   sudo apt-get install cuda-drivers
   ```
4. Set nvidia-persistenced to start at boot

   ```
   sudo systemctl enable nvidia-persistenced
   ```
5. Reboot the system

Verify the GPU driver

Verify that the CUDA drivers are installed by running the `/usr/bin/nvidia-smi` application.

Example output

```
# nvidia-smi
Fri Mar 15 12:23:50 2019
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 418.29       Driver Version: 418.29       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|===============================+======================+======================|
|   0  Tesla P100-SXM2...  On   | 00000002:01:00.0 Off |                    0 |
| N/A   50C    P0   109W / 300W |   2618MiB / 16280MiB |     43%      Default |
+-------------------------------+----------------------+----------------------+
|   1  Tesla P100-SXM2...  On   | 00000003:01:00.0 Off |                    0 |
| N/A   34C    P0    34W / 300W |      0MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+
|   2  Tesla P100-SXM2...  On   | 0000000A:01:00.0 Off |                    0 |
| N/A   48C    P0    44W / 300W |   5007MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+
|   3  Tesla P100-SXM2...  On   | 0000000B:01:00.0 Off |                    0 |
| N/A   36C    P0    33W / 300W |      0MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                       GPU Memory |
|  GPU       PID   Type   Process name                             Usage      |
|=============================================================================|
|    0    114476      C   /opt/miniconda2/bin/python                  2608MiB |
|    2    114497      C   /opt/miniconda2/bin/python                   958MiB |
|    2    114519      C   /opt/miniconda2/bin/python                   958MiB |
|    2    116655      C   /opt/miniconda2/bin/python                  2121MiB |
|    2    116656      C   /opt/miniconda2/bin/python                   958MiB |
+-----------------------------------------------------------------------------+
```

For help understanding the output, see “Checking system GPU status” on page 60.

Install Docker and nvidia-docker2 (RHEL)

Follow these steps to install Docker on RHEL. For full details, refer to https://github.com/NVIDIA/nvidia-docker#rhel-docker.

1. Install Docker:

   ```
   sudo yum install docker
   ```

   Note: docker-1.13.1-108.git4ef4b30.el7 has a known issue with the Nvidia GPUs. The docker-1.13.1-104.git4ef4b30.el7 version can explicitly be installed, or newer versions of RHEL Docker work as well. Ensure that docker-1.13.1-108.git4ef4b30.el7 is NOT installed.
2. Reboot the system.
3. Add the package repositories:

   On x86:

   ```
   distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
   curl -s -L https://nvidia.github.io/nvidia-docker/$distribution/nvidia-docker.repo |
   sudo tee /etc/yum.repos.d/nvidia-docker.repo
   sudo yum install -y nvidia-container-toolkit
   sudo systemctl restart docker
   ```

   On IBM Power:

   ```
   distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
   curl -s -L https://nvidia.github.io/docker/$distribution/docker.repo | sudo tee /etc/
   yum.repos.d/docker.repo
   sudo yum install -y nvidia-container-runtime-hook
   sudo systemctl restart docker
   ```

Install Docker and nvidia-docker2 (Ubuntu)

Use these steps to install Docker and nvidia-docker 2.

1. For Ubuntu platforms, a Docker runtime must be installed. If there is no Docker runtime installed yet, install Docker-CE on Ubuntu.

   IBM Power

   ```
   sudo apt-get update
   sudo apt-get install apt-transport-https ca-certificates curl gnupg-agent software-
   properties-common
   curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
   sudo add-apt-repository "deb [arch=ppc64el] https://download.docker.com/linux/ubuntu
   bionic stable"
   sudo apt-get update
   sudo apt-get install docker-ce=18.06.1~ce~3-0~ubuntu
   ```

   x86_64

   ```
   sudo apt-get update
   sudo apt-get install apt-transport-https ca-certificates curl gnupg-agent software-
   properties-common
   curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
   sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu
   bionic stable"
   sudo apt-get update
   sudo apt-get install docker-ce
   ```

2. Install `nvidia-docker 2`.

   ```
   curl -s -L https://nvidia.github.io/nvidia-docker/gpgkey | sudo apt-key add -
   distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
   curl -s -L https://nvidia.github.io/nvidia-docker/$distribution/nvidia-docker.list | sudo
   tee /etc/apt/sources.list.d/nvidia-docker.list
   sudo apt-get update
   sudo apt-get install nvidia-docker2
   sudo systemctl restart docker.service
   ```

3. For each userid that will run docker, add the userid to the docker group:

   ```
   sudo usermod -a -G docker <userid>
   ```

   Users must log out and log back in to pick up this group change.

4. Verify the setup.

   IBM Power

   ```
   nvidia-docker run --rm nvidia/cuda-ppc64le nvidia-smi
   ```

   x86_64

   ```
   nvidia-docker run --rm nvidia/cuda nvidia-smi
   ```

Note:

The **`nvidia-docker run`** command must be used with `docker-ce` (in other words, an Ubuntu host) to leverage the GPUs from within a container.

Installing IBM Visual Insights stand-alone

You use the command line to install IBM Visual Insights stand-alone.

IBM Visual Insights stand-alone installation prerequisites

You must complete the following installation prerequisites steps before you install IBM Visual Insights.

1. Complete all steps in the "Prerequisites for installing IBM Visual Insights" on page 25 topic.
2. Your system must have a proper subscription and repository that provides you with updated packages. For information, see the Red Hat Subscription Manager documentation.
3. Turn on Extra Packages for Enterprise Linux (EPEL). For information, see the EPEL website.

4. If there was a previous version of PowerAI Vision installed but you do **NOT** wish to migrate the data, delete or move `/opt/powerai-vision/volume`. This will ensure that data for the previous install, such as data sets and trained models, will not appear in the newer version of the product.

Attention: You cannot install IBM Visual Insights stand-alone on the same system that has the following software installed:

- IBM Data Science Experience (DSX)
- IBM Cloud Private
- IBM Watson Studio Local Edition
- Any other Kubernetes based applications

- "Install IBM Visual Insights from IBM Passport Advantage" on page 32
- "Install IBM Visual Insights from AAS" on page 34
- "Install IBM Visual Insights trial mode" on page 35

Install IBM Visual Insights from IBM Passport Advantage

To install IBM Visual Insights stand-alone, complete the following steps:

1. Download the product tar file from the IBM Passport Advantage website.
2. (Optional) Verify the downloaded tar file by following the instructions in this topic: "Verify the downloaded tar file" on page 43.
3. Unzip and untar the product tar file, and run the installation command for the platform you are installing on.

   RHEL

   ```
   sudo yum install ./<file_name>.rpm
   ```

   Ubuntu

   ```
   sudo dpkg -i ./<file_name>.deb
   ```

   The install files are extracted to `visual-insights-`*`arch`*`-1.2.0.0-`ppa, where *arch* is x86 or ppc, depending on your platform.
4. Load the IBM Visual Insights images from the directory that contains the extracted tar file. The user running the script must have Docker privileges:

   ```
   sudo /opt/ibm/vision/bin/load_images.sh -f ./file_name.tar
   ```

   Note: The installation process can take some time to complete.
5. (RHEL only) Open ports for the firewall to access IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/sbin/firewall.sh
   ```

6. After the installation is complete, you can start IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

   A user named `admin` is created with a password of `passw0rd`. For instructions to change these values, see "Managing users" on page 145.

   Note: The startup script will modify ownership and permissions on `/opt/ibm/vision/volume` so that the containers can run under a non-root ID and access the data.

   You must read and accept the license agreement that is displayed before you can use IBM Visual Insights.

It can take several minutes to start IBM Visual Insights. To check the status of the startup process, run this script:

```
sudo /opt/ibm/vision/bin/helm.sh status vision
```

In the output from the **`helm.sh status vision`** script, you can verify which IBM Visual Insights components are available by locating the Deployment section and identifying that the AVAILABLE column has a value of 1 for each component. The following is an example of the output from the **`helm.sh status vision`** script that shows all components are available:

```
user@system:~$ /opt/ibm/vision/bin/helm.sh status vision
LAST DEPLOYED: Mon Feb 17 19:25:40 2020
NAMESPACE: default
STATUS: DEPLOYED
RESOURCES:
==> v1beta1/Ingress
NAME        HOSTS  ADDRESS  PORTS  AGE
vision-ing  *      80       6d21h
==> v1/Pod(related)
NAME                                        READY  STATUS   RESTARTS  AGE
vision-elasticsearch-777f6bcc6c-5xvlg       1/1    Running  0         17h
vision-fpga-device-plugin-bm8qx             1/1    Running  0         17h
vision-keycloak-f57979785-fpw8q             1/1    Running  0         17h
vision-logstash-f8cc6fcc6-rhqtc             1/1    Running  0         17h
vision-mongodb-79b9d7977c-2twtb             1/1    Running  0         17h
vision-postgres-6f4788c594-gxcjp            1/1    Running  0         17h
vision-service-799c94f575-2cr48             1/1    Running  0         4h34m
vision-taskanaly-67745bc59f-qd225           1/1    Running  0         17h
vision-ui-774d989b47-2swvb                  1/1    Running  0         17h
vision-video-microservice-6fc86b5866-s8x44  1/1    Running  0         17h
==> v1/Secret
NAME            TYPE    DATA  AGE
vision-secrets  Opaque  4     6d21h
==> v1/ConfigMap
NAME           DATA  AGE
vision-config  53    6d21h
==> v1/PersistentVolumeClaim
NAME             STATUS  VOLUME       CAPACITY  ACCESS MODES  STORAGECLASS  AGE
vision-data-pvc  Bound   vision-data  40Gi      RWX           6d21h
==> v1/Service
NAME                       TYPE       CLUSTER-IP   EXTERNAL-IP  PORT(S)            AGE
vision-elasticsearch       ClusterIP  10.10.0.169  <none>       9200/TCP,9300/TCP  6d21h
vision-keycloak            ClusterIP  10.10.0.30   <none>       8080/TCP,8443/TCP  6d21h
vision-logstash            ClusterIP  10.10.0.198  <none>       9600/TCP           6d21h
vision-mongodb             ClusterIP  10.10.0.173  <none>       27017/TCP          6d21h
vision-postgres            ClusterIP  10.10.0.201  <none>       5432/TCP           6d21h
vision-service             ClusterIP  10.10.0.85   <none>       9080/TCP           6d21h
vision-taskanaly           ClusterIP  10.10.0.44   <none>       5000/TCP           6d21h
vision-ui                  ClusterIP  10.10.0.41   <none>       8080/TCP           6d21h
vision-video-microservice  ClusterIP  10.10.0.216  <none>       38080/TCP          6d21h
==> v1beta1/DaemonSet
NAME                       DESIRED  CURRENT  READY  UP-TO-DATE  AVAILABLE  NODE SELECTOR  AGE
vision-fpga-device-plugin  1        1        1      1           1          <none>         17h
==> v1/Deployment
NAME                       DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE
vision-elasticsearch       1        1        1           1          17h
vision-keycloak            1        1        1           1          17h
vision-logstash            1        1        1           1          17h
vision-mongodb             1        1        1           1          17h
vision-postgres            1        1        1           1          17h
vision-service             1        1        1           1          17h
vision-taskanaly           1        1        1           1          17h
vision-ui                  1        1        1           1          17h
vision-video-microservice  1        1        1           1          17h
NOTES:
Find the Visual Insights UI URL by running the following commands:
export NODE_IP=$(kubectl get ing vision-ing --namespace default -o
jsonpath="{.status.loadBalancer.ingress[0].ip}")
echo https://${NODE_IP}/vision/
```

After the application startup has completed and the user interface is available, it can be accessed at `https://`*`hostname`*`/visual-insights/`, where *hostname* is the system on which you installed IBM Visual Insights.

7. Install any available fix packs. For instructions see "Getting fixes from Fix Central" on page 191.

Install IBM Visual Insights from AAS

1. Download the product tar.gz file from Advanced Administration System (AAS). This system is also called Entitled Software Support (ESS).
2. Untar the tar.gz file by running this command.

   ```
   gunzip -c file_name.tar.gz | tar -xvf
       -
   ```

3. Unzip and untar the visual-insights-aas-*arch*-1.2.0.0.tar.gz file (where *arch* is x86 or ppc depending on the installation platform) by running this command:

   ```
   gunzip -c file_name.tar.gz | tar -xvf -
   ```

   The install files are extracted to `visual-insights-aas-arch-1.2.0.0/`, where *arch* is x86 or ppc, depending on your platform.
4. Decompress the product tar file and run the installation command for the platform you are installing on:

   RHEL

   ```
   sudo yum install ./<file_name>.rpm
   ```

   Ubuntu

   ```
   sudo dpkg -i ./<file_name>.deb
   ```

5. Load the IBM Visual Insights images from the directory that contains the extracted tar file. The user running the script must have Docker privileges:

   ```
   sudo /opt/ibm/vision/bin/load_images.sh -f ./file_name.tar
   ```

   Note: The installation process can take some time to complete.
6. (RHEL only) Open ports for the firewall to access IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/sbin/firewall.sh
   ```

7. After the installation is complete, you can start IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

   A user named `admin` is created with a password of `passw0rd`. For instructions to change these values, see "Managing users" on page 145.

   Note: The startup script will modify ownership and permissions on `/opt/ibm/vision/volume` so that the containers can run under a non-root ID and access the data.

   You must read and accept the license agreement that is displayed before you can use IBM Visual Insights.

   It can take several minutes to start IBM Visual Insights. To check the status of the startup process, run this script:

   ```
   sudo /opt/ibm/vision/bin/helm.sh status vision
   ```

   In the output from the **`helm.sh status vision`** script, you can verify which IBM Visual Insights components are available by locating the Deployment section and identifying that the AVAILABLE column has a value of 1 for each component. The following is an example of the output from the **`helm.sh status vision`** script that shows all components are available:

```
user@system:~$ /opt/ibm/vision/bin/helm.sh status vision
LAST DEPLOYED: Mon Feb 17 19:25:40 2020
NAMESPACE: default
STATUS: DEPLOYED
RESOURCES:
==> v1beta1/Ingress
NAME        HOSTS  ADDRESS  PORTS  AGE
vision-ing  *      80       6d21h
==> v1/Pod(related)
NAME                                       READY  STATUS   RESTARTS  AGE
vision-elasticsearch-777f6bcc6c-5xvlg      1/1    Running  0         17h
vision-fpga-device-plugin-bm8qx            1/1    Running  0         17h
vision-keycloak-f57979785-fpw8q            1/1    Running  0         17h
vision-logstash-f8cc6fcc6-rhqtc            1/1    Running  0         17h
vision-mongodb-79b9d7977c-2twtb            1/1    Running  0         17h
vision-postgres-6f4788c594-gxcjp           1/1    Running  0         17h
vision-service-799c94f575-2cr48            1/1    Running  0         4h34m
vision-taskanaly-67745bc59f-qd225          1/1    Running  0         17h
vision-ui-774d989b47-2swvb                 1/1    Running  0         17h
vision-video-microservice-6fc86b5866-s8x44  1/1    Running  0         17h
==> v1/Secret
NAME            TYPE    DATA  AGE
vision-secrets  Opaque  4     6d21h
==> v1/ConfigMap
NAME           DATA  AGE
vision-config  53    6d21h
==> v1/PersistentVolumeClaim
NAME             STATUS  VOLUME       CAPACITY  ACCESS MODES  STORAGECLASS  AGE
vision-data-pvc  Bound   vision-data  40Gi      RWX           6d21h
==> v1/Service
NAME                       TYPE       CLUSTER-IP   EXTERNAL-IP  PORT(S)            AGE
vision-elasticsearch       ClusterIP  10.10.0.169  <none>       9200/TCP,9300/TCP  6d21h
vision-keycloak            ClusterIP  10.10.0.30   <none>       8080/TCP,8443/TCP  6d21h
vision-logstash            ClusterIP  10.10.0.198  <none>       9600/TCP           6d21h
vision-mongodb             ClusterIP  10.10.0.173  <none>       27017/TCP          6d21h
vision-postgres            ClusterIP  10.10.0.201  <none>       5432/TCP           6d21h
vision-service             ClusterIP  10.10.0.85   <none>       9080/TCP           6d21h
vision-taskanaly           ClusterIP  10.10.0.44   <none>       5000/TCP           6d21h
vision-ui                  ClusterIP  10.10.0.41   <none>       8080/TCP           6d21h
vision-video-microservice  ClusterIP  10.10.0.216  <none>       38080/TCP          6d21h
==> v1beta1/DaemonSet
NAME                       DESIRED  CURRENT  READY  UP-TO-DATE  AVAILABLE  NODE SELECTOR  AGE
vision-fpga-device-plugin  1        1        1      1           1          <none>         17h
==> v1/Deployment
NAME                       DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE
vision-elasticsearch       1        1        1           1          17h
vision-keycloak            1        1        1           1          17h
vision-logstash            1        1        1           1          17h
vision-mongodb             1        1        1           1          17h
vision-postgres            1        1        1           1          17h
vision-service             1        1        1           1          17h
vision-taskanaly           1        1        1           1          17h
vision-ui                  1        1        1           1          17h
vision-video-microservice  1        1        1           1          17h
NOTES:
Find the Visual Insights UI URL by running the following commands:
export NODE_IP=$(kubectl get ing vision-ing --namespace default -o
jsonpath="{.status.loadBalancer.ingress[0].ip}")
echo https://${NODE_IP}/vision/
```

After the application startup has completed and the user interface is available, it can be accessed at `https://`*`hostname`*`/visual-insights/`, where *hostname* is the system on which you installed IBM Visual Insights.

8. Install any available fix packs. For instructions see "Getting fixes from Fix Central" on page 191.

Install IBM Visual Insights trial mode

1. Go to the IBM Visual Insights Trial download site, then download the .tar file and the .rpm files as instructed.
2. Unzip and untar the product tar file, and run the installation command for the platform you are installing on.

RHEL

```
sudo yum install ./<file_name>.rpm
```

Ubuntu

```
sudo dpkg -i ./<file_name>.deb
```

The install files are extracted to `visual-insights-`*`arch`*`-1.2.0.0-`ppa, where *arch* is x86 or ppc, depending on your platform.

3. (Optional) Verify the downloaded tar file by following the instructions in this topic: "Verify the downloaded tar file" on page 43.
4. Load the IBM Visual Insights images from the directory that contains the extracted tar file. The user running the script must have Docker privileges:

   ```
   sudo /opt/ibm/vision/bin/load_images.sh -f ./file_name.tar
   ```

   Note: The installation process can take some time to complete.
5. (RHEL only) Open ports for the firewall to access IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/sbin/firewall.sh
   ```

6. After the installation is complete, you can start IBM Visual Insights by running this script:

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

   A user named `admin` is created with a password of `passw0rd`. For instructions to change these values, see "Managing users" on page 145.

   Note: The startup script will modify ownership and permissions on `/opt/ibm/vision/volume` so that the containers can run under a non-root ID and access the data.

   You must read and accept the license agreement that is displayed before you can use IBM Visual Insights.

   It can take several minutes to start IBM Visual Insights. To check the status of the startup process, run this script:

   ```
   sudo /opt/ibm/vision/bin/helm.sh status vision
   ```

   In the output from the **`helm.sh status vision`** script, you can verify which IBM Visual Insights components are available by locating the Deployment section and identifying that the AVAILABLE column has a value of 1 for each component. The following is an example of the output from the **`helm.sh status vision`** script that shows all components are available:

```
user@system:~$ /opt/ibm/vision/bin/helm.sh status vision
LAST DEPLOYED: Mon Feb 17 19:25:40 2020
NAMESPACE: default
STATUS: DEPLOYED
RESOURCES:
==> v1beta1/Ingress
NAME        HOSTS  ADDRESS  PORTS  AGE
vision-ing  *      80       6d21h
==> v1/Pod(related)
NAME                                     READY  STATUS   RESTARTS  AGE
vision-elasticsearch-777f6bcc6c-5xvlg    1/1    Running  0         17h
vision-fpga-device-plugin-bm8qx          1/1    Running  0         17h
vision-keycloak-f57979785-fpw8q          1/1    Running  0         17h
vision-logstash-f8cc6fcc6-rhqtc          1/1    Running  0         17h
vision-mongodb-79b9d7977c-2twtb          1/1    Running  0         17h
vision-postgres-6f4788c594-gxcjp         1/1    Running  0         17h
vision-service-799c94f575-2cr48          1/1    Running  0         4h34m
vision-taskanaly-67745bc59f-qd225        1/1    Running  0         17h
vision-ui-774d989b47-2swvb               1/1    Running  0         17h
vision-video-microservice-6fc86b5866-s8x44  1/1    Running  0         17h
==> v1/Secret
NAME            TYPE    DATA  AGE
vision-secrets  Opaque  4     6d21h
==> v1/ConfigMap
NAME           DATA  AGE
vision-config  53    6d21h
==> v1/PersistentVolumeClaim
NAME             STATUS  VOLUME       CAPACITY  ACCESS MODES  STORAGECLASS  AGE
vision-data-pvc  Bound   vision-data  40Gi      RWX           6d21h
==> v1/Service
NAME                       TYPE       CLUSTER-IP   EXTERNAL-IP  PORT(S)            AGE
vision-elasticsearch       ClusterIP  10.10.0.169  <none>       9200/TCP,9300/TCP  6d21h
vision-keycloak            ClusterIP  10.10.0.30   <none>       8080/TCP,8443/TCP  6d21h
vision-logstash            ClusterIP  10.10.0.198  <none>       9600/TCP           6d21h
vision-mongodb             ClusterIP  10.10.0.173  <none>       27017/TCP          6d21h
vision-postgres            ClusterIP  10.10.0.201  <none>       5432/TCP           6d21h
vision-service             ClusterIP  10.10.0.85   <none>       9080/TCP           6d21h
vision-taskanaly           ClusterIP  10.10.0.44   <none>       5000/TCP           6d21h
vision-ui                  ClusterIP  10.10.0.41   <none>       8080/TCP           6d21h
vision-video-microservice  ClusterIP  10.10.0.216  <none>       38080/TCP          6d21h
==> v1beta1/DaemonSet
NAME                       DESIRED  CURRENT  READY  UP-TO-DATE  AVAILABLE  NODE SELECTOR  AGE
vision-fpga-device-plugin  1        1        1      1           1          <none>         17h
==> v1/Deployment
NAME                       DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE
vision-elasticsearch       1        1        1           1          17h
vision-keycloak            1        1        1           1          17h
vision-logstash            1        1        1           1          17h
vision-mongodb             1        1        1           1          17h
vision-postgres            1        1        1           1          17h
vision-service             1        1        1           1          17h
vision-taskanaly           1        1        1           1          17h
vision-ui                  1        1        1           1          17h
vision-video-microservice  1        1        1           1          17h
NOTES:
Find the Visual Insights UI URL by running the following commands:
export NODE_IP=$(kubectl get ing vision-ing --namespace default -o
jsonpath="{.status.loadBalancer.ingress[0].ip}")
echo https://${NODE_IP}/vision/
```

After the application startup has completed and the user interface is available, it can be accessed at `https://`*`hostname`*`/visual-insights/`, where *hostname* is the system on which you installed IBM Visual Insights.

Related concepts

Logging in to IBM Visual Insights

Follow these steps to log in to IBM Visual Insights.

Installing IBM Visual Insights with IBM Cloud Private

If you have more than one IBM Power Systems server available, you can use IBM Cloud Private 3.1.0 or later to install a single instance of IBM Visual Insights that has access to all the Power Systems GPUs across the entire cluster.

If you have only a single Power Systems server and do not have an existing IBM Cloud Private environment, you should use the IBM Visual Insights stand-alone process. For more information, see the "Installing IBM Visual Insights stand-alone" on page 31 topic.

To install IBM Visual Insights with IBM Cloud Private, complete the following steps:

Notes:

- If IBM Cloud Private is already installed and configured in your environment, you can go to step 4.
- The links to IBM Cloud Private go to the 3.1.0 Knowledge Center. To go to a different version, click the link, then click **Change version**.

1. Install IBM Cloud Private. For more information, see the Installing IBM Cloud Private topic.
2. Install the IBM Cloud CLI. For more information, see the Install IBM Cloud CLI topic.
3. Authenticate to your master node in your IBM Cloud Private environment. For more information, see the Configuring authentication for the Docker CLI topic.

   To log in to the IBM Cloud Private cluster, run the following command:

   ```
   cloudctl login -a https://<cluster-domain-name>:8443/ --skip-ssl-validation
   ```

4. Set up your system to install your IBM Cloud Private deployment into a non-default namespace. It is recommended that you do not install into the default namespace for security reasons.

   Important: Install each distinct deployment of IBM Cloud Private into a unique namespace.

   a. Create an appropriate `ClusterRoleBinding` to enable IBM Visual Insights to query Kubernetes. To create this, copy the below text into a `crb.yaml` file, where *CustomNamespace* is your custom namespace name:

   ```
   apiVersion: rbac.authorization.k8s.io/v1
   kind: ClusterRoleBinding
   metadata:
     name: CustomNamespace-crb
   roleRef:
     apiGroup: rbac.authorization.k8s.io
     kind: ClusterRole
     name: cluster-admin
   subjects:
     -
       kind: ServiceAccount
       name: default
       namespace: CustomNamespace
   ```

   b. Run the following command:

   ```
   kubectl create -f crb.yaml
   ```

5. Download the appropriate tar file from IBM Passport Advantage.
6. (Optional) Verify the downloaded tar file by following the instructions in this topic: "Verify the downloaded tar file" on page 43.
7. Untar the `visual-insights-<architecture>-<version_number>-ppa.tar` tar file. It contains install packages for the standalone product, as well as the tar file with the containers that must be loaded for the IBM Cloud Private installation.

8. To make IBM Visual Insights available in the IBM Cloud Private catalog, run the following command:

   ```
   cloudctl catalog load-archive --archive file_name.tar --registry <icp full host name>:8500/
   <namespace>
   ```

   Where:

   --registry <*value*>
      Lets you specify the docker registry that the images will be pushed to.

      Example:

      ```
      mycluster-icp:8500/<namespace>
      ```

   --clustername <*cluster_CA_domain*>
      Lets you specify the certificate authority (CA) domain. If you did not specify a CA domain, the default value is `mycluster.icp`.

9. Review the Chart README for IBM Visual Insights carefully. It documents prerequisites, requirements, and limitations of IBM Visual Insights in IBM Cloud Private.
10. Verify that you have a minimum of 40 GB of persistent storage. If your IBM Cloud Private installation has dynamic provisioned storage, you can use it for your 40 GB of persistent storage. To manually create persistent volumes in IBM Cloud Private, see the Creating a Persistent Volume topic. After you create the persistent volume, you must make the volume sharable across all nodes in the cluster.

    Note: Do not use `HostPath` for the persistent storage unless you have only one node in your cluster. See Creating a Persistent Volume and Creating a hostPath PersistentVolume in the IBM Cloud Private documentation for details.

11. **Important:** You must run the following commands to set up the persistent volume. This is required because the containers run under the non-root id `1979`:

    ```
    AIV_USER=1979
    VOL_DIR=<persistent_volume_path>
    mkdir -p ${VOL_DIR}/data ${VOL_DIR}/run/logstash ${VOL_DIR}/run/elasticsearch $
    {VOL_DIR}/run/mongodb ${VOL_DIR}/run/pgsql
    chown ${AIV_USER}:${AIV_USER} ${VOL_DIR} ${VOL_DIR}/run
    chown -R ${AIV_USER}:${AIV_USER} ${VOL_DIR}/data
    chown 1000:1000 ${VOL_DIR}/run/logstash ${VOL_DIR}/run/elasticsearch
    chown 999 ${VOL_DIR}/run/mongodb
    chown 999 ${VOL_DIR}/run/pgsql
    ```

12. To install IBM Visual Insights from the IBM Cloud Private catalog, from the navigation menu select **Catalog** > **Helm Charts**.
13. In the search box, enter `vision` and click **visual-insights**. Review the information.
14. Click **Configure** and enter information for the **Release name** and the **Namespace** fields. The default user name is `admin` and the default password is `passw0rd`. For instructions to change these values, see "Managing users" on page 145. For information about namespaces, see Namespaces in the IBM Cloud Private Knowledge Center.
15. Click **Install**.

    It can take several minutes for the application to be deployed and the user interface to be made available. When the application startup has completed, it can be accessed using the URL `https://`*`proxyhost`*`/visual-insights-`*`RELEASE`*`/`, where *proxyhost* is the host name of your IBM Cloud Private proxy server, and *RELEASE* is the name you specified in the **Release name** field when you deployed the Helm chart.

16. For information about accessing IBM Visual Insights, see Logging into IBM Visual Insights.

Important: NFS volumes should have the "no_root_squash" flag set in `/etc/exports`:

```
/var/nfs *(rw,no_root_squash,no_subtree_check)
```

Upgrading IBM Visual Insights

When upgrading to the latest version of IBM Visual Insights, your data from the previous release will not be lost, as long as you are upgrading to the same type of install. For example; from the stand-alone version to the stand-alone version. However, you should undeploy all models before upgrading and redeploy after upgrade.

Important: Before following these steps, undeploy any deployed models. To undeploy a model, click **Deployed Models**. Next, select the model that you want to undeploy and click the **X** (undeploy) in the header bar. The trained model is not deleted from IBM Visual Insights.

Prior to upgrading, is recommended that you back up your environment by following the steps in this topic: "Backing up IBM Visual Insights" on page 148.

- Upgrade the stand-alone version
- Upgrade IBM Visual Insights with IBM Cloud Private
- Upgrade from the stand-alone version to IBM Cloud Private

Upgrade the stand-alone version

1. Stop the current instance of IBM PowerAI Vision by running the following script:

```
sudo  /opt/vision/bin/powerai_vision_stop.sh
```

2. Optionally uninstall the current version of IBM PowerAI Vision. Doing so will not remove your data under `/opt/ibm/powerai-vision/volume`.
3. Obtain and install IBM Visual Insights 1.2.0:

   Install IBM Visual Insights from IBM Passport Advantage

   a. Download the product tar file from the IBM Passport Advantage website.
   b. (Optional) Verify the downloaded tar file by following the instructions in this topic: "Verify the downloaded tar file" on page 43.
   c. Unzip and untar the product tar file, and run the installation command for the platform you are installing on.

      RHEL

      ```
      sudo yum install ./<file_name>.rpm
      ```

      Ubuntu

      ```
      sudo dpkg -i ./<file_name>.deb
      ```

      You will be prompted to accept the upgrade of the product if you are running an interactive install.

   Install IBM Visual Insights from AAS

   a. Download the product tar.gz file from Advanced Administration System (AAS). This system is also called Entitled Software Support (ESS).
   b. Untar the tar.gz file by running this command.

      ```
      gunzip -c file_name.tar.gz | tar -xvf
          -
      ```

   c. Unzip and untar the visual-insights-aas-*arch*-1.2.0.0.tar.gz file (where *arch* is x86 or ppc depending on the installation platform) by running this command:

      ```
      gunzip -c file_name.tar.gz | tar -xvf -
      ```

      The install files are extracted to `visual-insights-aas-arch-1.2.0.0/`, where *arch* is x86 or ppc, depending on your platform.

4. Load the IBM Visual Insights images from the directory that contains the extracted tar file. The user running the script must have Docker privileges:

   ```
   sudo /opt/ibm/vision/bin/load_images.sh -f ./file_name.tar
   ```

   Note: The installation process can take some time to complete.
5. Install any available fix packs. For instructions see "Getting fixes from Fix Central" on page 191.
6. Run the migration script. Do not perform this step when upgrading to fix pack 1.2.0.1:

   ```
   $ sudo /opt/ibm/vision/bin/vision-migrate-1.2.0.0.sh
   ```

7. After the migration completes successfully, start IBM Visual Insights:

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

   Note: After the application is restarted, the URL to access the application is changed from `https://`*`hostname`*`/`**`powerai-vision`**`/` to `https://`*`hostname`*`/`**`visual-insights`**`/`, where *hostname* is the system on which the product is installed.
8. Remove the prior installation data from `/opt/powerai-vision`.
9. Redeploy trained models as necessary.
   a. Click **Models** from the menu.
   b. Select the model you want to deploy and click **Deploy**.
   c. Specify a name for the model, and for models that were trained with the **Optimized for speed (tiny YOLO v2)** model, choose the accelerator to deploy to. You can choose GPU, CPU, or Xilinx FPGA - 16 bit (technology preview).
   d. Click **Deploy**. The **Deployed Models** page is displayed. When the model has been deployed, the status column displays **Ready**.
   e. Click the deployed model to get the API endpoint, to view details about the model, such as the owner and the accuracy, and to test other videos or images against the model.

Upgrade IBM Visual Insights with IBM Cloud Private

1. Download the product tar file from the IBM Passport Advantage website.
2. To make IBM Visual Insights available in the IBM Cloud Private catalog, run the following command:

   ```
   cloudctl catalog load-archive --archive file_name.tar --registry <icp full host name>:8500/
   <namespace>
   ```

   Where:

   --registry *<value>*

   Lets you specify the docker registry that the images will be pushed to.

   Example:

   ```
   mycluster-icp:8500/<namespace>
   ```

   --clustername *<cluster_CA_domain>*

   Lets you specify the certificate authority (CA) domain. If you did not specify a CA domain, the default value is `mycluster.icp`.

3. If you are upgrading from a release prior to 1.1.5, modify your persistent volume to allow the non-root containers to access the data using the non-root ID they run under. Run the following against the associated persistent volume of the instance of IBM Visual Insights that you want to upgrade:

   ```
   AIV_USER=1979
   VOL_DIR=<persistent_volume_path>
   mkdir -p ${VOL_DIR}/data ${VOL_DIR}/run/logstash ${VOL_DIR}/run/elasticsearch ${VOL_DIR}/run/
   mongodb ${VOL_DIR}/run/pgsql
   chown ${AIV_USER}:${AIV_USER} ${VOL_DIR} ${VOL_DIR}/run
   chown -R ${AIV_USER}:${AIV_USER} ${VOL_DIR}/data
   chown 1000:1000 ${VOL_DIR}/run/logstash ${VOL_DIR}/run/elasticsearch
   chown 999 ${VOL_DIR}/run/mongodb
   chown 999 ${VOL_DIR}/run/pgsql
   ```

4. Navigate to your Helm Release. Click **Upgrade** and the upgrade to the new IBM Visual Insights images starts.

   Note: The upgrade process can take some time to complete.

5. As part of the upgrade process, IBM Visual Insights is restarted and a user named `admin` is created with a password of `passw0rd`. Users will be preserved from the previous installation on upgrade. For instructions to manage existing users, and to learn how to create new users, see "Managing users" on page 145.

   Note: After the application is restarted, the URL to access the application is changed from `https://`*`proxyhost`*`/`**`powerai-vision`**`-`*RELEASE*`/` to `https://`*`proxyhost`*`/`**`visual-insights`**`-`*RELEASE*`/`, where *proxyhost* is the host name of the IBM Cloud Private proxy server on which the product is installed, and *RELEASE* is the name you specified in the **Release name** field when you deployed the Helm chart.

Upgrade from the stand-alone version to IBM Cloud Private

1. Stop the current instance of IBM PowerAI Vision by running the following script:

   ```
   sudo  /opt/vision/bin/powerai_vision_stop.sh
   ```

2. Back up `/opt/ibm/powerai-vision/volume`.
3. Install IBM Cloud Private. For more information, see the Installing IBM Cloud Private topic.
4. Install the IBM Cloud CLI. For more information, see the Install IBM Cloud CLI topic.
5. Configure IBM Cloud Private by following the instructions in this topic: "Installing IBM Visual Insights with IBM Cloud Private" on page 38.
6. Move the backed up volume directory to a path that is NFS-exported or accessible to all worker nodes in the ICP cluster by Spectrum Scale (GPFS), Gluster, or another file system that enables Kubernetes to schedule pods with read/write/many semantics.
7. Create a persistent volume in the cluster. For example, if the volume path goes to `/mnt/foo/bar` then we should find `/mnt/foo/bar/data` and `/mnt/foo/bar/run` inside that directory, copied from the original `volume` directory above.
8. Create a persistent volume claim against that volume. To manually create persistent volumes in IBM Cloud Private, see the Creating a Persistent Volume topic. After you create the persistent volume, you must make the volume sharable across all nodes in the cluster.

   Note: Do not use `HostPath` for the persistent storage unless you have only one node in your cluster. See Creating a Persistent Volume and Creating a hostPath PersistentVolume in the IBM Cloud Private documentation for details.

9. Follow the instructions in "Installing IBM Visual Insights with IBM Cloud Private" on page 38, starting with step "8" on page 39. For step "10" on page 39, use the persistent volume claim you created previously.

Uninstalling IBM Visual Insights stand-alone

You must uninstall IBM Visual Insights stand-alone on your system, before you can install IBM Cloud Private, IBM Data Science Experience Local, or other Kubernetes-based applications.

To uninstall IBM Visual Insights, complete the following steps:

Warning: If you run the following commands, all the data that you gathered is deleted. Export your data sets and models before you run the following commands.

1. Stop the current instance of IBM Visual Insights by running the following script:

   ```
   sudo  /opt/ibm/vision/bin/vision-stop.sh
   ```

2. Remove previously installed images by running the following script:

   ```

   sudo /opt/ibm/vision/bin/purge_image.sh 1.2.0.0
   ```

   Optionally remove all product data by running the following script. This will remove data sets, models, and so on:

   ```
   sudo /opt/ibm/vision/bin/purge_data.sh
   ```

3. Remove IBM Visual Insights by running the following command:
   - For RHEL:

     ```
     sudo yum remove visual-insights
     ```

   - For Ubuntu:

     ```
     sudo dpkg --remove visual-insights
     ```

4. Delete the data directory by running the following command:

   ```

   sudo rm -rf /opt/ibm/vision/
   ```

5. Verify that IBM Visual Insights was uninstalled by running the following command:
   - For RHEL:

     ```
     rpm -q visual-insights
     ```

   - For Ubuntu:

     ```
     dpkg -l visual-insights
     ```

Verify the downloaded tar file

After downloading a tar file, you can optionally verify it by using the CISO code signing service or with the signing certificate authority.

1. Download the product public key, OCSP public key, and OCSP chain public key:

   visual-insights-1.2.0.0-key.pub
   visual-insights-ocsp-1.2.0.0-key.pub
   visual-insights-ocspchain-1.2.0.0-key.pub

2. Download the appropriate sig file for your product version and platform:

Table 5. Available signature files

Version	Platform	File Name and description
Full	Power Systems	visual-insights-ppc-1.2.0.0-ppa.sig IBM Visual Insights Training and Inference 1.2.0 Power Signature File English
Full	x86	visual-insights-x86-1.2.0.0-ppa.sig IBM Visual Insights Training and Inference 1.2.0 x86 Signature File English
Inference only	Power Systems	visual-insight-infer-ppc-1.2.0.0-ppa.sig IBM Visual Insights Inference for Servers 1.2.0 Power Signature File English
Inference only	x86	visual-insight-infer-x86-1.2.0.0-ppa.sig IBM Visual Insights Inference for Servers 1.2.0 x86 Signature File English
Nonproduction	Power Systems	visual-insight-noprd-ppc-1.2.0.0-ppa.sig IBM Visual Insights Non-Production 1.2.0 Power Signature File English
Nonproduction	x86	visual-insight-noprd-ppc-1.2.0.0-ppa.sig IBM Visual Insights Non-Production 1.2.0 x86 Signature File English
Trial	Power Systems	visual-insight-trial-ppc-1.2.0.0.sig
Trial	x86	visual-insight-trial-x86-1.2.0.0.sig

3. Perform the verification:

   - To verify the tar file by using the CISO code signing service, run the following command with the appropriate .sig and .tar file and ensure that the output is `Verified OK`:

     ```
     openssl dgst -sha256 -verify key_file \
       -signature sig_file tar_file
     ```

     For example, if you downloaded the install package for Power Systems from Passport Advantage (PPA):

     ```
     openssl dgst -sha256 -verify visual-insights-1.2.0.0-key.pub \
     -signature visual-insights-ppc-1.2.0.0-ppa.sig visual-insights-ppc-1.2.0.0-ppa.tar
     ```

- The product's certificate validity can be verified using the Online Certificate Status Protocol (OCSP). Run the following command and ensure that the output includes `Response verify OK`:

  ```
  openssl ocsp -no_nonce -issuer visual-insights-ocspchain-1.2.0.0-key.pub -cert visual-
  insights-ocspchain-1.2.0.0-key.pub -VAfile visual-insights-ocspchain-1.2.0.0-key.pub -text
  -url http://ocsp.digicert.com -respout
  ```

  For example:

```
# openssl ocsp -no_nonce -issuer visual-insights-ocspchain-1.2.0.0-key.pub -cert visual-
insights-ocsp-1.2.0.0-key.pub -VAfile visual-insights-ocspchain-1.2.0.0-key.pub -text -url
http://ocsp.digicert.com -respout ocsptest
OCSP Request Data:
...

Response verify OK
visual-insights-ocsp-1.2.0.0-key.pub: good
        This Update: Feb 27 18:19:14 2020 GMT
        Next Update: Mar  5 18:19:14 2020 GMT
```

Chapter 6. Checking the application and environment

After installation of IBM Visual Insights, you can check the status of the application and environment by using commands documented in these topics. The Kubernetes commands `helm.sh` and `kubectl.sh` are installed in the bin directory of the product install path. (default: `/opt/ibm/vision`).

Checking the application Docker images in standalone installation

Space limitations or Kubernetes garbage collection activities can result in IBM Visual Insights Docker images not being available in the Docker repository on a system.

- "Using docker images to validate IBM Visual Insights Docker image availability" on page 47
- "Loading missing images" on page 48

Using `docker images` to validate IBM Visual Insights Docker image availability

When `load_images.sh` runs successfully, it indicates that the following images were successfully loaded:

```
$ /opt/ibm/vision/bin/load_images.sh -f ./visual-insights-images-1.2.0.0.tar
[ INFO ] Waiting for docker loads to complete. This will take some time...
Loaded image: gcr.io/google_containers/pause:3.1
Loaded image: vision-tiller:2.12.0
Loaded image: gcr.io/google_containers/hyperkube:v1.13.12
Loaded image: sys-powerai-vision-docker-local.artifactory.swg-devops.com/nginx-ingress-
controller:0.26.1
Loaded image: gcr.io/google_containers/etcd:3.3.10
Loaded image: nvidia/k8s-device-plugin:1.11
Loaded image: coredns/coredns:1.2.6
Loaded image: vision-mongodb:1.2.0.0
Loaded image: vision-dnn-ssd:1.2.0.0
Loaded image: vision-dnn-microservices:1.2.0.0
Loaded image: vision-fpga-device-plugin:1.2.0.0
Loaded image: vision-taskanaly:1.2.0.0
Loaded image: vision-dnn-edge:1.2.0.0
Loaded image: vision-preprocessing:1.2.0.0
Loaded image: vision-logstash:1.2.0.0
Loaded image: vision-elasticsearch:1.2.0.0
Loaded image: postgres:9.6.8
Loaded image: vision-dnn-detectron:1.2.0.0
Loaded image: vision-dnn-actiondetect:1.2.0.0
Loaded image: vision-video-microservice:1.2.0.0
Loaded image: vision-models:1.2.0.0
Loaded image: vision-ui:1.2.0.0
Loaded image: vision-usermgt:1.2.0.0
Loaded image: vision-service:1.2.0.0
Loaded image: vision-dnn-custom:1.2.0.0
Loaded image: vision-keycloak:1.2.0.0




[ INFO ] SUCCESS> All images loaded successfully.
```

At any time, these images should also show in the output of Docker images:

```
$ docker images | grep 1.2.0.0
vision-dnn-edge                                 1.2.0.0             7b7557eba7a2        44 hours
ago         4.87 GB
vision-dnn-custom                               1.2.0.0             9d5ba3b431c1        44 hours
ago         10.4 GB
vision-taskanaly                                1.2.0.0             f09b6735ed30        44 hours
ago         276 MB
vision-preprocessing                            1.2.0.0             3a7230bccac4        44 hours
ago         1.63 GB
vision-dnn-microservices                        1.2.0.0             ee9544b2fa37        44 hours
ago         5.06 GB
vision-ui                                       1.2.0.0             fd03536976f1        44 hours
ago         201 MB
vision-service                                  1.2.0.0             b0e19fb29723        44 hours
```

```
ago        461 MB
vision-dnn-actiondetect                         1.2.0.0             b133f4b144e9        44 hours
ago        4.32 GB
vision-mongodb                                  1.2.0.0             03f60c2e24a0        44 hours
ago        395 MB
vision-dnn-ssd                                  1.2.0.0             71cc5cf8919f        44 hours
ago        4.82 GB
vision-dnn-detectron                            1.2.0.0             7aef5a6a9d97        44 hours
ago        4.42 GB
vision-video-microservice                       1.2.0.0             8792e532bfde        3 days
ago          1.92 GB
vision-usermgt                                  1.2.0.0             3c4a3567be30        3 days
ago          219 MB
vision-keycloak                                 1.2.0.0             69e805c6aa92        3 days
ago          498 MB
vision-models                                   1.2.0.0             fd90900305ae        3 days
ago          1.84 GB
vision-logstash                                 1.2.0.0             9e682d7dcbae        3 days
ago          822 MB
vision-fpga-device-plugin                       1.2.0.0             7cb1dea7a84a        3 days
ago          1.06 GB
vision-elasticsearch                            1.2.0.0             c6285604f05a        3 days
ago          691 MB
```

Loading missing images
If any of the IBM Visual Insights Docker images are not available in the Docker repository, application failures can occur. In this case, run `load_images.sh` again to load any of the images that are missing.

Checking the application status in an ICP installation

Before you can use the `kubectl` commands to check the application status, you must log in to the IBM Cloud Private cluster.

```
cloudctl login -a https://<cluster-domain-name>:8443/ --skip-ssl-validation
```

Example

In the following example, `cloudctl` is used to log in to the IBM Cloud Private cluster `icp1` with master node `icp1.domain.com` as the user `admin`, to access the `default` namespace where the IBM Visual Insights application is installed:

```

# cloudctl login -a https://icp1.domain.com:8443 --skip-ssl-validation -u admin

Password>
Authenticating...
OK

Targeted account icp1 Account (id-icp1-account)

Select a namespace:
1. cert-manager
2. default
3. ibmcom
4. istio-system
5. kube-public
6. kube-system
7. platform
8. services
9. vision
Enter a number> 2
Targeted namespace default

Configuring kubectl ...
Property "clusters.icp1" unset.
Property "users.icp1-user" unset.
Property "contexts.icp1-context" unset.
Cluster "icp1" set.
User "icp1-user" set.
Context "icp1-context" created.
Switched to context "icp1-context".
OK
```

```
Configuring helm: /root/.helm
OK
#
```

Now the `kubectl` commands can be used to similar to the way they are used in the standalone environment.

Checking Kubernetes services status

The Kubernetes infrastructure is used to run the IBM Visual Insights application. The **`kubectl`** command can be used to check the status of these underlying services, using the **`--namespace kube-system`** option.

- “Using kubectl get pods to check kube-system” on page 49
- “Using kubectl describe pods to check kube-system” on page 49

Using kubectl get pods to check kube-system

The `kubectl` command is used to show the detailed status of the Kubernetes pods deployed to run the IBM Visual Insights application.

Example output

```
# /opt/ibm/vision/bin/kubectl.sh get pods --namespace kube-system
NAME                                   READY   STATUS    RESTARTS   AGE
coredns-76f484447b-9sqwz               1/1     Running   0          3d4h
nginx-ingress-lb-ppc64le-hmtg5         1/1     Running   0          3d4h
nvidia-device-plugin-daemonset-wdlkl   1/1     Running   0          3d4h
tiller-deploy-7f65888dc8-kcglg         1/1     Running   0          3d4h
```

Interpreting the output

- When the Kubernetes system is running correctly, each of the pods should have:
  - In the READY column all pods should be counted - for example, "1/1".
  - A value of "Running" in the STATUS column.
- A STATUS value other than "Running" indicates an issue with the Kubernetes infrastructure.
- A non-0, and growing, value in the RESTARTS column indicates an issue with that Kubernetes pod.

Using kubectl describe pods to check kube-system

The `kubectl describe pods` command provides detailed information about each of the pods that provide Kubernetes infrastructure. If the output from a specific pod is desired, run the command `kubectl describe pod` *`pod_name`* `--namespace kube-system`.

Example output

The output from the command is verbose, so sample output from only one pod is shown:

```
# /opt/ibm/vision/bin/kubectl.sh describe pods --namespace kube-system
Name:            coredns-76f484447b-9sqwz
Namespace:       kube-system
Node:            127.0.0.1/127.0.0.1
Start Time:      Tue, 12 Mar 2019 07:44:34 -0500
Labels:          k8s-app=kube-dns
                 pod-template-hash=76f484447b
Annotations:     <none>
Status:          Running
IP:              172.17.0.2
Controlled By:   ReplicaSet/coredns-76f484447b
Containers:
  coredns:
    Container ID:   docker://e94399e73b84c4fe55f54807cfbfdcacdafcab27fa2f746421bfd5ba9443e175
    Image:          coredns/coredns:1.2.6
    Image ID:       docker-pullable://coredns/
coredns@sha256:81936728011c0df9404cb70b95c17bbc8af922ec9a70d0561a5d01fefa6ffa51
    Ports:          53/UDP, 53/TCP, 9153/TCP
    Host Ports:     0/UDP, 0/TCP, 0/TCP
    Args:           -conf /etc/coredns/Corefile
    State:          Running
      Started:      Tue, 12 Mar 2019 07:44:44 -0500
    Ready:          True
    Restart Count:  0
    Limits:
       memory:      170Mi
    Requests:
       cpu:         100m
       memory:      70Mi
    Liveness:       http-get http://:8080/health delay=60s timeout=5s period=10s #success=1
#failure=5
    Environment:    <none>
    Mounts:
      /etc/coredns from config-volume (ro) /var/run/secrets/kubernetes.io/serviceaccount from
default-token-wgpqf (ro)
Conditions:
  Type            Status
  Initialized     True
  Ready           True
  ContainersReady True
  PodScheduled    True
Volumes:
  config-volume:
    Type:        ConfigMap (a volume populated by a ConfigMap)
    Name:        coredns
    Optional:    false
  default-token-wgpqf:
    Type:        Secret (a volume populated by a Secret)
    SecretName:  default-token-wgpqf
    Optional:    false
QoS Class:       Burstable
Node-Selectors:  beta.kubernetes.io/os=linux
Tolerations:     CriticalAddonsOnly
                 node.kubernetes.io/not-ready:NoExecute for 300s
                 node.kubernetes.io/unreachable:NoExecute for 300sE
Events:          <none>
```

Interpreting the output

Significant fields providing status of the Kubernetes pods include:

- The **Status** field should be "Running" - any other status will indicate issues with the environment.
- In the **Conditions** section, the **Ready** field should indicate "True". Any other value indicates that there are issues with the environment.
- If there are issues with any pods, the **Events** section of the pod should have information about issues the pod encountered.

Checking Kubernetes node status

Use these commands to check the status of the nodes in the environment.

- "kubectl.sh get pods" on page 51
- "kubectl describe nodes command" on page 51
- "kubectl describe pods command" on page 53

kubectl.sh get pods

The `kubectl` command is used to show the detailed status of the Kubernetes pods deployed to run the IBM Visual Insights application.

Example output

```
$ /opt/ibm/vision/bin/kubectl.sh get pods
NAME                                       READY   STATUS    RESTARTS   AGE
vision-elasticsearch-59fcb48446-q64zc      1/1     Running   0          4h49m
vision-fpga-device-plugin-w7gb7            1/1     Running   0          4h49m
vision-keycloak-7c88568f56-zcc9c           1/1     Running   0          4h49m
vision-logstash-ff888487c-6vnzt            1/1     Running   0          4h49m
vision-mongodb-7cb5cdf54b-krpc8            1/1     Running   0          4h49m
vision-postgres-8cf756958-6d8gz            1/1     Running   0          4h49m
vision-service-86c6f58d7b-947md            1/1     Running   0          4h49m
vision-taskanaly-558c7644c8-ww6kw          1/1     Running   0          4h49m
vision-ui-76f8bc46b-btwps                  1/1     Running   0          4h49m
vision-video-microservice-7d5dd58969-9lr4p   1/1     Running   0          4h49m
```

Interpreting the output

- When the application is running correctly, each of the pods should have:
  - A value of `1/1` in the READY column
  - A value of `Running` in the STATUS column
- In the above example output, pods with `infer` in the name are created when a model is deployed. These will only appear if there are models deployed in the instance of the application running on the system.
- A STATUS value other than `Running` indicates an issue with the pod.
- A non-0 and increasing value in the RESTARTS column indicates an issue with that pod.

If there are indications of issues with pods, see "Troubleshooting known issues - IBM Visual Insights standard install" on page 169.

kubectl describe nodes command

The `kubectl describe nodes` command provides status information regarding the Kubernetes environment used to run the IBM Visual Insights application.

Example output

```
$ /opt/ibm/vision/bin/kubectl.sh describe nodes
Name:               127.0.0.1
Roles:              <none>
Labels:             beta.kubernetes.io/arch=ppc64le
                    beta.kubernetes.io/os=linux
                    kubernetes.io/hostname=127.0.0.1
Annotations:        node.alpha.kubernetes.io/ttl: 0
                    volumes.kubernetes.io/controller-managed-attach-detach: true
CreationTimestamp:  Thu, 13 Feb 2020 12:19:29 -0600
Taints:             <none>
Unschedulable:      false
Conditions:
  Type             Status  LastHeartbeatTime                 LastTransitionTime
Reason                       Message
  ----             ------  -----------------                 ------------------
------                       -------
  MemoryPressure   False   Mon, 02 Mar 2020 21:52:39 -0600   Thu, 13 Feb 2020 12:19:29 -0600
KubeletHasSufficientMemory   kubelet has sufficient memory available
  DiskPressure     False   Mon, 02 Mar 2020 21:52:39 -0600   Thu, 13 Feb 2020 12:19:29 -0600
KubeletHasNoDiskPressure     kubelet has no disk pressure
  PIDPressure      False   Mon, 02 Mar 2020 21:52:39 -0600   Thu, 13 Feb 2020 12:19:29 -0600
KubeletHasSufficientPID      kubelet has sufficient PID available
  Ready            True    Mon, 02 Mar 2020 21:52:39 -0600   Thu, 27 Feb 2020 12:25:21 -0600
KubeletReady                 kubelet is posting ready status
Addresses:
  InternalIP:  127.0.0.1
  Hostname:    127.0.0.1
Capacity:
 cpu:                 128
 ephemeral-storage:  409400Mi
 hugepages-1Gi:       0
 hugepages-2Mi:       0
 memory:              598021504Ki
 nvidia.com/gpu:      4
 pods:                500
Allocatable:
 cpu:                 128
 ephemeral-storage:  404280Mi
 hugepages-1Gi:       0
 hugepages-2Mi:       0
 memory:              597919104Ki
 nvidia.com/gpu:      4
 pods:                500
System Info:
 Machine ID:                 3d6ff2f75c7d3ae927580249a28e7e05
 System UUID:                788BFBA^@
 Boot ID:                    cafabe87-d34f-4e16-b79e-7bafac13ba18
 Kernel Version:             4.14.0-115.2.2.el7a.ppc64le
 OS Image:                   Debian GNU/Linux 9 (stretch)
 Operating System:           linux
 Architecture:               ppc64le
 Container Runtime Version:  docker://1.13.1
 Kubelet Version:            v1.13.12
 Kube-Proxy Version:         v1.13.12
Non-terminated Pods:         (15 in total)
  Namespace                  Name
CPU Requests  CPU Limits  Memory Requests  Memory Limits  AGE
  ---------                  ----
------------  ----------  ---------------  -------------  ---
  default                    vision-dnn-infer-bc82ad87-af86-479c-8ac4-e4e37da5fb66-7d462nt55    0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h41m
  default                    vision-elasticsearch-59fcb48446-ww9n7                              0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-fpga-device-plugin-fwwdm                                    0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-keycloak-7c88568f56-f7wkg                                   0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-logstash-ff888487c-ldbzg                                    0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-mongodb-7cb5cdf54b-wqrhf                                    0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-postgres-8cf756958-2bp4q                                    0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-service-86c6f58d7b-g2r75                                    0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-taskanaly-558c7644c8-r5bwx                                  0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-ui-76f8bc46b-fcnhq                                          0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  default                    vision-video-microservice-7d5dd58969-rfs8h                         0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  kube-system                coredns-84786db598-p89ll
100m (0%)     0 (0%)      70Mi (0%)       170Mi (0%)     4h42m
  kube-system                nginx-ingress-lb-t98ff                                             0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
  kube-system                nvidia-device-plugin-daemonset-gmthd                               0
(0%)        0 (0%)      0 (0%)           0 (0%)         4h42m
```

Interpreting the output

- Most of the information is informational regarding the system resources (CPUs, GPUs, memory) and version information (OS, Docker, Kubernetes).
- The **Conditions** section can indicate whether there are system resource issues that will affect the running of the application. For example, if any of the **OutOfDisk**, **MemoryPressure**, or **DiskPressure** conditions are `True`, there are insufficient system resources to run IBM Visual Insights. For example, the following **Conditions** section shows a system that does not have sufficient disk space available, indicated by **DiskPressure** status of `True`:

```
Conditions:
  Type             Status  LastHeartbeatTime                 LastTransitionTime
Reason                       Message
  ----             ------  -----------------                 ------------------
------                       -------
  OutOfDisk        False   [...]                               [...]
KubeletHasSufficientDisk     kubelet has sufficient disk space available
  MemoryPressure   False   [...]                               [...]
KubeletHasSufficientMemory   kubelet has sufficient memory available
  DiskPressure     True    [...]                               [...]
KubeletHasDiskPressure       kubelet has disk pressure
  Ready            True    [...]                               [...]
KubeletReady                 kubelet is posting ready status
```

- The **Events** section will also have messages that can indicate if there are issues with the environment. For example, the following events indicate issues with disk space that have led to Kubernetes attempting to reclaim resources ("eviction") which can affect the availability of Kubernetes applications:

```
Events:
  Type     Reason                 Age               From               Message
  ----     ------                 ----              ----               -------
  Normal   NodeHasDiskPressure    5m                kubelet, 127.0.0.1  Node 127.0.0.1 status is
now: NodeHasDiskPressure
  Warning  EvictionThresholdMet  3s (x23 over 5m)  kubelet, 127.0.0.1  Attempting to reclaim
nodefs
```

kubectl describe pods command

The `kubectl.sh describe pods` command provides detailed information about each of the pods used by the IBM Visual Insights application. If the output from a specific pod is desired, the command `kubectl.sh describe pod` *podname*. To determine the values for *podname* look at the output from `kubectl.sh get pods`.

Example output

The output from the command is verbose, so sample output from only one pod is shown:

```
$ /opt/ibm/vision/bin/kubectl.sh describe pods
...
Name:           vision-ui-76f8bc46b-btwps
Namespace:      default
Node:           127.0.0.1/127.0.0.1
Start Time:     Thu, 27 Feb 2020 12:25:41 -0600
Labels:         app=vision
                chart=ibm-visual-insights-prod-2.0.0
                component=vision-ui
                heritage=Tiller
                pod-template-hash=76f8bc46b
                release=vision
                run=vision-ui-deployment-pod
Annotations:    checksum/config: f213e302ced04315e606a52c9632fcf34e5ae898c55e39c4f9e1fcb83ddd9c7e
                productID: 5737-H10
                productName: IBM Visual Insights
                productVersion: 1.2.0.0
Status:         Running
IP:             172.17.0.11
Controlled By:  ReplicaSet/vision-ui-76f8bc46b
Containers:
  vision-ui:
    Container ID:   docker://694163f88bd03145dc7b5486d951ab4c3452640627153d2bbd97c5027ee12929
    Image:          vision-ui:1.2.0.0
    Image ID:       docker://
sha256:fd03536976f1513fe5ac1e1357f829b8bd10d3eac86d50bf92a4c255b1fc6f3e
    Port:           8080/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Thu, 27 Feb 2020 12:25:48 -0600
    Ready:          True
    Restart Count:  0
    Liveness:       http-get http://:http/visual-insights/index.html delay=240s timeout=5s
period=10s #success=1 #failure=3
    Readiness:      http-get http://:http/visual-insights/index.html delay=5s timeout=1s
period=10s #success=1 #failure=3
    Environment:
      CONTEXT_ROOT:             <set to the key 'CONTEXT_ROOT' of config map 'vision-
config'>             Optional: false
      DLAAS_API_SERVER:         <set to the key 'DLAAS_API_SERVER' of config map 'vision-
config'>         Optional: false
      SERVER_HOST_VIDEO_TEST:   <set to the key 'SERVER_HOST_VIDEO_TEST' of config map 'vision-
config'>   Optional: false
      SERVICE_PORT_VIDEO_TEST:  <set to the key 'SERVICE_PORT_VIDEO_TEST' of config map 'vision-
config'>  Optional: false
      WEBROOT_VIDEO_TEST:       <set to the key 'WEBROOT_VIDEO_TEST' of config map 'vision-
config'>       Optional: false
    Mounts:
      /opt/powerai-vision/data from data-mount (rw)
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-sf7ng (ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
  data-mount:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same
namespace)
    ClaimName:  vision-data-pvc
    ReadOnly:   false
  default-token-sf7ng:
    Type:        Secret (a volume populated by a Secret)
    SecretName:  default-token-sf7ng
    Optional:    false
QoS Class:       BestEffort
Node-Selectors:  <none>
Tolerations:     node.kubernetes.io/not-ready:NoExecute for 300s
                 node.kubernetes.io/unreachable:NoExecute for 300s
Events:          <none>
```

Interpreting the output

Significant fields providing status of the application pods include:

- Information about the product name and version are given in **productName** and **productVersion**.
- The **Status** field should be `Running`. Any other status indicates problems with the application pod.

- If there are issues with a pod, the **Events** section of the pod should have information about problems encountered.

Checking Kubernetes storage status

The IBM Visual Insights application requires disk storage for activities including data set storage. The disk space requirements are described using Kubernetes Persistent Volume configuration. The `kubectl` command can be used to examine the *pv* (PersistentVolume) and *pvc* (PersistentVolumeClaims) resources.

Note: The storage requirements described in the **PersistentVolume** and **PersistentVolumeClaims** are not enforced in the standalone deployment. Therefore, the requested space might not be available in the underlying storage of the system. See "Disk space requirements" on page 18 for information about product storage requirements.

- "Using kubectl get pv and pvc commands" on page 55
- "Using the kubectl describe pv command" on page 55
- "Using the kubectl describe pvc command" on page 56

Using kubectl get pv and pvc commands

The `kubectl get pv` and `kubectl get pvc` commands can be used to see what PersistentVolume and PersistentVolumeClaim have been defined for the application.

Example output

```
# /opt/ibm/vision/bin/kubectl.sh get pv
NAME          CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS   CLAIM
STORAGECLASS   REASON   AGE
vision-data   40Gi       RWX            Retain           Bound    default/vision-data-
pvc                          14d
```

```
# /opt/ibm/vision/bin/kubectl.sh get pvc
NAME              STATUS   VOLUME        CAPACITY   ACCESS MODES   STORAGECLASS   AGE
vision-data-pvc   Bound    vision-data   40Gi       RWX                           14d
```

Interpreting the output

The above output shows information about the Persistent Volume and Persistent Volume Claim for IBM Visual Insights. The application currently has a capacity claim of 40G and it is successfully "Bound". If the **STATUS** is not "Bound", the application does not have access to the necessary storage.

Using the kubectl describe pv command

The `kubectl describe pv` command is used to see detailed information about the Persistent Volume used by the application.

Example output

```
# /opt/ibm/vision/bin/kubectl.sh describe pv
Name:            vision-data
Labels:          assign-to=vision-data
                 type=local
Annotations:     pv.kubernetes.io/bound-by-controller: yes
Finalizers:      [kubernetes.io/pv-protection]
StorageClass:
Status:          Bound
Claim:           default/vision-data-pvc
Reclaim Policy:  Retain
Access Modes:    RWX
VolumeMode:      Filesystem
Capacity:        40Gi
Node Affinity:   <none>
Message:
Source:
    Type:          HostPath (bare host directory volume)
    Path:          /opt/ibm/vision/volume/
    HostPathType:
Events:            <none>
```

Interpreting the output

The above output shows more details about the Persistent Volume used by the application. The **Source**section has the critical configuration values for **Type** and **Path**. The **Events** section will have information about Error events if there were issues with the Persistent Volume.

Using the kubectl describe pvc command

The `kubectl describe pvc` command is used to see detailed information about the Persistent Volume Claim for the application.

Example output

```
# /opt/ibm/vision/bin/kubectl.sh describe pvc
Name:          vision-data-pvc
Namespace:     default
StorageClass:
Status:        Bound
Volume:        vision-data
Labels:        app=vision
               chart=ibm-visual-insights-prod-2.0.0
               heritage=Tiller
               release=vision
Annotations:   pv.kubernetes.io/bind-completed: yes
               pv.kubernetes.io/bound-by-controller: yes
Finalizers:    [kubernetes.io/pvc-protection]
Capacity:      40Gi
Access Modes:  RWX
VolumeMode:    Filesystem
Events:        <none>
Mounted By:    vision-elasticsearch-59fcb48446-q64zc
               vision-logstash-ff888487c-6vnzt
               vision-mongodb-7cb5cdf54b-krpc8
               vision-postgres-8cf756958-6d8gz
               vision-service-86c6f58d7b-947md
               vision-taskanaly-558c7644c8-ww6kw
               vision-ui-76f8bc46b-btwps
               vision-video-microservice-7d5dd58969-9lr4p
```

Interpreting the output

The above output shows more details about the Persistent Volume Claim used by the application. The **Volume** section references the underlying Persistent Volume, and the **Status** should be "Bound" if it has been successfully allocated to the application. The **Events** section will show if there were issues with the Persistent Volume Claim.

Checking application deployment

IBM Visual Insights processes require a Kubernetes environment. Use these commands to verify that the Kubernetes environment was deployed correctly and that all nodes are configured appropriately.

- "helm.sh" on page 57
- "kubectl get deployment" on page 58
- "kubectl describe deployment" on page 58

helm.sh

The `helm.sh` command shows the status of the full Kubernetes environment of the IBM Visual Insights application.

Example output

```
user@system:~$ /opt/ibm/vision/bin/helm.sh status vision
LAST DEPLOYED: Mon Feb 17 19:25:40 2020
NAMESPACE: default
STATUS: DEPLOYED
RESOURCES:
==> v1beta1/Ingress
NAME        HOSTS  ADDRESS  PORTS  AGE
vision-ing  *      80       6d21h
==> v1/Pod(related)
NAME                                        READY  STATUS   RESTARTS  AGE
vision-elasticsearch-777f6bcc6c-5xvlg       1/1    Running  0         17h
vision-fpga-device-plugin-bm8qx             1/1    Running  0         17h
vision-keycloak-f57979785-fpw8q             1/1    Running  0         17h
vision-logstash-f8cc6fcc6-rhqtc             1/1    Running  0         17h
vision-mongodb-79b9d7977c-2twtb             1/1    Running  0         17h
vision-postgres-6f4788c594-gxcjp            1/1    Running  0         17h
vision-service-799c94f575-2cr48             1/1    Running  0         4h34m
vision-taskanaly-67745bc59f-qd225           1/1    Running  0         17h
vision-ui-774d989b47-2swvb                  1/1    Running  0         17h
vision-video-microservice-6fc86b5866-s8x44  1/1    Running  0         17h
==> v1/Secret
NAME            TYPE    DATA  AGE
vision-secrets  Opaque  4     6d21h
==> v1/ConfigMap
NAME           DATA  AGE
vision-config  53    6d21h
==> v1/PersistentVolumeClaim
NAME             STATUS  VOLUME       CAPACITY  ACCESS MODES  STORAGECLASS  AGE
vision-data-pvc  Bound   vision-data  40Gi      RWX           6d21h
==> v1/Service
NAME                       TYPE       CLUSTER-IP   EXTERNAL-IP  PORT(S)            AGE
vision-elasticsearch       ClusterIP  10.10.0.169  <none>       9200/TCP,9300/TCP  6d21h
vision-keycloak            ClusterIP  10.10.0.30   <none>       8080/TCP,8443/TCP  6d21h
vision-logstash            ClusterIP  10.10.0.198  <none>       9600/TCP           6d21h
vision-mongodb             ClusterIP  10.10.0.173  <none>       27017/TCP          6d21h
vision-postgres            ClusterIP  10.10.0.201  <none>       5432/TCP           6d21h
vision-service             ClusterIP  10.10.0.85   <none>       9080/TCP           6d21h
vision-taskanaly           ClusterIP  10.10.0.44   <none>       5000/TCP           6d21h
vision-ui                  ClusterIP  10.10.0.41   <none>       8080/TCP           6d21h
vision-video-microservice  ClusterIP  10.10.0.216  <none>       38080/TCP          6d21h
==> v1beta1/DaemonSet
NAME                       DESIRED  CURRENT  READY  UP-TO-DATE  AVAILABLE  NODE SELECTOR  AGE
vision-fpga-device-plugin  1        1        1      1           1          <none>         17h
==> v1/Deployment
NAME                       DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE
vision-elasticsearch       1        1        1           1          17h
vision-keycloak            1        1        1           1          17h
vision-logstash            1        1        1           1          17h
vision-mongodb             1        1        1           1          17h
vision-postgres            1        1        1           1          17h
vision-service             1        1        1           1          17h
vision-taskanaly           1        1        1           1          17h
vision-ui                  1        1        1           1          17h
vision-video-microservice  1        1        1           1          17h
NOTES:
Find the Visual Insights UI URL by running the following commands:
export NODE_IP=$(kubectl get ing vision-ing --namespace default -o
jsonpath="{.status.loadBalancer.ingress[0].ip}")
echo https://${NODE_IP}/vision/
```

Important fields in the output

STATUS
The value for STATUS should be DEPLOYED after a successful installation.

RESOURCES
The status of individual Kubernetes pods is displayed in this section. The CURRENT and AVAILABLE values for each pod should be equal to or greater than the DESIRED value.

```
RESOURCES:
==> v1beta1/Deployment
NAME                              DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE
...
vision-portal             1        1        1           1          14d
...
```

kubectl get deployment

The `kubectl get deployment` command shows summary information about the active deployments in the environment. This includes dynamically started pods used for training and deployment of models.

Example output

```
$ /opt/ibm/vision/bin/kubectl.sh get deployment
NAME                                READY   UP-TO-DATE   AVAILABLE   AGE
vision-elasticsearch        1/1     1            1           18h
vision-keycloak             1/1     1            1           18h
vision-logstash             1/1     1            1           18h
vision-mongodb              1/1     1            1           18h
vision-postgres             1/1     1            1           18h
vision-service              1/1     1            1           18h
vision-taskanaly            1/1     1            1           18h
vision-ui                   1/1     1            1           18h
vision-video-microservice   1/1     1            1           18h
```

kubectl describe deployment

The `kubectl describe deployment` command provides verbose status information about each of the deployed nodes in the Kubernetes environment that is being used to run IBM Visual Insights.

Example output

The following shows the output from one of the nodes. The full output for all nodes is much longer and has similar entries for each node.

```
# /opt/ibm/vision/bin/kubectl.sh describe deployment
...
Name:                   vision-ui
Namespace:              default
CreationTimestamp:      Thu, 27 Feb 2020 12:25:40 -0600
Labels:                 app=vision
                        chart=ibm-visual-insights-prod-2.0.0
                        heritage=Tiller
                        release=vision
                        run=vision-ui-deployment
Annotations:            deployment.kubernetes.io/revision: 1
Selector:               run=vision-ui-deployment-pod
Replicas:               1 desired | 1 updated | 1 total | 1 available | 0 unavailable
StrategyType:           RollingUpdate
MinReadySeconds:        0
RollingUpdateStrategy:  25% max unavailable, 25% max surge
Pod Template:
  Labels:       app=vision
                chart=ibm-visual-insights-prod-2.0.0
                component=vision-ui
                heritage=Tiller
                release=vision
                run=vision-ui-deployment-pod
  Annotations:  checksum/config: f213e302ced04315e606a52c9632fcf34e5ae898c55e39c4f9e1fcb83ddd9c7e
                productID: 5737-H10
                productName: IBM Visual Insights
                productVersion: 1.2.0.0
  Containers:
   vision-ui:
    Image:      vision-ui:1.2.0.0
    Port:       8080/TCP
    Host Port:  0/TCP
    Liveness:   http-get http://:http/visual-insights/index.html delay=240s timeout=5s period=10s
#success=1 #failure=3
    Readiness:  http-get http://:http/visual-insights/index.html delay=5s timeout=1s period=10s
#success=1 #failure=3
    Environment:
      CONTEXT_ROOT:             <set to the key 'CONTEXT_ROOT' of config map 'vision-
config'>             Optional: false
      DLAAS_API_SERVER:         <set to the key 'DLAAS_API_SERVER' of config map 'vision-
config'>         Optional: false
      SERVER_HOST_VIDEO_TEST:   <set to the key 'SERVER_HOST_VIDEO_TEST' of config map 'vision-
config'>   Optional: false
      SERVICE_PORT_VIDEO_TEST:  <set to the key 'SERVICE_PORT_VIDEO_TEST' of config map 'vision-
config'>  Optional: false
      WEBROOT_VIDEO_TEST:       <set to the key 'WEBROOT_VIDEO_TEST' of config map 'vision-
config'>       Optional: false
    Mounts:
      /opt/powerai-vision/data from data-mount (rw)
  Volumes:
   data-mount:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same
namespace)
    ClaimName:  vision-data-pvc
    ReadOnly:   false
Conditions:
  Type           Status  Reason
  ----           ------  ------
  Available      True    MinimumReplicasAvailable
  Progressing    True    NewReplicaSetAvailable
OldReplicaSets:  <none>
NewReplicaSet:   vision-ui-76f8bc46b (1/1 replicas created)
Events:          <none>
```

Interpreting the output

- The **Replicas** line shows information regarding how many images are desired and available (similar to the output from `kubectl get pods`):

  ```
  Replicas: 1 desired | 1 updated | 1 total | 1 available | 0 unavailable
  ```

  The "available" value should be equal to the "desired" value.
- The **productVersion** value indicates the level of IBM Visual Insights installed:

  ```
  productVersion: 1.2.0.0
  ```
- The **Image** value provides information about the Docker container:

```
Image: vision-ui:1.2.0.0
```

- The **Conditions** section has important information about the current status of the image, and any reasons if the status is "failure".

Checking system GPU status

In IBM Visual Insights, GPUs are used to train and deploy models. Use these commands to verify that GPUs are set up and available.

nvidia-smi

The `nvidia-smi` command is a NVIDIA utility, installed with the CUDA toolkit. For details, see "Prerequisites for installing IBM Visual Insights" on page 25. With `nvidia-smi`, you can view the status of the GPUs on the system.

Example output

```
# nvidia-smi
Fri Mar 15 12:23:50 2019
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 418.29       Driver Version: 418.29       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|===============================+======================+======================|
|   0  Tesla P100-SXM2...  On   | 00000002:01:00.0 Off |                    0 |
| N/A   50C    P0   109W / 300W |   2618MiB / 16280MiB |     43%      Default |
+-------------------------------+----------------------+----------------------+
|   1  Tesla P100-SXM2...  On   | 00000003:01:00.0 Off |                    0 |
| N/A   34C    P0    34W / 300W |      0MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+
|   2  Tesla P100-SXM2...  On   | 0000000A:01:00.0 Off |                    0 |
| N/A   48C    P0    44W / 300W |   5007MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+
|   3  Tesla P100-SXM2...  On   | 0000000B:01:00.0 Off |                    0 |
| N/A   36C    P0    33W / 300W |      0MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                       GPU Memory |
|  GPU       PID   Type   Process name                             Usage      |
|=============================================================================|
|    0    114476      C   /opt/miniconda2/bin/python                  2608MiB |
|    2    114497      C   /opt/miniconda2/bin/python                   958MiB |
|    2    114519      C   /opt/miniconda2/bin/python                   958MiB |
|    2    116655      C   /opt/miniconda2/bin/python                  2121MiB |
|    2    116656      C   /opt/miniconda2/bin/python                   958MiB |
+-----------------------------------------------------------------------------+
```

Interpreting the output

The above output shows the following:

- The system has 4 (0-3) **Tesla P100** GPUs.
- In the last portion of the output, it shows that GPU **0** has a process deployed and running. This can indicate a IBM Visual Insights training task or a deployed model. Any GPUs with running jobs are not available for training jobs or deployment of trained models from the user interface. The output also shows multiple processes running on GPU 2, which can indicate that multiple models deployed for inferencing are sharing that GPU resource.
- The output should correctly display the memory configuration of the GPUs. For example, "Unknown error" indicates an issue with the driver setup or configuration. See "GPUs are not available for training or inference" on page 175 for more information.

Chapter 7. Logging in to IBM Visual Insights

Follow these steps to log in to IBM Visual Insights.

Note: IBM Visual Insights is supported on these browsers:

- Google Chrome Version 60, or later
- Firefox Quantum 59.0, or later

1. Enter the appropriate IBM Visual Insights URL in a supported browser:

   IBM Visual Insights stand-alone URL

   `https://`*`hostname`*`/visual-insights/`, where *hostname* is the system on which you installed IBM Visual Insights.

   IBM Visual Insights with IBM Cloud Private URL

   `https://`*`proxyhost`*`/visual-insights-`*`RELEASE`*`/`, where *proxyhost* is the host name of your IBM Cloud Private proxy server, and *RELEASE* is the name you specified in the Release name field when you deployed the Helm chart.
2. Enter your user name and password. A default user name (`admin`) and password (`passw0rd`) was created at install time. For instructions to change these values, see "Managing users" on page 145.

Related concepts

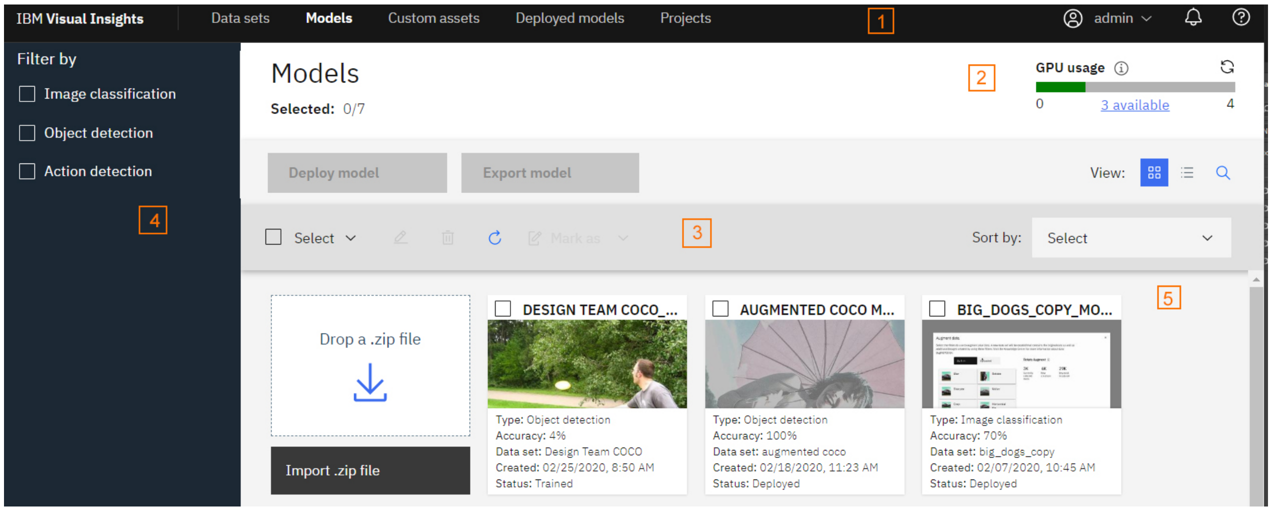
Managing users
There are two kinds of users in IBM Visual Insights: administrators, and everyone else. The way you work with users and passwords differs, depending on how IBM Visual Insights is installed.

Chapter 8. Working with the user interface

The IBM Visual Insights user interface is made up of these basic parts: the navigation bar, the side bar, the action bar, the data area, and the notification center.

Interface areas

The user interface is made up of several different areas:



Selected: 0/7

Type: Object detection
Accuracy: 4%
Data set: Design Team COCO
Created: 02/25/2020, 8:50 AM
Status: Trained

Type: Object detection
Accuracy: 100%
Data set: augmented coco
Created: 02/18/2020, 11:23 AM
Status: Deployed

Type: Image classification
Accuracy: 70%
Data set: big_dogs_copy
Created: 02/07/2020, 10:45 AM
Status: Deployed

Figure 7. IBM Visual Insights user interface

1: The navigation bar
The navigation bar lets you access the notification area (the bell icon), work with your profile, or access the IBM Visual Insights Knowledge Center (the question mark icon). If you click the arrow by your user name, you can log out, view your usage metrics, and can see the version number of the product.

2: The header bar
The header bar on the Training, Models, Model details, and Deployed Models pages shows GPU usage details in these categories:

Training
GPUs currently used for training jobs by IBM Visual Insights.

Deployed Models
GPUs currently used for deployed models by IBM Visual Insights.

External
External GPUs are those that are used for processes outside of IBM Visual Insights. For IBM Cloud Private installations, all GPUs are listed as External.

Note: If the output shows "Unknown", then GPUs are in use, but not for IBM Visual Insights training or deployment. This either indicates an issue with a GPU in use by a training or deploy job that failed unexpectedly, or there are other applications on the system using GPUs. This could lead to unexpected resource contention and application issues.

3: The action bar
This is where you find the actions that you can take on images, videos, data sets, and models in the current data area. The available actions differ depending on what type of object you are working with.

4: The side bar
Data sets and models have a side bar with filtering options. Filtering helps you specify which objects to include in the data area.

Navigating: If the side bar is long, for example, if you have a data set with a lot of different types of objects, you can scroll through the side bar content. To scroll, hover over the appropriate content and use your mouse roller or keyboard arrow keys. If the mouse pointer is right over the categories, for example, scrolling moves you through that list. If the mouse pointer is further to the right, on the edge of the side bar, scrolling moves you through all of the content on the side bar.

5: The data area

This is where you find the objects that you can act on. It lists the objects of the selected type, or displays the data included in the data set.

Filtering

With large data sets, you might need to filter the files that are shown in the data area. By default, your whole data set is shown.

Filter by

When you deselect a file type, those files are no longer shown in the data area. Therefore, if you only have Images selected, only images are shown in the data area.

Categories / objects

When you select categories, objects, or both, *all* files of the specified type that belong to any of the selected categories, or contain the selected objects, are shown.

For example, assume you have a data set with two categories: `Cats` and `Dogs`. Also assume that you tagged these types of objects: `Face`, `Collar`, and `Tail`. Then if you select `Images`, the category `Dogs`, and the object `Collar`, you will see all images that are dogs *or* contain a collar. This will include images of cats if they have a collar as well as images of dogs with no collar.

Using filtering and "Select all" with video data

When you capture frames from a video, these frames always maintain a child / parent relationship with the original video. That has some selection and filtering implications.

- When using the filter on the side bar, if *any* video frame matches the filter criteria, both the frame and its parent video are selected and are shown in the data area.
- If you click the "Select" box in the action bar, everything in the data area is selected. Therefore, if there is a video shown in the data area, it, and all of its child frames, are selected. Any action performed in this situation applies to all selected images, the video, and all of its child frames.

Example

A user has captured 50 frames from a video file `Cars Video`. Fourteen frames of the 50 have no labels.

1. The user selects **Unlabeled** in the Objects filter in the sidebar. The 14 frames with no labels and their parent video, `Cars Video`, are shown in the data area.
2. The user clicks **Select** in the action bar. The frames and the video are all selected.
3. The user clicks the trash can icon, intending to delete the unlabeled frames. However, because the video was selected, it, and the 36 labeled frames, are also deleted.

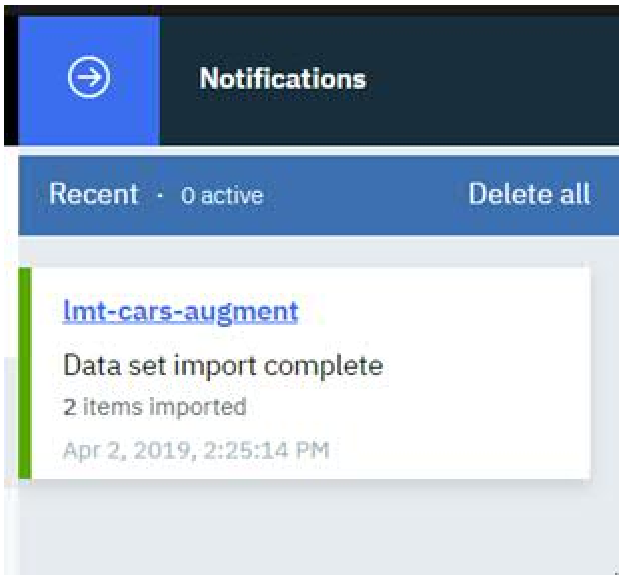
To delete only the unlabeled frames, the user should click **Select** in the action bar to quickly select all 14 frames, then deselect the video file before clicking the trash can icon.

Deleting items

In general, to delete items, you select and delete the files. However, because video frames always maintain a child / parent relationship with the original video, when you select a video for deletion, the video *and* all of the frames are deleted. You can delete frames and leave the video, but you cannot delete the video and leave the frames.

The notification area

Click the bell icon in the navigation bar to access the notification area. This allows you to view and work with messages. Click the arrow to return to your previous view.


Notifications

Recent · 0 active

Delete all

lmt-cars-augment

Data set import complete

2 items imported

Apr 2, 2019, 2:25:14 PM

Figure 8. Notification area

Related concepts

Training and working with models
Use these processes to create, deploy, and refine models.

Example: Detecting objects in a video
In this fictional scenario, you want to create a deep learning model to monitor traffic on a busy road. You have a video that displays the traffic during the day. From this video, you want to know how many cars are on the busy road every day, and what are the peak times that have the most cars on the road.

Related tasks

Training a model
After the data set has been prepared, you can train your deep learning model. Trained models can then be deployed for use.

Creating and working with data sets
Before you can work with videos or images, you need to create a data set. A data set is a group of images, videos, or both that you will use to train a deployable model.

Deploying a trained model
Deploy a trained model to get it ready to use within IBM Visual Insights or a different program, such as IBM Watson Machine Learning Community Edition. Deploying a model creates a unique API endpoint based on that model for inference operations.

Example: Classifying images
The goal of this example is to train a model to classify images of birds into groups based on their physiological similarities. Once the model is trained with a known dataset, users can upload new data sets to auto classify the birds into their respective categories. We will prepare the data, create a data set, train the model, and test the model.

Determining the product version

The product version is shown on the login screen. To determine which version of IBM Visual Insights is installed after logging in, click your user name in the upper right corner of the user interface. The product version is listed in the menu that opens.

Chapter 9. Training and working with models

Use these processes to create, deploy, and refine models.

You can only see and work with objects (data sets, files, trained models, and deployed models) that you own. An object is owned by the user who created it.

Creating and working with data sets

Before you can work with videos or images, you need to create a data set. A data set is a group of images, videos, or both that you will use to train a deployable model.

To create a data set and add content to it, follow these steps:

1. Log in to IBM Visual Insights.
2. Click **Data Sets** in the navigation bar to open the **Data Sets** page. There are several ways to create a new data set:
   - To create an empty data set, click **Create new data set**.
   - If you have a previously exported data set, click **Import .zip file**.
   - If you want to copy an existing data set, select the data set and click the "Duplicate" icon.

   File considerations:

   - **Videos**
     - You can play only the following video types in the IBM Visual Insights video player:
       - Ogg Vorbis (.ogg)
       - VP8 or VP9 (.webm)
       - H.264 encoded videos with MP4 format (.mp4)
     - Before importing videos for use with action detection models, it is recommended that you prepare them as follows:
       - Cut out long periods of background video without any actions.
       - Transcode videos with FPS greater than 30 down to 30 FPS
       - Crop the video so that actions should take up a large part of the frame.
   - **Images**
     - DICOM images are converted to PNG files for storage in the data set, and can then be labeled or augmented like any other image.
     - IBM Visual Insights has limited support for Pascal VOC annotations. Annotations for multiple files residing in a common XML file are not supported. In other words, each annotation XML file can only contain annotations for a single image, identified by the `filename` attribute.

       If you have a single XML annotation file containing annotations for multiple images in the data set to be imported, the annotations need to be split out into separate XML files before IBM Visual Insights can import the annotations successfully.
     - IBM Visual Insights supports importing COCO data sets with the following limitations:

       Only "object detection" annotations are supported. You can review the annotation format on the COCO data format page. When you import images with COCO annotations, IBM Visual Insights only keeps the information it will use, as follows:

       - IBM Visual Insights extracts the information from the `images`, `categories`, and `annotations` lists and ignores everything else.

- Unused annotations are not saved. For example, if there is annotation information for `clock`, but no image is tagged with a clock, then the `clock` object (called *category* in COCO) is not saved.
- For COCO annotations that use the RLE format, the entire annotation is ignored.

Note: Images without tags *are* saved.

3. Optionally add the data set to a project group:
   a) From the Project Groups page, open the relevant project group.
   b) Click **Add assets to this project**. For Asset type, choose **Data set**, then select your data set.
4. Click the data set you just created to open it. Add images and videos by using **Import file** or by dragging them to the **+** area.

   If you do not follow these considerations, your upload will fail and a message will be shown on the screen. For details about why the upload failed, click the bell icon at the top of the page to open the Notifications center.

   Upload considerations:

   - You can select multiple image or video files, or a single .zip file that contains images and videos, but you cannot upload a folder that contains images or videos.
   - If you import a .zip file into an existing data set, the .zip file cannot contain a directory structure.
   - You cannot navigate away from the IBM Visual Insights page or refresh until the upload completes. You can navigate to different pages within IBM Visual Insights during the upload.
   - There is a 24 GB size limit per upload session. This limit applies to a single .zip file or a set of files. You can, however upload 24 GB of files, then upload more after the original upload completes.

Working with data sets

After your data set has been created, select it in the **Data Sets** page to duplicate, rename, delete it, and so on. To work with the images and videos contained in the data set, click the name of the data set to open it.

Note: Moving and copying images and videos between data sets requires fix pack 1.

You can view the metadata associated with an image by opening the image and clicking the Show metadata icon ().

To move or copy images and videos between data sets, open the data set, select the images and videos, and click the **Copy** icon in the Action bar. Select **Move** or **Copy**, then the appropriate data set or data sets in the window that opens.

- You can copy images and videos to multiple data sets.
- You can move images and videos to a single data set.
- When you move or copy a video, all captured frames are also moved or copied.
- You cannot move or copy video frames without the video. If you select video frames but not the parent video, you will get an error.

By default, the data sets are displayed as thumbnails. If you select the list view, you will see the information displayed as columns.

Note: If an older data set is imported, the original file names are missing or inaccurate. Additionally, original file names are not available for captured video frames or augmented files.

Working with video data and captured frames

In general, to delete items, you select and delete the files. However, because video frames always maintain a child / parent relationship with the original video, when you select a video for deletion, the video *and* all of the frames are deleted. You can delete frames and leave the video, but you cannot delete the video and leave the frames.

Related concepts

Creating and working with project groups
Project groups allow you to group trained models with the data sets that were used for training. This grouping is optional but is a useful way to organize related data sets. For example, project groups would be useful with a workflow that clones data sets as you refine labels and work toward a more accurate model. Project groups can be used with a production work flow strategy and automatic model deployment for even more functionality.

Data set considerations

When preparing a data set for training, consider the following information to ensure the best results.

Note: Unless otherwise noted, mentions of "images" refer to both individual images and captured video frames.

- “What are the limitations on uploaded files?” on page 69
- “How many images are needed?” on page 70
- “Special considerations for object detection models” on page 71

What are the limitations on uploaded files?

- The following image formats are supported:
  - JPEG
  - PNG
  - DICOM
- You can play only the following video types in IBM Visual Insights:
  - Ogg Vorbis (.ogg)
  - VP8 or VP9 (.webm)
  - H.264 encoded videos with MP4 format (.mp4)
- The models used by IBM Visual Insights have limitations on the size and resolution of images. If the original data is high resolution, then the user must consider:
  - If the images do not need fine detail for classification or object detection, they should be down-sampled to 1-2 megapixels.
  - If the images do require fine detail, they should to be divided into smaller images of 1-2 megapixels each.
  - There is a 24 GB size limit per upload session. This limit applies to a single .zip file or a set of files. You can, however upload 24 GB of files, then upload more after the original upload completes.
  - Large images will be scaled to the appropriate dimensions for the model as follows:
    - SSD: 512 x 512 pixels

      The original aspect ratio is maintained. If necessary, black bands are added to the image to make it fit.
    - tiny YOLO V2: 416 x 416 pixels

The longest edge is scaled to 416 pixels and, if necessary, black bands are added to the shorter side to make it 416 pixels.

  - YOLO V3: 608 x 608 pixels
  - Faster R-CNN: 1000 x 600 pixels

    The original aspect ratio is maintained. If necessary, black bands are added to the image to make it fit.
  - Detectron: 1333 x 800 pixels
  - GoogLeNet: 224 x 224 pixels
  - Action detection: 224 x 224 pixels
- Images with COCO annotations are supported. For details, see "Importing images with COCO annotations" on page 71.

How many images are needed?

A data set with a variety of representative objects labeled will train a more accurate model. The exact number of images and objects cannot be specified, but some guidelines recommend as many as 1,000 representative images for each class. However, you might not need a data set this large to train a model with satisfactory accuracy. The number of images required depends on the kind of training you plan on doing:

Image classification

- There must be at least two categories.
- Each category must have at least five images.

Object detection

The data set must contain at least five images with an object labeled for each defined object. For example, if you want to train the data set to recognize cars and you have three images and one video, you must add the "car" label to each image and at least two frames of the video. Labeling five cars in one image is not adequate. If this requirement is not met and you train the model, it will not be trained to recognize that type of object.

For object detection model training, images that do not have any objects labeled are not used in the training of the model.

Tiny YOLO V2 considerations:

- Tiny YOLO V2 requires at least five unique bounding boxes in the data set. If multiple images have the same coordinates for the bounding box resulting in fewer than five uniquely sized boxes, the model will fail to train.
- The data set is split into training and validation images for the model per the Ratio training parameter, see "Model hyperparameters" in "Training a model" on page 78. The Ratio parameter determines how many images are used for training and how many are used for validation, but the images are selected for each group at random. For a small data set, this can result in insufficient validation images. If that happens, training fails.

  It is recommended that the data set contain at least 20 labeled images.

Important: Not all of the images in a data set are used for training. Assuming that you did not change the value for Ratio (an advanced hyperparameter setting) when training your model, 20% of the images are randomly selected and used for validation instead of training. Because of this, it is important that you have enough images of every category or object.

For example, consider a data set to be used for training of an object detection model that has 200 images. With the default configuration for model training, 20% of the images (40 images) will be selected for testing the model. If there is a label **LabelA** used to identify an object in the data set, the following scenarios are possible if the number of images labeled with the object are smaller than the test data set, for example, if there are only 20 images with objects labeled as **LabelA**:

- It is possible that all of the images with **LabelA** are in the "training" data set, and none of the images are actually used for testing of the model. This will result in *unknown* accuracy for **LabelA**, since there are no tests of the accuracy.
- Similarly, it is possible that all 20 images with **LabelA** objects are in the test data set but there are no images used for training. This will result in very low or 0% accuracy for the object because the model was not actually trained with any images containing the **LabelA** objects.

If your data set does not have many images or sufficient variety for training, consider using the Augmentation feature to increase the data set.

Special considerations for object detection models

Accuracy for object detection models can be more challenging since it includes intersection over union (IoU), especially for models that use segmentation instead of bounding boxes. IoU is calculated by the intersection between a ground truth bounding box and a predicted bounding box, divided by the union of both bounding boxes; where the intersection is the area of overlap, a *ground truth* bounding box is the hand drawn box, and the *predicted bounding box* is the one drawn by IBM Visual Insights.

In the case of object detection, the object might have been correctly identified but the overlap of the boundary generated by the model is not accurate resulting in a poor IoU metric. This metric might be improved by more precise object labeling to reduce background "noise", by training the model longer, or both.

Importing images with COCO annotations

Images with Common Objects in Context (COCO) annotations have been labeled outside of IBM Visual Insights. You can import (upload) these images into an existing IBM Visual Insights data set, along with the COCO annotation file, to inter-operate with other collections of information and to ease your labeling effort.

Only "object detection" annotations are supported. You can review the annotation format on the COCO data format page. When you import images with COCO annotations, IBM Visual Insights only keeps the information it will use, as follows:

- IBM Visual Insights extracts the information from the `images`, `categories`, and `annotations` lists and ignores everything else.
- Unused annotations are not saved. For example, if there is annotation information for `clock`, but no image is tagged with a clock, then the `clock` object (called *category* in COCO) is not saved.
- For COCO annotations that use the RLE format, the entire annotation is ignored.

Note: Images without tags *are* saved.

To import images with COCO annotations into IBM Visual Insights, follow these steps:

1. If necessary, create a new data set. The data set must exist before importing the COCO annotated data.
2. Download the images that you want to import.
3. If you downloaded `train2017.zip`, IBM Visual Insights cannot train the entire data set. Therefore, you must make a new file that contains just the images you want to train. For example, by running this command:

   ```
   ls train2017 | grep jpg | head -20000 >/tmp/flist
   ```

4. Download the annotations file for your images. For example, `annotations_trainval2017.zip` contains the annotations for the `train2017` data set. For example, if you downloaded `annotations_trainval2017.zip`, extract the `annotations/instances_train2017.json` file, which is the COCO annotation file for object detection.

   If you are using a .json file from a different source, it cannot be called `prop.json`.
5. Create a zip file that contains the annotations file and the images.

- There can be only one `.json` file in the zip file. If more that one `.json` file is discovered, only the first one is used.
- The `.json` file cannot be named props.json because this is used by IBM Visual Insights exported data sets, which use different annotations.
- The images and the annotation file can reside in different directories.

6. Import the zip file into an existing IBM Visual Insights data set.

Note: COCO data sets are created for competition and are designed to be challenging to identify objects. Therefore, do not be surprised if the accuracy numbers achieved when training are relatively low, especially with the default 4000 iterations. However, these data sets will allow you to experiment with segmentation training and inference without having to manually label a lot of images

For details about COCO data sets, refer to the COCO web site.

Search for assets in a data set

There are several ways to find images and videos in a data set. You can search based on file names, metadata, categorization, or tags.

Note: Metadata search is only available if fix pack 1 is installed.

You can use the search bar, filtering, or a combination of these to find assets in a data set. For example, if you filter based on a specific category, you can then use the search bar to search for objects with a specific file name within that category. You could then further narrow your search results by searching for specific metadata associated with the file.

Search bar

Click the magnifying glass to access the search bar. You can add search terms that allow you search for specific file names. To search for metadata, open the search bar, then click the metadata search icon to the right of the search bar ( ). You can then enter as many key / value pairs as you want, based on the keys and values that are available in the data set. If you enter multiple pairs, all values must be satisfied for any files that are returned.

Filtering

With large data sets, you might need to filter the files that are shown in the data area. By default, your whole data set is shown.

Filter by

When you deselect a file type, those files are no longer shown in the data area. Therefore, if you only have Images selected, only images are shown in the data area.

Categories / objects

When you select categories, objects, or both, *all* files of the specified type that belong to any of the selected categories, or contain the selected objects, are shown.

For example, assume you have a data set with two categories: `Cats` and `Dogs`. Also assume that you tagged these types of objects: `Face`, `Collar`, and `Tail`. Then if you select `Images`, the category `Dogs`, and the object `Collar`, you will see all images that are dogs *or* contain a collar. This will include images of cats if they have a collar as well as images of dogs with no collar.

Using filtering and "Select all" with video data

When you capture frames from a video, these frames always maintain a child / parent relationship with the original video. That has some selection and filtering implications.

- When using the filter on the side bar, if *any* video frame matches the filter criteria, both the frame and its parent video are selected and are shown in the data area.

- If you click the "Select" box in the action bar, everything in the data area is selected. Therefore, if there is a video shown in the data area, it, and all of its child frames, are selected. Any action performed in this situation applies to all selected images, the video, and all of its child frames.

Example

A user has captured 50 frames from a video file `Cars Video`. Fourteen frames of the 50 have no labels.

1. The user selects **Unlabeled** in the Objects filter in the sidebar. The 14 frames with no labels and their parent video, `Cars Video`, are shown in the data area.
2. The user clicks **Select** in the action bar. The frames and the video are all selected.
3. The user clicks the trash can icon, intending to delete the unlabeled frames. However, because the video was selected, it, and the 36 labeled frames, are also deleted.

To delete only the unlabeled frames, the user should click **Select** in the action bar to quickly select all 14 frames, then deselect the video file before clicking the trash can icon.

Labeling objects

One of the most important steps is to ensure that you properly label objects by adding tags to your data.

Requirements

Recommendation: Label and class names should be 64 characters or less. Longer label names are supported but using international characters or very long label names can cause an internal metadata error, resulting in a training failure.

Image classification

- There must be at least two categories.
- Each category must have at least five images.

Object detection

The data set must contain at least five images with an object labeled for each defined object. For example, if you want to train the data set to recognize cars and you have three images and one video, you must add the "car" label to each image and at least two frames of the video. Labeling five cars in one image is not adequate. If this requirement is not met and you train the model, it will not be trained to recognize that type of object.

For object detection model training, images that do not have any objects labeled are not used in the training of the model.

Tiny YOLO V2 considerations:

- Tiny YOLO V2 requires at least five unique bounding boxes in the data set. If multiple images have the same coordinates for the bounding box resulting in fewer than five uniquely sized boxes, the model will fail to train.
- The data set is split into training and validation images for the model per the Ratio training parameter, see "Model hyperparameters" in “Training a model” on page 78. The Ratio parameter determines how many images are used for training and how many are used for validation, but the images are selected for each group at random. For a small data set, this can result in insufficient validation images. If that happens, training fails.

  It is recommended that the data set contain at least 20 labeled images.

Note: A data set with a variety of representative objects labeled will train a more accurate model. The exact number of images and objects cannot be specified, but some guidelines recommend as many as 1,000 representative images for each class. However, you might not need a data set this large to train a model with satisfactory accuracy.

If your data set does not have many images or sufficient variety for training, consider using the Augmentation feature to increase the data set.

- “Labeling videos” on page 74
- “Labeling images” on page 75

Labeling videos

1. Select the video from your data set and select **Label Objects**.
2. Capture frames by using one of these options:
   - **Auto capture frames** - IBM Visual Insights captures a video frame every *n* seconds, where *n* is specified in the **Capture Interval (seconds)** field.

     Note: Depending on the length and size of the video and the interval you specified to capture frames, the process to capture frames can take several minutes.
   - **Manually capture frames** - use **Capture frame** to capture relevant frames.

   Note: When you capture frames from a video, these frames always maintain a child / parent relationship with the original video.
3. If required, manually add new frames to an existing data set. This might happen if **Auto capture frames** does not produce enough frames with a specific object type. To manually add new frames, follow these steps:
   a. Play the video and when the frame you want is displayed, click the pause icon.

      Tip: You can use the video player's status bar to find a frame you want.

   b. Click **Capture Frame**.
4. Create new object labels for the data set by clicking **Add new** by the Objects list. To add multiple object labels, enter one label, click **Add**, then enter the next until you are done. Label names cannot contain any special characters other than the underscore (_). For example, characters such as these are not allowed: -"/ \ | { } ( ) ; : ,

   Note: If non-ASCII characters are used in the label name, they will not be displayed correctly when using a video to test the deployed model. See “Testing a model” on page 93.

   You can rename objects later. However, after you rename an object, you will no longer be able to undo actions done before the rename.
5. Label the objects in the frames by following these steps.
   a. Select the first frame in the carousel.

   b. Select the correct object label.

   c. Choose **Box** or **Polygon** from the bottom left, depending on the shape you want to draw around each object. Boxes are faster to label and train, but less accurate. Only Detectron models support polygons. However, if you use polygons to label your objects, then use this data set to train a model that does not support polygons, bounding boxes are defined and used. Draw the appropriate shape around the object.

      Tip: The **Paste previous** button is active if there is at least one frame before the current frame being edited. Clicking **Paste previous** copies all the labels from the previous video frame and paste them into the current frame.

   Follow these guidelines when identifying and drawing objects in video frames:
   - Do not label part of an object. For example, do not label a car that is only partially in the frame.
   - If an image has more than one object, you must label all objects. For example, if you have cars and motorcycles defined as objects for the data set, and there is an image with both cars and motorcycles in it, you must label the cars and the motorcycles. Otherwise, you decrease the accuracy of the model.
   - Label each individual object. Do not label groups of objects. For example, if two cars are right next to each other, you must draw a label around each car.
   - Draw the shape as close to the objects as possible. Do not leave blank space around the objects.

- You can draw shapes around objects that touch or overlap. For example, if one object is behind another object, you can label them both. However, it is recommended that you only label objects if the majority of the object is visible.
- Use the zoom buttons (+ and -) on the bottom right side of the editing panels to help draw more accurate shapes.

  Note: If you are zoomed in on an image and use the right arrow key to move all the way to the right edge, you might have to click the left arrow key several times to start panning in the other direction.
- Shapes cannot extend off the edge of the frame.
- After defining a shape, you can copy and paste it elsewhere in the same image or in a different image by using standard keyboard shortcuts. After pasting the shape, it can be selected and dragged to the desired location in the image. The shape can also be edited to add or remove points in the outline.

  Note: To copy and paste a shape from one image to another, both images have to be available in the image carousel. From the data set, select all images that will share shapes, then click **Label objects**. All images will be listed in the image carousel in the left side of the Label objects window.
- After a shape has been defined, you will no longer see the points on the outline. To edit a defined box, exit drawing mode, then edit the points as necessary. To exit drawing mode, do one of the following:
  - Click the object name on the right side of the window.
  - Alt+click (option +click) inside the defined box.

  After moving a defined point, drawing mode is automatically enabled again.
- The video object preview does not support non-ascii labels. This is a limitation of the module that generates the displayed label from the label name. The result of the conversion of non-ascii labels will be a label that is all question marks: "?????".
- **Labeling with polygons**
  - After a shape has been defined, you will no longer see the points on the outline. To edit a defined shape, exit drawing mode, then edit the points as necessary. To exit drawing mode, do one of the following:
    - Click the object name on the right side of the window.
    - Click inside the defined shape.

    When you are done editing the shape, click outside the shape to enter drawing mode again.
  - To delete a point from an outline, ctrl+click (or cmd+click).
  - To add a point to an outline, click the translucent white square between any two points on the outline.
  - To move a point on the outline, click it and drag.

Labeling images
Follow these steps to label images in your data set:

1. Create new object labels for the data set by clicking **Add new** by the Objects list. To add multiple object labels, enter one label, click **Add**, then enter the next until you are done. Label names cannot contain any special characters other than the underscore (_). For example, characters such as these are not allowed: -"/ \ | { } ( ) ; : ,
2. Open an image. In the right pane, select the object you want to label.
3. Choose **Box** or **Polygon** from the bottom left, depending on the shape you want to draw around each object. Boxes are faster to label and train, but less accurate. Only Detectron models support polygons. However, if you use polygons to label your objects, then use this data set to train a model that does not support polygons, bounding boxes are defined and used. Draw the appropriate shape around the object.
   - Do not label part of an object. For example, do not label a car that is only partially in the frame.

- If an image has more than one object, you must label all objects. For example, if you have cars and motorcycles defined as objects for the data set, and there is an image with both cars and motorcycles in it, you must label the cars and the motorcycles. Otherwise, you decrease the accuracy of the model.
- Label each individual object. Do not label groups of objects. For example, if two cars are right next to each other, you must draw a label around each car.
- Draw the shape as close to the objects as possible. Do not leave blank space around the objects.
- You can draw shapes around objects that touch or overlap. For example, if one object is behind another object, you can label them both. However, it is recommended that you only label objects if the majority of the object is visible.
- Use the zoom buttons (+ and -) on the bottom right side of the editing panels to help draw more accurate shapes.

  Note: If you are zoomed in on an image and use the right arrow key to move all the way to the right edge, you might have to click the left arrow key several times to start panning in the other direction.
- Shapes cannot extend off the edge of the frame.
- After defining a shape, you can copy and paste it elsewhere in the same image or in a different image by using standard keyboard shortcuts. After pasting the shape, it can be selected and dragged to the desired location in the image. The shape can also be edited to add or remove points in the outline.

  Note: To copy and paste a shape from one image to another, both images have to be available in the image carousel. From the data set, select all images that will share shapes, then click **Label objects**. All images will be listed in the image carousel in the left side of the Label objects window.
- After a shape has been defined, you will no longer see the points on the outline. To edit a defined box, exit drawing mode, then edit the points as necessary. To exit drawing mode, do one of the following:
  - Click the object name on the right side of the window.
  - Alt+click (option +click) inside the defined box.

  After moving a defined point, drawing mode is automatically enabled again.
- The video object preview does not support non-ascii labels. This is a limitation of the module that generates the displayed label from the label name. The result of the conversion of non-ascii labels will be a label that is all question marks: "?????".
- **Labeling with polygons**
  - After a shape has been defined, you will no longer see the points on the outline. To edit a defined shape, exit drawing mode, then edit the points as necessary. To exit drawing mode, do one of the following:
    - Click the object name on the right side of the window.
    - Click inside the defined shape.

    When you are done editing the shape, click outside the shape to enter drawing mode again.
  - To delete a point from an outline, ctrl+click (or cmd+click).
  - To add a point to an outline, click the translucent white square between any two points on the outline.
  - To move a point on the outline, click it and drag.

Objects panel

Click the settings icon on the right side of the Objects panel to change the labeling settings, such as whether to show object labels inside shapes, hide all shapes except the one being drawn, change the shape opacity, and so on.

As you label objects, they are added to the list in the Objects panel on the right. To work with a labeled object, select it in the Objects panel. You can hide the object outline, rename it, or delete it.

To work with all objects of one type, such as cars, click the three dots to the right of the object title. These actions apply only to the items identified as this type of object in the current image.

Related tasks

Automatically labeling objects
After deploying a model for object detection, you can improve its accuracy by using the Auto label function. This function uses the labels in the deployed model to generate new labels in the data set; increasing the number of images that are labeled in the data set. The updated data set can be used to train a new, more accurate model.

Labeling actions

To label an action in a video, you will mark the start and end of the action, then assign it a tag. These tags exist at the data set level and can be used by any video in the data set. Videos with action tags are marked with an action icon in the lower right corner.

- “Recommendations” on page 77
- “Preparing videos for import” on page 77
- “Steps to label actions” on page 77
- “Working with action labels” on page 78
- “Tips” on page 78

Recommendations

There is no minimum number of labels required, but more data will typically give better results.

- Each action label must be in the range of 5 - 1000 frames. The required length of time depends on the video's FPS. For 30 FPS, each action label must be in the range of .166 - 33.367 seconds.

  The label's duration is checked based on the frames per second and the selected start and end times. For example, if an action label is marked with a start time of 12.295 seconds and end time of 12.296 seconds for a 30 FPS video, you will get an error message like the following: "Label duration of '100' milliseconds does not meet required duration between '166.83333' milliseconds and '33366.668' milliseconds".
- At least 10 instances of each action tag in the data set are recommended.
- The longer the total labeled action time is, the better your results will be.
- If multiple types of actions are labeled in a data set, the total amount of time for each action type should be similar. For example, if you tag 20 instances of the action "jump" in a data set with a total time of 27 seconds, and you tag 10 instances of the action "drive" in the data set with a total time of 53 seconds, the model will be biased toward the "drive" action.

  The total time for each action type is shown in the left pane in the Actions section.

Preparing videos for import

Before importing videos for use with action detection models, it is recommended that you prepare them as follows:

- Cut out long periods of background video without any actions.
- Transcode videos with FPS greater than 30 down to 30 FPS
- Crop the video so that actions should take up a large part of the frame.

Steps to label actions

1. Open the data set that contains the video you want to label.
2. Create an action tag in the data set by expanding **Actions** on the left and clicking **Add action**. If you delete the tag, all instances of that tag are removed from any video in the data set that used that tag.

3. Select the video and click **Label actions**. The existing tags are listed on the right. You can click the settings icon (gear) to choose how the action tags are organized in the Actions list.

   Note: If you click **Add label** to create a new tag, it is added to the video and the data set. If the action does not meet the criteria described above, the label will still be created, but the label count will not be increased. The tag is created with a count of 0.
4. Find the start of an action by using the video control bar:
   - Use the slider or play button to get near the part of the video you want.
   - Set the playback rate (1x, .5x, and so on) to control how fast the video plays.
   - Use the +1 and -1 buttons to move forward or backward one frame.
5. Click **+** in **Start time**. Actions cannot overlap. That is, the start time cannot be between an existing Start time and End time.
6. Find the end of the action, then click **+** in **End time**.
7. Specify an action name, either by selecting an existing tag or by entering the name for a new tag, then click **Create action**.

Working with action labels

- To delete one instance of a tag, select the tag in the Action panel and click the trash can.
- To delete all instances of a tag in the current video, select the top level tag in the action panel, click the three vertical dots, and click **Delete actions**.
- To delete a tag and all instances of the tag in every video in the data set, go to the data set main page, expand Actions, and click **Edit**. Click **X**.
- If you select a tag in the Action panel, the video player moves to the start of that action.
- To edit a tag, select the tag in the Actions panel and click the pencil. You can change the values for start time, end time, or action name, then click **Edit action** to save your changes. To cancel editing the tag, click the "X" in the Actions panel.

Tips

- The best actions to label are relatively short directional motions, with minimal camera viewpoint movement.
- Actions should be at least 3-5 frames long. If there are similar, unlabeled actions in a video, this can result in false positives. Any similar actions should be given a different label.
- There should only be one action taking place in the parts of the video that you label. For example, if part of a video shows people driving and people riding bicycles, it should not be labeled with an action.
- Portions of the video that have been labeled are shown as in the associated action color in the video progress bar. Unlabeled portions are blue.

Training a model

After the data set has been prepared, you can train your deep learning model. Trained models can then be deployed for use.

1. From the **Data set** page, click **Train**.
2. In the **Train data set** window, fill out the values as appropriate, then click **Train**:

   Type of training

   Image classification
   Choose this if you want to use the model to categorize images as belonging to one of the types that you defined in the data set.

   Note:

   - There must be at least two categories.

- Each category must have at least five images.

Optimize model using

System default (GoogLeNet)

Models trained with this model can only be run on a GPU. Under **Training options**, you can enable Core ML. After deploying the model, you can download the generated Core ML assets from the Deployed models page.

Custom packaged model

Select an imported model to use for training.

Object detection

Choose this if you want to use the model to label objects within images.

Note: The data set must contain at least five images with an object labeled for each defined object. For example, if you want to train the data set to recognize cars and you have three images and one video, you must add the "car" label to each image and at least two frames of the video. Labeling five cars in one image is not adequate. If this requirement is not met and you train the model, it will not be trained to recognize that type of object.

Optimize model using

Faster R-CNN

Models optimized for accuracy can only be run on a GPU. It is always enabled for TensorRT. After deploying the model, you can download the TensorRT assets from the Deployed models page.

tiny YOLO V2

Models optimized for speed can be run anywhere, but might not be as accurate as those optimized for accuracy. These models use "you only look once" (YOLO) V2 and will take several hours to train.

You will choose the accelerator to deploy to when deploying the model. You can choose GPU, CPU, or Xilinx FPGA - 16 bit (technology preview). Under **Training options**, you can enable Core ML. After deploying the model, you can download the generated Core ML assets from the Deployed models page.

YOLO V3

Models optimized for speed can be run anywhere and support CoreML deployment. These models use "you only look once" (YOLO) V3 and may take longer to train for desired accuracy.

A CoreML asset is always generated.

Detectron

Detectron Mask R-CNN models can only be run on a GPU. They can use objects labeled with polygons for greater training accuracy. Labeling with polygons is especially useful for small objects, objects that are at a diagonal, and objects with irregular shapes. However, training a data set that uses polygon labels takes longer than training with rectangular bounding boxes. If you want to use a Detectron model but want a shorter training time, you can disable segmentation and IBM Visual Insights will use rectangles instead of polygons. The actual images are not modified, so you can train with segmentation later.

Single Shot Detector (SSD)

Suitable for real-time inference and embedded devices. It is almost as fast as YOLO but not as accurate as Faster R-CNN. It is always enabled for TensorRT. After deploying the model, you can download the TensorRT assets from the Deployed models page.

Custom packaged model
Select an imported model to use for training.

Action detection
Choose this if you want to use this model to label actions within videos.

Optimize model using

Structured segment network (SSN)
Used for action detection models only to detect short activity or actions in videos. It is best at classifying short bursts of time that have a strong sense of direction.

Advanced settings

Base model
You must select a base model when training for image classification with GoogLeNet. You can optionally choose a base model when training for object detection with Faster R-CNN.

When you specify a base model, IBM Visual Insights uses the information in the base model to train the new model. This allows you to transfer learning that has already been done with one model to a new model, resulting in more accurate training. You can choose a model that is included with IBM Visual Insights, or you can choose your own model that you previously trained or imported. For models that were trained in IBM Visual Insights versions prior to 1.1.2, the list of associated objects or categories is not shown in the user interface. However, those models are still usable.

The base model's network must be Faster R-CNN (for object detection) or GoogLeNet (for image classification). Only viable models are listed in the Base model table.

Note: Base models are not available for tiny YOLO v2, Detectron, and custom models used for object detection, or custom models used for image classification.

IBM Visual Insights comes with several common models such as flowers, food, and so on, that you can use to help classify your data. If you do not select a base model when training with GoogLeNet, General is used. For more information, see “Base models included with IBM Visual Insights” on page 90.

Model hyperparameters
For advanced users, these setting are available to help fine-tune the training. The user interface presents ranges for several of the hyperparamters, with lower and upper bounds marked with either a parenthesis, ( ), or a bracket, [ ]. A parenthesis indicates a non-inclusive bound, and a bracket indicates an inclusive bound. For example, (0-0.5] indicates the value must be greater than 0 and can be up to and including 0.5.

Epochs (Action detection only)
The number of times the entire data set is passed through the training algorithm. Large data sets are divided into smaller parts to fit the GPU memory and processed as batches. One batch is passed through the algorithm during each iteration. Therefore, each epoch is made up of many iterations.

Specifying a large number of epochs can increase the training time substantially especially for larger data sets.

Max iteration (Image classification and object detection only)
The maximum number of times the data is passed through the training algorithm, up to 1,000,000 iterations. In general, the more iterations the model is trained, the more accurate the model will be. However, in many cases the test accuracy will plateau at some point beyond which further iterations do not result in a significant improvement in the accuracy of the model.

The default number of iterations is a placeholder, chosen based on characteristics of the model. For example, tiny YOLO V2 models typically require more iterations to achieve a class and IoU accuracy comparable to other object detection models in the product. Therefore, the default is higher for this model.

Depending on training factors, such as the number of data set samples, number of classes, inter and intra similarity between classes/objects, target accuracy, and so on, the optimal number of iterations may be higher or lower than the default. One strategy for determining the optimal number of iterations is to choose a target accuracy and train the model until the desired accuracy is reached or the loss rate no longer is improving.

Momentum (Object detection only)
This value increases the step size used when trying to find the minimum value of the error curve. A larger step size can keep the algorithm from stopping at a local minimum instead of finding the global minimum.

Ratio
IBM Visual Insights automatically “splits” the data set for internal validation of the model’s performance during training. The default Ratio value of 80/20 will result in 80% of the images in the data set (at random) being used for training, and 20% being used for measurement / validation.

Note: Image classification models do not allow a ratio of 100%, as some images are required for validation.

Test iteration (Image classification only)
The number of times data is passed through the training algorithm before possible completion. For example, if this value is 100, and Test interval is 50, the model is run through the algorithm at least 100 times; being tested ever 50 times.

Test interval (Image classification only)
The number of times the model is passed through the algorithm before testing. For example, if this value is 50, the model is tested every 50 iterations. Each of these tests becomes a data point on the metrics graphs.

Learning rate
This option determines how much the weights in the network are adjusted with respect to the loss gradient. A correctly tuned value can result in a shorter training time. However, it is recommended that only advanced users change this value. A learning rate that is too large can result in significant oscillations in the loss function, and in the worst case "exploding gradients" resulting in failure to train the model.

Weight decay
This value specifies regularization in the network. It protects against over-fitting and is used to multiply the weights when training.

Notes (Do not apply if fix pack 1 is installed.):

- If a training job appears to be hanging, it might be waiting for another training job to complete, or there might not be a GPU available to run it. For information to fix this, see “IBM Visual Insights cannot train a model” on page 175.
- When training an action detection model, it can take several minutes before the status changes from Scheduled to Training, depending on the data set size.

3.

(Training queue is only available with fix pack 1.) The model starts to train (if there is a GPU available) or is added to the training queue. Each active training job takes one GPU. If all GPUs are in use, the training job is added to the queue. You can see the status on the Models page. To view details about a model that is being trained or is in the queue, click on the name of the model in the Models page. The time listed in **Queued time** is the time that the user submitted the training job and it was added to the queue.

You can remove the model from the queue by clicking **Stop training**, whether training has started or not. If training has started, you have the option to keep the model.

4. (Optional - *Only supported when training for object detection.*) Stop the training process by clicking **Stop training** > **Keep Model** > **Continue**.

   You can wait for the entire training model process complete, but you can optionally stop the training process when the lines in the training graph start to flatten out, as shown in the figure below. This is because improvements in quality of training might plateau over time. Therefore, the fastest way to deploy a model and refine the data set is to stop the process before quality stops improving.

   Note: Use early stop with caution when training segmented object detection models (such as with Detectron), because larger iteration counts and training times have been demonstrated to improve accuracy even when the graph indicates the accuracy is plateauing. The precision of the label is can still being improved even when the accuracy of identifying the object location stopped improving.

   Understanding the model training graph

   As IBM Visual Insights trains the model, the graph shows the relative performance of the model over time. The model should converge at the end of the training with low error and high accuracy.

   In the figure, you can see the Loss CLS line and the Loss Bbox lines start to plateau. In the training graph, the lower the loss value, the better. Therefore, you can stop the training process when the loss value stops decreasing. The training model has completed enough iterations and you can continue to the next step.

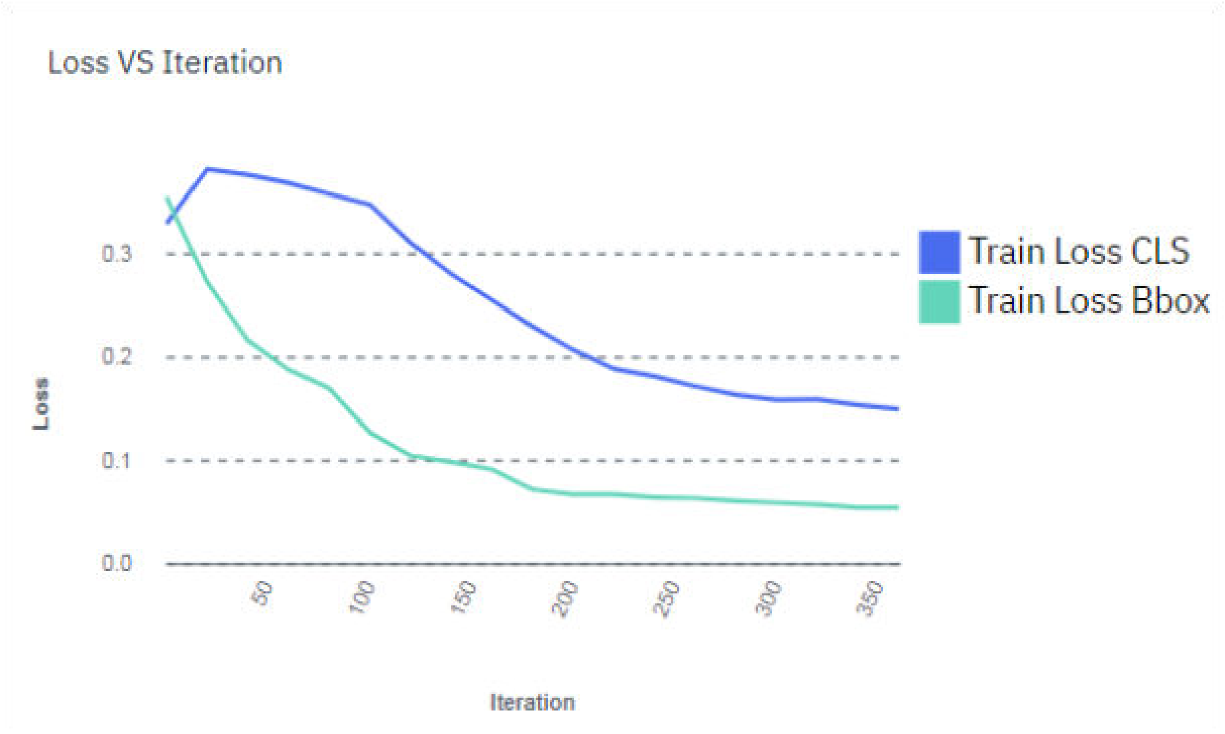


   Figure 9. Model training graph

   Important: If the training graph converges quickly and has 100% accuracy, the data set does not have enough information. The same is true if the accuracy of the training graph fails to rise or the errors in the graph do not decrease at the end of the training process. For example, a model with high accuracy might be able to discover all instances of different race cars, but might have trouble differentiating between specific race cars or those that have different colors. In this situation, add more images, video frames, or videos to the data set, label them, then try the training again.

   The "Loss vs. Iteration" graph is different for the SSD model than for other object detection models. This is because the SSD model combines the "Train Loss Bbox" and "Train Loss CLS" into a single statistic that is presented in the training graph. For SSD models, the "Train Loss Bbox" value is not valid and the graph shows a constant value of '0', while the "Train Loss CLS" tracks a combination of Bbox and CLS loss.

   Training time

The total training time depends on the data set size and the number of iterations.

The time required to prepare the data set (including setting up the DNN container usage, partitioning the data set into training and testing portions, and resizing training) and the time to generate model training statistics (accuracy per object, and confusion matrix) is directly related to the size of the data set. With a very large data set, the preprocessing and post-processing steps can take many minutes.

The training time for a model is also directly related to the number of iterations, or the number of times a batch of images is run through a forward and backward pass of the model. The execution time for an iteration varies significantly from model to model, but the more iterations the model is trained, the longer it will take. More training iterations usually also generates a more accurate model.

Related concepts

Understanding metrics
IBM Visual Insights provides several metrics to help you measure how effectively your model has been trained.

Working with custom models

You can save time and resources by using your own TensorFlow based custom models (also referred to as *custom networks*) with IBM Visual Insights. In general, custom models work the same as any other model in IBM Visual Insights. However, there are some differences you should understand.

When you upload a custom model to the **Custom Models** page, you can use the model to train a data set in IBM Visual Insights and generate a IBM Visual Insights trained model.

Note: Custom models cannot be used to import pre-trained models into IBM Visual Insights. Additionally, transfer learning is not supported with custom models.

Use the information in this topic to prepare a IBM Visual Insights trained model by using a custom TensorFlow model: "Preparing a model that will be used to train data sets in IBM Visual Insights" on page 83.

This repository has examples with detailed instructions and sample files for using custom models.

Related information

Examples on github

Preparing a model that will be used to train data sets in IBM Visual Insights

If your custom model will be used to train data sets in the IBM Visual Insights framework, your custom model must meet the following requirements.

After the model is properly prepared, upload it to IBM Visual Insights by opening the **Custom Models** page and clicking **Browse files**. You can then use it to train a data set. Follow these instructions to train a data set; selecting **Custom model**: "Training a model" on page 78.

Custom model requirements:

- It must be TensorFlow or PyTorch based.
- It must conform to Python 3. Any trained custom models from releases prior to Version 1.2.0 will not work if the custom model only supports Python 2.
- It must implement the `MyTrain` Python class.
  - The `MyTrain` implementation must reside in a file named `train.py` in the top level directory of the zip file contents.
  - The following import must be added to the `train.py` file in order to define the training callbacks:

    ```
    from train_interface import TrainCallback
    ```

  - The class name must be `MyTrain`.

`MyTrain` Template:

```
class MyTrain(TrainCallback):
    def __init__():
```

```
      pass
    def onPreprocessing(self, labels, images, workspace_path, params):
      pass
    def onTraining(self, monitor_handler):
      pass
    def onCompleted(self, model_path):
      pass
    def onFailed(self, train_status, e, tb_message):
      pass
```

class MyTrain(TrainCallback)

Use the MyTrain API to prepare a TensorFlow or PyTorch model that will be used to train data sets with IBM Visual Insights.

- "Template" on page 84
- "def onPreprocessing(self, labels, images, workspace_path, params)" on page 84
- "def onTraining(self, monitor_handler)" on page 85
- "def onCompleted(self, model_path)" on page 85
- "def onFailed(self, train_status, e, tb_message):" on page 85
- "Monitoring and reporting statistics" on page 86

Template

This is a template you can use for the MyTrain API:

```
class MyTrain(TrainCallback):
    def __init__():
      pass
    def onPreprocessing(self, labels, images, workspace_path, params):
      pass
    def onTraining(self, monitor_handler):
      pass
    def onCompleted(self, model_path):
      pass
    def onFailed(self, train_status, e, tb_message):
      pass
```

def onPreprocessing(self, labels, images, workspace_path, params)

Callback for data set preprocessing.

Input

***labels* (dict)**

Image categories and index.

Example: `{'safety_vest': 1, 'helmet': 0, 'no_safety_vest': 2, 'no_helmet': 3}`

images

- *image classification* (dict): Image path and its category.

  Example: `{'/dataset/Acridotheres/001.jpg': 'Acridotheres', '/dataset/Butorides/002.jpg': 'Gallinula', '/dataset/Butorides/003.jpg': 'Butorides'}`
- *object detection* (list): List of annotation objects; including the image name and annotation.

  Example:

  ```
  [annotation[0] annotation[1] ...]
  image filename
  annotations[0].filename: /dataset/safety-detection/ee1fba93-a5f0-4c8b-8496-
  ce7605914651.jpg
  image size [width, height, depth]
  annotations[0].size: [450, 330, 3]
  bounding box #0 label
  annotations[0].objects[0].label: helmet
  # bounding box #0 position [xmin, ymin, xmax, ymax]
  ```

```
annotations[0].objects[0].bbox: [111, 16, 205, 106]
annotations[0].objects[1].label: helmet
annotations[0].objects[1].bbox: [257, 42, 340, 140]
annotations[0].objects[2].label: safety_vest
annotations[0].objects[2].bbox: [40, 105, 215, 291]
annotations[0].objects[3].label: safety_vest
annotations[0].objects[3].bbox: [207, 124, 382, 309]
```

***workspace_path* (string)**
Temporary workspace path recommended to be used in all training life cycles.

Example: `"/tmp/workspace"`

***params* (dict)**
Hyper parameters for training. These parameters are available to the custom model, but they are not required.

- Object detection example:

  `{ 'max_iter' : 4000, 'learning_rate' : 0.001, 'weight_decay' : 0.0005, 'momemtum' : 0.9 , 'traintest_ratio' : 0.8 }`
- Classification example:

  `{ 'max_iter' : 4000, 'learning_rate' : 0.001, 'weight_decay' : 0.0005, 'test_iteration' : 100, 'test_interval' : 20}`

Output:

None

def onTraining(self, monitor_handler)

Callback for training.

Input

monitor_handler (MonitorHandler): Handler for train/test status monitoring.

Output

None

def onCompleted(self, model_path)

Callback for training completed. A training task is terminated either with `onCompleted()` or with `onFailed()`. You need to save the trained model in this callback.

Input

model_path (String): The absolute model path and file.

Output

None

def onFailed(self, train_status, e, tb_message):

Callback for training failed. A train task is terminated either with `onCompleted()` or with `onFailed()`

Input

***train_status* (string)**
Training status when the failure occurred.

***e* (Exception object)**
Programming exception object.

***tb_message* (string)**
Formatted traceback message.

Output

None

Monitoring and reporting statistics

The `onTraining` API passes a `monitor_handler` object. This object provides callbacks to report both training and test messages back to IBM Visual Insights. Depending on the type of training being performed, classification or object detection, the appropriate callback must be used.

Object detection callbacks
Use this callback when the custom model is trained for object detection.

- "def updateTrainMetrics(current_iter, max_iter, loss_cls, loss_bbox, epoch)" on page 86
- "def updateTestMetrics(mAP)" on page 86

def updateTrainMetrics(current_iter, max_iter, loss_cls, loss_bbox, epoch)

Handler for status updates from the training process. This should be called **actively** by your custom code to post training status to the IBM Visual Insights user interface.

Input

***current_iter* (int)**
Current iteration in the epoch

***max_iter* (int)**
Maximum iterations in one epoch

***loss_cls* (float)**
Training loss of classification

***loss_bbox* (float)**
Training loss of bounding box prediction

***epoch* (int)**
Current training epoch

Example

```
monitor_handler.updateTrainMetrics(current_iter, max_iter, loss_cls, loss_bbox,
epoch)
```

Output

None

def updateTestMetrics(mAP)

Handler for status updates from the testing process. This should be called **actively** by your custom code to post testing status to the IBM Visual Insights user interface.

Input

mAP (float): Testing mean average precision

Example

```
monitor_handler.updateTestMetrics(mAP)
```

Output

None

Classification callbacks
Use this callback when the custom model is trained for image classification.

- "def updateTrainMetrics(current_iter, max_iter, loss, epoch)" on page 87

- “def updateTestMetrics(current_iter, accuracy, loss, epoch)” on page 87

def updateTrainMetrics(current_iter, max_iter, loss, epoch)

Handler for status updates from the training process. This should be called **actively** by your custom code to post training status to the IBM Visual Insights user interface.

Input

current_iter **(int)**
: Current iteration in the epoch

max_iter **(int)**
: Maximum iterations in one epoch

loss **(float)**
: Training loss

epoch **(int)**
: Current training epoch

Example

```
monitor_handler.updateTrainMetrics(current_iter, max_iter, loss, epoch)
```

Output

None

def updateTestMetrics(current_iter, accuracy, loss, epoch)

Handler for status updates from the testing process. This should be called **actively** by your custom code to post testing status to the IBM Visual Insights user interface.

Input

current_iter **(int)**
: Current iteration in the epoch

accuracy **(float)**
: Testing accuracy

loss **(float)**
: Training loss

epoch **(int)**
: Current training epoch

Example

```
monitor_handler.updateTrainMetrics(iter_num, accuracy, loss, epoch_num)
```

Output

None

Preparing a model that will be deployed in IBM Visual Insights

If your custom model will be deployed in the IBM Visual Insights framework, your custom model must meet the following requirements.

After the model is properly prepared, import it to IBM Visual Insights by navigating to the **Models** page and clicking **Import .zip file**. To deploy the model, on the **Models** page, select the model and click **Deploy model**.

Custom model requirements:

- It must be TensorFlow or PyTorch based.
- It must conform to Python 3. Any trained custom models from releases prior to Version 1.2.0 will not work if the custom model only supports Python 2.

- It must implement the `MyDeploy` Python class.
  - The `MyDeploy` implementation must reside in a file named `deploy.py` in the top level directory of the zip file contents.
  - The following import must be added to the `deploy.py` file in order to define the deploy callbacks:

    ```
    from deploy_interface import DeployCallback
    ```

  - The class name must be `MyDeploy`.

MyDeploy Template:

```
class MyDeploy(DeployCallback):
def __init__(self):
    pass
def onModelLoading(self, model_path, labels, workspace_path):
    pass
def onTest(self):
    pass
def onInference(self, image_url, params):
    pass
def onFailed(self, deploy_status, e, tb_message):
    pass
```

class MyDeploy(DeployCallback)

Use the MyDeploy API to prepare a TensorFlow or PyTorch model that will be deployed in IBM Visual Insights.

Template

This is a template you can use for the MyDeploy API:

```
class MyDeploy(DeployCallback):
def __init__(self):
    pass
def onModelLoading(self, model_path, labels, workspace_path):
    pass
def onTest(self):
    pass
def onInference(self, image_url, params):
    pass
def onFailed(self, deploy_status, e, tb_message):
    pass
```

def onModelLoading(self, model_path, labels, workspace_path)

Callback for load model.

Input

model_path **(string)**
    Model path. The model must be decompressed before this callback.

workspace_path **(string)**
    Temporary workspace path recommended to be used in all deploy activities.

labels **(dict)**
    The label index to name mapping.

    Example: `{1: 'safety_vest', 0: 'helmet', 2: 'no_safety_vest', 3: 'no_helmet'}`

Output:

None

def onTest(self)

Test API interface with a custom message. This method is used to test responsiveness of the deployed model, and can return any arbitrary string as a response.

Input

None

Output

message (string): Output message.

def onInference(self, image_url, params)

Inference with a single image.

Input

***image_url* (string)**
Path of the image for inference.

***params* (dict)**
Additional inference options.

***heatmap* (string)**
Request a heat map. This is only supported for classification. Possible values:

- "true" : A heat map is requested.
- "false" : A heat map is not requested.

***conf_threshold* (float)**
Confidence threshold. Value in the range 0.0 - 1.0, to be treated as a percentage. Only results with a confidence greater than the specified threshold are returned. The smaller confidence threshold you specify, the more results are returned. If you specify 0, many, many results will be returned because there is no filter based on the confidence level of the model.

Output (classification)

`result({"label": "apple", "confidence": 0.9, "heatmap": "_value_"})`: predicted label and its score
`label (string)` : predicted label name
`confidence (float)` : number for certainty. between 0 and 1
`heatmap (string)` : heatmap return

Output (object detection)

`result([{"confidence": 0.95, "label": "badge", "ymax": 145, "xmax": 172, "xmin": 157, "ymin": 123}])`: predicted results in list
`confidence(float)`: number for certainty. between 0 and 1
`label(string)`: predicted label name
`ymax(int)`: the max Y axis of bounding box
`xmax(int)`: the max X axis of bounding box
`ymin(int)`: the min Y axis of bounding box
`xmin(int)`: the min X axis of bounding box

def onFailed(self, deploy_status, e, tb_message)

Callback for deploy failed. A deploy task is terminated with `onFailed()`.

Input

***deploy_status* (string)**
Deploy status when the failure occurred.

***e* (Exception object)**
Programming exception object.

***tb_message* (string)**
Formatted traceback message.

Output

None

Base models included with IBM Visual Insights

You can use a *base model* to help train your model. You can choose your own Faster R-CNN or GoogLeNet model, or select one of the models that is included with IBM Visual Insights.

Table 6. Base models included with IBM Visual Insights

Type	Number of images	Size	Source
Action	9532	310M	Stanford 40 actions
Flower	8189	348M	Visual Geometry Group
Food	1503	14.6M	https://ibm.box.com/s/cbocm5pvtyudaoaypdwl3jaypets1hel
General	ImageNet dataset		ilsvrc12 http://image-net.org/download
Landscape	1472	22.2M	Proprietary data set
Scene	108754	38G	SUN database
Vehicle	16185	1.9G	https://ai.stanford.edu/%7Ejkrause/cars/car_dataset.html

Deploying a trained model

Deploy a trained model to get it ready to use within IBM Visual Insights or a different program, such as IBM Watson Machine Learning Community Edition. Deploying a model creates a unique API endpoint based on that model for inference operations.

Note:

Models trained in IBM Visual Insights can also be exported and deployed using the Chapter 14, “IBM Visual Insights Inference Server,” on page 155.

To deploy the trained model, follow these steps:

1. Click **Models** from the menu.
2. Select the model you want to deploy and click **Deploy**.
3. Specify a name for the model, and for models that were trained with the **Optimized for speed (tiny YOLO v2)** model, choose the accelerator to deploy to. You can choose GPU, CPU, or Xilinx FPGA - 16 bit (technology preview).

   If custom inference scripts have been uploaded, you can optionally select **Advanced deployment**. These options allow you to choose a custom inference script and to specify whether inference results are saved.

   Notes:

   - You can save inference results to a data set without choosing a custom inference script for this deployment. However, if you did not install fix pack 1.2.0.1, a custom inference script must have been uploaded in order for the **Advanced deployment** option to be shown. With fix pack 1.2.0.1, you can select **Advanced deployment** without having custom inference scripts.
   - For image classification models trained prior to fix pack 1.2.0.1, categories that are added as a result of an inference are listed by category UUID, rather than category name. To see category names instead, apply fix pack 1.2.0.1 and retrain the model, then run the inference again.

For information about uploading custom inference scripts, see "Preprocessing and post-processing" on page 92.

If the option to save inference results to a data set is chosen, then an existing data set must be selected for the results to be saved to. Labels generated in the inference results will be marked as "inferred" when viewing the images in the Label objects view. This can be used to validate the performance of the model.

Note: Deploying a model to a Xilinx FPGA requires the Xilinx Alveo U200 Accelerator card.

GPUs are used as follows:

- Each Tiny YOLO V2, YOLO V3, Detectron, Single Shot Detector (SSD), Structured segment network (SSN), or custom deployed model takes one GPU. The GPU group is listed as '-', which indicates that this model uses a full GPU and does not share the resource with any other deployed models.
- Multiple Faster R-CNN and GoogLeNet models are deployed to a single GPU. IBM Visual Insights uses packing to deploy the models. That is, the model is deployed to the GPU that has the most models deployed on it, if there is sufficient memory available on the GPU. The GPU group can be used to determine which deployed models share a GPU resource. To free up a GPU, *all* deployed models in a GPU group must be deleted (undeployed).

  Note: IBM Visual Insights leaves a 500MB buffer on the GPU.

4. Click **Deploy**. The **Deployed Models** page is displayed. When the model has been deployed, the status column displays **Ready**.
5. Click the deployed model to get the API endpoint, to view details about the model, such as the owner and the accuracy, and to test other videos or images against the model.

   For information about using the API see Vision Service API documentation.

   Note: When using the API, the smaller confidence threshold you specify, the more results are returned. If you specify 0, many, many results will be returned because there is no filter based on the confidence level of the model.
6. If necessary, you can delete a deployed model. To undeploy a model, click **Deployed Models**. Next, select the model that you want to undeploy and click the **X** (undeploy) in the header bar. The trained model is not deleted from IBM Visual Insights.

Related concepts

Automatically deploying the newest model
If you are using the production work flow within a project group, you can also turn on auto deploy. When auto deploy is turned on, IBM Visual Insights automatically deploys a model when it is successfully trained and when it is marked as Production. IBM Visual Insights automatically undeploys any deployed models when the associated trained model is marked as Rejected. Additionally, it tracks the latest model marked as Production or Untested and ensures that the latest production-ready model is deployed for a project group.

Working with the user interface
The IBM Visual Insights user interface is made up of these basic parts: the navigation bar, the side bar, the action bar, the data area, and the notification center.

Understanding metrics
IBM Visual Insights provides several metrics to help you measure how effectively your model has been trained.

Related information

Vision Service API documentation

Preprocessing and post-processing

You can upload customizations that enable you to perform operations before and after each inference operation with no manual intervention.

Note: Action detection models are not supported.

- "custom.py Template" on page 92
- "Optional requirements.txt file" on page 93
- "Deploying a model with preprocessing, post-processing, or both" on page 93

custom.py Template

Use this template to generate one Python file named `custom.py`, which can contain instructions for preprocessing, postprocessing, or both. This file must conform to Python 2 for all model types except custom models, which require Python 3.

Important: This file must be packaged in a zip file with `custom.py` in the top level directory of the zip file.

Other files, such as additional Python files, shell scripts, and images can also reside in the zip file. If the customization script requires Python modules aside from those built-in modules in Python, you can create a `requirements.txt` file, which contains a list of modules to be installed by using pip. The template contains this information:

class CustomInference
: The only Python class in the file. It must be named `CustomInference` and holds the "pre" and "post" callouts.

onPreProcessing
: If defined, this function must be in `CustomInference`. This function will be called before inference is run on the image.

onPostProcessing
: If defined, this function must be in `CustomInference`. This function will be called after inference is run on the image.

```
class CustomInference:
# Callout for inference pre-processing.  Will be called before the
# actual inference on the “image”
#
# Input:
#    image:    Image represented as a NumPy array that inference is to be
#              performed on.
#
# params:  To be used for additional parameters.  This will be
#             a listof key/value pairs.
#
# Output:
#    image:    Return the image represented as a NumPy array that is to
#              be used for inference.  This array may been manipulated
#              in this function, or it may be the same exact NumPy array.
#
def onPreProcessing(self, image, params):

     return image
# Callout for the inference post-processing.  Will be called
# after the image has been inferred.
#
# Input:
#    Image:    Image represented as a NumPy array that inference is to be
#              performed on.
#
# results:  JSON of the inference results.  The JSON will be
#              dependent on thetype of inference.
#
# params: To be used for additional parameters.  This will
#              be a list of key/value pairs
#
# Output:
#    results:  A json object that is a copy of the original
#               inference results.  However, if the callout
#               intends to return additional information, that
#               information can bereturnedin the json results
#               under the key “user”.
#
def onPostProcessing(self, image, results, params):

     return results
```

Optional requirements.txt file

If the customization script requires Python modules aside from those built-in modules in Python, you can create a `requirements.txt` file, which contains a list of modules to be installed by using pip.

Example:

```
sseclient==0.0.19
tflearn==0.3.2
keras==2.2.4
```

Deploying a model with preprocessing, post-processing, or both

To deploy a model that will use additional processing, you will upload the custom zip file, then specify it on the deploy:

1. Navigate to the **Custom assets** page and upload the zip file that contains `custom.py`. For Asset type, select **Custom inference script**.
2. Navigate to the model you want to deploy and click **Deploy model**. In the upper right corner, select **Advanced deployment**.
3. For **Custom inference script**, select the inference script that you want to use, specify what you want done with the inference results, and click **Deploy**.

   Note:

   - Inference results can be saved even if you do not choose a custom inference script.
   - Inference results for videos are not saved.

Testing a model

After deploying your model, you should test it against other images and videos to make sure that it works as expected.

1. Click **Deployed Models** from the menu.
2. Click the deployed model you want to test. The model opens in the **Deployed model** page.
3. Use the **Test Model** area to upload images and videos, one at a time. If you provide a DICOM image, it will be converted to PNG before inferencing.

   If you are testing an action detection model, optionally set the following values:

   Generate annotated video
   Select this option if you want to export the results, including the annotated video.

   Minimum action duration (frames)
   Specify the minimum number of consecutive frames in which an action must be detected, with a confidence higher than the specified **Confidence threshold**, in order for it to be identified in the inference. For example, if this is set to 20 frames and the confidence threshold is 60%, the only actions that are returned are at least 20 frames long and have a confidence level of at least 60%.

   Confidence threshold
   Specify the minimum confidence level for returned actions. For example, if you set the value to 60%, only actions that have at least a 60% confidence threshold are returned.
4. The results are shown on the bottom of the window.

If you used an image to test an image classification model

The test result displays the uploaded picture with the resultant heat map overlayed, and gives the classification and the confidence of the classification. Multiple classes are returned with the decreasing levels of confidence for the different classes. The heat map is for the highest confidence classification and can help you determine whether the model has correctly learned the features of this classification. To hide classes with a lower confidence level, use the **Confidence threshold** slider.

The red area of the heat map corresponds to the areas of the picture that are of highest relevance. Use the slider to change the opacity of the heat map. Because the heat map is a square, the test image is compressed into a square. This might cause the image to look distorted, but it will reliably show you the areas that the algorithm identified as relevant.

If you used an image to test an object detection model

The identified objects are labeled in the image, with the calculated precision.

If you used a video to test an object detection model

The video is processed, then the processed video is displayed, with a list of all of the objects on the right. As you watch the processed video, the identified objects are labeled as they appear in the video. Objects are labeled with a dot at the center of the object, with the name displayed next to the dot, even if the model is trained for segmentation. If you click an object in the list, it takes you to that point in the video. Processing the video might take a while, depending on its size.

The inference might take a long time to complete; however, you can run multiple inferences simultaneously. Additionally, you do not have to stay on the deployed model details page. If you leave the page, a notification window opens, where you can watch the progress. Clicking the link in this window loads the inference results section in the deployed model details page.

To download the result, click **Export result** in the Results section. A ZIP file is downloaded to your system. This file contains the original video, a JSON file that contains the result information, and the processed video with object labels added as annotations.

When you close the results area for an inference, the results are not removed. They are saved for seven days, unless you delete them. To access the results of previous inferences, click **Results history** in the Test Model section of the Deployed Models page. You can open or delete any of the saved results.

Note: The video object preview does not support non-ascii labels. This is a limitation of the module that generates the displayed label from the label name. The result of the conversion of non-ascii labels will be a label that is all question marks: "?????".

If you used a video to test an action detection model

The video is processed, then as you watch the processed video, the identified actions are output, along with the confidence and start and end times, as they appear in the video. Processing the video might take a while, depending on its size.

The inference might take a long time to complete; however, you can run multiple inferences simultaneously. Additionally, you do not have to stay on the deployed model details page. If you leave the page, a notification window opens, where you can watch the progress. Clicking the link in this window loads the inference results section in the deployed model details page.

The identified actions are grouped by action tag. To see individual actions that were discovered, expand the action tag. Clicking on an action moves the video preview to the start of that action.

To download the result, click **Export result** in the Results section. A ZIP file is downloaded to your system. This file contains the original video, a CSV file that contains the result information, and if the option to generate the annotated video was selected when the inference operation was started, the processed video with action labels added as annotations.

When you close the results area for an inference, the results are not removed. They are saved for seven days, unless you delete them. To access the results of previous inferences, click **Results history** in the Test Model section of the Deployed Models page. You can open or delete any of the saved results.

5. If you are satisfied with the results, the model is ready to be used in production. Otherwise, you can refine the model by following the instructions in this topic: “Refining a model” on page 95.

Related concepts

Importing, exporting, and downloading IBM Visual Insights information
You can import and export IBM Visual Insights models and data sets. This allows you to save them for archiving then use them later, use them on a different IBM Visual Insights install, and so on.

Refining a model

After deploying a model, you can improve its accuracy by supplying more data. There are several methods you can use to add more data to the model.

You can add more data by using any combination of the following options:

1. Upload new images or videos to the data set and classify or label them as appropriate.
2. For an existing video, capture more frames and classify or label them as appropriate. Or, for action detection models, label more actions.
3. Use data augmentation. *Data augmentation* is the use of filters, such as blur and rotate, to create new versions of existing images or frames. Augmentation does not apply to full videos. It can be applied to a video’s captured frames just as it is applied to images. When you use data augmentation, a new data set is created that contains all of the existing images, plus the newly generated images, which are marked as augmented. For instructions, see “Augmenting the data set” on page 97.
4. For models trained for object detection, you can use the Auto label function to identify more objects in the existing data. See “Automatically labeling objects” on page 95 for instructions.
5. When deploying an object detection model, you can choose **Advanced deployment** and specify that inference results should be saved to a data set. Objects labeled this way have the type "inferred" and the label is green. You can accept or reject the inferred labels. Accepted labels are considered manually added and are changed to blue.

After adding more data, train the model again.

Automatically labeling objects

After deploying a model for object detection, you can improve its accuracy by using the Auto label function. This function uses the labels in the deployed model to generate new labels in the data set; increasing the number of images that are labeled in the data set. The updated data set can be used to train a new, more accurate model.

It will improve the number of images that are labeled in the dataset which can then be used to train a new model that is more accurate.

Notes:

- You can automatically label images or videos that have not had labels manually added. If any labels have been manually added, that image or frame is skipped.
- Any automatically added labels that are saved or edited are converted to manual labels.
- If images or frames have labels that have only been added through the auto label function, those images and frames are reprocessed. The previous labels are removed and new labels are added.
- If you use a trained Detectron model with segmentation turned on to generate the labels, polygons are used instead of rectangular boxes.
- When also augmenting images, it is recommended that you accept or reject labels before augmenting the data set because auto label confidence levels are not preserved in augmented images.

Automatically labeling objects in a data set

When you auto label a data set, an existing trained model is used to generate labels for images and video frames that have not been manually labeled.

Notes:

- You can automatically label images or videos that have not had labels manually added. If any labels have been manually added, that image or frame is skipped.
- If images or frames have labels that have only been added through the auto label function, those images and frames are reprocessed. The previous labels are removed and new labels are added.
- When auto labeling a data set, only images and frames are auto labeled. Therefore, any videos that do not have captured frames are skipped. For instructions to automatically add labels to a video, see "Automatically labeling videos" on page 96.

Follow these steps to generate new labels in the data set.

1. Open the data set that you want to add more data to and select **Auto label**.
2. Choose the appropriate settings, then click **Auto label**.
3. Labels are added to existing images or video frames that have not been manually labeled. By default, the automatically added labels are light red. For videos, if frames have already been captured, those frames are used for auto labeling. If frames have not been captured, the video is ignored.
4. Review the automatically added labels on the Data Set page. You can manipulate (move or resize) the labels that were automatically generated. You can also save or reject individual labels, or you can reject them all by selecting **Clear all**. Saving or manipulating a label converts it to a manually added label. Rejecting a label deletes it. If you run **Auto label** again, any images or frames that now have manually added labels are skipped.

   You can use the confidence filter in the sidebar to review labels by the confidence level assigned by the model used to auto label the data set. For example, you could filter low confidence labels, which are likely wrong, and easily reject them, or filter on high confidence labels to quickly accept labels that are probably accurate.

   Note: Auto labels that were created before IBM Visual Insights 1.1.5 will not have a confidence value. These auto labels will be treated as 0% confidence. Therefore, when using the confidence filter, they will only show up if the minimum confidence is set to 0.

Automatically labeling videos
When using the auto label function on a data set, only frames and images are processed. Videos are ignored. However, you can run the auto label function on an individual video.

Note: Any frames that were previously captured by using auto capture and were not manually labeled are deleted before auto labeling. This helps avoid labeling duplicate frames. Manually captured frames are not deleted.

Follow these steps to run the auto label function on a video.

1. Open the data set that contains the video.
2. Select the video and click **Label objects**.
3. Click **Auto label**, choose the appropriate settings, then click **Auto label**.

   Frames are captured at the specified interval and then the specified trained model is used to process the frames. When an object is identified with the specified confidence threshold, it is labeled. By default, the automatically added labels are light red.
4. Review the automatically added labels on the Data Set page. You can manipulate (move or resize) the labels that were automatically generated. You can also save or reject individual labels, or you can reject them all by selecting **Clear all**. Saving or manipulating a label converts it to a manually added label. Rejecting a label deletes it. If you run **Auto label** again, any images or frames that now have manually added labels are skipped.

   You can use the confidence filter in the sidebar to review labels by the confidence level assigned by the model used to auto label the data set. For example, you could filter low confidence labels, which are likely wrong, and easily reject them, or filter on high confidence labels to quickly accept labels that are probably accurate.

   Note: Auto labels that were created before IBM Visual Insights 1.1.5 will not have a confidence value. These auto labels will be treated as 0% confidence. Therefore, when using the confidence filter, they will only show up if the minimum confidence is set to 0.

Augmenting the data set

After deploying a model, you can improve the model by using data augmentation to add modified images to the data set, then retraining the model. *Data augmentation* is the use of filters, such as blur and rotate, to create new versions of existing images or frames. Augmentation does not apply to full videos. It can be applied to a video's captured frames just as it is applied to images. When you use data augmentation, a new data set is created that contains all of the existing images, plus the newly generated images, which are marked as augmented.

Notes:

- When also using auto label, it is recommended that you accept or reject labels before augmenting the data set because auto label confidence levels are not preserved in augmented images.
- Augmented images contain any labels and categories identified in the original image.
- The tiny YOLO V2 model requires that images have unique object anchors - bounding box location and size. Using augmentations with color, noise, sharpen, or blur will generate modified images with identical bounding boxes, which causes a training failure for this type of model.

To augment a data set, follow these steps:

1. Open the data set for a deployed model.
2. Select the images to use for augmentation, then click **Augment data**. If you select a video, every captured frame is used for augmentation. If you select some, but not all, frames in a video, only the selected frames are used for augmentation.
3. Choose any combination of filters to apply to your data set, then click **Continue**.

   Each filter generates one or more new versions of each selected image; the filters are not cumulative. For example, if you select **Sharpen** and **Flip horizontal**, six new images are generated; one flipped and five sharpened.

   When you select a filter, you can see an example of what that filter would do to an image. This sample image is **not** a live preview of the filter. It is an example of what an image might look like with that filter applied. Some filters, such as Blur and Sharpen, have additional settings you can choose.
4. Specify a name for the new data set and click **Create data set**.
5. The new data set, containing the original images, is created immediately. The augmented images are added after all processing completes. After the new data set is created, you can train a model based on the new data set. See this topic for instructions: "Training a model" on page 78.

Augmentation settings

These settings are available when augmenting data.

Each filter generates one or more new versions of each selected image; the filters are not cumulative. For example, if you select **Sharpen** and **Flip horizontal**, six new images are generated; one flipped and five sharpened.

Note: When you select a filter, you can see an example of what that filter would do to an image. This sample image is **not** a live preview of the filter. It is an example of what an image might look like with that filter applied.

Blur

Select the maximum amount of Gaussian and motion blur. Gaussian blur makes the entire image appear out of focus by reducing detail and noise. Motion blur makes the image appear as if it (or the camera) is in motion.

Five new images are generated in the range of each nonzero selection. For example, if Motion = 25 and Gaussian = 10, then five images are generated by applying a motion blur filter in random strengths in the range 0-25, and five additional images are generated by applying a Gaussian blur filter in the range 0-10.

Sharpen
Select the maximum amount of sharpening to apply. Some noise will be introduced. Five new images are generated in the specified range. For example, if Sharpness = 25, five new images are generated by applying the sharpen filter in random strengths in the range of 0-25.

Color
Select the maximum amount of change in the image's brightness, contrast, hue, and saturation. Five new images are generated by using randomly selected values in the selected ranges. The resultant values can be either positive or negative.

For example, if Brightness = 30, Contrast = 15, Hue = 5, and Saturation = 10, five images are generated that have brightness changed by (-30, 30)% , contrast is changed by (-15, 15)%, and so on.

Crop
Select the maximum percentage of the image that should remain. For example, selecting 25 means that at most 25% of the original image remains and 75% is removed. Five new images will be generated that are cropped in the selected range. The crop is centered at a random point.

For example, if Crop = 25, five images are generated cropped to retain 100% - 25% of the original image.

Vertical flip
Create a new image by flipping the existing image across the top edge. That is, the top of the image becomes the bottom.

Horizontal flip
Create a new image by flipping the existing image across the side edge. That is, the left side of the image becomes the right side.

Rotate
Select the maximum value of rotation for the new images. Rotation can be either clockwise or counter-clockwise. Five new images are generated that are rotated by this amount. For example, if this value is 45, five new images are generated that are rotated either clockwise or counter-clockwise by a random number in the range 0-45.

Noise
Select the maximum amount of noise to add to the new images, specified as a percentage of what IBM Visual Insights determines to be a reasonable amount of noise for the images to remain usable. Therefore, if you select 100, none of the generated images will have 100% noise added. Instead, the output images will possibly have the maximum amount of noise added while still remaining usable.

Five new images are generated with noise added in the specified range. For example, if this value is 25, five new images are created with a random amount of noise added in the range 0 - 25% of a reasonable amount of noise.

Importing, exporting, and downloading IBM Visual Insights information

You can import and export IBM Visual Insights models and data sets. This allows you to save them for archiving then use them later, use them on a different IBM Visual Insights install, and so on.

- “Exporting” on page 98
- “Downloading assets” on page 99
- “Importing” on page 100

Exporting

Export a data set
To export a data set, open the Data sets page, open the data set you want to export, then click **Export** in the action bar. The data set is saved in your default download directory as `*data_set_name*.zip`. This zip file contains the images as well as any tags or categories you have assigned.

Notes:

- When exporting a data set, any objects that are not used in the data set are not contained in the exported data set. Therefore, they are not included when the data set is imported.

  For example, if the object or label "car" is defined but is not used in any of the images in the data set, the exported data set does not include the "car" object or label. When the data set is imported, the "car" object or label is not created.
- In IBM Visual Insights 1.1.1, any information about augmented images is lost on export. Therefore, if the data set is later imported (regardless of the product version), the augmented images will be in the data set, but they will no longer be marked as augmented.

Export a model

When you export a model, a zip file is generated that contains the model and some additional files, depending on the model type. The generated zip file is not encrypted or password protected.

To export a model, open the Models page, select the model you want to export, then click **Export** in the left pane. The model is saved in your default download directory as `character_string.zip`; where *character_string* is randomly generated by the system.

Note:

If the model is not a Custom model that was imported from the Models page, the exported model can only be used with IBM Visual Insights. It *can* be imported into the Inference Server product and deployed with the Inference Server product.

It is not recommended that you use an exported model with an earlier version of the product than it was exported from. Additionally, a model from a prior version will not have support for features that were added to later versions of the product. That is, if you export a model from version *x*.1 and import it into *x*.2, features that were added in *x*.2 will not be supported on the imported model.

Export the results of action detection or object detection inference

You can download the results from an inference that was run in the last seven days on an action detection or object detection model by following these steps:

1. Open the Deployed model page, then click the name of the model.
2. Scroll to the Test Model section and click **Results history**. A window opens that shows all inference results from the past seven days.
3. Select the results that you want to view and click **Load results**.
4. Scroll down to any results that you want to download and click **Export result**.
   - For action detection: A ZIP file is downloaded to your system. This file contains the original video, a CSV file that contains the result information, and if the option to generate the annotated video was selected when the inference operation was started, the processed video with action labels added as annotations.
   - For object detection: A ZIP file is downloaded to your system. This file contains the original video, a JSON file that contains the result information, and the processed video with object labels added as annotations.

Downloading assets

When you train certain types of models, additional downloadable assets are generated. To download these assets, open the Deployed models page and click the appropriate model.

Core ML assets

When you download Core ML assets, the model is downloaded as an .mlmodel file. This file can be deployed onto an Xcode project and can be used for inference directly on the device.

TensorRT assets

When you download TensorRT assets, the model is downloaded as a .tar.gz file.

Importing

Import a data set

1. Navigate to the Data sets page.
2. Drag and drop an exported data set .zip file onto the **Create** box.

   Important: After the upload starts, do not close the IBM Visual Insights tab or refresh the page. Doing so stops the upload.
3. After the upload completes, the data set has its original name.

Notes:

- In IBM Visual Insights 1.1.1, any information about augmented images is lost on export. Therefore, if the data set is later imported (regardless of the product version), the augmented images will be in the data set, but they will no longer be marked as augmented.
- The data set associated with a model is not preserved when it is exported. Therefore, for imported models, the Data set field is set to "Not found".

Import a model

Instead of using IBM Visual Insights to train a new model, you can *import* a model that was previously trained with IBM Visual Insights, and was then exported. This lets you streamline data processing by offloading training tasks and allowing you to reuse models on multiple systems. After the model is imported to the **Models** page, you can deploy it in IBM Visual Insights. Use the information in this topic to prepare a custom model that will be deployed in IBM Visual Insights: "Preparing a model that will be deployed in IBM Visual Insights" on page 87.

1. Navigate to the Models page.
2. Drag and drop a previously exported model .zip file onto the **Import** box.

   Important: After the upload starts, do not close the IBM Visual Insights tab or refresh the page. Doing so stops the upload.
3. After the upload completes, the model has its original name.

IBM Visual Insights REST APIs

You can use REST APIs to work with IBM Visual Insights data sets and models, such as performing training and deployment. You can also use them to perform administrative tasks, such as monitoring events. These APIs allow you to bypass the user interface and automate IBM Visual Insights processes or solutions.

For information about using the APIs see Vision Service API documentation.

There are also examples of using the APIs for different actions, published here.

Understanding metrics

IBM Visual Insights provides several metrics to help you measure how effectively your model has been trained.

To understand these metrics, you must understand these terms:

True positive
A *true positive* result is when IBM Visual Insights correctly labels or categorizes an image. For example, categorizing an image of a cat as a cat.

False positive
A *false positive* result is when IBM Visual Insights labels or categorizes an image when it should not have. For example, categorizing an image of a cat as a dog.

True negative
A *true negative* result is when IBM Visual Insights correctly does not label or categorize an image. For example, not categorizing an image of a cat as a dog.

False negative
A *false negative* result is when IBM Visual Insights does not label or categorize an image, but should have. For example, not categorizing an image of a cat as a cat.

Of course, for a model in production, the values for true negative / positive and false negative / positive can't accurately be known. These values are the expected values for these measurements.

- “Metrics for image classification (Optimized for accuracy)” on page 101
- “Metrics for object detection” on page 101
- “Metrics for object detection using the Tiny Yolo model (Optimized for speed)” on page 102
- “Metrics for object detection using Segmentation (Optimized for Detectron)” on page 102
- “Metrics for custom models” on page 103
- “Metrics for action detection models” on page 103

Metrics for image classification (Optimized for accuracy)

Accuracy
Measures the percentage of correctly classified images. It is calculated by (true positives + true negatives) / (true positives + true negatives + false positives+ false negatives).

PR curve (Advanced)
The precision-recall (PR) curve plots precision vs. recall (sensitivity). Because precision and recall are typically inversely related, it can help you decide whether the model is appropriate for your needs. That is, do you need a system with high precision (fewer results, but the results are more likely to be accurate), or high recall (more results, but the results are more likely to contain false positives)?

Precision
Precision describes how "clean" the population of hits is. It measures the percentage of images that are correctly classified. That is, when the model classifies an image into a category, how often is it correct? It is calculated by true positives / (true positives + false positives).

Recall
The percentage of the images that were classified into a category, compared to all images that should have been classified into that category. That is, when an image belongs in a category, how often is it identified? It is calculated as true positives/(true positives + false negatives).

Confusion matrix (Advanced)
The confusion matrix is used to calculate the other metrics, such as precision and recall. Each column of the matrix represents the instances in a predicted class (those that IBM Visual Insights marked as belonging to a category, for example). Each row represents the instances in an actual class. Therefore, each cell measures how many times an image was correctly and incorrectly classified.

You can view the confusion matrix as a table of values or a heat map. A heat map is a way of visualizing the data, so that the higher values appear more "hot" (closer to red) and lower values appear more "cool" (closer to blue). Higher values show more confidence in the model.

This matrix makes it easy to see if the model is confusing classes, or not identifying certain classes.

Metrics for object detection

Accuracy
Measures the percentage of correct image classifications. It is calculated by (true positives + true negatives) / all cases.

Loss vs. Iteration
The Loss vs. Iteration graph presents information about the training loss over the range of iterations used during training. There are two measurements of the "Train Loss":

- **CLS = Classification, Localization, Segmentation**: Combined error measurement of how accurately the trained model can split the original image into smaller regions, select (localize) the most interesting regions, and classify any objects in the region.

- **BBox = bounding box**: Measures how precisely the trained model can locate bounding box coordinates for any recognized object, compared to the test subset.

Mean Average precision (mAP)

The average over all classes of the maximum *precision* for each object at each *recall* value. Precision measures how accurate the model is. That is, the percent of the classified objects that are correct. Recall measures how well the model returns the correct objects. For example, out of 100 images of dogs, how many of them were classified as dogs?

To calculate this, first, the PR curve is found. Then, the maximum precision for each recall value is determined. This is the maximum precision for any recall value greater than or equal to the current recall value. For example, if the precision values range from .35 to .55 (and then never reach .55 again) for recall values in the interval .3 - .6, then the maximum precision for every recall value in the interval .3 - .6 is set to .55.

The mAP is then calculated as the average of the maximum precision values.

IoU (Intersection over union)

The accuracy of the location and size of the image label boxes.

It is calculated by the intersection between a ground truth bounding box and a predicted bounding box, divided by the union of both bounding boxes; where the intersection is the area of overlap, a *ground truth* bounding box is the hand drawn box, and the *predicted bounding box* is the one drawn by IBM Visual Insights.

Confusion matrix (Advanced)

The confusion matrix is used to calculate the other metrics, such as precision and recall. Each column of the matrix represents the instances in a predicted class (those that IBM Visual Insights marked as belonging to a category, for example). Each row represents the instances in an actual class. Therefore, each cell measures how many times an image was correctly and incorrectly classified.

You can view the confusion matrix as a table of values or a heat map. A heat map is a way of visualizing the data, so that the higher values appear more "hot" (closer to red) and lower values appear more "cool" (closer to blue). Higher values show more confidence in the model.

This matrix makes it easy to see if the model is confusing classes, or not identifying certain classes.

PR curve (Advanced)

The precision-recall (PR) curve plots precision vs. recall (sensitivity). Because precision and recall are typically inversely related, it can help you decide whether the model is appropriate for your needs. That is, do you need a system with high precision (fewer results, but the results are more likely to be accurate), or high recall (more results, but the results are more likely to contain false positives)?

Precision

Precision describes how "clean" the population of hits is. It measures the percentage of objects that are correctly identified. That is, when the model identifies an object, how often is it correct? It is calculated by true positives / (true positives + false positives).

Recall

The percentage of the images that were labeled as an object, compared to all images that contain that object. That is, how often is an object correctly identified? It is calculated as true positives/ (true positives + false negatives).

Metrics for object detection using the Tiny Yolo model (Optimized for speed)

Accuracy

Measures the percentage of correctly classified objects. It is calculated by (true positives + true negatives) / (true positives + true negatives + false positives+ false negatives).

Metrics for object detection using Segmentation (Optimized for Detectron)

Confusion matrix (Advanced)

The confusion matrix is used to calculate the other metrics, such as precision and recall. Each column of the matrix represents the instances in a predicted class (those that IBM Visual Insights marked as belonging to a category, for example). Each row represents the instances in an actual class. Therefore, each cell measures how many times an image was correctly and incorrectly classified.

You can view the confusion matrix as a table of values or a heat map. A heat map is a way of visualizing the data, so that the higher values appear more "hot" (closer to red) and lower values appear more "cool" (closer to blue). Higher values show more confidence in the model.

This matrix makes it easy to see if the model is confusing classes, or not identifying certain classes.

Loss vs. Iteration

The Loss vs. Iteration graph presents information about the training loss over the range of iterations used during training. There are two measurements of the "Train Loss":

- **CLS = Classification, Localization, Segmentation**: Combined error measurement of how accurately the trained model can split the original image into smaller regions, select (localize) the most interesting regions, and classify any objects in the region.
- **BBox = bounding box**: Measures how precisely the trained model can locate bounding box coordinates for any recognized object, compared to the test subset.

PR curve (Advanced)

The precision-recall (PR) curve plots precision vs. recall (sensitivity). Because precision and recall are typically inversely related, it can help you decide whether the model is appropriate for your needs. That is, do you need a system with high precision (fewer results, but the results are more likely to be accurate), or high recall (more results, but the results are more likely to contain false positives)?

Precision

Precision describes how "clean" the population of hits is. It measures the percentage of objects that are correctly identified. That is, when the model identifies an object, how often is it correct? It is calculated by true positives / (true positives + false positives).

Recall

The percentage of the images that were labeled as an object, compared to all images that contain that object. That is, how often is an object correctly identified? It is calculated as true positives/ (true positives + false negatives).

Metrics for custom models

When a custom model is imported and deployed, the following metric is shown:

Accuracy

Measures the percentage of correct categorizations. It is calculated by (true positives + true negatives) / (true positives + true negatives + false positives + false negatives).

Metrics for action detection models

Accuracy

Measures the percentage of correctly detected actions. It is calculated by (true positives + true negatives) / (true positives + true negatives + false positives + false negatives).

Precision

Precision describes how "clean" the population of hits is. It measures the percentage of actions that are correctly identified. That is, when the model identifies an action, how often is it correct? It is calculated by true positives / (true positives + false positives).

Recall

The percentage of the video segments that were labeled as an action, compared to all segments in the video that contain that action. That is, how often is an action correctly identified? It is calculated as true positives/(true positives + false negatives).

Confusion matrix (Advanced)

The confusion matrix is used to calculate the other metrics, such as precision and recall. Each column of the matrix represents the instances in a predicted class (those that IBM Visual Insights marked as belonging to a category, for example). Each row represents the instances in an actual class. Therefore, each cell measures how many times an image was correctly and incorrectly classified.

You can view the confusion matrix as a table of values or a heat map. A heat map is a way of visualizing the data, so that the higher values appear more "hot" (closer to red) and lower values appear more "cool" (closer to blue). Higher values show more confidence in the model.

This matrix makes it easy to see if the model is confusing classes, or not identifying certain classes.

Chapter 10. Creating and working with project groups

Project groups allow you to group trained models with the data sets that were used for training. This grouping is optional but is a useful way to organize related data sets. For example, project groups would be useful with a workflow that clones data sets as you refine labels and work toward a more accurate model. Project groups can be used with a production work flow strategy and automatic model deployment for even more functionality.

Project groups provide API shortcuts for certain trained model actions. That is, you can deploy or perform inferences on the most recently trained or deployed model without knowing the model ID. Instead, the APIs use project group IDs, which never change. This means that as better performing models are generated, your scripts can act on the latest model without needing to be updated.

Project groups track the latest trained model and the latest deployed model separately. If Production work flow is enabled, you can additionally add tags to denote a trained model (and its deployed instance) as production-ready or as untested. See Chapter 11, "Production work flow," on page 107 for more information about these tags. When using project groups with the production work flow, you can use project group APIs to work with these models:

- Latest trained model in a project group
- Latest deployed model in a project group
- Latest trained model that is production-ready in a project group*
- Latest deployed model that is production-ready in a project group *
- Latest trained model that is untested in a project group*
- Latest deployed model that is untested in a project group*

*: Production work flow must be enabled for the project group.

Note: All models trained from any data set in a project group will automatically be associated with that project group.

- "Working with project groups and project group assets" on page 105
- "Using the production work flow with project groups" on page 106
- "Automatically deploying models in project groups" on page 106

Working with project groups and project group assets

Project groups can be created at any point in your work flow. To create a project group, click **Projects** in the navigation bar, then click **+**. After the project group is created, you can add resources (data sets and trained models) to it.

To delete a project group, from the Projects page, select the project name and click the trash can icon. None of the assets in the project are deleted, but they will no longer be associated with any project group.

Working with project group assets

To work with project group assets, navigate to the Projects page and click the name of the project group.

Add an asset

To add a data set or model, click **+**, specify the asset type, and select the asset to add. You can start typing the asset name to filter the available assets.

Note: An administrator can add assets to a project group that was created by a different user. However, the project group owner will not be able to see the added assets because only administrators can see resources created by other users. Because of that, the value for "Total items" on the Projects page might be larger than the number of items shown on a project's details page.

Remove an asset

To remove an asset, navigate to the project group, select all assets that you want to remove, and click remove. The assets are not deleted from IBM Visual Insights. Additionally, each asset in a project group is independent. For example, If you remove a data set, none of the models derived from that data set are removed.

Notes:

- Any model trained from a data set in a project group is automatically added to that project group. However, any models that were trained from a data set before it was added to the project group must be added manually.
- Each data set or trained model can be a member of only one project group.

Using the production work flow with project groups

If Production work flow is enabled, project groups keep track of the most recently trained model that is marked Production and the most recently trained model that is unmarked. You can use an API to work with the latest deployed model that is marked Production or is Unmarked (untested). This simplifies your workflow because you never have to update the script to point to a different deployed model, and you do not have to manually track model names.

Note: Because the latest trained model is tracked separately from the latest deployed model, it is possible to train a new model and still be using an older model for inferences. This delineation can be reduced (almost eliminated) if you enable production work flow *and* auto deploy. With both of these flags set, the project group tries to keep the deployed models in sync with the trained model's `latest` trackers.

For details, see Chapter 11, "Production work flow," on page 107.

Automatically deploying models in project groups

If you are using the production work flow within a project group, you can also turn on auto deploy. When auto deploy is turned on, IBM Visual Insights automatically deploys a model when it is successfully trained and when it is marked as Production. IBM Visual Insights automatically undeploys any deployed models when the associated trained model is marked as Rejected. Additionally, it tracks the latest model marked as Production or Untested and ensures that the latest production-ready model is deployed for a project group. For details, see "Automatically deploying the newest model" on page 108.

Related tasks

Creating and working with data sets
Before you can work with videos or images, you need to create a data set. A data set is a group of images, videos, or both that you will use to train a deployable model.

Chapter 11. Production work flow

You can use an API to enable the production work flow. This helps you track which models are ready for production, which failed testing, and which still need to be tested. If you are using the production work flow and project groups, you can use scripts to deploy or perform inferences on the most recently trained model of a specified status in the project group.

Overview

You can mark a trained model as one of the following:

- **Production** - The model has been deployed and tested and is ready for use.
- **Rejected** - The model has been deployed and tested but failed validation and should not be used.
- **Unmarked** - The model has not been deployed and tested. All newly trained models are Unmarked.

  Note: In the API, this corresponds to a `production status` value of `untested`.

All states must be set manually; except that newly trained models are assigned a status of Unmarked. There are no rules enforced about state changes, so you can set any status on any trained model.

Enabling production work flow

Set `enforce_pwf` to `true` to enable production work flow. To set `enforce_pwf`, use the HTTP PUT verb to the endpoint `/projects/{project-UUID}` and include a JSON body of `{"enforce_pwf":"true"}`.

CURL example:

```
curl -kXPUT -H "x-auth-token: PAIV-AUTH_TOKEN-STRING"
    https://PAIV-SERVER.COMPANY.COM/vision/api/projects/PAIV-PROJECT-UUID
    -d '{"enforce_pwf":"true"}'
```

For detailed information about the APIs, see Vision Service API documentation.

Setting a model's status

To set a model's status, follow these steps:

1. Navigate to the Models page.

   Note: The "Production" status can also be set on the Deployed models page.
2. Select one or more models and click **Mark as**.
3. Select the appropriate status.

   Note: If auto deploy is enabled, changing a model's status might result in the model being deployed or undeployed. See "Automatically deploying the newest model" on page 108 for details.

When you set a trained model's status, the associated deployed model (if one exists) will have the same status.

Using the production work flow with project groups

If Production work flow is enabled, project groups keep track of the most recently trained model that is marked Production and the most recently trained model that is unmarked. You can use an API to work with the latest deployed model that is marked Production or is Unmarked (untested). This simplifies your workflow because you never have to update the script to point to a different deployed model, and you do not have to manually track model names.

Note: Because the latest trained model is tracked separately from the latest deployed model, it is possible to train a new model and still be using an older model for inferences. This delineation can be reduced (almost eliminated) if you enable production work flow *and* auto deploy. With both of these flags set, the project group tries to keep the deployed models in sync with the trained model's `latest` trackers.

Using the production work flow with autodeploy

If you are using the production work flow within a project group, you can also turn on auto deploy. When auto deploy is turned on, IBM Visual Insights automatically deploys a model when it is successfully trained and when it is marked as Production. IBM Visual Insights automatically undeploys any deployed models when the associated trained model is marked as Rejected. Additionally, it tracks the latest model marked as Production or Untested and ensures that the latest production-ready model is deployed for a project group. For details, see "Automatically deploying the newest model" on page 108.

Using the production work flow APIs for inferences

Use the `projects` API to do predictions to the latest deployed model with a status of "production" or "untested": `/projects/{id}/models/{status}/predict`, where *status* is `latest`, `production`, or `untested`.

Examples:

Do a prediction on the latest deployed model

If PWF is set to `enforce`, the latest deployed model with a status of "production" is used.

```
/projects/123-456/models/latest/predict
```

Do a prediction on the latest deployed "production" model

```
/projects/123-456/models/production/predict
```

Do a prediction on the latest deployed "untested" (unmarked) model

```
/projects/123-456/models/untested/predict
```

For detailed information about the APIs, see Vision Service API documentation.

Automatically deploying the newest model

If you are using the production work flow within a project group, you can also turn on auto deploy. When auto deploy is turned on, IBM Visual Insights automatically deploys a model when it is successfully trained and when it is marked as Production. IBM Visual Insights automatically undeploys any deployed models when the associated trained model is marked as Rejected. Additionally, it tracks the latest model marked as Production or Untested and ensures that the latest production-ready model is deployed for a project group.

Note: If you do not mark a model as "production" or "rejected," and you manually deploy it, it will never be automatically undeployed by IBM Visual Insights.

- "Overview" on page 109
- "Enabling auto deploy" on page 110

Overview

IBM Visual Insights does the following when auto deploy is enabled:

When a model is newly trained
The latest trained model is marked Untested and it is automatically deployed. If there is another model marked Untested that is already deployed, the older deployed model is undeployed. The goal of this process is to help people who want to test the latest trained model.

When a model is marked as Production
When a trained model is marked as Production, it is automatically deployed. The goal of this process is to always keep the latest production-ready model deployed. If it is already deployed, the following happens:

1. The deployed model becomes the current deployed Production model.
2. Any other deployed Production model is undeployed.
3. IBM Visual Insights finds the most recent trained model with Untested status and deploys it. If there is no other trained model marked as Untested, attempted inferences to the latest Untested model will fail.

When a model is changed from Untested to Rejected
When a trained model is marked as Rejected, the associated deployed model is undeployed.

When a model is changed from Production to Rejected
When a trained model is marked as Rejected, the associated deployed model is undeployed. IBM Visual Insights finds the most recent trained model with Production status and deploys it. If there is no other trained model marked as Production, attempted inferences to the latest Production model will fail.

Although auto deploy tracks and deploys the latest model marked with each status, you can manually deploy additional models from the project group by using the Models page. However, those additional models will not be accessible via the API shortcuts.

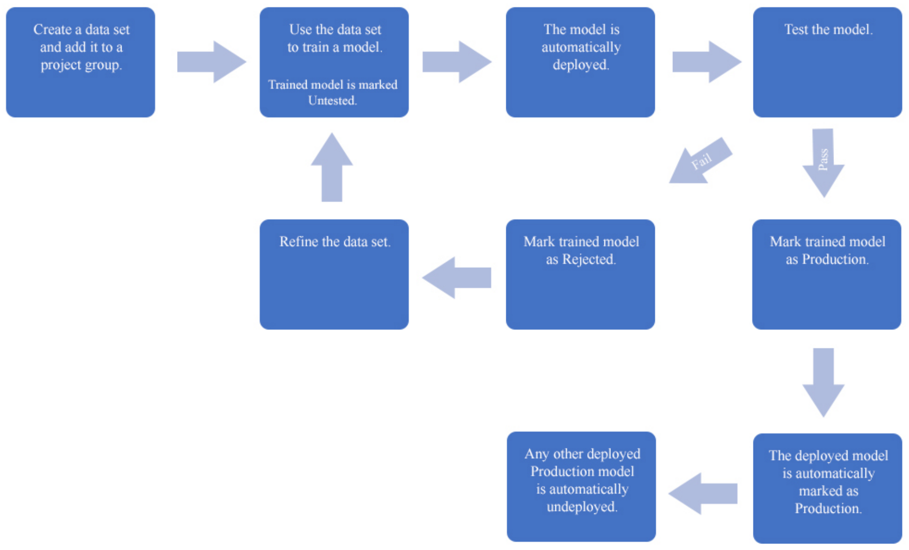

Create a data set and add it to a project group.
Use the data set to train a model.
Trained model is marked Untested.
The model is automatically deployed.
Test the model.
Fail
Pass
Refine the data set.
Mark trained model as Rejected.
Mark trained model as Production.
Any other deployed Production model is automatically undeployed.
The deployed model is automatically marked as Production.

Figure 10. Auto deploy in IBM Visual Insights

Enabling auto deploy

To enable auto-deploy, you need to set two pieces of information via the API. You can use CURL to set them.

```
curl -kXPUT -H "x-auth-token: insights-auth-token-value" https://insights-
server.your_company.com/visual-insights/projects/{project-UUID} -d '{"enforce_pwf": "true",
"auto_deploy":"true"}'
```

Note: Case is ignored for the `true` string, but the word must be `true`. For example, it will not work if you set the value as `yes`.

Chapter 12. Using IBM Visual Insights

These fictional examples give step-by-step instructions of how to use IBM Visual Insights to accomplish various tasks.

Example: Detecting objects in images

In this fictional scenario, you want to create a deep learning model to determine the make and model of a car caught by a traffic camera.

The image file used in this scenario is available for download here: Download car image.

To create a deep learning model, you will perform the following steps:

1. "Import images and create a data set" on page 111
2. "Labeling objects in an image" on page 111
3. "Training a model" on page 112
4. "Deploying a trained model" on page 113

Import images and create a data set

First, create a data set and add images to it.

1. Log in to IBM Visual Insights.
2. Click **Data Sets** in the navigation bar to open the **Data Sets** page. There are several ways to create a new data set. We will create a new, empty data set.
3. From the **Data set** page, click the icon and name the data set Traffic camera.
4. To add an image to the data set, click the Traffic image data set and click **Import file** or drag the image to the **+** area.

   Important: You cannot navigate away from the IBM Visual Insights page or refresh until the upload completes. You can navigate to different pages within IBM Visual Insights during the upload.

Labeling objects in an image

The next step is to label objects in the images. For object detection, you must have at minimum five labels for each object. We will create "Black car" and "White car" objects and will label at least five images as black cars, and at least five as white cars.

1. Select the images from your data set and click **Label Objects**.
2. Create new object labels for the data set by clicking **Add new** by the Objects list. Enter `Black car`, click **Add**, then enter `Black car`, then click **OK**.
3. Label the objects in the images:
   a. The first image is open in the data area, with thumbnails of all the selected image on the left side. Select the correct object label, for example, "Black car".
   b. Choose **Box** or **Polygon** from the bottom left, depending on the shape you want to draw around each object. Boxes are faster to label and train, but less accurate. Only Detectron models support polygons. However, if you use polygons to label your objects, then use this data set to train a model that does not support polygons, bounding boxes are defined and used. Draw the appropriate shape around the object.
   c. Select the thumbnail of the next image to open it. Add the appropriate labels, and continue through the rest of the images.

   - Do not label part of an object. For example, do not label a car that is only partially in the image.

- If an image has more than one object, you must label all objects. For example, if you have cars and motorcycles defined as objects for the data set, and there is an image with both cars and motorcycles in it, you must label the cars and the motorcycles. Otherwise, you decrease the accuracy of the model.
- Label each individual object. Do not label groups of objects. For example, if two cars are right next to each other, you must draw a label around each car.
- Draw the shape as close to the objects as possible. Do not leave blank space around the objects.
- You can draw shapes around objects that touch or overlap. For example, if one object is behind another object, you can label them both. However, it is recommended that you only label objects if the majority of the object is visible.
- Use the zoom buttons (+ and -) on the bottom right side of the editing panels to help draw more accurate shapes.

  Note: If you are zoomed in on an image and use the right arrow key to move all the way to the right edge, you might have to click the left arrow key several times to start panning in the other direction.
- Shapes cannot extend off the edge of the image.
- After defining a shape, you can copy and paste it elsewhere in the same image or in a different image by using standard keyboard shortcuts. After you paste it, you can refine the shape by moving, adding, or removing points in the outline.

  Note: To copy and paste a shape from one image to another, both images have to be available in the image carousel. From the data set, select all images that will share shapes, then click **Label objects**. All images will be listed in the image carousel in the left side of the Label objects window.
- **Labeling with polygons**
  - To delete a point from an outline, ctrl+click (or cmd+click).
  - To add a point to an outline, click the translucent white square between any two points on the outline.
  - To move a point on the outline, click it and drag.

4. After all objects are labeled in all of the image, click **Done editing**.

Training a model

With all the object labels that are identified in your data set, you can now train your deep learning model. To train a model, complete the following steps:

1. From the **Data set** page, click **Train**.
2. Fill out the fields on the **Train Data set** page, ensuring that you select **Object Detection**. We will choose **Accuracy (faster R-CNN)** for **Model selection**
3. Click **Train**.
4. (Optional - *Only supported when training for object detection.*) Stop the training process by clicking **Stop training** > **Keep Model** > **Continue**.

   You can wait for the entire training model process complete, but you can optionally stop the training process when the lines in the training graph start to flatten out, as shown in the figure below. This is because improvements in quality of training might plateau over time. Therefore, the fastest way to deploy a model and refine the data set is to stop the process before quality stops improving.

   Note: Use early stop with caution when training segmented object detection models (such as with Detectron), because larger iteration counts and training times have been demonstrated to improve accuracy even when the graph indicates the accuracy is plateauing. The precision of the label is can still being improved even when the accuracy of identifying the object location stopped improving.

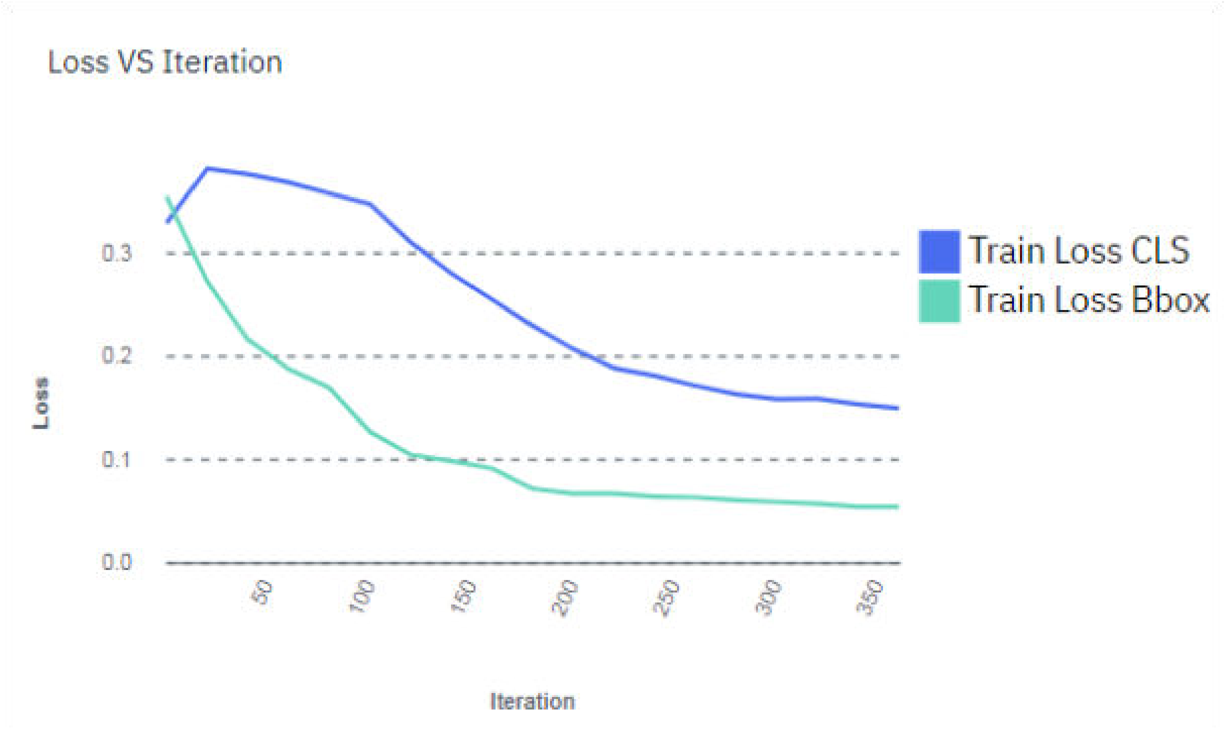


Figure 11. Model training graph

Important: If the training graph converges quickly and has 100% accuracy, the data set does not have enough information. The same is true if the accuracy of the training graph fails to rise or the errors in the graph do not decrease at the end of the training process. For example, a model with high accuracy might be able to discover all instances of different race cars, but might have trouble differentiating between specific race cars or those that have different colors. In this situation, add more images, video frames, or videos to the data set, label them, then try the training again.

Deploying a trained model

To deploy the trained model, complete the following steps. GPUs are used as follows:

- Each Tiny YOLO V2, YOLO V3, Detectron, Single Shot Detector (SSD), Structured segment network (SSN), or custom deployed model takes one GPU. The GPU group is listed as '-', which indicates that this model uses a full GPU and does not share the resource with any other deployed models.
- Multiple Faster R-CNN and GoogLeNet models are deployed to a single GPU. IBM Visual Insights uses packing to deploy the models. That is, the model is deployed to the GPU that has the most models deployed on it, if there is sufficient memory available on the GPU. The GPU group can be used to determine which deployed models share a GPU resource. To free up a GPU, *all* deployed models in a GPU group must be deleted (undeployed).

  Note: IBM Visual Insights leaves a 500MB buffer on the GPU.

1. Click **Models** from the menu.
2. Select the model you created in the previous section and click **Deploy**.
3. Specify a name for the model, and click **Deploy**. The **Deployed Models** page is displayed, and the model is deployed when the status column displays **Ready**.
4. Double-click the deployed model to get the API endpoint and test other videos or images against the model. For information about using the API see Vision Service API documentation.

Next steps

You can continue to refine the data set as much as you want. When you are satisfied with the data set, you can train the model again. This time when you train the model, you might want to train the model for a longer time to improve the overall accuracy of the model. The loss lines in the training model graph should converge to a stable flat line. The lower the loss lines are in the training graph the better. After the training completes, you can deploy the model again. You can double-click the deployed model to get the API endpoint and test other images or images against the model.

Example: Detecting objects in a video

In this fictional scenario, you want to create a deep learning model to monitor traffic on a busy road. You have a video that displays the traffic during the day. From this video, you want to know how many cars are on the busy road every day, and what are the peak times that have the most cars on the road.

The video file used in this scenario is available for download here: Download car video.

To create a deep learning model, you will perform the following steps:

1. Importing a video
2. Labeling objects in a video
3. Training a model
4. Deploying a model
5. Automatically label frames in a video

Import a video and create a data set

First, create a data set and add videos to it.

1. Log in to IBM Visual Insights.
2. Click **Data Sets** in the navigation bar to open the **Data Sets** page. There are several ways to create a new data set
3. From the **Data set** page, click the icon and name the data set Traffic Video.
4. To add a video to the data set, click the Traffic Video data set and click **Import file** or drag the video to the **+** area.

   Important: You cannot navigate away from the IBM Visual Insights page or refresh until the upload completes. You can navigate to different pages within IBM Visual Insights during the upload.

Labeling objects in a video

The next step is to label objects in the video. For object detection, you must have at minimum five labels for each object. We will create Car and Motorcycle objects and will label at least five frames in the video with cars and at least five frames with motorcycles.

1. Select the video from your data set and select **Label Objects**.
2. Capture frames by using one of these methods:
   - Click **Auto capture frames** and specify a value for **Capture Interval (Seconds)** that will result in at least five frames. We will select this option and specify 10 seconds.

     Note: Depending on the length and size of the video and the interval you specified to capture frames, the process to capture frames can take several minutes.
   - Click **Capture frame** to manually capture frames. If you use this option, you must capture a minimum of five frames from the video.
3. If you used **Auto capture frames**, verify that there are enough of each object type in the video frames. If not, follow these steps to add new frames to the existing data set.

   In this scenario, the motorcycle is only in a single automatically captured frame at 40 seconds. Therefore, we must capture at least four more frames with the motorcycle. The motorcycle comes into view at 36.72 seconds. To correctly capture the motorcycle in motion we will create extra frames at 37.79 seconds, 41.53 seconds, and 42.61 seconds.

a. Play the video. When the frame you want is displayed, click pause.

b. Click **Capture Frame**.

4. Create new object labels for the data set by clicking **Add new** by the Objects list. Enter `Car`, click **Add**, then enter `Motorcycle`, then click **OK**.

   Note: If you later want to delete the label, it must be done at the data set level. It cannot be done from an individual frame or image.

5. Label the objects in the frames:

   - Select the first frame in the carousel.
   - Select the correct object label, for example, "Car".
   - Choose **Box** or **Polygon** from the bottom left, depending on the shape you want to draw around each object. Boxes are faster to label and train, but less accurate. Only Detectron models support polygons. However, if you use polygons to label your objects, then use this data set to train a model that does not support polygons, bounding boxes are defined and used. Draw the appropriate shape around the object.

     Note: When **Box** or **Polygon** is selected, you have to hold down the Alt key for non-drawing interactions in the image. This includes trying to select, move, or edit previously drawn shapes in the image, and panning the image by using the mouse. To return to the normal mouse interactions, deselect the **Box** or **Polygon** button.

   Review the following tips about identifying and drawing objects in video frames and images:

   - Do not label part of an object. For example, do not label a car that is only partially in the frame.
   - If an image has more than one object, you must label all objects. For example, if you have cars and motorcycles defined as objects for the data set, and there is an image with both cars and motorcycles in it, you must label the cars and the motorcycles. Otherwise, you decrease the accuracy of the model.
   - Label each individual object. Do not label groups of objects. For example, if two cars are right next to each other, you must draw a label around each car.
   - Draw the shape as close to the objects as possible. Do not leave blank space around the objects.
   - You can draw shapes around objects that touch or overlap. For example, if one object is behind another object, you can label them both. However, it is recommended that you only label objects if the majority of the object is visible.
   - Use the zoom buttons (+ and -) on the bottom right side of the editing panels to help draw more accurate shapes.

     Note: If you are zoomed in on an image and use the right arrow key to move all the way to the right edge, you might have to click the left arrow key several times to start panning in the other direction.
   - Shapes cannot extend off the edge of the frame.
   - After defining a shape, you can copy and paste it elsewhere in the same image or in a different image by using standard keyboard shortcuts. After pasting the shape, it can be selected and dragged to the desired location in the image. The shape can also be edited to add or remove points in the outline.

     Note: To copy and paste a shape from one image to another, both images have to be available in the image carousel. From the data set, select all images that will share shapes, then click **Label objects**. All images will be listed in the image carousel in the left side of the Label objects window.
   - After a shape has been defined, you will no longer see the points on the outline. To edit a defined box, exit drawing mode, then edit the points as necessary. To exit drawing mode, do one of the following:
     – Click the object name on the right side of the window.
     – Alt+click (option +click) inside the defined box.

After moving a defined point, drawing mode is automatically enabled again.

- The video object preview does not support non-ascii labels. This is a limitation of the module that generates the displayed label from the label name. The result of the conversion of non-ascii labels will be a label that is all question marks: "?????".
- **Labeling with polygons**
  - After a shape has been defined, you will no longer see the points on the outline. To edit a defined shape, exit drawing mode, then edit the points as necessary. To exit drawing mode, do one of the following:
    - Click the object name on the right side of the window.
    - Click inside the defined shape.

    When you are done editing the shape, click outside the shape to enter drawing mode again.
  - To delete a point from an outline, ctrl+click (or cmd+click).
  - To add a point to an outline, click the translucent white square between any two points on the outline.
  - To move a point on the outline, click it and drag.

The following figure displays the captured video frame at 41.53 seconds with object labels of **Car** and **Motorcycle**. Figure 1 also displays a box around the five frames (four of the frames were added manually) in the carousel that required object labels for the motorcycle that is in each frame.

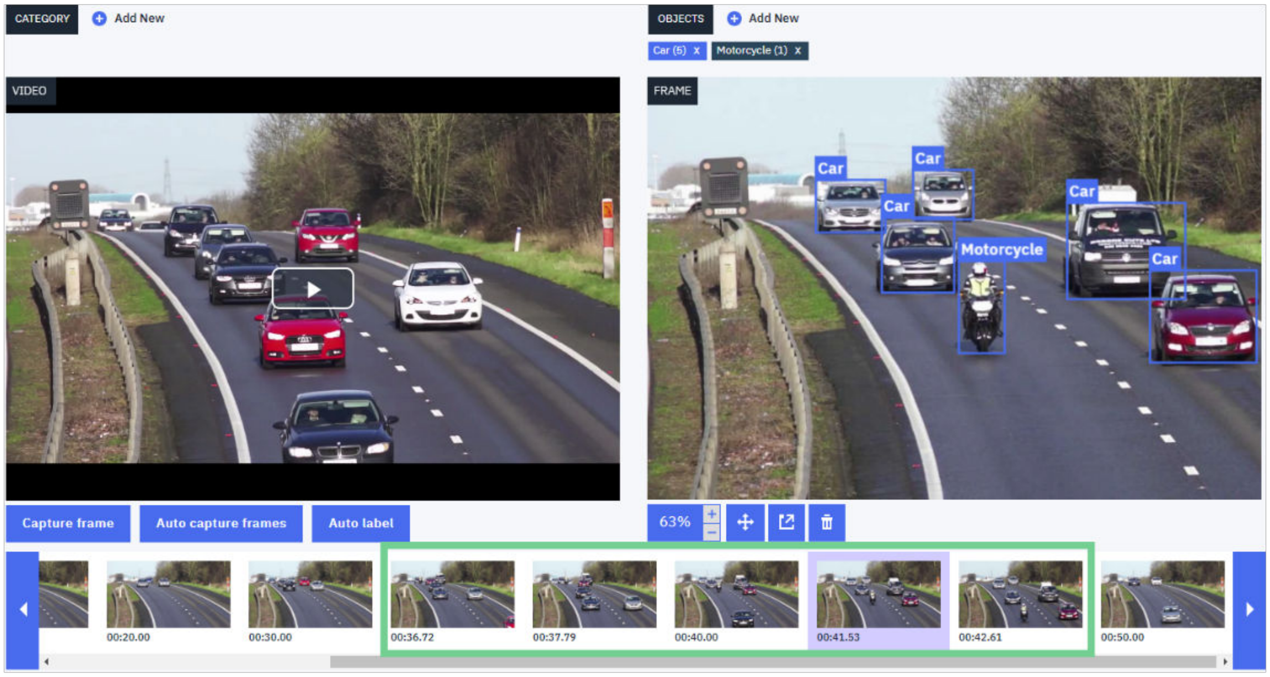


Figure 12. Labeling objects in IBM Visual Insights

Training a model

With all the object labels that are identified in your data set, you can now train your deep learning model. To train a model, complete the following steps:

1. From the **Data set** page, click **Train**.
2. Fill out the fields on the **Train Data set** page, ensuring that you select **Object Detection**. We will choose **Accuracy (faster R-CNN)** for **Model selection**
3. Click **Train**.
4. (Optional - *Only supported when training for object detection.*) Stop the training process by clicking **Stop training** > **Keep Model** > **Continue**.

You can wait for the entire training model process complete, but you can optionally stop the training process when the lines in the training graph start to flatten out, as shown in the figure below. This is because improvements in quality of training might plateau over time. Therefore, the fastest way to deploy a model and refine the data set is to stop the process before quality stops improving.

Note: Use early stop with caution when training segmented object detection models (such as with Detectron), because larger iteration counts and training times have been demonstrated to improve accuracy even when the graph indicates the accuracy is plateauing. The precision of the label is can still being improved even when the accuracy of identifying the object location stopped improving.

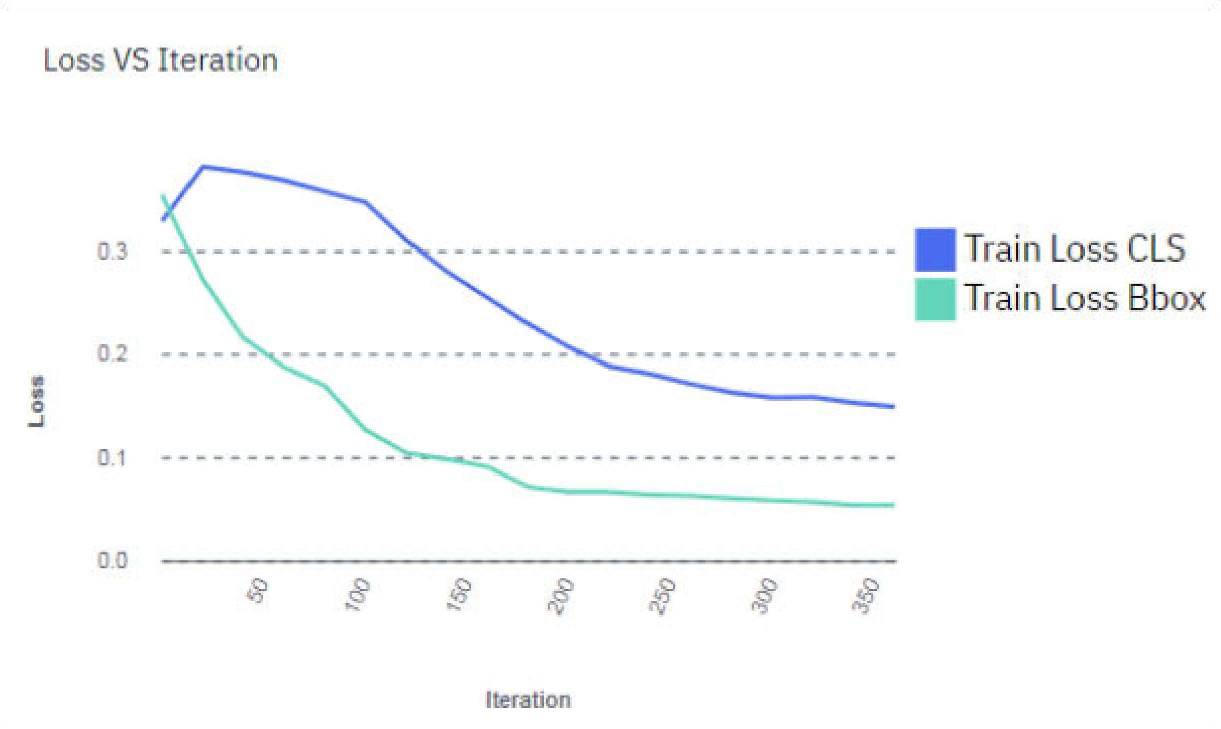


Figure 13. Model training graph

Important: If the training graph converges quickly and has 100% accuracy, the data set does not have enough information. The same is true if the accuracy of the training graph fails to rise or the errors in the graph do not decrease at the end of the training process. For example, a model with high accuracy might be able to discover all instances of different race cars, but might have trouble differentiating between specific race cars or those that have different colors. In this situation, add more images, video frames, or videos to the data set, label them, then try the training again.

Deploying a trained model

To deploy the trained model, complete the following steps. GPUs are used as follows:

- Each Tiny YOLO V2, YOLO V3, Detectron, Single Shot Detector (SSD), Structured segment network (SSN), or custom deployed model takes one GPU. The GPU group is listed as '-', which indicates that this model uses a full GPU and does not share the resource with any other deployed models.
- Multiple Faster R-CNN and GoogLeNet models are deployed to a single GPU. IBM Visual Insights uses packing to deploy the models. That is, the model is deployed to the GPU that has the most models deployed on it, if there is sufficient memory available on the GPU. The GPU group can be used to determine which deployed models share a GPU resource. To free up a GPU, *all* deployed models in a GPU group must be deleted (undeployed).

  Note: IBM Visual Insights leaves a 500MB buffer on the GPU.

1. Click **Models** from the menu.
2. Select the model you created in the previous section and click **Deploy**.
3. Specify a name for the model, and click **Deploy**. The **Deployed Models** page is displayed, and the model is deployed when the status column displays **Ready**.
4. Double-click the deployed model to get the API endpoint and test other videos or images against the model. For information about using the API see Vision Service API documentation.

Automatically label frames in a video

You can use the auto label function to automatically identify objects in the frames of a video after a model has been deployed.

In this scenario, you have only nine frames. To improve the accuracy for your deep learning model, you can add more frames to the data set. Remember, you can rapidly iterate by stopping the training on a model and checking the results of the model against a test data set. You can also use the model to auto label more objects in your data set. This process improves the overall accuracy of your final model.

To use the auto label function, complete the following steps:

Note: Any frames that were previously captured by using auto capture and were not manually labeled are deleted before auto labeling. This helps avoid labeling duplicate frames. Manually captured frames are not deleted.

1. Click **Data sets** from the menu, and select the data set that you used to create the previously trained model.
2. Select the video in the data set that had nine frames, and click **Label Objects**.
3. Click **Auto label**.
4. Specify how often you want to capture frames and automatically label the frames. Select the name of the trained model that you deployed in step 3, and click **Auto label**. In this scenario, you previously captured frames every 10 seconds. To improve the accuracy of the deep learning model by capturing and labeling more frames, you can specify 6 seconds.
5. After the auto label process completes, the new frames are added to the carousel. Click the new frames and verify that the objects have the correct labels. The object labels that were automatically added are green and the object labels you manually added are in blue. In this scenario, the carousel now has 17 frames.

Next steps

You can manipulate (move or resize) the labels that were automatically generated. You can also save or reject individual labels, or you can reject them all by selecting **Clear all**. Saving or manipulating a label converts it to a manually added label. Rejecting a label deletes it. If you run **Auto label** again, any images or frames that now have manually added labels are skipped.

You can continue to refine the data set as much as you want. When you are satisfied with the data set, you can retrain the model by completing steps 1 - 3. This time when you retrain the model, you might want to train the model for a longer time to improve the overall accuracy of the model. The loss lines in the training model graph should converge to a stable flat line. The lower the loss lines are in the training graph the better. After the training completes, you can redeploy the model by completing steps 1 - 3. You can double-click the deployed model to get the API endpoint and test other videos or images against the model.

Related concepts

Working with the user interface
The IBM Visual Insights user interface is made up of these basic parts: the navigation bar, the side bar, the action bar, the data area, and the notification center.

Understanding metrics

IBM Visual Insights provides several metrics to help you measure how effectively your model has been trained.

Related information

Vision Service API documentation

Example: Classifying images

The goal of this example is to train a model to classify images of birds into groups based on their physiological similarities. Once the model is trained with a known dataset, users can upload new data sets to auto classify the birds into their respective categories. We will prepare the data, create a data set, train the model, and test the model.

1. Prepare the data.

   Data preparation consists of gathering two types of data, *training data* and *test data*. Training data is used to teach the neural network features of the object so that it can build the classification model. Test data is used to validate the accuracy of the trained model. Our data will include pictures of different types of birds.

   Notes:

   - Different images should be used for training data and test data.
   - Images must be in one of these formats:
     - JPEG
     - PNG
     - DICOM
2. Create a data set. Log in to the IBM Visual Insights user interface, click **Data Sets** in the navigation bar, click **Create new data set** and name the data set Birds.
3. Populate the data set.
   a) In the left pane, expand Categories, click **Add category**. Add the "Acridotheres" category and click **Add**, then click **OK**.
   b) Upload images of Acridotheres by dragging the images onto the **Drag files here** area.
   c) In the left pane, click "Uncategorized". The newly uploaded files are shown.
   d) Click the **Select** box to select the images you just uploaded, then click **Assign category** and choose "Acridotheres".
   e) Repeat the above steps for the other categories.

   Note: To train a model for classification, the data set must meet these requirements:

   - There must be at least two categories.
   - Each category must have at least five images.
4. From the **Data set** page, click **Train**. In the Train data set window, choose **Image classification** and keep the default values for all other settings, then click **Train**.
5. After training is complete, click **Deploy model**.

   Important: Each deployed model uses one GPU.
6. Test the trained model. On the Deployed models page, open the model you just deployed. Scroll down to the Test Images area and input a test image.

   The test result displays the uploaded picture with the resultant heat map overlayed, and gives the classification and the confidence of the classification. Multiple classes are returned with the decreasing levels of confidence for the different classes. The heat map is for the highest confidence classification and can help you determine whether the model has correctly learned the features of this classification. To hide classes with a lower confidence level, use the **Confidence threshold** slider.

The red area of the heat map corresponds to the areas of the picture that are of highest relevance. Use the slider to change the opacity of the heat map. Because the heat map is a square, the test image is compressed into a square. This might cause the image to look distorted, but it will reliably show you the areas that the algorithm identified as relevant.

If you are not satisfied with the result, use the information in this topic to refine the model: "Refining a model" on page 95. Otherwise, the model is ready to be used in production.

Related concepts

Working with the user interface
The IBM Visual Insights user interface is made up of these basic parts: the navigation bar, the side bar, the action bar, the data area, and the notification center.

Understanding metrics
IBM Visual Insights provides several metrics to help you measure how effectively your model has been trained.

Related information

Vision Service API documentation

Example: Detecting segmented objects in images

In this fictional scenario, you want to create a deep learning model to detect segmented objects, such as a bicycle with a rider standing in front of it. To accomplish this, you will import a COCO data set and train a Detectron model.

To create a deep learning model to detect segmented objects, you will perform the following steps:

1. "Import images and create a data set" on page 120
2. "Training a model" on page 120
3. "Deploying a trained model" on page 121

Import images and create a data set

First, create a data set and add images to it.

1. Log in to IBM Visual Insights.
2. Click **Data Sets** in the navigation bar to open the Data Sets page. Create a new data set and give it a name.
3. From the COCO download site, click **2017 Train images** to download the `train2017.zip` file.
4. Create a new file that contains just the images that you want from `train2017` by running a command such as the following:

   ```
   ls train2017 | grep jpg | head -20000 >/tmp/flist
   ```

5. From the COCO download site, click **2017 Train/Val annotations** to download the `annotations_trainval2017.zip` file.
6. From `annotations_trainval2017.zip`, extract the `annotations/instances_train2017.json` file, which is the COCO annotation file for object detection.
7. Add `annotations/instances_train2017.json` to the file of images that you created in step "4" on page 120 and compress them into a zip file.
8. From your new data set, click **Import file** and select the zip file you just created.

   Important: You cannot navigate away from the IBM Visual Insights page or refresh until the upload completes. You can navigate to different pages within IBM Visual Insights during the upload.

Training a model

Because the images are already labeled, you can now train your deep learning model. Training a model uses one GPU:

1. From the **Data set** page, click **Train**.
2. Fill out the fields on the **Train Data set** page. Select **Object Detection** and **Segmentation (Detectron)**.
3. Click **Train**.
4. (Optional - *Only supported when training for object detection.*) Stop the training process by clicking **Stop training** > **Keep Model** > **Continue**.

   You can wait for the entire training model process complete, but you can optionally stop the training process when the lines in the training graph start to flatten out, as shown in the figure below. This is because improvements in quality of training might plateau over time. Therefore, the fastest way to deploy a model and refine the data set is to stop the process before quality stops improving.

   Note: Use early stop with caution when training segmented object detection models (such as with Detectron), because larger iteration counts and training times have been demonstrated to improve accuracy even when the graph indicates the accuracy is plateauing. The precision of the label is can still being improved even when the accuracy of identifying the object location stopped improving.

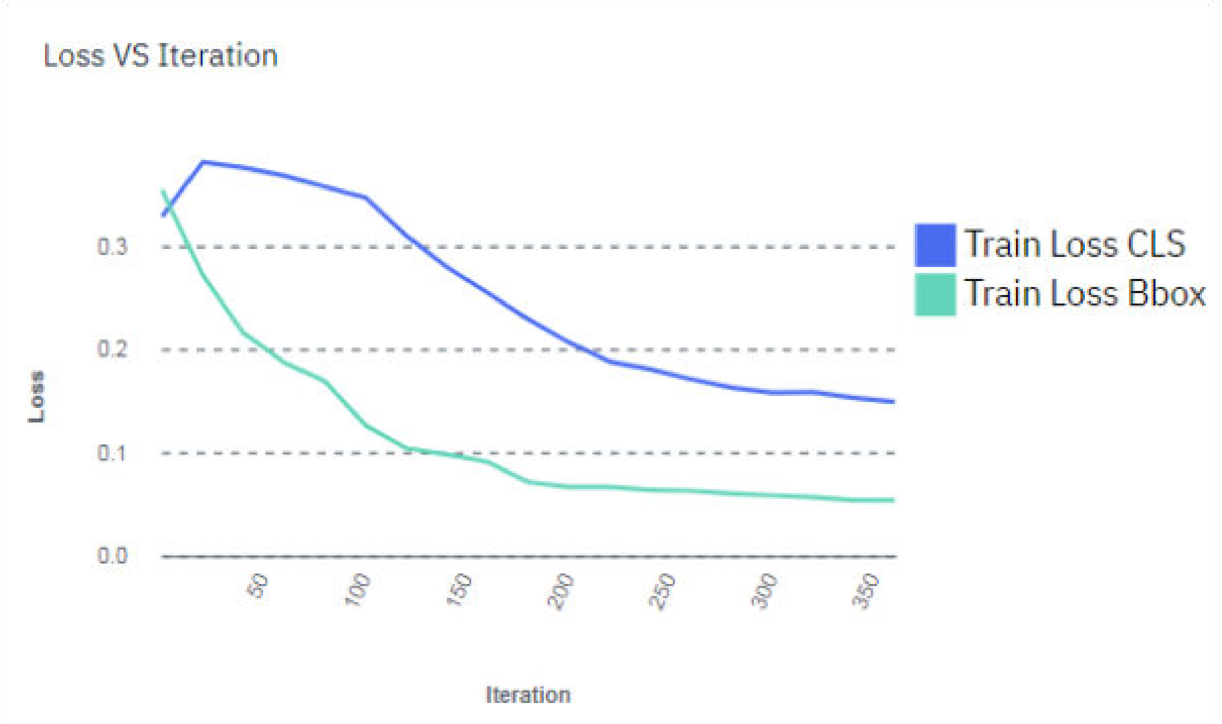


Figure 14. Model training graph

Important: If the training graph converges quickly and has 100% accuracy, the data set does not have enough information. The same is true if the accuracy of the training graph fails to rise or the errors in the graph do not decrease at the end of the training process. For example, a model with high accuracy might be able to discover all instances of different race cars, but might have trouble differentiating between specific race cars or those that have different colors. In this situation, add more images, video frames, or videos to the data set, label them, then try the training again.

Deploying a trained model

To deploy the trained model, follow these steps. Each deployed Detectron model takes one GPU:

1. Click **Models** from the menu.
2. Select the model you created in the previous section and click **Deploy**.
3. Specify a name for the model, and click **Deploy**. The **Deployed Models** page is displayed, and the model is deployed when the status column displays **Ready**.

4. Double-click the deployed model to get the API endpoint and test other images against the model. For information about using the API see Vision Service API documentation.

Next steps

You can continue to refine the data set as much as you want. When you are satisfied with the data set, you can train the model again. This time when you train the model, you might want to train the model for a longer time to improve the overall accuracy of the model. The loss lines in the training model graph should converge to a stable flat line. The lower the loss lines are in the training graph the better. After the training completes, you can deploy the model again. You can double-click the deployed model to get the API endpoint and test other images or images against the model.

Example: Detecting actions in a video

In this fictional scenario, you want to create a deep learning model to determine when a cash register is being opened in a video.

We will assume we have videos named Cashier 1 - Cashier 5, which we will add to a data set named "Open cash register" . To create a deep learning model, you will perform the following steps:

1. Preparing videos for import
2. "Import videos and create a data set" on page 122
3. "Labeling actions in a video" on page 123
4. "Training the model" on page 123
5. "Deploying a model" on page 124

Deploying a model

To deploy the trained model, complete the following steps.

Note: Each deployed action detection (SSD) model takes one GPU.

1. Click **Models** from the menu.
2. Select the model you created in the previous section and click **Deploy**.
3. Specify a name for the model, and click **Deploy**. The **Deployed Models** page is displayed, and the model is deployed when the status column displays **Ready**.
4. Double-click the deployed model to get the API endpoint and test other videos or images against the model. For information about using the API see Vision Service API documentation.

Preparing videos for import

Before importing videos for use with action detection models, it is recommended that you prepare them as follows:

- Cut out long periods of background video without any actions.
- Transcode videos with FPS greater than 30 down to 30 FPS
- Crop the video so that actions should take up a large part of the frame.

Import videos and create a data set

First, create a data set and add videos to it.

1. Log in to IBM Visual Insights.
2. Click **Data Sets** in the navigation bar to open the **Data Sets** page. There are several ways to create a new data set. We will create a new, empty data set.
3. From the **Data set** page, click the icon and name the data set "Open cash register".
4. To add a video to the data set, click the Open cash register data set and click **Import file** or drag the video to the **+** area. We will assume we have added the Cashier 1 - Cashier 5 videos.

Important: You cannot navigate away from the IBM Visual Insights page or refresh until the upload completes. You can navigate to different pages within IBM Visual Insights during the upload.

Labeling actions in a video

The next step is to label actions in the videos. We will create the "Open" action and will label it in several videos.

There is no minimum number of labels required, but more data will typically give better results.

- Each action label must be in the range of 5 - 1000 frames. The required length of time depends on the video's FPS. For 30 FPS, each action label must be in the range of .166 - 33.367 seconds.

  The label's duration is checked based on the frames per second and the selected start and end times. For example, if an action label is marked with a start time of 12.295 seconds and end time of 12.296 seconds for a 30 FPS video, you will get an error message like the following: "Label duration of '100' milliseconds does not meet required duration between '166.83333' milliseconds and '33366.668' milliseconds".
- At least 10 instances of each action tag in the data set are recommended.
- The longer the total labeled action time is, the better your results will be.
- If multiple types of actions are labeled in a data set, the total amount of time for each action type should be similar. For example, if you tag 20 instances of the action "jump" in a data set with a total time of 27 seconds, and you tag 10 instances of the action "drive" in the data set with a total time of 53 seconds, the model will be biased toward the "drive" action.

  The total time for each action type is shown in the left pane in the Actions section.

Follow these steps to label actions. For more information, see "Labeling actions" on page 77:

1. Open the "Open cash register" data set.
2. Create the "Open" action tag in the data set by expanding **Actions** on the left and clicking **Add action**.
3. Select the appropriate video and click **Label actions**. The existing tags are listed on the right.
4. Find the start of an action by using the video control bar:
   - Use the slider or play button to get near the part of the video you want.
   - Set the playback rate (1x, .5x, and so on) to control how fast the video plays.
   - Use the +1 and -1 buttons to move forward or backward one frame.
5. Find the end of the action, then click **+** in **End time**.
6. Select "Open" for the action name, then click **Save action**.
7. Continue adding actions to videos until you are done.

Training the model

With all the action labels identified in your data set, you can now train your deep learning model by following these steps:

1. From the **Data set** page, click **Train**.
2. Fill out the fields on the **Train Data set** page, ensuring that you select **Action detection**. Leave the default values for all other options.
3. Click **Train**.
4. (Optional - *Only supported when training for object detection.*) Stop the training process by clicking **Stop training** > **Keep Model** > **Continue**.You can wait for the entire training model process complete, but you can optionally stop the training process when the lines in the training graph start to flatten out, as shown in the figure below. This is because improvements in quality of training might plateau over time. Therefore, the fastest way to deploy a model and refine the data set is to stop the process before quality stops improving.

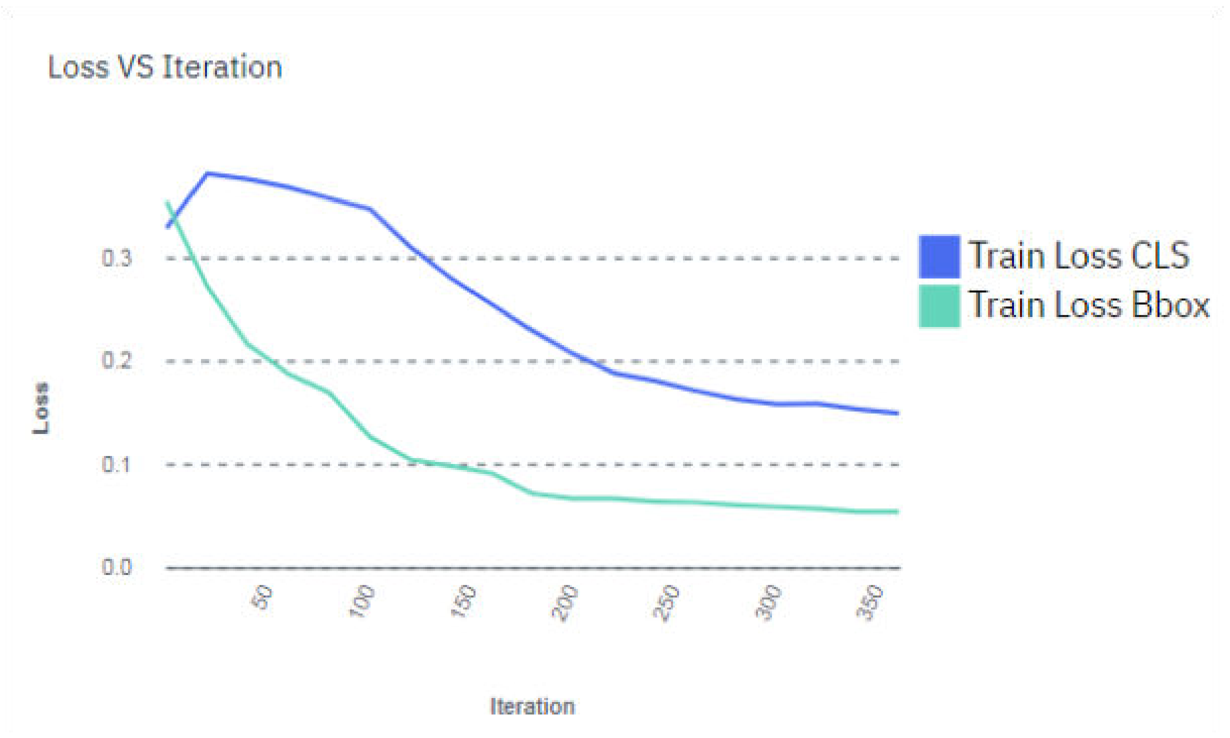


Figure 15. Model training graph

Important: If the training graph converges quickly and has 100% accuracy, the data set does not have enough information. The same is true if the accuracy of the training graph fails to rise or the errors in the graph do not decrease at the end of the training process. For example, a model with high accuracy might be able to discover all instances of different race cars, but might have trouble differentiating between specific race cars or those that have different colors. In this situation, add more images, video frames, or videos to the data set, label them, then try the training again.

Deploying a model

To deploy the trained model, complete the following steps.

Note: Each deployed action detection (SSD) model takes one GPU.

1. Click **Models** from the menu.
2. Select the model you created in the previous section and click **Deploy**.
3. Specify a name for the model, and click **Deploy**. The **Deployed Models** page is displayed, and the model is deployed when the status column displays **Ready**.
4. Double-click the deployed model to get the API endpoint and test other videos or images against the model. For information about using the API see Vision Service API documentation.

Example: Adding preprocessing and post-processing

In this fictional scenario, you want to create a model to detect license plates, then add post-processing that crops everything in the image outside of the license plate.

We will assume that we have a post-processing script that crops the area outside the identified license plates in the image, as well as a model trained to identify license plates. To create a deep learning model and add post-processing, perform the following steps:

1. "Import the post-processing script" on page 125
2. "Train the model" on page 125
3. "Deploy the model" on page 125
4. "Perform an inference and review results" on page 125

Import the post-processing script

The post-processing script is a .zip file created by using the `custom.py` template. See "Preprocessing and post-processing" on page 92 for details. Navigate to the **Custom assets** page and upload the zip file that contains `custom.py`. For Asset type, select **Custom inference script**. We will name our zip file `crop.zip`.

Train the model

Preprocessing and post-processing can be done on any type of model except action detection. We will be using an object detection model called `license_plates`. For instructions to train a model, see "Training a model" on page 78.

Deploy the model

Deploy the model, specifying the post-processing script:

1. Navigate to the model you want to deploy and click **Deploy model**. In the upper right corner, select **Advanced deployment**.
2. For **Custom inference script**, select the inference script that you want to use, specify what you want done with the inference results, and click **Deploy**. For this example, we will specify to save the inference results to the `cropped_license_plates` data set.

Perform an inference and review results

Use the deployed model API endpoint to perform an inference. After the inference, the `crop` script is called, and the resulting image, with the license plates labeled, is saved to the `cropped_license_plates` data set. When you view the data set in the table view, these images are labeled "Inference result" in the **Created** column.

Integrating IBM Visual Insights Training and Inference with Maximo Asset Monitor

Maximo Asset Monitor. Maximo Asset Monitor is a cloud service that enables users to remotely monitor devices at the edge. For example, it can help you notice manufacturing irregularities and take action. This integration allows IBM Visual Insights to send inference results to the Maximo Asset Monitor cloud platform for further analysis.

IBM Visual Insights Training and Inference must be installed and running before following these steps. For details about working with Maximo Asset Monitor, refer to the Maximo Asset Monitor Knowledge Center.

1. Verify that IBM Visual Insights can connect to the internet.
2. Verify that all files that are in the bundle (except the custom_py directory) are on IBM Visual Insights and ensure that you have the IBM Watson IoT Platform Organization ID available. If you do not know the ID, log in to the Watson IoT™ Platform . The ID is below your user name.
3. In IBM Visual Insights, set up users for Maximo Asset Monitor. It is recommend that you do not use the admin user. Follow these guidelines when creating your user name and password. See "Managing users" on page 145 for instructions.
   - The credentials need to be valid for retrieving the token from Maximo Asset Monitor.
   - The same user name and password must be set in `custom.py` and during Maximo Asset Monitor.
   - You cannot change these credentials later.
4. Create a project in IBM Visual Insights and add a data set and model to the project.
5. Configure the Watson IoT Platform instance. Use the Watson IoT Platform Service dashboard to create a new API key and authentication token pair:
   a) In the Service dashboard, navigate to **Apps** > **Browse API Keys**.
   b) Click **Generate API Key**.

c) Add a comment to identify the API key in the dashboard, for example: Key for enabling Edge support.

d) In the Permissions modal, set Role to Operations Application.

e) Click **Generate Key**.

Important: You must record the API key and token pair. You will need these to invoke the script `enableEdge.sh` later. The authentication tokens are **non-recoverable**.

Examples:

- API key (test_api_key): `a-9ixbbq-a84ps90Ajs`
- API token (test_api_token): `MP$08VKz!8rXwnR-Q*`

f) Click **Close**.

6. Enable integration functionality on the platform by running the `enableEdge.sh` script on the IBM Visual Insights server. The values for *apiKey* and *apiToken* were recorded in the previous step:

```
bash enableEdge.sh -o <orgID> -k '<apiKey>' -t '<apiToken>'
```

Example:

```

bash enableEdge.sh -o k5nf9d -k 'a-9ixbbq-a84ps90Ajs' -t 'MP$08VKz!8rXwnR-Q*'
```

Example output:

```

Enable Edge in Watson IoT Platform organization for Edge Solution


WIoTP Organization ID : k5nf9d
WIoTP API Key         : a-9ixbbq-a84ps90Ajs
WIoTP API Token       : MP$08VKz!8rXwnR-Q*
Edge Solution         : IoTCore
WIoTP API Endpoint    : k5nf9d.internetofthings.ibmcloud.com

Edge is enabled for the specified or default (IoTCore) solution
```

7. Use the Watson IoT Platform Service dashboard to configure the Gateway Type and Device ID for connecting the server to the platform instance. The edge solution will run on all the edge gateways of this type. Follow these steps to create a gateway device, noting the Device type, Device ID, and the token associated with it.

a) In the Overview dashboard, select Devices from the menu pane, then select **Device Types**.

b) From Device Type page, click **Add Device Type**, then fill out these fields:

- Select **Gateway** and enter the gateway type name.
- Add a description.
- Enable **Edge Solution**.
- From the drop down list, select **Architecture**, then click **Next**.

c) On the Device Information modal, enter the gateway type attributes, then click **Next**.

d) On the Edge Solutions modal, click **Add Edge Solution**.

e) On the Add Edge Solution window, hover over the solution to be configured on Edge devices, click **Select Solution**, then click **Done**.

f) Click **Finish**.

8. Register the edge device.

a) In the Overview dashboard, navigate to **Devices** > **Add Device**.

b) In the Identity model, select **Device Type** and select the gateway type registered in step "7" on page 126.

c) Enter the device ID and click **Next**.

d) In the Device Information modal, enter the device attributes and click **Next**.

e) In the Permissions, specify the appropriate role and click **Next**.

f) In the Security modal, enter the authentication token and click **Next**.

g) Verify the information in the Summary page, then click **Finish**.

h) In the Device details page, record the device credentials.

9. Ensure that the ports required by Maximo Asset Monitor are available.

   The following ports are required:

   - Ports used by IoT Core containers: 1883, 8883
   - Port used by Event Creation Service container: 9088
   - The containers will be in a docker network called: wiot-core-net

   a) Log on to IBM Visual Insights and run the following command for each required port. If the command returns "1", the port is available.

   ```
   sudo nc localhost <port> < /dev/null; echo $?
   ```

   Example:

   ```
   $ sudo nc localhost 9088 < /dev/null;echo$?
   ```

   b) If any ports are not available, contact your system administrator.

10. In a terminal session, navigate to the directory where the Maximo Asset Monitor integration bundle files are located and run `ls` to verify that the files from the bundle are available.

11. Log in as root and run the setup script `general_setup.sh`, which uses the following variables and parameters:

   -h, --h
   Display the usage message and exit.

   -un, --uninstall
   Uninstall Integration containers and images.

   -o, --orgid
   Watson IoT Platform organization ID.

   -dt, --devicetype
   Device type from Watson IoT Platform .

   -di, --deviceid
   Device ID from Watson IoT Platform .

   -dt, --devicetoken
   Device token from Watson IoT Platform .

   -u, --username
   User name that will be used in the `custom.py` file.

   -p, --password
   Password that will be used in the `custom.py` file.

   a) Run the `general_setup.sh` script:

   ```
   general_setup.sh -o <orgid> -dt <device_type> -di <device-id> -t <device-token> -u
   <username> -p <password>
   ```

   Example:

   ```
   general_setup.sh -o k5nf9d -dt Hardware -di hardware1 -t testPassw0rd -u admin -p
   masterpassword
   ```

   b) Review the output. Find the line "Test connection to Event Creation Service" and verify that no errors are listed.

If the test was successful, you will see `{"status": "success"}` in the terminal. The following container versions should be listed:

edge-broker: latest
edge-connector: latest
event-service: 1.0.1

12. Modify the provided `custom.py` script:
    - Change the base URL for an API to point to Maximo Asset Monitor. For example, if IBM Visual Insights is installed at `https://server.ibm.com/visual-insights` then the API is `https://server.ibm.com/visual-insights/api`.
    - Add the data set's UUID. To determine the UUID, navigate to the data set's details page in IBM Visual Insights. The UUID is all the text after the final forward slash (`/`) in the URL.
    - Insert the appropriate user ID and password

    Example custom.py script:

```
#
# These are the system credentials that need to be updated
# InferenceSystemURL: The URL to your IBM Visual Insights instance
# InferenceResultsDatasetID: The ID of the data set where you want to store your inferenced
images
#username: User ID for making the API call to IBM Visual Insights to persist image and
inference results
#password: Password for making API calls to IBM Visual Insights to persist image and
inference results
#
# TODO fill this out:
InferenceSystemURL = "https://my_instance_url"
# TODO fill this out:
InferenceResultsDatasetID = "data_set_id"


# This will be exposed in the code, please don't use an administrator user name
username = "maximo"  # TODO fill this out
# This will be exposed in the code, please don't use an administrator password
password = "passw0rd"  # TODO fill this out


# If you want to save the images in a data set, set this variable to True. Otherwise, choose
False.
SaveResults = True
# If you want to send the data to the Maximo Asset Monitoring dashboard, set this variable to
True.  Otherwise, choose False
SendToMAM = True
```

13. Create a file named `requirements.txt` and list any packages (and their versions) that are required in addition to the packages listed in `custom.py`. Any packages listed in this file will be installed during deploy.
14. Compress `custom.py` and `requirements.txt` into one zip file.
15. In IBM Visual Insights, navigate to the Custom Assets page, drag the zipped configuration file to the "Import custom asset .zip file" area, and choose **Custom inference script**.
16. Deploy a model from the project with the Maximo custom asset.
    a) From the Projects page, open your project.
    b) Open the model to deploy and click **Deploy model**. On the Deploy model window, from the **Custom inference script** drop down, select the configuration file, then click **Deploy**.

Integrating with IBM Visual Inspector

Visual Inspector is a native iOS/iPadOS mobile app that brings the capabilities of IBM Visual Insights to the edge and rapidly enables visual inspections on mounted or handheld devices. Visual Inspector uses the models trained on IBM Visual Insights and performs inferencing using the integrated camera on an iOS/iPadOS device. The app can run models remotely or can use Core ML models that are exported from IBM Visual Insights, which enables local inferencing on-device without requiring network connectivity.

Overview of Visual Inspector

Visual Inspector has the following capabilities:

- Perform local and remote inferencing on object detection and image classification models trained on IBM Visual Insights.
- Take photos and upload to IBM Visual Insights for model training and refinement
- Monitor inspection performance for to each device and its location via an integrated reporting dashboard
- Provide remote management and configuration of Visual Inspector instances running on remote devices

It is important that you follow the guidance in these topics carefully. Otherwise, the product might not work properly.

Concepts

The following terminology is used in Visual Inspector.

Collect mode
Using the app to take pictures that are uploaded to a data set to be used to train or refine a model.

Dashboard
A dashboard displays images from a single IBM Visual Insights data set within a project. Additionally, it displays Pass / Fail metrics for the displayed images.

Fixed (mounted) device
A device that is mounted in a single position, such as when monitoring a production line. Visual Inspector is used with only infrequent human intervention and can also be managed remotely by other Visual Inspector instances.

Handheld device
A device that is not mounted but is held, such as when taking photos of a damaged roof. Visual Inspector is used manually.

Inspect mode
Using the app to take pictures that are sent to a trained model for labeling and deep learning.

Inspection
An inspection is a group of settings that define specific IBM Visual Insights elements to interact with. It ties together one IBM Visual Insights trained model and one data set that exist in the same IBM Visual Insights *project* (also called project group). The data set is used as the target of uploads when the photos are taken on the app. The model is used when the app is in Inspect mode. The inspection also specifies a trigger string that external systems can use to identify the inspection when sending messages to capture photos.

Managed device
Managed devices have apps installed using MDM (managed apps). Managed apps can contain preconfigured settings that are controlled by the management party. The MDM server can remove managed apps and their associated data on demand, or specify whether the apps should be removed when the MDM profile is removed. Additionally, the MDM server can prevent managed app data from being backed up to iTunes and iCloud.

Single App Mode
Single App Mode, sometimes called "Single App Lock", is a feature for supervised devices that restricts the device to running only one app. While this mode is enabled, the selected app will stay in the foreground.

Supervised device
Supervision gives an organization more control over their iOS and iPadOS, allowing restrictions such as disabling AirDrop or Apple Music, or placing the device in Single App Mode.

Related concepts

Creating and working with project groups
Project groups allow you to group trained models with the data sets that were used for training. This grouping is optional but is a useful way to organize related data sets. For example, project groups would

be useful with a workflow that clones data sets as you refine labels and work toward a more accurate model. Project groups can be used with a production work flow strategy and automatic model deployment for even more functionality.

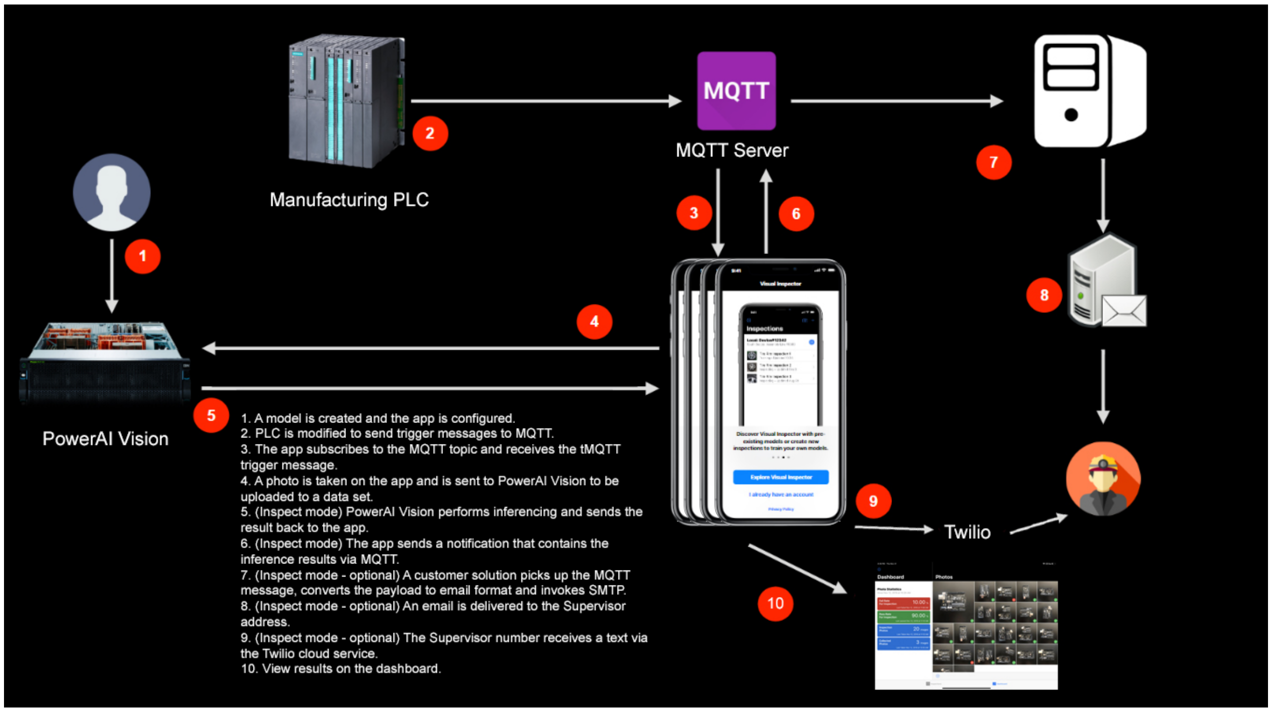
Related information

Apple Device Management

How Visual Inspector interacts with IBM Visual Insights

Visual Inspector is closely tied to IBM Visual Insights, as it uses IBM Visual Insights models and data sets.

The following figure illustrates how Visual Inspector works with IBM Visual Insights and other elements in your environment.



1. A model is created and the app is configured.
2. PLC is modified to send trigger messages to MQTT.
3. The app subscribes to the MQTT topic and receives the tMQTT trigger message.
4. A photo is taken on the app and is sent to PowerAI Vision to be uploaded to a data set.
5. (Inspect mode) PowerAI Vision performs inferencing and sends the result back to the app.
6. (Inspect mode) The app sends a notification that contains the inference results via MQTT.
7. (Inspect mode - optional) A customer solution picks up the MQTT message, converts the payload to email format and invokes SMTP.
8. (Inspect mode - optional) An email is delivered to the Supervisor address.
9. (Inspect mode - optional) The Supervisor number receives a text via the Twilio cloud service.
10. View results on the dashboard.

Figure 16. Visual Inspector and IBM Visual Insights environment

Impacts to IBM Visual Insights

In general, you can continue to work in IBM Visual Insights while Visual Inspector users run inferences and upload models with no impact to IBM Visual Insights. However, there are some ways that Visual Inspector will affect IBM Visual Insights:

- When photos are uploaded to a IBM Visual Insights data set after inferencing (inspection mode), the result and image metadata are kept in the **Original Filename** field. You will notice that this field is quite long:

  Classification example:

```
PhotoType___MMDDYYYYHHMMSS___TriggerDate___TriggerReference___TriggerString___InspectionName___

PASSORFAIL___Location___DeviceName___ModelType___Label1__Label2___Label1Percentage__Label2Percen
tage___

Label1Threshold__Label2Threshold___.jpegINSPECTION___20191112140038___20191112011___MANUALREFDAT
A___wheels___Wheels___

FAIL___Station123___Device123___Classification___ArduinoUno__ArduinoMega___99.99__94.56___75__75
___.jpeg
```

  Object detection example:

```
PhotoType___MMDDYYYYHHMMSS___TriggerDate___TriggerReference___TriggerString___InspectionName___P
ASSORFAIL___

Location___DeviceName___ModelType___Label1Threshold__Label2Threshold___Label1ExpectedCount__Labe
l2ExpectedCount___
     Label1BoundingBoxXmax_Label1BoundingBoxXmin_Label1BoundingBoxYmax_Label1BoundingBoxYmin__

Label2BoundingBoxXmax_Label2BoundingBoxXmin_Label2BoundingBoxYmax_Label2BoundingBoxYmin___.jpegI
NSPECTION___20191112200832___

20191112024___MANUALREFDATA___arduinouno___ArduinoInspect___FAIL___Station123___Device123___Obje
ctDetection___arduino_mega__
     arduino_uno___99.96__99.98___75__75___0__2___795_102_447_37__863_226_992_509___.jpeg
```

- Users can create new projects and data sets on the fly from Visual Inspector.

Planning for and installing

Learn the requirements and steps for installing Visual Inspector.

Requirements

The following are requirements for running Visual Inspector:

- Any iOS 13 compatible device including iPods, iPhones and iPads.
- One Visual Inspector license for each device.
- Any network connection, including WiFi, LTE and Ethernet, using a 3rd party Lightning to Ethernet adapter. If supported by your organization, you can access internal networks by using VPN. Internet connectivity is only required for sending Twilio text messages.
- IBM Visual Insights 1.1.5 (only one license is required)
- A IBM Visual Insights project that contains a trained model enabled for Core ML and a data set. Classification and object detection models are supported.
- (Optional. Required for fixed (mounted) devices) - An MQTT broker such as IBM Integration Bus, App Connect Enterprise, HiveMQ, or Mosquitto.

  Note: IoT cloud services that support MQTT, such as the IBM IoT Platform, are NOT compatible because they implement only a subset of the MQTT specification.
- (Optional. Required for fixed devices) - Mobile Device Management: devices must be "supervised" in order to put the device into "single app" mode. That means you must order from Apple Device Enrollment Program directly or use Apple Configurator on Mac to manually prepare (format) devices. Supervision is a stronger form of management than "managed".

  Using MDM, you can assign the app to an internal AppStore provided by the MDM vendor. This allows you to preconfigure device settings.

Installing

To install Visual Inspector, download the app from the appropriate app store. After install, it is important that the app is kept current by installing any updates as they are made available.

Setting up

Setting up Visual Inspector includes connecting it to IBM Visual Insights, optionally connecting it to an MQTT broker, and choosing configuration options.

- “Setting up Visual Inspector with IBM Visual Insights” on page 131
- “Configure the device settings” on page 132

Setting up Visual Inspector with IBM Visual Insights

Follow these steps to set up Visual Inspector and get it running in your environment:

1. In the Visual Inspector app, optionally select **Explore Visual Inspector** to access demo mode.

2. Select **I already have an account** to turn off demo mode and start configuring the app. When specifying the IBM Visual Insights server, for Base URL, you must include the server API. For example: `https://`*`xxx`*`/vision`**`/api/`**.

   Important: The device name must be unique or results will be unpredictable.

3. On the Global Settings page, you can toggle Demo Mode and Handheld Mode, as well as specifying the IBM Visual Insights server and MQTT broker details.

   Note: These settings cannot be edited remotely.

   Demo Mode
   The app runs locally using preloaded CoreML models and all other settings are hidden. There is an overlay that indicates to the user that it contains only demonstration data.

   Tap the + icon to attempt to create a new inspection. This opens a form that allows a user to request access to a IBM Visual Insights server. The requester will be contacted if access has been provisioned.

   Handheld Mode
   Auto-Capture and MQTT settings are disabled.

   IBM Visual Insights Server
   If possible, configure with TLS enabled and a valid CA-issued certificate.

   MQTT broker
   Used for fixed (mounted) devices. The broker must conform to the full MQTT specification.

Configure the device settings

To access a device's configuration settings, tap the ellipsis icon next to the device name. If the device you want to configure is not listed, tap Change to Another Device. This will search for other devices connected on the same MQTT broker. It may take up to 10 seconds to see all devices. The device in your hand will be prefixed by "Local". Other devices are prefixed by "Remote".

The following settings are available:

Trigger Config
An external system can invoke the device using a socket based connection. The device accepts a trigger message that is similar to MQTT trigger format, except that it is comma separated. For example:

```
"date","ref","triggerString"
```

Visual Inspector responds with PASS or `FAIL` over the socket connection, depending on the inspection results.

Note: The response merely signals back to the calling system whether the inspection passed or failed, defined by the configured rules in the inspection. Detailed inspection results are still sent by the configured channels, such as MQTT notification or Socket Notification.

To maintain a persistent socket based connection, the calling system can send a `pingreq` message, to which the app will respond with `PINGOK`. This is optional. Any processing errors, such as a nonconforming trigger message results in a `NOTOK` response instead.

App Settings

Flash Mode
Controls the camera flash mode.

Save to Power AI Server
Saves photos from collections and inspections to the data set defined in the inspection being used.

Image pixel dimensions
The size of the photo uploaded to the IBM Visual Insights data set. It is recommended that you keep the default settings.

Shutter Time
How much time to give the iOS camera to auto focus.

Camera Always On
Supports rapid photos at max 1 photo a second when in auto capture mode

Notify On Inspection Pass
Sends out notifications even if an inspection passes. By default, only failed inspections send notifications.

Use lens position
Retain the focal length used on the first photo taken so that less auto focus time is required for subsequent photos. This might be useful in high volume production lines where the device is mounted and always has the same angle.

Lens reset
The number of images to re-use the focal length for.

Save to Photos
Save the images to the device camera roll.

Note: This setting can use a lot of storage.

Enable Continuous Learning
This enables the Use Latest Model inspection setting. When Use Latest Model is turned on, inferences always occur on the latest deployed model in a IBM Visual Insights project. In the case of models that are enabled for CoreML, the latest *trained* model is used.

Note: This does not turn on Use Latest Model. It enables the setting so it can be turned on in an inspection. If this is not turned on, you cannot turn on Use Latest Model for any inspections.

Location Details
Location details that were entered on the Welcome screen can be edited here. If you change these settings, ensure that any systems sending MQTT messages to this device are reconfigured as the Visual Inspector will resubscribe to the MQTT topics accordingly, with the specified location and device name in the topic path.

Twilio Settings
You must have a Twilio account to enable Twilio notifications. When Twilio notifications are on, the `thresholdMsg` field in the more comprehensive MQTT message payload is sent out as a text message using the Twilio Cloud Messaging platform. You must specify the account information as well as the following:

Note: For the account **User name**, specify the Twilio account SID.

From No.
A phone number set up in the Twilio account, used as the message sender.

Supervisor No
The phone number that text messages will be sent to.

Socket Notification Settings
Writes out to a socket the JSON payload that is identical to the MQTT message for inspection results. This is useful if MQTT brokers are not be available.

Creating inspections

An inspection is a group of settings that define specific IBM Visual Insights elements to interact with. Inspections are used in both handheld mode and fixed (or mounted) mode. To create an inspection, from the Inspections home screen, tap the circle with three dots, then tap Create new inspection. Specify the following when creating a new inspection:

Image
A reference image for the inspection to help identify this inspection. This image is not uploaded to IBM Visual Insights.

Project

The project in IBM Visual Insights to use. You can select an existing project or create a new one, which will be added to IBM Visual Insights.

Model

The model within the project to use for inference (if this inspection will be used for inference). If this inspection will only be used to collect and upload photos, choose **None** for the model.

Considerations for Core ML models:

- Only Core ML models are downloaded to the Visual Inspector device. Therefore, if you want to do local inspections, you must have a GoogLeNet or tiny YOLO V2 (from IBM Visual Insights 1.1.5), or a YOLO V3 model. Other types of models will not have Core ML assets.
- If the selected model has been trained to support Core ML, that is indicated in the app. For such models, the app will always use the Core ML model if "Core ML support enabled" is turned on. Core ML files are downloaded for use on the device and support offline inference. However, they do not support remote inference.

  If you do not want to use the device for local inspections and want to use a GoogLeNet, tiny YOLO V2, or YOLO V3 model, do not turn on the "Core ML support enabled" setting.
- For models that support Core ML, the model only needs to be trained. It does not need to be deployed, since Visual Inspector downloads the necessary files to the device.
- You can update the Core ML model later by opening the inspection and tapping **Update CoreML model**. The Core ML assets associated with the latest trained model in the project are downloaded to the device.

  Important: If the latest model has labels that do not match those in the model specified in the inspection, an error will result.

Set Thresholds and Counts

- The results threshold is the required accuracy threshold for each label in the model. Inference results with a confidence lower than the value set for Ignore Results Below are not included in the results.

  The inspection will be marked as a fail if the confidence returned for any label is above the specified threshold. Conversely, if you set Notify When to "below", then the inspection will be marked as a failure when any label returns a confidence that is less than specified.

  For example, if you trained on "bad connector" and an inspection resulted in a bad connector with 75% confidence, then the inspection would be marked as a failure and you would want Notify When to be set to "above".

  Alternatively, if you trained on "good connector", you would set Notify When to "below".
- The expected count specifies how many of each type of object should be in a scene. Each successfully identified object type is counted. If the number of objects that are found does not match the "expected count" value, the inspection is marked as "fail".

Data Set

The data set within the project to upload images to. You can select an existing data set or create a new one, which will be added to IBM Visual Insights.

Use Latest Model

Whether to use the latest model. This option is only available if Enable Continuous Learning has been enabled in App Settings, which means that remote inferences occur on the latest deployed model in a project in IBM Visual Insights. However, if the labels in the latest model do not match the labels that were being used initially for this inspection, no results will occur.

Considerations for Core ML models:

The Core ML assets associated with the latest trained model in the project are downloaded to the device. However, if the labels in the latest model do not match the labels that were being used initially for this inspection, no results will occur.

Trigger String

A trigger string that identifies this inspection uniquely on the device. When an MQTT or socket based message is received from an external system in auto capture mode, the message's `trigger` field is used to find an inspection that has a matching trigger string defined. A photo is taken only if there is a match. The results of an attempted match are shown in the top right corner of the Auto Capture screen. Trigger strings are only used in auto capture mode on a mounted device.

Dashboard view

A dashboard displays images from a single IBM Visual Insights data set within a project. Additionally, it displays Pass / Fail metrics for the displayed images.

Multiple inspections can upload to a single data set, however, it is recommended that each dashboard displays data for just one inspection or the metrics might be skewed. The dashboard refreshes on an interval defined in App Settings, which is 60 seconds by default. It also refreshes when a new image is uploaded.

Metrics are calculated over the number of images available, up to the configured number of images to return from IBM Visual Insights (which is up to 500 images).

Photo thumbnails display a green check mark if they passed, red if they failed, and no mark if it was only collected. Click the photo to see more details, such as the confidence level. If you do not want to see all the images, you can filter by image type. For example, inspection images only.

Configure a dashboard

From the Dashboard screen, tap the ellipses and fill in the fields presented. When specifying the number of images to return, it is recommended that you do not exceed the default value of 100.

Collecting data for training

When you take photos in *collect* mode, they are uploaded to a data set in IBM Visual Insights. The uploaded images can then be labeled and used to train a model, or they can be used to validate a model. You can then "upgrade" your inspection to specify the newly trained model, thereby retaining all of the existing settings, such as the trigger string.

You can collect data for training in either handheld or fixed mode.

Using Visual Inspector for labeling and deep learning

If you want to take photos that will be sent to a model for inferencing, use *inspect* mode when taking pictures. This mode is available whether you are taking photos manually (handheld devices) or are using auto capture (fixed devices).

The photo and inference result are then uploaded to a IBM Visual Insights data set (specified in the Inspection) and are also displayed in a Visual Inspector dashboard. See "Dashboard view" on page 135 for details.

Demo mode

You can turn on Demo mode from the Global Settings page. The app runs locally using preloaded CoreML models and all other settings are hidden. There is an overlay that indicates to the user that it contains only demonstration data.

Tap the + icon to attempt to create a new inspection. This opens a form that allows a user to request access to a IBM Visual Insights server. The requester will be contacted if access has been provisioned.

Handheld mode

If the device is not in a fixed position, it should be used in Handheld mode. When in Handheld mode, you take photos manually.

To take a photo, from the Inspection home screen, tap the Capture icon. Ensure that the right model is selected. Choose **Collect** or **Inspect** and take the picture.

The results are displayed in the text box at the bottom of the screen. If it says "No Results" then the model returned no results or the calculated accuracy was below the value set for "Ignore Results Below" in Threshold Configuration. The resulting photo can be shared using iOS share sheet.

- When an inference is performed on an object detection model, results with bounding boxes are stamped on the photo.
- When Visual Inspector performs an inference, it fails or passes inspection and the results are sent via MQTT or socket, text (to the number configured for the Supervisor), or both. You must turn off handheld mode before taking a picture if you want the results sent by MQTT or socket. This enables outbound MQTT or TCP/IP socket based communication.

Fixed (mounted) devices

Using Visual Inspector on fixed devices requires the device to be in Single App mode and also requires a connection to an MQTT broker or a TCP/IP based socket server.

To capture photos, the app should be in Auto Capture mode. To enable Auto Capture, from the Inspection home screen, tap the camera icon, select the mode (**Collect** or **Inspect**), then tap **Auto Capture** to connect to the MQTT or the socket. The device will wait for the external trigger message.

Note: If Auto Capture mode is not available, turn off Handheld mode.

A single device can automatically switch between inspections based on external triggers when in Auto capture mode. The device is locked to Visual Inspector so the app always remains in the foreground, even though the screen turns off automatically after 30 seconds. Additionally, if the device runs out of power, the app crashes, or the app is terminated by iOS, when it is launched (which will happen automatically if Single App Mode is enabled on the device) the app will immediately go back into the previously engaged mode.

If you use a zoom setting via pinching, it will be maintained in auto capture mode.

Accessing a remote device

To access a remote device that is connected on the same MQTT broker, tap the ellipsis icon and tap Change to Another Device. It can take up to 10 seconds for all available devices to appear. On the remote device, you can do the following:

- Create, edit, and delete inspections.
- Modify app settings (not Global settings).
- Engage Collect or Inspect modes for auto capture. Camera preview is not available.

You cannot configure global settings or the dashboard for a remote device.

Note: While a remote device is downloading CoreML assets, Visual Inspector cannot be engaged remotely.

Configuring MQTT

Configure MQTT to allow external systems to interact with Visual Inspector.

- "Topic structure" on page 137
- "Topics in use" on page 137
- "Inbound trigger" on page 137
- "Inbound example" on page 138
- "Outbound notification" on page 138

- “Outbound Examples” on page 140
- “Outbound error” on page 141

Topic structure
All topics include the location and device name that is configured within each iOS app instance. Refer to the MQTT Specification for full details.

Notes:

- Do not use a leading forward slash or ending slash, in accordance with MQTT best practices.
- Additional JSON attributes may be included in subsequent releases. Any consuming systems must code defensively to ensure they do not error if additional elements or attributes are present in the JSON.

Topics in use

The following are the topics that Visual Inspector leverages. All topics include the location and device name which is configured within each iOS app instance. While the full list of topics are listed for informational purposes, this information focuses only on the inbound trigger message, the outbound notification message and outbound error message, which are the three messages that external systems need to work with in order to interface with the app.

ibmvi/heartbeat/<location>/<device>
Publishes the heartbeat information of all devices connected to the same MQTT broker so that they can be monitored remotely.

ibmvi/error/<location>/<device>
Signals any errors in iOS app instances running in Inspection mode, such as failed inferences.

ibmvi/threshold/<location>/<device>
Publishes the inference results.

ibmvi/systemrequest/<location>/<device>
Sends device configuration updates.

ibmvi/uploadresult/dataset/<datasetID>/<location>/<device>
Refreshes the dashboard when a new image is captured and uploaded to IBM Visual Insights server.

ibmvi/takephoto/<location>/<device>
Sends commands to the app to take photos.

Inbound trigger

This MQTT message is used to trigger Visual Inspector to take a photo. It requires the message to be sent to a particular location and device using the topic structure:

```
ibmvi/takephoto/<location>/<device>
```

Note: The trigger field must match a defined inspection on the device and the device must be in Auto Capture mode. It can be used for collections or inspections.

YAML Specification

```
---
required:
  - "date"
  - "reference"
  - "trigger"
properties:
  date:
    type: "string"
    example: “20190925232952”
    description: “Date the trigger request was sent in YYYYMMDDHHMMSS format"
  reference:
    type: "string"
    example: “VIN12345"
    description: “External reference used to invoke the inspection on the device"
  trigger:
    type: "string"
    example: “TELE"
    description: “Value used to route the trigger request to a specific Inspection on the
device, this must match the Trigger String set in an Inspection”
```

Inbound example

```
{
   "date":"20190925232952",
   "reference":"VIN12345",
   "trigger":"TELE"
}
```

Outbound notification

This is used to send the results of inference via this topic:

```
ibmvi/threshold/<location>/<device>
```

The most important data element is `thresholdMsg`, which contains the human readable content of inferencing. This should be included in the body of any email or text message. Examples:

```
<Label> at <Confidence %> is <Above or Below> specified confidence of <threshold value>
<Label> with a count of <count> is <above or below> specified count of <count value>
```

Further, under the `deviceInfo` element, the `locationName` and `deviceNames` are important to identify the device that produces the outbound notification.

YAML specification

```
---
required:
  - “isPass"
  - “modelType"
  - "scoresAndThresholds"
  - "reference"
  - "datasetId"
  - "thresholdMsg"
  - "fileId"
  - "imageURL"
  - "deepLink"
  - "deviceInfo"
properties:
  isPass:
    type: "boolean"
    example: false
    description: “Indicates whether this inference was a pass
  modelType:
    type: "string"
    example: "ObjectDetection"
    description: “Indicates the type of model, either Classification or ObjectDetection“
  scoresAndThresholds:
    type: "array"
    items:
      type: "object"
      properties:
        isBelow:
          type: "boolean"
          example: false
          description: “If true, indicates if the score returned by PAIV should be compared
below the specified threshold to indicate a fail. The default (false) is to always check that
the returned score is above the threshold.”
        score:
          type: "string"
          example: “6.89"
          description: “The confidence score for the label (name) returned by PAIV“
        bbData:
          required:
            - "xmin"
            - "xmax"
            - "ymin"
            - "ymax"
          properties:
            xmin:
              type: "number"
              example: 0
              description: “Xmin coordinate for bounding box"
            xmax:
              type: "number"
              example: 999
              description: “Xmax coordinate for bounding box"
            ymin:
              type: "number"
              example: 256
              description: “Ymin coordinate for bounding box"
            ymax:
              type: "number"
              example: 810
              description: “Ymax coordinate for bounding box"
          type: "object"
        name:
          type: "string"
          example: “arduino_mega"
          description: “Name of label from PAIV"
        threshold:
          type: "string"
          example: “0.0"
          description: “Configured threshold value from the app"
  reference:
    type: "string"
    example: “MANUALREFDATA"
    description: “The external reference specified by the MQTT trigger message. Will read
MANUALREFDATA if photo was taken manually by the iOS app.”
  datasetId:
    type: "string"
    example: “1b48624c-1cb0-43f1-9f1c-5f03cb40d5af"
    description: “UUID of the PAIV Dataset the image was uploaded to"
  thresholdMsg:
    type: "string"
    example: "arduino_uno at 99.73% is Above specified confidence of 10.0%”
    description: “Human readable result message intended for emails or text messages"
  fileId:
    type: "string"
    example: “476706a9-8c9e-417b-bffa-515b698edf4b"
    description: “UUID of the file uploaded to PAIV"
  imageURL:
    type: "string"
    example: “https://vision-poc1.aus.stglabs.ibm.com/visual-insights-v120-daily/uploads/coreml/
datasets/1b48624c-1cb0-43f1-9f1c-5f03cb40d5af/files/476706a9-8c9e-417b-bffa-515b698edf4b.jpg"
    description: “Link to IBM visual Insights to view the image that was uploaded to the data
set"
  deepLink:
    type: "string"
    example: “ibmvisualinspector://openImage?
datasetId=1b48624c-1cb0-43f1-9f1c-5f03cb40d5af&fileId=476706a9-8c9e-417b-bffa-515b698edf4b"
    description: “Deep link to the image in the dashboard in the IBM Visual Inspector app using
iOS URL schema"
  deviceInfo:
    required:
      - "mqttClientId"
      - "locationName"
      - "engagedMode"
      - "lastPhotoTaken"
      - "deviceName"
    properties:
      mqttClientId:
        type: "string"
        example: “658B163D-0C9D-47A9-9169-3B6ECA157788"
        description: “MQTT client ID of the iOS device sending the message"
      locationName:
        type: "string"
        example: “loc1"
        description: “Location name specified in the IBM Visual Inspector app"
      engagedMode:
        type: "string"
        example: “RUNTIME"
        description: “Whether the device was in TRAINING or RUNTIME mode. Inference results are
included only in RUNTIME mode.”
      lastPhotoTaken:
        type: "number"
        example: 593964309.603459
        description: “Time the last photo was taken on device, expressed as the interval in
seconds since 00:00:00 UTC on 1 January 2001, expressed as a float”
      deviceName:
        type: "string"
        example: “dev123"
        description: “Device name specified in the IBM Visual Inspector app"
    type: "object"
```

Outbound Examples

Object detection result example:

```
{
    "isPass": false,
    "modelType": "ObjectDetection",
    "scoresAndThresholds": [{
        "isBelow": false,
        "score": "6.89",
        "bbData": {
            "xmin": 0,
            "xmax": 999,
            "ymin": 256,
            "ymax": 810
        },
        "name": "arduino_mega",
        "threshold": "0.0"
    }, {
        "isBelow": false,
        "score": "99.73",
        "bbData": {
            "xmin": 0,
            "xmax": 950,
            "ymin": 235,
            "ymax": 789
        },
        "name": "arduino_uno",
        "threshold": "10"
    }],
    "reference": "MANUALREFDATA",
    "datasetId": "1b48624c-1cb0-43f1-9f1c-5f03cb40d5af",
    "thresholdMsg": "arduino_uno at 99.73% is Above specified confidence of 10.0%",
    "fileId": "476706a9-8c9e-417b-bffa-515b698edf4b",
    "imageURL": "https:\/\/vision-poc1.aus.stglabs.ibm.com\/powerai-vision-v115-daily\/uploads\/
coreml\/datasets\/1b48624c-1cb0-43f1-9f1c-5f03cb40d5af\/files\/476706a9-8c9e-417b-
bffa-515b698edf4b.jpg",
    "deepLink": "ibmvisualinspector:\/\/openImage?
datasetId=1b48624c-1cb0-43f1-9f1c-5f03cb40d5af&fileId=476706a9-8c9e-417b-bffa-515b698edf4b",
    "deviceInfo": {
        "mqttClientId": "658B163D-0C9D-47A9-9169-3B6ECA157788",
        "locationName": "loc1",
        "engagedMode": "RUNTIME",
        "lastPhotoTaken": 593964309.603459,
        "deviceName": "dev123"
    }
}
```

Object detection example with a result based on the expected count:

```
{
    "isPass": false,
    "modelType": "ObjectDetection",
    "scoresAndThresholds": [{
        "isBelow": false,
        "score": "2.74",
        "bbData": {
            "xmin": 25,
            "xmax": 770,
            "ymin": 229,
            "ymax": 801
        },
        "name": "arduino_mega",
        "threshold": "0.0"
    }, {
        "expectedCount": 2,
        "isBelow": false,
        "score": "99.77",
        "bbData": {
            "xmin": 0,
            "xmax": 999,
            "ymin": 221,
            "ymax": 761
        },
        "name": "arduino_uno",
        "threshold": "10"
    }],
    "reference": "MANUALREFDATA",
    "datasetId": "1b48624c-1cb0-43f1-9f1c-5f03cb40d5af",
    "thresholdMsg": "arduino_uno with a count of 1 is not matching specified count of 2",
    "fileId": "fba1a41b-5ac5-4d5f-aba7-599aea726b5a",
    "imageURL": "https:\/\/vision-poc1.aus.stglabs.ibm.com\/powerai-vision-v115-daily\/uploads\/
coreml\/datasets\/1b48624c-1cb0-43f1-9f1c-5f03cb40d5af\/files\/fba1a41b-5ac5-4d5f-
aba7-599aea726b5a.jpg",
    "deepLink": "ibmvisualinspector:\/\/openImage?
datasetId=1b48624c-1cb0-43f1-9f1c-5f03cb40d5af&fileId=fba1a41b-5ac5-4d5f-aba7-599aea726b5a",
    "deviceInfo": {
        "mqttClientId": "658B163D-0C9D-47A9-9169-3B6ECA157788",
        "locationName": "loc1",
        "engagedMode": "RUNTIME",
        "lastPhotoTaken": 593964572.57300794,
        "deviceName": "dev123"
    }
}
```

Classification model example:

```
{
    "isPass": false,
    "modelType": "Classification",
    "scoresAndThresholds": [{
        "isBelow": true,
        "score": "89.28",
        "name": "ArduinoUno",
        "threshold": "99"
    }],
    "reference": "MANUALREFDATA",
    "datasetId": "bd363f4b-e48c-47c5-9fee-d9904e9a1911",
    "thresholdMsg": "ArduinoUno at 89.28% is Below specified confidence of 99.0%",
    "fileId": "0132d3bd-0b74-41c0-b40b-c7b12d7ecf17",
    "imageURL": "https:\/\/vision-poc1.aus.stglabs.ibm.com\/powerai-vision-v115-daily\/uploads\/
coreml\/datasets\/bd363f4b-e48c-47c5-9fee-d9904e9a1911\/files\/0132d3bd-0b74-41c0-b40b-
c7b12d7ecf17.jpg",
    "deepLink": "ibmvisualinspector:\/\/openImage?datasetId=bd363f4b-e48c-47c5-9fee-
d9904e9a1911&fileId=0132d3bd-0b74-41c0-b40b-c7b12d7ecf17",
    "deviceInfo": {
        "mqttClientId": "658B163D-0C9D-47A9-9169-3B6ECA157788",
        "locationName": "loc1",
        "engagedMode": "RUNTIME",
        "lastPhotoTaken": 593985750.97822499,
        "deviceName": "dev123"
    }
}
```

Outbound error

This is the error message when inference fails on a device due to misconfiguration or server or device error. These are published via:

```
ibmvi/error/<location>/<device>
```

YAML Specification

```
---
required:
  - "msg"
  - "deviceInfo"
  - "time"
properties:
  msg:
    type: "string"
    example: "Device: dev123, Location: loc1 Unable to update token while making the request
https://vision-poc1.aus.stglabs.ibm.com/powerai-vision-v115-daily/api/projects, ErrorCode:
-1003, ErrorDesc: Optional(Error Domain=NSURLErrorDomain Code=-1003 \"A server with the
specified hostname could not be found.\" UserInfo={NSUnderlyingError=0x2814bb8a0 {Error
Domain=kCFErrorDomainCFNetwork Code=-1003 \"(null)\" UserInfo={_kCFStreamErrorCodeKey=8,
_kCFStreamErrorDomainKey=12}}, NSErrorFailingURLStringKey=https://vision-
poc1.aus.stglabs.ibm.com/powerai-vision-v115-daily/api/tokens, NSErrorFailingURLKey=https://
vision-poc1.aus.stglabs.ibm.com/powerai-vision-v115-daily/api/tokens,
_kCFStreamErrorDomainKey=12, _kCFStreamErrorCodeKey=8, NSLocalizedDescription=A server with the
specified hostname could not be found.})"
  deviceInfo:
    required:
      - "mqttClientId"
      - "locationName"
      - "lastPhotoTaken"
      - "deviceName"
    properties:
      mqttClientId:
        type: "string"
        example: “658B163D-0C9D-47A9-9169-3B6ECA157788"
        description: “MQTT client ID of the iOS device sending the message"
      locationName:
        type: "string"
        example: “loc1"
        description: “Location name specified in the IBM Visual Inspector app"
      lastPhotoTaken:
        type: "number"
        example: 593974708.779805
        description: “Time last photo taken on the device, expressed as the interval in seconds
since 00:00:00 UTC on 1 January 2001, expressed as a float”
      deviceName:
        type: "string"
        example: “dev123"
        description: “Device name specified in the IBM Visual Inspector app"
    type: "object"
  time:
    type: "number"
    example: 593985487.698025
    description: “Error timestamp, to be precise the interval in seconds since 00:00:00 UTC on
1 January 2001, expressed as a float”
```

Example JSON

```
{
    "msg": "Device: dev123, Location: loc1 Unable to update token while making the request
https:\/\/vision-poc1.aus.stglabs.ibm.com\/powerai-vision-v115-daily\/api\/projects, ErrorCode:
-1003, ErrorDesc: Optional(Error Domain=NSURLErrorDomain Code=-1003 \"A server with the
specified hostname could not be found.\" UserInfo={NSUnderlyingError=0x2814bb8a0 {Error
Domain=kCFErrorDomainCFNetwork Code=-1003 \"(null)\" UserInfo={_kCFStreamErrorCodeKey=8,
_kCFStreamErrorDomainKey=12}}, NSErrorFailingURLStringKey=https:\/\/vision-
poc1.aus.stglabs.ibm.com\/powerai-vision-v115-daily\/api\/tokens,
NSErrorFailingURLKey=https:\/\/vision-poc1.aus.stglabs.ibm.com\/powerai-vision-v115-daily\/api\/
tokens, _kCFStreamErrorDomainKey=12, _kCFStreamErrorCodeKey=8, NSLocalizedDescription=A server
with the specified hostname could not be found.})",
    "deviceInfo": {
        "mqttClientId": "658B163D-0C9D-47A9-9169-3B6ECA157788",
        "locationName": "loc1",
        "lastPhotoTaken": 593974708.77980494,
        "deviceName": "dev123"
    },
    "time": 593985487.69802499
}
```

Troubleshooting

If something is not working right with Visual Inspector, there are several places to look for errors, depending on where they occurred. It is recommended that you enable the ability to share crash logs with developers.

- “Finding error messages” on page 142
- “Crash logs” on page 143

Finding error messages

- Application errors, such as being unable to reach the IBM Visual Insights server, are displayed on the Visual Inspector user interface. They are also posted to an MQTT topic with a payload similar to this JSON:

```
ibmvi/error/<location>/<device>

{
  "msg": "Device: my phone, Location: office Unable to update token while making the request
  "deviceInfo": {
    "mqttClientID": 99C9827-FC33-46AB-917A-1081510151D",
    "locationName": "office",
    "lastPhotoTaken": 595289659.985447,
    "deviceName": "my phone"
   },
   "time": 5936155.207686
}
```

- Any API invocation that fails, for example, the IBM Visual Insights server is misconfigured or invalid login credentials will be posted on the Visual Inspector user interface and on the MQTT error queue.
- Errors that occur during Auto Capture mode are only posted on the MQTT error queue. Therefore, observing the error queue is particularly important during Auto Capture mode, where the device screen is unlikely to be viewed by a user.

Crash logs

Support can use AppStore Connect Crash Logs, if the option is enabled. These reports are anonymous and do not link to individual devices. To leverage this capability, from the Privacy page, open the Analytics page and enable "Share With App Developers".

Chapter 13. Administering IBM Visual Insights

Use this information to administer IBM Visual Insights, such as stopping, starting, and determining the status of the pods.

Start or stop IBM Visual Insights

There are several situations when you might need to stop and start IBM Visual Insights. For example, when upgrading or performing maintenance on the product or on the system, when troubleshooting a problem, and so on. Use these commands to start or stop IBM Visual Insights, as appropriate:

```
/opt/ibm/vision/bin/vision-stop.sh
```

```
/opt/ibm/vision/bin/vision-start.sh
```

Determine the status of IBM Visual Insights pods

When troubleshooting a problem with IBM Visual Insights, you might need to check the status of the Docker pods that are part of IBM Visual Insights. For example, if the product does not start, if it is returning errors, or if actions are not completing. Run `kubectl get pods` to see the status. For example:

```
$ /opt/ibm/vision/bin/kubectl get pods
NAME                                                 READY   STATUS    RESTARTS   AGE
vision-elasticsearch-fbfc584f9-n7jqc          1/1     Running   0          14d
vision-fpga-device-plugin-qkfxj               1/1     Running   0          14d
vision-keycloak-5df778c997-95h8s              1/1     Running   0          14d
vision-logstash-84cc5cbcc4-9s28j              1/1     Running   0          14d
vision-mongodb-79d964cfb9-zp6cp               1/1     Running   0          14d
vision-postgres-85b6ddc9b6-7565q              1/1     Running   0          14d
vision-service-8657f8878c-nlf2k               1/1     Running   0          10d
vision-taskanaly-589447ffcf-r6wjn             1/1     Running   0          14d
vision-ui-659dbc4657-npvb9                    1/1     Running   0          14d
vision-video-microservice-5db68fc8fd-s8bg2    1/1     Running   0          14d
```

If one or more pods is not running, try stopping and restarting IBM Visual Insights.

Managing users

There are two kinds of users in IBM Visual Insights: administrators, and everyone else. The way you work with users and passwords differs, depending on how IBM Visual Insights is installed.

IBM Visual Insights uses Keycloak for user management and authentication. All users and passwords are maintained by Keycloak and stored in a Postgres database. A default user name of `admin` with a password of `passw0rd` are created at install time. You can add, remove, or modify users by using the `kubectl` command.

- "Types of users" on page 145
- "IBM Visual Insights installed as stand-alone" on page 146
- "IBM Visual Insights installed with IBM Cloud Private" on page 147

Types of users

Non-administrator users
Users other than the administrator can only see and edit resources that they created.

Administrator
The administrator user (admin) can see and manage all resources in IBM Visual Insights regardless of who owns it. A default user name of `admin` with a password of `passw0rd` are created at install time.

You can add, remove, or modify users by using the `kubectl` command. You should be aware of the following considerations when working with admin users:

Data sets

- The administrator can see and edit all data sets. That is, this user can add and delete files, create labels, assign categories, duplicate, rename, and delete the data set.
- If the administrator uploads a file to a different user's data set, it is listed as being owned by the data set owner.
- If the administrator duplicates a data set, the duplicate data set is owned by the administrator.

Models

- The administrator can see, rename, and delete all models, including after they are deployed.
- If the administrator trains a model, the training task and the generated model is owned by the administrator.
- If the administrator deploys a model, the deployed model is owned by the administrator.

Project groups

An administrator can add assets to a project group that was created by a different user. However, the project group owner will not be able to see the added assets because only administrators can see resources created by other users. Because of that, the value for "Total items" on the Projects page might be larger than the number of items shown on a project's details page.

IBM Visual Insights installed as stand-alone

If you installed IBM Visual Insights stand-alone, you can use the `vision-users.sh` script in the `/opt/ibm/vision/bin/` directory to create, delete, modify, and list users.

Usage

```
vision-users.sh [command] [ --user name ] [ --password password ]
```

Command

Specifies the action to take.

create

Create a user in the IBM Visual Insights instance. The `user` argument is required for this operation. You can set the password by one of these methods:

- Specify it with the command by using the `password` argument.
- Store it in the environment variable, VISION_USER_PASSWORD.

delete

Delete a user from the IBM Visual Insights instance. The `user` argument is required for this operation.

list

List the currently created users for a specified IBM Visual Insights instance.

modify

Modifies the user's password. The `user` argument is required for this operation. You can set the new password by one of these methods:

- Specify it with the command by using the `password` argument.
- Store it in the environment variable, VISION_USER_PASSWORD.

Name

The user name on which the command is to operate on.

Password

Optionally set a user's password when creating or modfying a user.

IBM Visual Insights installed with IBM Cloud Private

1. Authenticate to the cluster, so that you can run kubectl commands. For example:

   ```
   cloudctl login -a https://<cluster-domain-name>:8443/ --skip-ssl-validation
   ```

2. Note your release name. In the example below, this is `aivision`.
3. To manage users, run the following command:

   ```
   kubectl run --rm -i --restart=Never usermgt --image=cluster-domain-name:8443/vision-
   usermgt:version -- action
               --user newusername --password password --release release
   ```

   The above command has the following variables:

   - *action* can be one of these values: `create`, `delete`, `modify`, or `list`.
   - *version* is the release number of the IBM Visual Insights product. For example, 1.2.0.0. To find the correct value, view the configmap. For example:

   ```
   $ kubectl get cm
   NAME                         DATA      AGE
   vision-v1.2.0-config   52        56d
   ```

   The `password` argument is optional. You can set the password in one of these ways:

   - The `--password` argument in `vision-usermgt`.
   - The `--env` option for kubectl with the VISION_USER_PASSWORD environment variable. For example, add `--env="VISION_USER_PASSORD=${MY_PASS}` to the kubectl `run` command.

   Example: To create `customusername` with password `custompassw0rd1234` on release `aivision`, run:

   ```
   $ kubectl run --rm -i --restart=Never usermgt --image=myicpcluster.com:8443/vision-
   usermgt:1.2.0.0
                 -- create --user customusername --password custompassw0rd1234 --release aivision
   Created user: customusername
   ```

   Example: To list users in the IBM Visual Insights 1.2.0 deployment, run:

   ```
   $ kubectl run --rm -i --restart=Never usermgt --image=vision-usermgt:1.2.0.0 -- list --release
   v120
   If you don't see a command prompt, try pressing enter.
   admin
   testuser1
   testuser2
   ```

   Notes:

   - If running in the non-default namespace, make sure to specify the `--namespace` option.
   - The `version` tag on the container should match `image.releaseTag` in the `values.yaml` file.
   - The argument `release` should match the release name you assigned when deploying the chart.
   - There is not a typo with the spacing of the "--" before `create`. It should be `--<SPACE>create<SPACE> --user` *username*`....` This is intentional and an artifact of how the commands are passed into the user management tool.

Installing a new SSL certificate in IBM Visual Insights stand-alone

IBM Visual Insights ships with a self-signed certificate that is used by default, but this can be replaced with a certificate generated for IBM Visual Insights for secure communications. If you want to use your own certificate, follow these steps to update the IBM Visual Insights configuration.

1. Shut down IBM Visual Insights:

```
sudo /opt/ibm/vision/bin/vision-stop.sh
```

2. Edit `/opt/ibm/vision/bin/config.sh` and specify the following information:
   - **TLS_CERT_PATH** - Path to your custom PEM encoded public key certificate.
   - **TLS_KEY_PATH** - Path to the private key associated with the TLS_CERT_PATH certificate.
   - **INGRESS_HOSTS** - The host names defined in your certificate that you wish to use to access IBM Visual Insights.

3. Start IBM Visual Insights:

```
$ sudo /opt/ibm/vision/bin/vision-start.sh
```

Backing up IBM Visual Insights

It is important to occasionally back up IBM Visual Insights by shutting it down, then creating a backup of the data volume.

All IBM Visual Insights data is stored in the data volume for the installation. For the standalone installation, this is `/opt/ibm/vision/volume`:

- **data** - This directory contains a sub-directory for each user with the data sets, dnn-sources (imported custom models), and trained-models the user has created.
- **run** - This directory contains runtime information for usage metrics, user registry, and metadata for the data sets.

Backing up application data

To back up the critical application data, create a backup of the data volume for the installation. For example:

1. Shut down IBM Visual Insights. Wait until everything is stopped and all pods are destroyed.

   To verify that everything is stopped, run `kubectl get pods`, as described in "Checking Kubernetes node status" on page 50. kubectl will not run when IBM Visual Insights is stopped:

```
# kubectl get pods
The connection to the server localhost:8080 was refused - did you specify the right host or
port?
```

2. Create a backup of the data volume by using your preferred method. For example:

```
$ cd /opt/ibm/vision; tar -zpcf vision-volume.tgz /opt/ibm/vision/volume /opt/ibm/vision/run
```

   Note: For IBM Cloud Private and OpenShift installations, the physical volume defined for the deployment should be backed up.

3. Restart IBM Visual Insights.

Alternatively, to protect your data while IBM Visual Insights is running, you can download each data set and model manually. If they are imported later, they will have different UUIDs.

Restoring a backup

To restore a back up prepared using the above instructions provided, follow these steps:

1. Stop IBM Visual Insights.
2. (Optional) Back up the current run (volume) directories in case there are any issues:

```
$ cd /opt/ibm/vision; mv run volume <backup_dir>
```

3. Restore the previously created backup:

```
$ cd /opt/ibm/vision; tar -zxf vision-backup.tgz
```

4. Restart IBM Visual Insights.

Monitoring usage metrics

Administrators can view the IBM Visual Insights usage metrics to see how many times an inference API was called for models that have been deployed. This might include models that were deployed previously but are no longer deployed.

To access the **Usage metrics** page, click your user name then click **Usage metrics**.

All metrics are kept from the time that IBM Visual Insights 1.1.4 (or later) was installed, but you can use the date range selector to filter the data you want displayed.

The following inference metrics are gathered, depending on the model type:

Action detection
The number of times inferencing was performed for a deployed model. This is the duration of the video multiplied by the frame rate because inferencing is run once per frame.

Auto label
The number of images or frames labeled.

Note: When you run auto label on a video, IBM Visual Insights automatically captures frames, then labels the frames. These frames are also counted under Total files. For more information about auto labeling, see "Automatically labeling videos" on page 96 and "Automatically labeling objects in a data set" on page 95.

Inferences
The number of times the deployed model was used for inferencing with images. When inferencing is done on a video, it is counted under **Video object detection** or **Action detection**.

Video object detection
The number of times inferencing was performed for a deployed model. This is the duration of the video multiplied by the frame rate because inferencing is run once per frame.

The following file metrics are gathered:

Augmented
The number of files generated by augmenting the data set.

Cloned
The number of files generated by duplicating the data set.

Frames captured
The number of files generated by manually or automatically capturing frames.

Uploaded
The number of files uploaded to a data set. For zip files, the zip file itself is not counted, but each file in the zip file is counted, excluding any .json control files.

Note: The file metrics are not available for data sets created prior to 1.1.5.

The following export metrics are gathered:

Exported data sets
The number of data sets exported by the user.

Exported models
The number of models exported by the user.

Note: The export metrics are not available for data sets or models exported prior to 1.1.5.

IBM Visual Insights utilities

IBM Visual Insights includes these utilities for working with the product.

- "Administer" on page 150
- "Troubleshooting" on page 152
- "Cleanup and uninstall" on page 153

Administer

accept-vision-license

Usage

```
# accept-vision-license.sh
```

Description

The `accept-vision-license.sh` utility is used to accept the product license. The environment variable `IBM_POWERAI_VISION_LICENSE_ACCEPT` can be set to `yes` or `no` to automatically accept or reject the license. Otherwise, the license is presented along with a prompt to accept:

```
Press Enter to continue viewing the license agreement, or, Enter "1" to accept the
agreement, "2" to decline it or "99" to go back to the previous screen, "3"
Print, "4" Read non-IBM terms.
```

Note: This is called by the startup script `vision-start.sh` the first time the application is started to ensure that the license is accepted. If not accepted, the product will not start.

Requirements

The user must have sudo/root permissions.

check-vision-license

Usage

```
# check-vision-license.sh
```

Description

Checks whether the product license has already been accepted.

- If the license is accepted, the utility silently exits with success (`0`).
- If the license has not been accepted, the utility prints an error and exits with error (1).

Requirements

The user must have sudo/root permissions.

config.sh

Usage

```
# config.sh
```

Description

This file can be used to specify the following configuration values for the application:

EXTERNAL_IP

An IP address for the web portal if it is different from the system host name.

TLS_CERT_PATH, TLS_KEY_PATH, INGRESS_HOSTS

Specifies custom TLS certificates to be used by the application. See "Installing a new SSL certificate in IBM Visual Insights stand-alone" on page 147 for details.

Requirements

None - not an executable.

gpu_setup.sh

Usage

```
# gpu_setup.sh
```

Description

Utility that checks the availability of GPUs on the system and the Docker setup to verify that it supports using GPUs in Docker containers. It is called by the `vision-start.sh` startup script.

Requirements
The user must have sudo/root permissions.

helm.sh

Usage

```
# helm.sh [ command ]
```

Description
A wrapper for the Kubernetes `Helm` utility, which works with deployment charts. The `helm.sh` utility can be used to check the status of the IBM Visual Insights deployment. See "Checking application deployment" on page 57 for details. For information about the `Helm` utility, see Using Helm.

Requirements
None.

kubectl.sh

Usage

```
# kubectl.sh [ command ]
```

Description
A wrapper for the Kubernetes `kubectl` utility, which works with pods and deployments. The `kubectl.sh` utility can be used to check the status of the IBM Visual Insights deployment. See these topics for details:

- "Checking Kubernetes services status" on page 49
- "Checking Kubernetes node status" on page 50
- "Checking application deployment" on page 57

For information about the `kubectl` utility, see Overview of kubectl.

Requirements
None.

load_images.sh

Usage

```
# load_images.sh-f [ <vision-images-release>.tar ]
```

Description
Utility to load the IBM Visual Insights Docker images, which are provided with the product installation package in the <*vision-images-release*>.tar file. The `load_images.sh` utility requires approximately 30 Gb of free space in the `/var` file system to extract and load the Docker images. Images are loaded in parallel, so if there are space limitations on the system, errors will only be output after all images have attempted to load. The `docker images` command can be used to validate that all images have been loaded. See "Checking the application Docker images in standalone installation" on page 47 for details.

Requirements
The user must have Docker group permissions.

port.sh

Usage

```
# port.sh
```

Description

A file that can be used to specify configuration values for the ports used by the application. This is only required if there are multiple web services running on the system.

POWERAI_VISION_EXTERNAL_HTTPS_PORT

Specifies the SSL port that the IBM Visual Insights user interface will use. The default port is 443.

Requirements

None - not an executable.

vision-start.sh

Usage

```
# vision-start.sh [ -nD ]
```

Description

Used to start the IBM Visual Insights application and required Kubernetes services. This startup script runs some checks of system requirements that require elevated privileges, such as GPU availability. You can optionally specify the following flags:

-n or --nocheck

Suppress checks of the system environment. For example, SELinux contexts on GPU devices are checked and fixed if they are found to be incorrect. By default, checks are run and any issues found are fixed.

-D or --debug

Output debug information by using the `-x` bash flag.

Requirements

The user must have sudo/root permissions.

vision-stop.sh

Usage

```
# vision-stop.sh
```

Description

Used to stop the IBM Visual Insights application and required Kubernetes services.

Requirements

The user must have sudo/root permissions.

Troubleshooting

collect_logs.sh

Usage

```
# collect_logs.sh
```

Description

Utility for collecting system logs and information, and IBM Visual Insights application logs and information. The utility creates a single `tar.gz` file with the logs and configuration files that can be provided to IBM support to investigate issues.

Requirements

The user must have sudo/root permissions.

Cleanup and uninstall

purge_data

Usage

```
# purge_data.sh
```

Description
Remove log and runtime data used by the IBM Visual Insights application. This **does not** remove the data sets and models created by application users. This data is in `<install_dir>/volume`, and must be removed manually.

Requirements
The user must have the required file system permissions.

purge_images

Usage

```
# purge_image.sh <release_tag>
```

Description
All IBM Visual Insights Docker images matching the tag will be removed from the Docker repository. This script can be used to clean up images from a priorIBM Visual Insights installation after an upgrade, or to remove IBM Visual Insights images when uninstalling the product.

For example, to remove Docker images for the 1.2.0.0 release from the Docker repository, run this command:

```
# purge_images 1.2.0.0
```

You can use the `docker images` command to see what containers are in your Docker repository that are be associated with previous releases and can be purged.

Requirements
The user must have Docker group permissions.

Chapter 14. IBM Visual Insights Inference Server

With a IBM Visual Insights Inference server, you can quickly and easily deploy multiple models that were trained in IBM Visual Insights to a single server. These models are portable and can be used by many users and on different systems. This allows you to make trained models available to others, such as customers or collaborators.

Planning for IBM Visual Insights Inference Server

Ensure that the following requirements are met before installing IBM Visual Insights Inference Server.

- "Hardware requirements" on page 155
- "Platform requirements" on page 156
- "Software requirements" on page 156

Hardware requirements

Disk space requirements

- Installation - The Inference Server install package contains Docker containers for deployment on all supported platforms and requires 15 GB to download. Only the images needed for the platform will be installed by the `load_images.sh` operation, but this requires at least 70 GB available in the file system used by Docker, usually `/var/lib/docker`.
- Deploying a model - Models are extracted into the `/tmp` directory before loading. The size of the model depends on the framework, but at least 1 GB should be available in `/tmp` before deploying a model.

GPU model requirements

The Inference Server is supported only on NVIDIA Tesla GPUs: T4, V100, and P100.

GPU memory requirements

- For deployment, the amount of memory required depends on the type of model you want to deploy. To determine how large a deployed GoogLeNet, Faster R-CNN, Tiny Yolo v2, or Detectron model is, run `nvidia-smi` from the host after deployment. Find the corresponding PID that correlates to the model you deployed and look at the Memory Usage.

  Example:

```
$ nvidia-smi
Tue Feb 26 09:12:59 2019
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 418.29       Driver Version: 418.29       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|===============================+======================+======================|
|   0  Tesla P100-SXM2...  On   | 00000002:01:00.0 Off |                    0 |
| N/A   36C    P0    39W / 300W |   1853MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+
|   1  Tesla P100-SXM2...  On   | 00000003:01:00.0 Off |                    0 |
| N/A   38C    P0    42W / 300W |   4179MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+
|   2  Tesla P100-SXM2...  On   | 0000000A:01:00.0 Off |                    0 |
| N/A   63C    P0   243W / 300W |   3351MiB / 16280MiB |     73%      Default |
+-------------------------------+----------------------+----------------------+
|   3  Tesla P100-SXM2...  On   | 0000000B:01:00.0 Off |                    0 |
| N/A   35C    P0    31W / 300W |     10MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+


+-----------------------------------------------------------------------------+
| Processes:                                                       GPU Memory |
|  GPU       PID   Type   Process name                             Usage      |
|=============================================================================|
|    0     15735      C   /opt/miniconda2/bin/python                    958MiB |
|    0     16225      C   python                                        885MiB |
|    1     39541      C   python                                       2253MiB |
|    1     86043      C   /opt/miniconda2/bin/python                     958MiB |
|    1     86299      C   /opt/miniconda2/bin/python                     958MiB |
|    2    103835      C   /opt/miniconda2/bin/python                    3341MiB |
+-----------------------------------------------------------------------------+
```

- A custom model based on TensorFlow will take all remaining memory on a GPU. However, you can deploy it to a GPU that has at least 2 GB memory.

Platform requirements

- The Inference Server can be deployed on x86 and IBM Power Systems platforms.
- Detectron and SSD models require Nvidia GPUs. Other models can be deployed in CPU only environments.

Software requirements

Linux

- Red Hat Enterprise Linux (RHEL) RHEL 7.6 ALT (little endian) for POWER9
- RHEL 7.7 for x86
- Ubuntu 18.04

  Note: The Ubuntu Hardware Enablement (HWE) kernel is not supported. Kubernetes services do not function correctly, preventing IBM Visual Insights from starting successfully.

NVIDIA CUDA

- x86 - 10.1 or later drivers. For information, see the NVIDIA CUDA Toolkit website.
- ppc64le - 10.1 Update 1 (if fix pack 1 is not installed) or later drivers. If fix pack 1 is installed, 10.2 or later drivers are required. For information, see the NVIDIA CUDA Toolkit website.

Docker

- RHEL: docker-1.13.1
- Ubuntu: Docker CE or EE 18.06.01
- When running Docker, nvidia-docker 2 is supported. For RHEL 7.6, see Using nvidia-docker 2.0 with RHEL 7.

Unzip

The unzip package is required on the system to deploy the zipped models.

Installing Docker on IBM Visual Insights Inference Server

Follow these instructions to install Docker on Inference Server.

- Installing Docker on Red Hat Enterprise Linux (RHEL)
- Installing Docker on Ubuntu

Install Docker and nvidia-docker2 (RHEL)

Follow these steps to install Docker on RHEL. For full details, refer to https://github.com/NVIDIA/nvidia-docker#rhel-docker.

1. Install Docker:

   ```
   sudo yum install docker
   ```

   Note: docker-1.13.1-108.git4ef4b30.el7 has a known issue with the Nvidia GPUs. The docker-1.13.1-104.git4ef4b30.el7 version can explicitly be installed, or newer versions of RHEL Docker work as well. Ensure that docker-1.13.1-108.git4ef4b30.el7 is NOT installed.

2. Reboot the system.
3. Add the package repositories:

   On x86:

   ```
   distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
   curl -s -L https://nvidia.github.io/nvidia-docker/$distribution/nvidia-docker.repo |
   sudo tee /etc/yum.repos.d/nvidia-docker.repo
   sudo yum install -y nvidia-container-toolkit
   sudo systemctl restart docker
   ```

   On IBM Power:

   ```
   distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
   curl -s -L https://nvidia.github.io/docker/$distribution/docker.repo | sudo tee /etc/
   yum.repos.d/docker.repo
   sudo yum install -y nvidia-container-runtime-hook
   sudo systemctl restart docker
   ```

Install Docker and nvidia-docker2 (Ubuntu)

Use these steps to install Docker and nvidia-docker 2.

1. For Ubuntu platforms, a Docker runtime must be installed. If there is no Docker runtime installed yet, install Docker-CE on Ubuntu.

   IBM Power

   ```
   sudo apt-get update
   sudo apt-get install apt-transport-https ca-certificates curl gnupg-agent software-
   properties-common
   curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
   sudo add-apt-repository "deb [arch=ppc64el] https://download.docker.com/linux/ubuntu
   bionic stable"
   sudo apt-get update
   sudo apt-get install docker-ce=18.06.1~ce~3-0~ubuntu
   ```

   x86_64

   ```
   sudo apt-get update
   sudo apt-get install apt-transport-https ca-certificates curl gnupg-agent software-
   properties-common
   curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
   sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu
   bionic stable"
   sudo apt-get update
   sudo apt-get install docker-ce
   ```

2. Install `nvidia-docker 2`.

   ```
   curl -s -L https://nvidia.github.io/nvidia-docker/gpgkey | sudo apt-key add -
   distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
   curl -s -L https://nvidia.github.io/nvidia-docker/$distribution/nvidia-docker.list | sudo
   tee /etc/apt/sources.list.d/nvidia-docker.list
   sudo apt-get update
   sudo apt-get install nvidia-docker2
   sudo systemctl restart docker.service
   ```

3. For each userid that will run docker, add the userid to the docker group:

   ```
   sudo usermod -a -G docker <userid>
   ```

   Users must log out and log back in to pick up this group change.

4. Verify the setup.

   IBM Power

   ```
   nvidia-docker run --rm nvidia/cuda-ppc64le nvidia-smi
   ```

x86_64

```
nvidia-docker run --rm nvidia/cuda nvidia-smi
```

Note:

The **`nvidia-docker run`** command must be used with `docker-ce` (in other words, an Ubuntu host) to leverage the GPUs from within a container.

Installing, upgrading, and uninstalling IBM Visual Insights Inference Server Version 1.2.0

Follow these steps to install, upgrade, or uninstall IBM Visual Insights Inference Server.

- “Upgrading IBM Visual Insights Inference Server” on page 158
- “Installing from IBM Passport Advantage” on page 158
- “Installing from AAS” on page 159
- “Uninstalling IBM Visual Insights Inference Server” on page 160

Upgrading IBM Visual Insights Inference Server

The IBM Visual Insights Inference Server does not have any application state. A new version can be installed without any required upgrade steps.

The prior version of the application can be safely uninstalled before installing the new version - see “Uninstalling IBM Visual Insights Inference Server” on page 160.

To reduce disk space usage, the docker containers required for the prior version of the product can be purged - see “Uninstalling IBM Visual Insights Inference Server” on page 160.

Installing from IBM Passport Advantage

1. Download the product tar file from the IBM Passport Advantage website.
2. Optionally verify the downloaded product tar file by following the steps in this topic: “Verify the downloaded tar file” on page 43

   a. Download these files:

      For x86

      visual-insight-infer-x86-1.2.0.0-ppa.sig
      visual-insights-1.2.0.0-key.pub
      visual-insights-ocsp-1.2.0.0-key.pub
      visual-insights-ocspchain-1.2.0.0-key.pub

      For Power Systems :

      visual-insight-infer-ppc-1.2.0.0-ppa.sig
      visual-insights-1.2.0.0-key.pub
      visual-insights-ocsp-1.2.0.0-key.pub
      visual-insights-ocspchain-1.2.0.0-key.pub

3. Decompress the product tar file, change directories to the newly created directory, then run the installation command. For example, using the downloaded package for Power:

```
$ tar -xvf visual-insight-infer-ppc-1.2.0.1-ppa.tar
visual-insight-infer-ppc-1.2.0.1-ppa/
visual-insight-infer-ppc-1.2.0.1-ppa/visual-insights-inference-ppc64le-containers-1.2.0.1.tar
visual-insight-infer-ppc-1.2.0.1-ppa/visual-insights-inference-1.2.0.1-472.22b7a1d.ppc64le.rpm
visual-insight-infer-ppc-1.2.0.1-ppa/visual-insights-inference_1.2.0.1-472.22b7a1d_ppc64el.deb
$ cd visual-insight-infer-ppc-1.2.0
```

Run the installation command for the platform you are installing on:

RHEL
: `sudo yum install ./<`*`file_name`*`>.rpm`

Ubuntu
: `sudo dpkg -i ./<`*`file_name`*`>.deb`

4. Load the product Docker images with the container tar file:

   ```
   /opt/ibm/vision-inference/bin/load_images.sh -f <tar_file>
   ```

   The file name has this format: `visual-insights-inference-\<`*`arch`*`\>-containers-\<`*`release`*`\>.tar`, where \<*arch*\> is x86 or ppc, and \<*release*\> is the product version being installed.

   IBM Visual Insights Inference Server will be installed at `/opt/ibm/vision-inference`.

Installing from AAS

1. Download the product tar.gz file from Advanced Administration System (AAS). This system is also called Entitled Software Support (ESS).
2. Unzip and untar the tar.gz file by running this command.

   ```
   gunzip -c file_name.tar.gz | tar -xvf
       -
   ```

   This will extract the following files:

   On Power Systems :

   visual-insight-infer-aas-ppc-1.2.0.0.sig
   visual-insight-infer-aas-ppc-1.2.0.0.tar.gz
   visual-insights-1.2.0.0-key.pub
   visual-insights-ocsp-1.2.0.0-key.pub
   visual-insights-ocspchain-1.2.0.0-key.pub

   On x86:

   visual-insight-infer-x86-1.2.0.0-aas.sig
   visual-insight-infer-aas-x86-1.2.0.0.tar.gz
   visual-insights-1.2.0.0-key.pub
   visual-insights-ocsp-1.2.0.0-key.pub
   visual-insights-ocspchain-1.2.0.0-key.pub
3. (Optional) Verify the downloaded tar file by following the instructions in this topic: "Verify the downloaded tar file" on page 43.

4. Unzip and untar the appropriate tar.gz file, `visual-insts-inferenc-aas-<arch>-<version>.tar.gz`, where <*arch*> is x86 or ppc and <*version*> is the product version:

   ```
   gunzip -c file_name.tar.gz | tar -xvf -
   ```

   The install files are extracted to `vision-inference-aas-1.2.0.0/`.
5. Decompress the product tar file, and run the installation command for the platform you are installing on:

   RHEL
   `sudo yum install ./<file_name>.rpm`

   Ubuntu
   `sudo dpkg -i ./<file_name>.deb`
6. Load the product Docker images with the container tar file:

   ```
   /opt/ibm/vision-inference/bin/load_images.sh -f <tar_file>
   ```

   The file name has this format: `visual-insights-inference-\<arch\>-containers-\<release\>.tar`, where \<*arch*\> is x86 or ppc, and \<*release*\> is the product version being installed.

   IBM Visual Insights Inference Server will be installed at `/opt/ibm/vision-inference`.

Uninstalling IBM Visual Insights Inference Server

Follow these steps to uninstall IBM Visual Insights Inference Server:

1. It is recommended that deployed models be undeployed, see "Stopping a deployed model" on page 163.
2. To recover disk space, run `docker rmi` to remove the "deploy" docker images with the current release tag. For example, to remove all deploy images for the 1.2.0.0 release:

   ```
   $ for deploy_img in $(docker images --format '{{.Repository}}:{{.Tag}}' | egrep 'vision-dnn-
   [a-z]*[-]*deploy[-]*[a-z0-9]*\:1.2.0.0') ; do docker rmi ${deploy_img} ; echo "Purged image $
   {deploy_img}." ; done
   ```
3. Optionally also uninstall the package:
   - For RHEL:

     ```
     sudo yum remove visual-insights-inference
     ```
   - For Ubuntu:

     ```
     sudo dpkg --remove visual-insights-inference
     ```

Deploying a trained model on IBM Visual Insights Inference Server Version 1.2.0

After training and exporting a model via IBM Visual Insights, you can deploy it in Inference Server.

See "Exporting a model" in "Importing, exporting, and downloading IBM Visual Insights information" on page 98 for instructions to export a model.

The following types of models of models trained in IBM Visual Insights can be deployed:

- Object detection using Faster R-CNN (default), tiny-YOLO V2, Detectron, Single Shot Detector (SSD) (POWER only; x86 deployment not supported), custom TensorFlow or PyTorch models, and Keras models.

- Image classification using GoogLeNet (default) and custom TensorFlow or PyTorch models.
- "Deploying a trained model" on page 161
- "Deployment output" on page 161
- "Stopping a deployed model" on page 163

Deploying a trained model

To deploy a model, run this command:

```
/opt/ibm/vision-inference/bin/deploy_zip_model.sh
```

Note: The first time you run this command, you are prompted to accept the license agreement.

Usage:

```
./deploy_zip_model.sh -m <model-name> -p <port> -g <gpu> -t <time-limit> zipped_model_file
```

model-name
The docker container name for the deployed model.

port
The port to deploy the model to.

gpu
The GPU to deploy the model to. If specified as -1, the model will be deployed to a CPU.

Note: Detectron and SSD models cannot be deployed to a CPU.

time-limit
(Optional) Specify the time out limit for model deployment in seconds. The default value is 180 seconds.

zipped_model_file
The full path and file name of the trained model that was exported from IBM Visual Insights. It can be an image classification model or an object detection model, but must be in zip format.

Examples:

```
/opt/ibm/vision-inference/bin/deploy_zip_model.sh --model dog --port 6001 --gpu 1 ./
dog_classification.zip
/opt/ibm/vision-inference/bin/deploy_zip_model.sh --m car -p 6002 -g -1 /home/user/mydata/
car.zip
/opt/ibm/vision-inference/bin/deploy_zip_model.sh -m coco -p 6001 -g 1 /home/user/model/
new_models/cdb-coco-30k_model.zip
```

Deployment output

There are several different results you might see when you deploy a model. For example:

Success
If a model is deployed successfully, it reports back with the message "Successfully deployed model."

```
/opt/ibm/vision-inference/bin/deploy_zip_model.sh -m coco -p 6001 -g 1 /home/user/model/
new_models/cdb-coco-30k_model.zip

Successfully deployed model.

Deployed in 22 seconds
```

Failure
If the deployment fails, it reports back with log information from the docker container, including error messages regarding the failure. Some possible error examples follow. See "Troubleshooting known issues - IBM Visual Insights Inference Server" on page 184 for details about dealing with errors.

- Ran out of GPU memory

```
root@hostname ~]# /opt/ibm/vision-inference/bin/deploy_zip_model.sh -m
user_detectron_cars8 -p 7018 -g 1 /root/inference-only-testing/cars_detectron_model.zip
Deployment failed. Here are logs before the failure:
  File "/opt/detectron/detectron/core/test_engine.py", line 331, in
initialize_model_from_cfg
    model, weights_file, gpu_id=gpu_id,
  File "/opt/detectron/detectron/utils/net.py", line 112, in
initialize_gpu_from_weights_file
    src_blobs[src_name].astype(np.float32, copy=False))
  File "/usr/local/lib/python2.7/dist-packages/caffe2/python/workspace.py", line 321, in
FeedBlob
    return C.feed_blob(name, arr, StringifyProto(device_option))
RuntimeError: [enforce fail at context_gpu.cu:359] error == cudaSuccess. 2 vs 0. Error
at: /tmp/pytorch/caffe2/core/context_gpu.cu:359: out of memory
root        : INFO     Callback message: {'msgId':
'6ef7e371-1209-47b3-94c3-940640324ac8', 'msgReturnCode': 'ErrModelLoading', 'msgDesc':
'Traceback (most recent call last):\n  File "/opt/DNN/dnn/deploy_process.py", line 165,
in modelLoading\n    self.caller.onModelLoading()\n  File "/opt/DNN/dnn_impl/
cod_detectron/deploy_service.py", line 64, in onModelLoading\n    self.model =
infer_engine.initialize_model_from_cfg(self.deploy)\n  File "/opt/detectron/detectron/
core/test_engine.py", line 331, in initialize_model_from_cfg\n    model, weights_file,
gpu_id=gpu_id,\n  File "/opt/detectron/detectron/utils/net.py", line 112, in
initialize_gpu_from_weights_file\n    src_blobs[src_name].astype(np.float32, copy=False))
\n  File "/usr/local/lib/python2.7/dist-packages/caffe2/python/workspace.py", line 321,
in FeedBlob\n    return C.feed_blob(name, arr, StringifyProto(device_option))
\nRuntimeError: [enforce fail at context_gpu.cu:359] error == cudaSuccess. 2 vs 0. Error
at: /tmp/pytorch/caffe2/core/context_gpu.cu:359: out of memory \n', 'msgState':
'aborted', 'msgTime': 1551801403956}
root        : INFO     Wait 5s for messaging completed...
[root@hostname ~]#
```

- Invalid GPU ID specified

```
[root@hostname ~]# /opt/ibm/vision-inference/bin/deploy_zip_model.sh -m
user_detectron_cars8 -p 7018 -g 5 /root/inference-only-testing/cars_detectron_model.zip
        Deployment failed. Here are logs before the failure:
  Failed building wheel for nvidia-ml-py
  Running setup.py clean for nvidia-ml-py
Failed to build nvidia-ml-py
Installing collected packages: nvidia-ml-py
  Running setup.py install for nvidia-ml-py: started
    Running setup.py install for nvidia-ml-py: finished with status 'done'
Successfully installed nvidia-ml-py-375.53.1
You are using pip version 8.1.1, however version 19.0.3 is available.
You should consider upgrading via the 'pip install --upgrade pip' command.
Cannot find gpu 5.
[root@hostname ~]#
```

- Processing was interrupted:

```
/usr/bin/docker-current: Error response from daemon: Conflict. The container name "/
decrypt" is already in use by container
ec0932898a65b82ed47504c8baa2507046d7bb0fcf460405d6201d3088bc9731.
You have to remove (or rename) that container to be able to reuse that name.
```

To fix the problem, run these commands:

```
docker stop decrypt
docker rm decrypt
```

- Tried to deploy a Detectron model on a CPU:

```
[root@hostname ~]# /opt/ibm/vision-inference/bin/deploy_zip_model.sh -m
user_detectron_cars8 -p 7018 -g -1 /root/inference-only-testing/cars_detectron_model.zip
Deployment failed. Here are logs before the failure:
  Failed building wheel for nvidia-ml-py
  Running setup.py clean for nvidia-ml-py
Failed to build nvidia-ml-py
Installing collected packages: nvidia-ml-py
  Running setup.py install for nvidia-ml-py: started
    Running setup.py install for nvidia-ml-py: finished with status 'done'
Successfully installed nvidia-ml-py-375.53.1
You are using pip version 8.1.1, however version 19.0.3 is available.
You should consider upgrading via the 'pip install --upgrade pip' command.
```

```
We currently do not support CPU mode for Detectron models.
[root@hostname ~]#
```

- Deployment times out:

  ```
  [root@hostname ~]# /opt/ibm/vision-inference/bin/deploy_zip_model.sh -t 15 -m
  user_custom_cars3 -p 7008 -g -1 /root/inference-only-testing/cars_keras-
  frcnn_custom_model.zip
  Deployment timed out at 15 seconds
  ```

  If the deployment times out, increase the time limit by using the `-t` option.

Stopping a deployed model

To stop the deployed model, run the following commands. When you stop the deployed model, the GPU memory is made available.

```
docker stop <model-name>
docker rm <model-name>
```

Example 1:

```
docker stop dog
docker rm dog
```

Example 2:

```
docker stop car
docker rm car
```

Performing an inference with IBM Visual Insights Inference Server

Inference can be done by using the deployed model with a local image file or a URL to an uploaded image file.

- "Performing an inference" on page 163
- "Inference output" on page 164

Performing an inference

Use this information to perform an inference.

Optional Parameters:

confthre
Confidence threshold. Specify a value in the range [0.0,1.0], treated as a percentage. Only results with a confidence greater than the specified threshold are returned. The smaller confidence threshold you specify, the more results are returned. If you specify 0, many, many results will be returned because there is no filter based on the confidence level of the model. The default value is 0.5.

containRle
This option is only available for Detectron models. If this is true, the inference output will include RLEs of the segments. The default value is false.

containPolygon
This option is only available for Detectron models. If it is set to true, the polygon for the segments is included in the output. The default value is true.

GET method:

Required Parameters:

imageurl
The URL address of the image. The URL must start with http:// or https://.

Example:

```
    curl -G -d "imageurl=https://ibm.box.com/shared/static/
i98xa4dfpff6jwv0lxmcu4lybr8b5kxj.jpg&confthre=0.7&containPolygon=false&containRle=true" http://
localhost:5000/inference
```

POST method:

Required Parameters:

imagefile
The name of the image file to be used for inference.

Example:

```
    curl -F "imagefile=@$DIR/data/bird.jpg" \
         -F "confthre=0.7" \
         -F "containPolygon=false" \
         -F "containRle=true" \
         http://localhost:5000/inference
```

Example 1 - Classification:

```
curl -F "imagefile=@/home/testdata/cocker-spaniel-dogs-puppies-1.jpg" http://localhost:6001/
inference
```

Example 2 - Object detection:

```
curl -G -d "imageurl=https://assets.imgix.net/examples/couple.jpg" http://localhost:6002/
inference
```

Example 3 – Object detection of a tiny YOLO model with confidence threshold:

```
curl -F "imagefile=@/home/testdata/Chihuahua.jpeg" –F "confthre=0.8" http://localhost:6001/
inference
```

Note: Confidence threshold works for Faster R-CNN, Detectron, and tiny YOLO object detection models and GoogLeNet image classification models.

Example 4 - Object detection of a Detectron model that contains polygon segments instead of RLEs (default setting)

```
curl -F "imagefile=@/home/user/model/new_models/pics/cars.jpg" -F "confthre=0.98" http://
localhost:6001/inference
```

Example 5 - Object detection of a Detectron model that contains RLE segments instead of a polygon:

```
curl -F "imagefile=@/home/user/model/new_models/pics/cars.jpg" -F "confthre=0.98" -F
"containRle=true" -F "containPolygon=false" http://localhost:6001/inference
```

Inference output

The IBM Visual Insights Inference Server can deploy image classification and object detection models.

Image classification model
A successful classification will report something similar to the following:

Example 1 output - success

```
{"classified": {"Cocker Spaniel": 0.93}, "result": "success"}
```

The image has been classified as a Cocker Spaniel with a confidence of .93.

Example 1 output - fail

```
{"result": "fail"}
```

The image could not be classified. This might happen if the image could not be loaded, for example.

Object detection model

A successful detection will report something similar to the following:

Example 2 output - success

```
{"classified": [{"confidence": 0.94, "ymax": 335, "label": "car", "xmax": 576,
                  "xmin": 424, "ymin": 160, "attr": []}], "result": "success"}
```

The cars in the image are located at the specified coordinates. The confidence of each label is given.

Example 2 output - success

```
{"classified": [], "result": "success"}
```

Object detection was carried out successfully, but there was nothing to be labeled that has confidence above the threshold.

Example 2 output - fail

```
{"result": "fail"}
```

Objects could not be detected. This might happen if the image could not be loaded, for example.

Example 4 output - success

The output includes a rectangle and polygon.

```
{"classified": [{"confidence": 0.9874554872512817, "ymax": 244, "label": "car", "xmax":
391, "xmin": 291, "ymin": 166, "polygons": [[[325, 170], [322, 172], [318, 172], [311,
178], [311, 181], [300, 189], [297, 189], [289, 195], [289, 232], [297, 238], [297, 240],
[304, 246], [307, 246], [315, 240], [322, 240], [325, 238], [369, 238], [372, 240], [387,
240], [394, 235], [394, 198], [387, 192], [387, 189], [383, 187], [383, 184], [376, 178],
[376, 175], [372, 172], [369, 172], [365, 170]]]}], "result": "success"}
```

Example 5 output - success

The output includes a rectangle and rle.

```
{"classified": [{"confidence": 0.9874554872512817, "ymax": 244, "rle":
"RXb3h0e;e0^02nDcNl:b101000200000001000101N201N201N2010001010001010000010000010000000000010000
00000010000000000000000000000000000000000000000000000000000000000001000010000100010101010
10001010102N102N2N100N202M2N4Kmm2", "label": "car", "xmax": 391, "xmin": 291, "ymin":
166}], "result": "success"}
```

Inference on embedded edge devices

Using edge computing for your inference models helps save processing time by removing latency issues, ensures security, and also decreases bandwidth usage. This topic describes how to use IBM Visual Insights with embedded edge devices.

- A full end to end use case is available if you use the DeepRed FPGA by V3 Technology that takes camera input, analyzes the video, and outputs the video with bounding-boxes on an HDMI attached device. See the section "Inference on DeepRED" on page 165 for details.
- If you want to create your own solution or have a different FPGA board, then use the information in this section: "Inference with a custom solution" on page 166.

Inference on DeepRED

DeepRED is an embedded artificial intelligence development system that supports IBM Visual Insights. It lets you quickly deploy the trained model for testing and production.

Generate an IP core for use with DeepRED:

1. Perform customization. For DEEPRED this is not optional. If they want to use DEEPRED, they need to change the ZC706 to DEEPRED in the configmap (both instances of it). They should not add custom DSP_NUM, etc.

2. Perform optional customization.

   a. On the IBM Visual Insights host operating system, run the appropriate command.

      - For a standard install:

        ```
        $ /opt/ibm/vision/bin/kubectl.sh edit configmap vision-config
        ```

      - For IBM Visual Insights installed on IBM Cloud Private:

        ```
        $ kubectl edit configmap vision-release_name-config
        ```

   b. Find the row beginning `EMB_COD_IMAGE` in the configuration file and replace `ZC706` with `DEEPRED`:

      ```
      "EMB_COD_IMAGE": ["DEEPRED,DEEPRED,vision-dnn-edge:1.2.0.0"],
      ```

   c. Save and exit.

3. Restart IBM Visual Insights by running the appropriate command. The deleted pods will automatically restart.

   - For a standard install:

     ```
     $ /opt/ibm/vision/bin/kubectl.sh delete pod -l app=vision
     ```

   - For IBM Visual Insights installed on IBM Cloud Private:

     ```
     $ kubectl delete pod -l app=vision-release_name
     ```

4. Train your model.

   - On the **Train data set** page, for **Type of training**, select **Object detection**.
   - Under **Advanced options**, choose **Optimized for speed**

5. Copy the IP core file for compilation. The generated FPGA IP core is named *UUID*-ipcore.zip, where *UUID* is the UUID of the trained model. It is stored in the following location:

   - For a standard install: `/opt/ibm/vision/volume/data/trained-models`.
   - For IBM Visual Insights installed on IBM Cloud Private, it is stored in your Persistent Volume under `` `<PATH_TO_VOLUME>/data/trained-models``.

Inference with a custom solution

Using a custom solution requires appropriate hardware and software, as well as FPGA development skills. You must be able to:

- Take an existing IP core and use Vivado to merge it into a custom solution. Refer to the PIE DNN Accelerator IP Integration Guide.pdf for instructions to integrate the generated DNN IP core into your project.
- Set up and use Vivado, Petalinux, and other software.

Environment requirements

- A chip set that can provide enough BRAM, such as Xilinx 7035 or later
- A board with PL side (not just PS side) DRAM so that it can provide sufficient bandwidth between the FPGA and DRAM.

Follow these steps to generate an IP core for use with a custom solution. The examples included are for a ZC706 card:

1. Perform optional customization.

   By default, IBM Visual Insights is configured to use the following resources on a ZC706 card. However, you can customize these values.

DSP_NUM=700
RAM18E_NUM=800
DDR_BANDWIDTH=80000.0
DDR_DATA_WIDTH=512
FPGA_TYPE=xc7z045ffg900-2

a. On the IBM Visual Insights host operating system, run the appropriate command.

   - For a standard install:

     ```
     $ /opt/ibm/vision/bin/kubectl.sh edit configmap vision-config
     ```

   - For IBM Visual Insights installed on IBM Cloud Private:

     ```
     $ kubectl edit configmap vision-release_name-config
     ```

b. Find the row beginning `EMB_COD_IMAGE` in the configuration file and input your custom values.

   For example, for a ZC706 card, replace **ZC706** with the appropriate values for your card:`"EMB_COD_IMAGE": ["ZC706,`**`ZC706`**`,vision-dnn-edge:1.2.0.0"],` as shown here:

   ```
   "EMB_COD_IMAGE": ["ZC706,DSP_NUM=700:RAM18E_NUM=800:DDR_BANDWIDTH=80000.0:
   DDR_DATA_WIDTH=512:FPGA_TYPE=xcvu9pl2fsgd2104e,vision-dnn-edge:1.2.0.0"],
   ```

c. Save and exit.

2. Restart IBM Visual Insights by running the appropriate command. The deleted pods will automatically restart.

   - For a standard install:

     ```
     $ /opt/ibm/vision/bin/kubectl.sh delete pod -l app=vision
     ```

   - For IBM Visual Insights installed on IBM Cloud Private:

     ```
     $ kubectl delete pod -l app=vision-release_name
     ```

3. Train your model.

   - On the **Train data set** page, for **Type of training**, select **Object detection**.
   - Under **Advanced options**, choose **Optimized for speed**

4. Copy the IP core file for compilation. The generated FPGA IP core is named *UUID*-ipcore.zip, where *UUID* is the UUID of the trained model. It is stored in the following location:

   - For a standard install: `/opt/ibm/vision/volume/data/trained-models`.
   - For IBM Visual Insights installed on IBM Cloud Private, it is stored in your Persistent Volume under `` `<PATH_TO_VOLUME>/data/trained-models``.

Decrypting a trained model

Models trained and exported by version 1.1.4 and earlier versions of IBM Visual Insights are encrypted and are intended for deployment in IBM Visual Insights Training and Inference or Inference Server products. Starting with version 1.1.5, trained and exported models are not encrypted.

You can decrypt a model that was trained with IBM Visual Insights 1.1.4 or earlier by running `decrypt_zip_model`. This will allow data scientists to understand the weights and networks configured by IBM Visual Insights and possibly use that information to further train the model. The decrypted model can also be used to port these models to edge devices not supported by IBM Visual Insights.

Usage: `/opt/ibm/vision-inference/bin/decrypt_zip_model.sh [-h|--help] | [ [-o` *`string`* `]` *`model_file`*`.zip]`

output
   Specifies the file name for the output decrypted model.

model_file
A trained model exported from IBM Visual Insights.

Example:

```
/opt/ibm/vision-inference/bin/decrypt_zip_model.sh -o car_frcnn_decrypted.zip
car_frcnn.zip
```

This will generate a new zip file car_frcnn_decrypted.zip, which is not password protected.

Chapter 15. Troubleshooting and contacting support

To isolate and resolve problems with your IBM products, you can use the following troubleshooting and support information. This information contains instructions for using the problem-determination resources that are provided with your IBM products, including IBM Visual Insights.

Troubleshooting known issues - IBM Visual Insights standard install

Following are some problems you might encounter when using IBM Visual Insights, along with steps to fix them.

- "Action detection training fails, video inference does not process full video, or auto-capture does not capture frames in full video" on page 170
- "Action detection training fails some instances with error Internal Server Error - Generic exception thrown" on page 170
- "When importing a DICOM format file, the Waiting for import... notification does not go away" on page 171
- "The IBM Visual Insights user interface does not work" on page 171
- "Resource pages are not being populated in the user interface" on page 171
- "Unexpected / old pages displayed when accessing the user interface" on page 171
- "IBM Visual Insights does not play video" on page 172
- "IBM Visual Insights cannot train or deploy models after reboot" on page 172
- "A Tiny YOLO V2 model fails to train with a small data set" on page 172
- "A Tiny YOLO V2 model fails to train using a data set with many similar bounding boxes" on page 172
- "Tiny YOLO V2 models do not train, but other models train" on page 173
- "Changing the port for the IBM Visual Insights user interface" on page 173
- "Out of space error from load_images.sh" on page 174
- "GPUs are not available for training or inference" on page 175
- "I forgot my user name or password" on page 174
- "IBM Visual Insights cannot train a model" on page 175
- "Thumbnails do not load or images previews are missing" on page 176
- "Training or deployment hangs - Kubernetes pod cleanup" on page 176
- "Training fails with error indicating "You must retrain the model."" on page 177
- "Training or deployment of models fails - sometimes inconsistently" on page 177
- "Model import generates an error alert" on page 178
- "Model training and inference fails" on page 177
- "Model accuracy value is unexpected" on page 178
- "Deployed models stuck in "Starting"" on page 178
- "Auto labeling of a data set returns "Auto Label Error"" on page 178
- "IBM Visual Insights does not start" on page 178
- "IBM Visual Insights does not start with non-default Docker root directory" on page 179
- "IBM Visual Insights fails to start - Kubernetes connection issue" on page 180
- "IBM Visual Insights startup hangs - helm issue" on page 181
- "Helm status errors when starting IBM Visual Insights" on page 182
- "Uploading a large file fails" on page 183
- "Some IBM Visual Insights functions don't work" on page 183

Action detection training fails, video inference does not process full video, or auto-capture does not capture frames in full video

Problem

Operations on a video (auto-capture, frame capture, or video inference) do not process the full video, or training of an action detection model fails.

IBM Visual Insights uses video processing utilities to read frames from the videos and some videos cannot be fully processed.

If an action detection training failed, the **video-service** log can be checked for specific errors that indicate this failure. For example, the following command shows the `ERROR` for a failed training because only 613 of the 741 frames in the video could be read:

```
# kubectl logs  `kubectl get pods -o custom-columns=NAME:.metadata.name | grep vision-service`
| grep -A2 -C2 ERROR
root        : INFO     processing 000500/000741 ...
root        : INFO     processing 000600/000741 ...
root        : ERROR    Could not read frame 614.
root        : INFO     Extract video as RGB frame is completed 614
root        : INFO     complete extracting video /opt/ibm/vision/data/admin/datasets/
fd1d7222-2800-4585-b711-000120592811/training/fc575915-5be5-42c8-8d8b-125d5c7a85e2/96c9b3d2-
da24-4e1d-b624-d8ce3141be97.mp4
```

Solution

Try one of these options to solve this problem:

- **Recreate the video** - Use a video processing tool to recreate the video in a standardized format. Such tools can regenerate the video using commonly used and supported video codecs.
- **Avoid labeling past failing frame** - After identifying the problematic point in the video by using product logs or attempting to capture at different frames in the video, ensure that there are no labeled actions that start or end past the problematic point in the video.

Action detection training fails some instances with error "Internal Server Error - Generic exception thrown"

Problem

Multiple action detection labels are selected and renamed. When training is attempted, it fails with Generic exception thrown.

Solution

Rename each label individually, then train the model again.

Postgres Kubernetes pod fails to start

Problem

The IBM Visual Insights application does not start, and the Kubernetes node status indicate the `postgres` pod is in `CrashLoopBackOff` state. For example:

```
vision-elasticsearch-59b9b89b56-8h9bt       1/1    Running          0         2m41s
vision-fpga-device-plugin-q9p7b             1/1    Running          0         2m41s
vision-keycloak-98d6cf9db-jfvgl             0/1    Init:0/1         0         2m41s
vision-logstash-7778f58977-b2bqg            1/1    Running          0         2m41s
vision-mongodb-5c9956d784-ws8h4             1/1    Running          0         2m41s
vision-postgres-769698d5c4-j5wtm            0/1    CrashLoopBackOff  4        2m41s
vision-service-6c48b5688b-lmcs2             1/1    Running          0         2m41s
vision-taskanaly-6c8bbb9868-t4xxr           1/1    Running          0         2m41s
vision-ui-589dbd466-sk9tk                   1/1    Running          0         2m41s
vision-video-microservice-5678fbdcbc-kfn85  1/1    Running          0         2m41s
```

Solution

The problem may be related to system configuration that prevents the postgres pod from running successfully. When the log is captured successfully for the pod it shows:

```
./kubectl logs vision-postgres-769698d5c4-sbpm2 -p
...
fixing permissions on existing directory /var/lib/postgresql/data ... ok
creating subdirectories ... ok
selecting default max_connections ... 10
selecting default shared_buffers ... 400kB
selecting dynamic shared memory implementation ... posix
creating configuration files ... ok
Bus error (core dumped)
child process exited with exit code 135
initdb: removing contents of data directory "/var/lib/postgresql/data"
running bootstrap script ...
```

The exit code 135 can occur when `huge pages` is enabled in the system configuration (reference https://github.com/docker-library/postgres/issues/451).

The solution can be to set `vm.nr_hugepages = 0` in `/etc/sysctl.conf` if it was set to non-zero, then reboot the system to have the new configuration take effect.

When importing a DICOM format file, the "Waiting for import..." notification does not go away

Problem

When using the IBM Visual Insights user interface on a Windows platform to import a DICOM file, the "Waiting for import..." notification does not automatically close.

Solution

There is no actual impact to the import of the image, and it should be visible in the data set view. The notification can safely be closed or deleted.

The IBM Visual Insights user interface does not work

Problem

You cannot label objects, view training charts, or create categories.

Solution

Verify that you are using a supported web browser. The following web browsers are supported:

- Google Chrome Version 60, or later
- Firefox Quantum 59.0, or later

Resource pages are not being populated in the user interface

Problem

Resource pages, such as data sets and models, are not being populated. Notifications indicate that there is an error obtaining the resource. For example, "Error obtaining data sets."

Solution

Check the status of the `vision-service` pod. This pod provides the data to the user interface, and until it is ready (`1/1`) with a status of `Running`, these errors will occur. See “Checking Kubernetes node status” on page 50 for instructions.

If the application is restarting, there is an expected delay before all services are available and fully functioning. Otherwise, this may indicate an unexpected termination (error) of the `vision-service` pod. If that happens, follow these instructions: “Gather IBM Visual Insights logs and contact support” on page 189.

Unexpected / old pages displayed when accessing the user interface

Problem

After updating, reinstalling, or restarting IBM Visual Insights, the browser presents pages that are from the previous version or are stale.

Solution

This problem is typically caused by the browser using a cached version of the page. To solve the problem, try one of these methods:

- Use a Firefox Private Window to access the user interface.
- Use a Chrome Incognito Window to access the user interface.
- Bypass the browser cache:
  - In most Windows and Linux browsers: Hold down `Ctrl` and press F5.
  - In Chrome and Firefox for Mac: Hold down ⌘ `Cmd` and ⇧ `Shift` and press R.

IBM Visual Insights does not play video

Problem

You cannot upload a video, or after the video is uploaded the video does not play.

Solution

Verify that your video is a supported type:

- Ogg Vorbis (.ogg)
- VP8 or VP9 (.webm)
- H.264 encoded videos with MP4 format (.mp4)

If your video is not in a supported format, transcode your video by using a conversion utility. Such utilities are available under various free and paid licenses.

IBM Visual Insights cannot train or deploy models after reboot

Problem

On RHEL 7.6 systems with CUDA 10.1, the SELinux context of NVIDA GPU files is lost at boot time. SELinux then prevents IBM Visual Insights from using the GPUs for training and deployment.

Solution

Restart IBM Visual Insights by running **`vision-stop.sh / vision-start.sh`**. This resets the problematic SELinux contexts if they are incorrect, restoring the ability to access GPUs for training and inference.

A Tiny YOLO V2 model fails to train with a small data set

Problem

When using a small data set with fewer than 15 labeled images, training a Tiny YOLO V2 model sometimes fails.

The vision-service log shows exceptions because of the ratio of images:

```
# kubectl logs  `kubectl get pods -o custom-columns=NAME:.metadata.name | grep vision-
service` | grep Exception | grep ratio
root        : INFO     Exception: Based on the ratio of 0.8, the data set was split into 13
training images and 0 test images. At least one test image is required. Please set a lower
ratio or add more images to the data set.
```

Solution

Try the training again, or follow the guidance in the message and increase the number of labeled images in the data set. See "Data set considerations" on page 69 for information.

A Tiny YOLO V2 model fails to train using a data set with many similar bounding boxes

Problem

When using a data set with many images and similar bounding boxes, training a Tiny YOLO V2 model may fail. The model requires unique bounding box "anchors" to successfully trained.

The vision-service log shows an error because of the ratio of images:

```
# kubectl logs  `kubectl get pods -o custom-columns=NAME:.metadata.name | grep vision-service`
| grep Error | grep anchor
root        : INFO     root        : ERROR    Requested to create 5 initial anchors but only
found 4 unique bounding box sizes in the data set. Please label more objects or make sure
there are at least 5 uniquly sized boxes.
```

Solution

Modify existing bounding boxes or use data augmentation to create new images with different bounding box anchors, then try the training again. See "Augmenting the data set" on page 97 for instructions.

Tiny YOLO V2 models do not train, but other models train

Problem

An object detection model cannot be trained using Tiny YOLO V2, but other object detection models, such as SSD, FR-CNN are training successfully.

Solution

Verify that the NVIDIA GPUs are not configured to run in "exclusive" mode. The nvidia-smi command can be used to ensure the GPUs are in "default" mode:

```
nvidia-smi -c 0
```

Compare the following `nvidia-smi` output to the standard `nvidia-smi` output by following these instructions: "Checking system GPU status" on page 60. It should show `E. Process` instead of `Default` for `Compute M.` in the final column:

```
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 418.87.00      Driver Version: 418.87.00      CUDA Version: 10.1 |
|-------------------------------+----------------------+----------------------+
| GPU Name Persistence-M     | Bus-Id Disp.A    |     Volatile Uncorr. ECC    |
| Fan Temp Perf Pwr:Usage/Cap| Memory-Usage     |     GPU-Util Compute M.     |
|===============================+======================+======================|
| 0 Tesla P100-SXM2... On    | 00000002:01:00.0 Off     |   0                 |
| N/A 30C P0 31W / 300W      | 0MiB / 16280MiB          |   0% E. Process     |
```

Changing the port for the IBM Visual Insights user interface

Problem

By default, the IBM Visual Insights user interface uses port 443, forwarded from port 80.

Solution

If you need to use either port for something else, follow these steps to change the IBM Visual Insights port.

1. If IBM Visual Insights is running, use the following command to stop it:

   ```
   $ /opt/ibm/vision/bin/vision-stop.sh
   ```

2. Change `/opt/ibm/vision/bin/port.sh`.
   - Update this line with the appropriate port: POWERAI_VISION_EXTERNAL_HTTP_PORT=**80**.
   - Update this line with the appropriate port: POWERAI_VISION_EXTERNAL_HTTPS_PORT=**443**.
3. Make sure the new port is open in your operating system's firewall by running the following command:

   ```
    $ /opt/ibm/vision/sbin/firewall.sh
   ```

4. Restart IBM Visual Insights by running the following command:

   ```
   $ /opt/ibm/vision/bin/vision-start.sh
   ```

Out of space error from load_images.sh

Problem

When installing the product, the `load_images.sh` script is used to load the IBM Visual Insights Docker images. The script might terminate with errors, the most frequent issue being insufficient disk space for loading the Docker images.

For example, the `/var/lib/docker` file system can run out of space, resulting in a message indicating that an image was not fully loaded. The following output shows that the Docker image `vision-dnn` was not able to be fully loaded because of insufficient file system space:

```
# df --output -BG "/var/lib/docker/"
Filesystem     Type  Inodes  IUsed   IFree IUse% 1G-blocks  Used Avail Use% File
Mounted on
/dev/vda2      ext4 8208384 595697 7612687    8%      124G   81G   37G  70% /var/lib/docker/ /
#

****************************************************************************************
892d6f64ce41: Loading layer [==================================================>]  21.26MB/
21.26MB
785af1d0c551: Loading layer [==================================================>]  1.692MB/
1.692MB
dc102f4a3565: Loading layer [==================================================>]  747.9MB/
747.9MB
aac4b03de02a: Loading layer [==================================================>]  344.1MB/
344.1MB
d0ea7f5f6aab: Loading layer [==================================================>]  2.689MB/
2.689MB
62d3d10c6cc2: Loading layer [==================================================>]  9.291MB/
9.291MB
240c4d86e5c7: Loading layer [==================================================>]    778MB/
778MB
889cd0648a86: Loading layer [==================================================>]  2.775MB/
2.775MB
56bbb2f20054: Loading layer [==================================================>]  3.584kB/
3.584kB
3d3c7acb72e2: Loading layer [================================>                  ]  2.117GB/
3.242GB
Error processing tar file(exit status 1): write /usr/bin/grops: no space left on device


[ FAIL ] Some images failed to load
[ FAIL ]   Failure info:
             Loading the PowerAI Vision docker images...
#
```

This situation can also be noted in the output from `/opt/ibm/vision/bin/kubectl get pods`. This command is described in Chapter 6, "Checking the application and environment," on page 47, which shows images that could not be loaded with a status of `ErrImagePull` or `ImagePullBackOff`.

Solution

The file system space for `/var/lib/docker` needs to be increased, even if the file system is not completely full. There might still be space in the file system where `/var/lib/docker` is located, but insufficient space for the IBM Visual Insights Docker images. There are operating system mechanisms to do this, including moving or mounting `/var/lib/docker` to a file system partition with more space.

After the error situation has been addressed by increasing or cleaning up disk space on the `/var/lib/docker/` file system, re-run the `load_images.sh` script to continue loading the images. No clean up of the previous run of `load_images.sh` is required.

I forgot my user name or password

Problem

You forgot your user name or password and cannot log in to the IBM Visual Insights GUI.

Solution

IBM Visual Insights uses an internally managed users account database. To change your user name or password, see Chapter 7, "Logging in to IBM Visual Insights," on page 61.

GPUs are not available for training or inference

Problem

If IBM Visual Insights cannot perform training or inference operations, check the following:

- Verify that the nvidia smi output shows all relevant information about the GPU devices. For example, the following output shows `Unknown error` messages indicating that the GPUs are not in the proper state:

```
Mon Dec  3 15:43:07 2018
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 410.72       Driver Version: 410.72       CUDA Version: 10.0     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|===============================+======================+======================|
|   0  Tesla V100-SXM2...  Off  | 00000004:04:00.0 Off |                    0 |
| N/A   31C    P0    49W / 300W | Unknown Error        |      0%      Default |
+-------------------------------+----------------------+----------------------+
...
```

- Verify that the **nvidia-persistenced** service is enabled and running (active) by using the command `sudo systemctl status nvidia-persistenced`:

```
# systemctl status nvidia-persistenced
*  nvidia-persistenced.service - NVIDIA Persistence Daemon
    Loaded: loaded (/etc/systemd/system/nvidia-persistenced.service; enabled; vendor
preset: disabled)
    Active: active (running) since Tue 2018-11-13 08:41:22 CST; 2 weeks 6 days ago
...
```

Solution

- If the GPU status indicates errors and the **nvidia-persistenced** service is not enabled and active, enable and start the service:

  1. Enable the service:

  ```
  sudo systemctl enable nvidia-persistenced
  ```

  2. Start the service:

  ```
  sudo systemctl start nvidia-persistenced
  ```

- If the **nvidia-persistenced** service is enabled but the Persistence-M state still shows Off, verify that the `udev` rules have been set correctly if the system is a RHEL server. See this topic for details: "NVIDIA Components: IBM POWER9 specific udev rules (Red Hat only)" on page 27.

IBM Visual Insights cannot train a model

Problem

The model training process might fail if your system does not have enough GPU resources or if there is not enough information defined in the model.

Note: If fix pack 1 is installed, training jobs are added to a queue, so training jobs will not fail due to lack of GPU resources.

Solution

- If you are training a data set for image classification, verify that at least two image categories are defined, and that each category has a minimum of five images.
- If you are training a data set for object detection, verify that at least one object label is used. You must also verify that each object is labeled in a minimum of five images.

- (Does not apply if fix pack 1 is installed.) Ensure that enough GPUs are available. GPUs are assigned as follows:
  - Each active training job takes one GPU.
  - Each Tiny YOLO V2, YOLO V3, Detectron, Single Shot Detector (SSD), Structured segment network (SSN), or custom deployed model takes one GPU. The GPU group is listed as '-', which indicates that this model uses a full GPU and does not share the resource with any other deployed models.
  - Multiple Faster R-CNN and GoogLeNet models are deployed to a single GPU. IBM Visual Insights uses packing to deploy the models. That is, the model is deployed to the GPU that has the most models deployed on it, if there is sufficient memory available on the GPU. The GPU group can be used to determine which deployed models share a GPU resource. To free up a GPU, *all* deployed models in a GPU group must be deleted (undeployed).

    Note: IBM Visual Insights leaves a 500MB buffer on the GPU.

  If a training job appears to be hanging, it might be waiting for another training job to complete, or there might not be a GPU available to run it.

  To determine how many GPUs are available on the system, view the GPU usage on the Models or Trained Models page in the user interface.

  If all the systems GPUs are in use, you can either delete the group of deployed models that are using a GPU (making the models unavailable for inference) or you can stop model that is being trained. The deployed models that share a GPU have the same group number. To free up a GPU, all deployed models in one group must be deleted.

  - To undeploy a model, click **Deployed Models**. Next, select the model that you want to undeploy and click the **X** (undeploy) in the header bar. The trained model is not deleted from IBM Visual Insights. You can redeploy the model later when more GPUs are available.
  - To stop a training model that is running, click **Models**. Next, select the model that has a status of **Training in Progress** and click **Stop Training**.

Thumbnails do not load or images previews are missing

Problem
IBM Visual Insights data set or model thumbnails do not load, or images are not visible when labeling or previewing an image.

Solution
Disable ad blockers, or exempt the IBM Visual Insights user interface from ad blocking.

Training or deployment hangs - Kubernetes pod cleanup

Problem
You submit a job for training or deployment, but it never completes. When doing training or deployments, sometimes some pods that are running previous jobs are not terminated correctly by the Kubernetes services. In turn, they hold GPUs so no new training or deployment jobs can complete. They will be in the Scheduled state forever.

To verify that this is the problem, run `kubectl get pods` and review the output. The last column shows the age of the pod. If it is older than a few minutes, use the information in the Solution section to solve the problem.

Example:

```
kubectl get pods
vision-infer-ic-06767722-47df-4ec1-bd58-91299255f6hxxzk 1/1 Running 0 22m
vision-infer-ic-35884119-87b6-4d1e-a263-8fb645f0addqd2z 1/1 Running 0 22m
```

```
vision-infer-ic-7e03c8f3-908a-4b52-b5d1-6d2befec69ggqw5 1/1 Running 0 5h
vision-infer-od-c1c16515-5955-4ec2-8f23-bd21d394128b6k4 1/1 Running 0 3h
```

Solution

Follow these steps to manually delete the deployments that are hanging.

1. Determine the running deployments and look for those that have been running longer than a few minutes:

   ```
   kubectl get deployments
   ```

2. Delete the deployments that were identified as hanging in the previous step.

   ```
   kubectl delete deployment deployment_id
   ```

3. You can now try the training or deploy again, assuming there are available GPUs.

Note: When a deployment is manually deleted, vision-service might try to recreate it when it is restarted. The only way to force Kubernetes to permanently delete it is to remove the failing model from IBM Visual Insights.

Training fails with error indicating "You must retrain the model."

Problem

Very long label names can result in training failures. Label or class names used in the data set are longer than 64 characters, and/or international characters that have multi-byte representation are used.

Solution

Label and class names should be 64 characters or less. Longer label names are supported but using international characters or very long label names can cause an internal metadata error, resulting in a training failure.

Model training and inference fails

Problem

The NVIDIA GPU device is not accessible by the IBM Visual Insights Docker containers. To confirm this, run `kubectl logs -f _vision-service-ID_` and then check pod`_vision-service-ID_vision-service.log` for an error indicating `error == cudaSuccess (30 vs. 0)`:

```
F0731 20:34:05.334903    35 common.cpp:159] Check failed: error == cudaSuccess (30 vs. 0)
unknown error
*** Check failure stack trace: ***
/opt/py-faster-rcnn/FRCNN/bin/train_frcnn.sh: line 24:    35 Aborted                 (core
dumped) _train_frcnn.sh
```

Solution

Use sudo to alter SELINUX permissions for all of the NVIDIA devices so they are accessible via the IBM Visual Insights Docker containers.

```
sudo chcon -t container_file_t /dev/nvidia*
```

Training or deployment of models fails - sometimes inconsistently

Problem

There is a known race issue on RHEL systems that can prevent Kubernetes from successfully initializing and using one or more GPUs. This issue is typically indicated by `cudaSuccess 3 vs. 0` errors that can be found in the log of the vision-service pod. To confirm this, follow these steps:

1. Run the following command:

   ```
   sudo /opt/ibm/vision/bin/kubectl logs `sudo /opt/ibm/vision/bin/kubectl get pods
      -o custom-columns=NAME:.metadata.name | grep vision-service` | grep cudaSuccess
   ```

2. Check the output for a message such as the following: `error == cudaSuccess (3 vs. 0)`:

```
F0731 20:34:05.334903    35 common.cpp:159]
     Check failed: error == cudaSuccess (3 vs. 0)  initialization error
     *** Check failure stack trace: ***
```

Solution
See the blog entry on this issue:What to do with “cudaSuccess (3 vs. 0) initialization error” on a POWER9 system?.

Model import generates an error alert

Problem
When you import a model, you get the error "The model was not imported. You can only import .zip files that were exported from an IBM Visual Insights model.".

Solution
This can occur when models are imported from older versions of IBM Visual Insights that do not include model metadata in the exported file, such as the model name or thumbnail image. The model should still be imported successfully and will be available on the model details page for deployment.

Model accuracy value is unexpected

Problem
A trained model has an unexpected value for accuracy, such as 0%, 100%, or "Unknown". This happens when there is not enough data for training to work properly.

Solution
Ensure that there are enough images in the data set for each category or object label. For details, see “Data set considerations” on page 69.

Deployed models stuck in "Starting"

Problem
IBM Visual Insights models remain in "Starting" state and do not become available for inference operations.

Solution
Delete and redeploy the models. One possible cause is that the IBM Visual Insights models were deployed in a prior version of the product that is not compatible with the currently installed version. For example, this can happen after upgrading.

Auto labeling of a data set returns "Auto Label Error"

Problem
Auto labeling cannot be performed on a data set that does not have unlabeled images, unless some of the images were previously labeled by the auto label function.

Solution
Ensure that the **Objects** section of the data set side bar shows there are objects that are "Unlabeled". If there are none, that is, if "Unlabeled (0)" is displayed in the side bar, add new images that are unlabeled or remove labels from some images, then run auto label again.

IBM Visual Insights does not start

Problem
When you enter the URL for IBM Visual Insights from a supported web browser, nothing is displayed. You see a 404 error or Connection Refused message.

Solution

Complete the following steps to solve this problem:

1. Verify that IP version 4 (IPv4) port forwarding is enabled by running the **/sbin/sysctl net.ipv4.conf.all.forwarding** command and verifying that the value for `net.ipv4.conf.all.forwarding` is set to 1.

   If IPv4 port forwarding is not enabled, run the **/sbin/sysctl -w net.ipv4.conf.all.forwarding=1** command. For more information about port forwarding with Docker, see UCP requires IPv4 IP Forwarding in the Docker success center.
2. If IPv4 port forwarding is enabled and the docker0 interface is a member of the trusted zone, check the Helm chart status by running this script:

   ```
   sudo /opt/ibm/vision/bin/helm.sh status vision
   ```

   In the script output, verify that the IBM Visual Insights components are available by locating the "related" section and identifying that the READY column has a value of 1 for each component. The following is an example of the output from the **helm.sh status vision** script that shows all components are available:

   ```
   ==> v1/Pod(related)
   NAME                                                READY  STATUS   RESTARTS  AGE
   vision-elasticsearch-576fbfbc9b-wt7m9       1/1    Running  0         3h13m
   vision-fpga-device-plugin-gnbgk             1/1    Running  0         3h13m
   vision-keycloak-6c947f47db-692rs            1/1    Running  0         3h13m
   vision-logstash-5d887486b5-rnzq5            1/1    Running  0         3h13m
   vision-mongodb-5bdc6c5d96-qhn7b             1/1    Running  0         3h13m
   vision-postgres-7b9955bf66-xcjlx            1/1    Running  0         3h13m
   vision-service-6c54c765fd-trfmd             1/1    Running  0         3h13m
   vision-taskanaly-57b7775484-cf87n           1/1    Running  0         3h13m
   vision-ui-bc984c7d6-jpjvn                   1/1    Running  0         3h13m
   vision-video-microservice-5c544967bc-sxj9n  1/1    Running  0         3h13m
   ```

   If you recently started IBM Visual Insights and some components are not available, wait a few minutes for these components to become available. If any components remain unavailable, gather the logs and contact IBM Support, as described in this topic: "Gather IBM Visual Insights logs and contact support" on page 189.
3. If the docker0 interface is a member of a trusted zone and all IBM Visual Insights components are available, verify that the firewall is configured to allow communication through port 443 (used to connect to IBM Visual Insights) by running this command:

   ```
   sudo firewall-cmd --permanent --zone=public --add-port=443/tcp
   ```

IBM Visual Insights does not start with non-default Docker root directory

Problem

The IBM Visual Insights application fails to start. "Checking Kubernetes node status" on page 50 shows the `vision-ui` pod failing to start, and dependent pods (`vision-service` and `vision-keycloak`) in `Init` state:

```
NAME                                                 READY   STATUS             RESTARTS
AGE   IP            NODE        NOMINATED NODE   READINESS GATES
vision-elasticsearch-7598c68579-cvvc6        1/1     Running            0          23h
172.17.0.9    127.0.0.1   <none>           <none>
vision-fpga-device-plugin-4tk6f              1/1     Running            0          23h
172.17.0.5    127.0.0.1   <none>           <none>
vision-keycloak-7884d55485-ngvlb              0/1     Init:0/1           0          23h
172.17.0.10   127.0.0.1   <none>           <none>
vision-logstash-59db969bd7-g7l79             1/1     Running            0          23h
172.17.0.11   127.0.0.1   <none>           <none>
vision-mongodb-5997fcfd57-flzzm              1/1     Running            0          23h
172.17.0.12   127.0.0.1   <none>           <none>
vision-postgres-cd4fdf548-gpkjp             1/1     Running            0          23h
172.17.0.13   127.0.0.1   <none>           <none>
vision-service-b6b8567b6-ckdr4              0/1     Init:1/2           0          23h
172.17.0.14   127.0.0.1   <none>           <none>
vision-taskanaly-84d4f88c48-tqs2c            1/1     Running            0          23h
172.17.0.6    127.0.0.1   <none>           <none>
vision-ui-66c7c4b8b8-wsjs2                    0/1     CrashLoopBackOff   280        23h
172.17.0.7    127.0.0.1   <none>           <none>
vision-video-microservice-b595d75b-llw55   1/1     Running            0          23h
172.17.0.8    127.0.0.1   <none>           <none>
```

The "kubectl describe pods command" on page 53 output for the `vision-ui` shows events indicating an issue with accessing the `resolv.conf` file, where `/mount/space` is a file path used for Docker data. For example:

```
$ kubectl describe pod vision-ui-66c7c4b8b8-wsjs2
Name:           vision-ui-66c7c4b8b8-wsjs2
...
Events:
  Type     Reason                  Age                   From                Message
  ----     ------                  ----                  ----                -------
  Normal   Scheduled               4m24s                 default-scheduler   Successfully
assigned default/vision-ui-589dbd466-bjmkb to 127.0.0.1
  Warning  FailedCreatePodSandBox  4m6s                  kubelet, 127.0.0.1  Failed create
pod sandbox: rpc error: code = Unknown desc = rewrite resolv.conf failed for pod "vision-
ui-66c7c4b8b8-wsjs2": ResolvConfPath "/mount/space/docker/containers/
4a26a137c352177bef6b2d5b99a9d16668c3f80fa88b0c45def1da90bb7d063c/resolv.conf" does not exist
  Normal   Started                 3m14s (x4 over 4m5s)   kubelet, 127.0.0.1  Started container
...
```

Solution

If `/var/lib/docker` is a symlink to a different file system space, this can cause issues with starting Kubernetes containers, as reported in https://github.com/kubernetes/kubernetes/issues/52655. The usage of the symlink must be avoided, alternatives include:

- Reallocating file system space so `/var/lib/docker` file system has sufficient space for the Docker containers and runtime data.
- Removing the symlink and using `mount --bind`.
- Configuring Docker to use the non-default root directory.

IBM Visual Insights fails to start - Kubernetes connection issue

Problem

There are different problems that can cause this issue:

- If the host system does not have a default route defined in the networking configuration the Kubernetes cluster will fail to start with connection issues. For example:

```
$ sudo /opt/ibm/vision/bin/vision_start.sh
[ INFO ] Starting kubernetes...
         Copying kubectl out of k8s image...
         Copying helm executable to /opt/ibm/vision/bin
Using /run/systemd/resolve/resolv.conf for name service configuration.
         Checking kubernetes cluster status...
         Probing cluster status #1: NotReady
         Probing cluster status #2: Ready
         Booting up ingress controller...
         Initializing helm...
         Initializing GPU device plugin...
```

- You might see this problem if `/opt` does not have enough space. For example:

```
[ INFO ] Starting kubernetes...
         Copying kubectl out of k8s image...
         Copying helm executable to /opt/ibm/vision/bin
Using /etc/resolv.conf for name service configuration.
         Checking kubernetes cluster status...
         Probing cluster status #1:
         Probing cluster status #2: NotReady
         Probing cluster status #3: NotReady
         Probing cluster status #4: NotReady
         Probing cluster status #5: NotReady
         Probing cluster status #6: NotReady
         Probing cluster status #7: NotReady
         Probing cluster status #8: NotReady
         Probing cluster status #9: NotReady
         Probing cluster status #10: NotReady
         Probing cluster status #11: NotReady

[ FAIL ] Retry timeout. Error in starting kubernetes cluster check logs
```

Solution

There are multiple possible solutions to this problem, depending on the underlying cause:

- Define a default route in the networking configuration.
  - For instructions to do this on Ubuntu, refer to the IP addressing section in the Ubuntu Network Configuration. Search for the steps to configure and verify the default gateway.
  - For instructions to do this on Red Hat Enterprise Linux (RHEL), refer to 2.2.4 Static Routes and the Default Gateway in the Red Hat Customer Portal.
- Confirm that at least five GB of free space exists in the file system that is hosting `/opt/ibm/vision/run`. Refer to Chapter 3, “Planning for IBM Visual Insights,” on page 17 for details on space requirements.

IBM Visual Insights startup hangs - helm issue

Problem

IBM Visual Insights startup hangs with the message "Unable to start helm within 30 seconds - trying again." For example:

```
root> sudo /opt/ibm/vision/bin/vision-start.sh
Checking ports usage...
Checking ports completed, no confict port usage detected.
[ INFO ] Setting up the GPU...
         Init cuda devices...
         Devices init completed!
         Persistence mode is already Enabled for GPU 00000004:04:00.0.
         Persistence mode is already Enabled for GPU 00000004:05:00.0.
         Persistence mode is already Enabled for GPU 00000035:03:00.0.
         Persistence mode is already Enabled for GPU 00000035:04:00.0.
         All done.
[ INFO ] Starting kubernetes...
         Checking kubernetes cluster status...
         Probing cluster status #1: NotReady
         Probing cluster status #2: NotReady
         Probing cluster status #3: NotReady
         Probing cluster status #4: Ready
         Booting up ingress controller...
         Initializing helm...
         [ WARN ] Unable to start helm within 30 seconds - trying again.  If this continues,
contact support.
         [ WARN ] Unable to start helm within 30 seconds - trying again.  If this continues,
contact support.
         [ WARN ] Unable to start helm within 30 seconds - trying again.  If this continues,
contact support.
         [ WARN ] Unable to start helm within 30 seconds - trying again.  If this continues,
contact support.
```

Solution

To solve this problem, you must follow these steps exactly as written:

1. Cancel IBM Visual Insights startup by pressing `ctrl+c`.
2. Stop IBM Visual Insights by running this command:

   ```
   sudo /opt/ibm/vision/bin/vision-stop.sh
   ```

3. Modify the RHEL settings as follows:

   ```
   sudo nmcli device set docker0 managed yes
   sudo nmcli connection modify docker0 connection.zone trusted
   sudo systemctl stop NetworkManager.service
   sudo firewall-cmd --permanent --zone=trusted --change-interface=docker0
   sudo systemctl start NetworkManager.service
   sudo nmcli connection modify docker0 connection.zone trusted
   sudo systemctl restart docker.service
   ```

4. Start IBM Visual Insights again:

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

If the above commands do not fix the startup issue, check for a cgroup leak that can impact Docker. A Kubernetes/Docker issue can cause this situation, and after fixing the firewall issue the start up can still fail if there was cgroup leakage.

One symptom of this situation is that the `df` command is slow to respond. To check for excessive cgroup mounts, run the `mount` command:

```
$ mount | grep cgroup | wc -l
```

If the cgroup count is in thousands, reboot the system to clear up the cgroups.

Helm status errors when starting IBM Visual Insights

Problem

There is an issue in some RHEL releases that causes the startup of IBM Visual Insights to fail after restarting the host system. When this is the problem, the system tries to initialize Helm at 30 second intervals but never succeeds. Therefore, the startup never succeeds. You can verify this status by running the Helm status vision command:

```
# /opt/ibm/vision/bin/helm status vision
```

Result:

```
Error: getting deployed release "vision": Get https://10.10.0.1:443/api/v1/namespaces/kube-
system/configmaps[...]: dial tcp 10.10.0.1:443: getsockopt: no route to host
```

Solution

To solve this problem, you must follow these steps exactly as written:

1. Cancel IBM Visual Insights startup by pressing `ctrl+c`.
2. Stop IBM Visual Insights by running this command:

   ```
   sudo /opt/ibm/vision/bin/vision-stop.sh
   ```

3. Modify the RHEL settings as follows:

   ```
   sudo nmcli device set docker0 managed yes
   sudo nmcli connection modify docker0 connection.zone trusted
   sudo systemctl stop NetworkManager.service
   sudo firewall-cmd --permanent --zone=trusted --change-interface=docker0
   sudo systemctl start NetworkManager.service
   sudo nmcli connection modify docker0 connection.zone trusted
   sudo systemctl restart docker.service
   ```

4. Start IBM Visual Insights again:

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

If the above commands do not fix the startup issue, check for a cgroup leak that can impact Docker. A Kubernetes/Docker issue can cause this situation, and after fixing the firewall issue the start up can still fail if there was cgroup leakage.

One symptom of this situation is that the `df` command is slow to respond. To check for excessive cgroup mounts, run the `mount` command:

```
$ mount | grep cgroup | wc -l
```

If the cgroup count is in thousands, reboot the system to clear up the cgroups.

Uploading a large file fails

When uploading files into a data set, there is a 24 GB size limit per upload session. This limit applies to a single .zip file or a set of files. When you upload a large file that is under 24 GB, you might see the upload start (showing a progress bar) but then you get an error message in the user interface. This error happens due to a Nginx timeout, where the file upload is taking longer than the defined 5 minute Nginx timeout.

Despite the notification error, the large file has been uploaded. Refreshing the page will show the uploaded files in the data set.

Some IBM Visual Insights functions don't work

Problem

IBM Visual Insights seems to start correctly, but some functions, like automatic labeling or automatic frame capture, do not function.

To verify that this is the problem, run `/opt/ibm/vision/bin/kubectl.sh get pods` and verify that one or more pods are in state `CrashLoopBackOff`. For example:

```
kubectl get pods
NAME                                                              READY     STATUS
RESTARTS   AGE
...
vision-video-rabmq-5d5d786f9f-7jfk9                      0/1       CrashLoopBackOff
2          54s
```

Solution
IBM Visual Insights requires IPv6. Enable IPv6 on the system.

Troubleshooting known issues - IBM Visual Insights Inference Server

Following are some problems you might encounter when using IBM Visual Insights, along with steps to fix them.

- "Problems installing an rpm on a RHEL system with Docker CE" on page 184
- "When deploying a model, you get an error that the /decrypt container name is already in use" on page 184
- #unique_102/unique_102_Connect_42_unexpected
- "Model fails to deploy on RHEL system with SE Linux" on page 184
- "Model fails to deploy to GPU on RHEL with a CUDA runtime error" on page 185
- "Model fails to deploy to GPU on RHEL - No GPU found" on page 185
- "Model fails to deploy with time out message" on page 185

Problems installing an rpm on a RHEL system with Docker CE

Problem
When installing an rpm on a RHEL system with Docker CE, you see this error: `Error: Failed dependencies: docker is needed by <`*`file_name`*`.rpm>`. For example:

Solution
To install an rpm on a system with Docker CE instead of Docker, force install the rpm by the following command

```
rpm --nodeps -i file_name.rpm
```

When deploying a model, you get an error that the /decrypt container name is already in use

Problem
When deploying a model, you get a docker error such as the following:

```
docker: Error response from daemon: Conflict. The container name "/decrypt" is already in use
by container "b9deb17c4651162aaf609cb97835098b69f6f6f9ac5c5558041a0ff52e8d0777".
You have to remove (or rename) that container to be able to reuse that name. See 'docker run --
help'.
```

This error can occur if a previous model deployment/decryption was terminated or failed unexpectedly during the deployment/decryption process.

Solution
Remove the Docker image by running the following commands:

```
docker stop decrypt; docker rm decrypt
```

Model fails to deploy on RHEL system with SE Linux

Problem
A model deployment fails, and the log of the container indicates the "model.zip was not mounted correctly:Deployment failed." The last few lines of the log should be displayed, and include the line "please mount...".

Example:

```
Deployment failed. Here are the last few log entries from the failed container:
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
No GPU available
please mount /config/dropins/model.zip as model
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
```

Solution

Check the SELinux context of the model file specified. If it does not have `container_file_t`, the model file cannot be successfully read in the container. Use `chcon` to correct the context, for example:

```
chcon unconfined_u:object_r:container_file_t:s0 <modelfile.zip>
```

Model fails to deploy to GPU on RHEL with a CUDA runtime error

Problem

When deploying a model to a GPU on a RHEL system, it fails with an error indicating an issue with the NVIDA CUDA driver:

```
F1113 18:46:17.689370 17 syncedmem.cpp:518] Check failed: error == cudaSuccess (35 vs. 0)
     CUDA driver version is insufficient for CUDA runtime version
```

Solution

Ensure that SELinux is enabled. If it is enabled, verify that the security context of the `/usr/lib64/libcuda*` libraries includes `textrel_shlib_t`. If it does not, use `chcon` to set the context correctly:

```

# getenforce
Enforcing

# # sudo chcon -t textrel_shlib_t /usr/lib64/libcuda.so.*
```

Model fails to deploy to GPU on RHEL - "No GPU found"

Problem

When deploying a model to a GPU on a RHEL system, it fails with error indicating that the GPU could not be found. For example, when attempting to deploy to a GPU

```
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
No GPU available
Cannot find gpu
0.<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
```

Solution

Ensure that SELinux is enabled. If it is enabled, verify that the security context of the `/dev/nvidia` devices includes `container_file_t`. If it does not, use `chcon` to set the context correctly:

```
# getenforce
Enforcing
# ls -lZ /dev/nvidia*crw-rw-rw-.
     root root system_u:object_r:xserver_misc_device_t:s0 /dev/nvidia0crw-rw-rw-.
     root root system_u:object_r:xserver_misc_device_t:s0 /dev/nvidia1
# sudo chcon -t container_file_t /dev/nvidia*
# ls -lZ /dev/nvidia*crw-rw-rw-.
     root root system_u:object_r:container_file_t:s0 /dev/nvidia0crw-rw-rw-.
     root root system_u:object_r:container_file_t:s0 /dev/nvidia1
```

Model fails to deploy with time out message

Problem

When using `deploy_zip_model.sh` to deploy a IBM Visual Insights model, the action fails with a message "Deployment timed out at 180 seconds".

Solution

This can occur if the GPU specified for the deployment no longer has available memory to deploy the model. Check the GPU usage by using the `nvidia-smi` command as described in this topic: "Checking system GPU status" on page 60. For example, if the model failed to deploy to GPU 1, run `nvidia-smi -i 1` to check the usage of GPU 1. If there are limited memory resources, stop and delete some of the models currently deployed to the GPU by running these commands:

```
docker stop <model-name>
docker rm <model-name>
```

The following output demonstrates a situation where the GPU does not have sufficient memory to deploy the model:

```
# /opt/ibm/vision-inference/dnn-deploy-service/bin/deploy_zip_model.sh -m
8193_cars_custom_COD_model -p 7005 -g 1 /root/inference-only-testing/new_models/cars-tf-
cod.zip
chcon: can't apply partial context to unlabeled file '/root/inference-only-testing/
new_models/cars-tf-cod.zip'
WARNING: This might cause model file permission issue inside container
chcon: can't apply partial context to unlabeled file '/tmp/aivision_inference'
WARNING: This might cause permission issue inside container

Deployment timed out at 180 seconds
[root@dldev4 ~]# nvidia-smi -i 1
Tue Apr 30 14:13:39 2019
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 418.29       Driver Version: 418.29       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|===============================+======================+======================|
|   1  Tesla P100-PCIE...  Off  | 00000000:81:00.0 Off |                    0 |
| N/A   32C    P0    31W / 250W |  15919MiB / 16280MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                       GPU Memory |
|  GPU       PID   Type   Process name                             Usage      |
|=============================================================================|
|    1     13691      C   python                                      2133MiB |
|    1     17165      C   python                                      2065MiB |
|    1     17955      C   python                                       958MiB |
|    1     18832      C   python                                       742MiB |
|    1     19545      C   python                                     10009MiB |
+-----------------------------------------------------------------------------+
```

Troubleshooting known issues - IBM Cloud Private install

Following are some problems you might encounter when using IBM Visual Insights in an IBM Cloud Private (ICP) environment, along with steps to fix them.

- "A new deployment of IBM Visual Insights fails to start" on page 186
- "IBM Visual Insights pods do not start - ICP installation" on page 187
- "IBM Visual Insights training and deployed model pods cannot access GPUs" on page 188

A new deployment of IBM Visual Insights fails to start

Problem

A new deployment of IBM Visual Insights fails to start. Multiple pods crash or fail to initialize. This is due to file ownership of the underlying file system, which must be assigned to user ID 1979. To confirm this problem, run the following command and verify that postgres, mongodb, and elasticsearch are all crashed or in a crash loop.

```
# kubectl get pods | grep v120-prod

vision-v120-prod-elasticsearch-6bb77bc676-rpn84          0/1     CrashLoopBackOff
2         46s
vision-v120-prod-keycloak-856c957b4d-4ngpb               0/1     Init:0/1
0         46s
vision-v120-prod-logstash-7df9474ff9-m6pm9               0/1     Running
1         46s
vision-v120-prod-mongodb-5747795dc4-nrxr7                0/1     CrashLoopBackOff
2         45s
vision-v120-prod-postgres-5cc85dccfb-67zqp               0/1     CrashLoopBackOff
2         44s
vision-v120-prod-service-58f9598b7b-l4cvm                0/1     Init:CrashLoopBackOff
2         43s
vision-v120-prod-taskanaly-595455d5b8-dfxn7              1/1     Running
0         43s
vision-v120-prod-ui-56d7cfff88-zjxhr                     1/1     Running
0         42s
vision-v120-prod-video-microservice-bb5cd6bc5-6fxlf      1/1     Running
0         41
```

Solution

1. You must run the following commands to set up the persistent volume. This is required because the containers run under the non-root id 1979:

   ```
   AIV_USER=1979
   VOL_DIR=<persistent_volume_path>
   mkdir -p ${VOL_DIR}/data ${VOL_DIR}/run/logstash ${VOL_DIR}/run/elasticsearch $
   {VOL_DIR}/run/mongodb ${VOL_DIR}/run/pgsql
   chown ${AIV_USER}:${AIV_USER} ${VOL_DIR} ${VOL_DIR}/run
   chown -R ${AIV_USER}:${AIV_USER} ${VOL_DIR}/data
   chown 1000:1000 ${VOL_DIR}/run/logstash ${VOL_DIR}/run/elasticsearch
   chown 999 ${VOL_DIR}/run/mongodb
   chown 999 ${VOL_DIR}/run/pgsql
   ```

2. Wait approximately 2 - 3 minutes for Kubernetes to recover the pods. Confirm that the pods become available and IBM Visual Insights is running properly.

IBM Visual Insights pods do not start - ICP installation

Problem

In an IBM Cloud Private installation, checking the status of the IBM Visual Insights pods shows many in `ContainerCreating` and `Init` state.

Example:

```
# kubectl get pods -o wide
NAME                                                       READY     STATUS
RESTARTS   AGE       IP             NODE         NOMINATED NODE
vision-icp-keycloak-7bff8db8b-8thfm            0/1       Init:0/1            0
7m        10.1.44.236   10.10.10.2   <none>
vision-icp-mongodb-5599969957-pgwvc            0/1       ContainerCreating   0
7m        <none>        10.10.10.2   <none>
vision-icp-portal-6dcc65cfd9-n4fnr             0/1       Init:0/2            0
7m        <none>        10.10.10.2   <none>
vision-icp-postgres-6ffc46dd59-hj6sq           0/1       Running             0
7m        10.1.44.247   10.10.10.2   <none>
vision-icp-taskanaly-97dffb698-p5qcg           0/1       ContainerCreating   0
7m        <none>        10.10.10.2   <none>
vision-icp-ui-5d64c856d6-mtzh9                 0/1       ContainerCreating   0
7m        <none>        10.10.10.2   <none>
vision-icp-video-nginx-77945f4cc9-9wjjq        0/1       ContainerCreating   0
7m        <none>        10.10.10.2   <none>
vision-icp-video-portal-774c5b799d-sgntt       0/1       Init:0/1            0
7m        <none>        10.10.10.2   <none>
vision-icp-video-rabmq-65bfbc5799-c5knd        0/1       ContainerCreating   0
7m        <none>        10.10.10.2   <none>
vision-icp-video-redis-fb67bb445-5r7s2         1/1       Running             0
7m        10.1.44.240   10.10.10.2   <none>
vision-icp-video-test-nginx-8675b6fd4d-rsf4b   0/1       Running             0
7m        10.1.44.239   10.10.10.2   <none>
vision-icp-video-test-portal-ccbc4c4f8-dxhns   0/1       Init:0/1            0
7m        <none>        10.10.10.2   <none>
vision-icp-video-test-rabmq-7bb766c575-2l4qm   0/1       ContainerCreating   0
7m        <none>        10.10.10.2   <none>
```

```
vision-icp-video-test-redis-d5ffd75f7-8jjcr    1/1       Running            0
7m        10.1.44.23
```

The pod `describe` output for the pods that are not starting will also show events indicating problems with the underlying storage. For example:

```
Volumes:
  run-mount:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same
namespace)
    ClaimName:  vision-icp-data-pvc
    ReadOnly:   false
  default-token-hz9c4:
    Type:        Secret (a volume populated by a Secret)
    SecretName:  default-token-hz9c4
    Optional:    false
QoS Class:       BestEffort
Node-Selectors:  beta.kubernetes.io/arch=ppc64le
Tolerations:     node.kubernetes.io/not-ready:NoExecute for 300s
                 node.kubernetes.io/unreachable:NoExecute for 300s
Events:
  Type     Reason       Age                    From                 Message
  ----     ------       ----                   ----                 -------
  Warning  FailedMount  24m (x28 over 103m)    kubelet, 10.10.10.4  Unable to mount volumes
for pod "vision-icp-elasticsearch-5fbb6d9b65-br78d_default(dbe0edd0-8375-11e9-
b64b-14630800178b)": timeout expired waiting for volumes to attach or mount for pod
"default"/"vision-icp-elasticsearch-5fbb6d9b65-br78d". list of unmounted volumes=[run-
mount]. list of unattached volumes=[run-mount default-token-hz9c4]
  Warning  FailedMount  5m42s (x59 over 103m)  kubelet, 10.10.10.4  (combined from similar
events): MountVolume.SetUp failed for volume "v114-sravan" : mount failed: exit status 32
Mounting command: systemd-run
Mounting arguments: --description=Kubernetes transient mount for /var/lib/kubelet/pods/
dbe0edd0-8375-11e9-b64b-14630800178b/volumes/kubernetes.io~nfs/icp --scope -- mount -t nfs
10.10.10.1:/data/nfs/v114-sravan /var/lib/kubelet/pods/dbe0edd0-8375-11e9-b64b-14630800178b/
volumes/kubernetes.io~nfs/icp
Output: Running scope as unit run-9236.scope.
mount.nfs: mounting 10.10.10.1:/data/nfs/icp failed, reason given by server: No such file
or directory
```

Solution

The problem is likely that the persistent volume claim is not being bound to a valid persistent volume.

1. Log in to the ICP environment. See "Checking the application status in an ICP installation" on page 48 for instructions.
2. Check the status of the storage and ensure that the state is "Bound:" by following the steps in this topic: "Checking Kubernetes storage status" on page 55.
3. If the storage is not correctly bound, fix the problem then redeploy the application.

IBM Visual Insights training and deployed model pods cannot access GPUs

Problem

When trying to train or deploy a model, the operation fails. Logs gathered may indicate issues with GPU initialization, noted by non-zero `cudaSuccess` values. For example:

```
root        : INFO     F0510 14:51:21.103844    23 common.cpp:159] Check failed: error ==
cudaSuccess (3 vs. 0)  initialization error
root        : INFO     *** Check failure stack trace: ***
root        : INFO     APPMSG:{'status': 'aborted', 'type': 'status_msg'}
```

Solution

Ensure that GPUs are visible in the ICP dashboard. If they are, then ensure that the `nvidia-container-runtime-hook` is not installed on the system:

```
# rpm -qa | grep nvidia-container-runtime-hook
nvidia-container-runtime-hook-1.4.0-2.ppc64le
```

The ICP environment provides a GPU plug-in container, and the `nvidia-container-runtime-hook` must be uninstalled.

After uninstalling the `nvidia-container-runtime-hook`, restart the ICP services on the node by following these instructions: .

Important: Before stopping the `kubelet` and `docker` service on the node, mark the node as unschedulable. Run the following command:

```
kubectl cordon 9.111.255.122
```

Note: Marking the node as unschedulable disables scheduling new pods on the node.

1. Shut down the system by stopping the kubelet on the target node by running the following command:

   ```
   sudo systemctl stop kubelet
   ```

   Allow the **kubelet** services time to quiesce - this can take up to one minute.
2. Stop the docker containers or the docker runtime by running the following command:

   ```
   sudo systemctl stop docker
   ```
3. Restart the Docker by running the following command:

   ```
   sudo systemctl start docker
   ```
4. Restart the kubelet and ensure that it is running successfully by running the following command:

   ```
   sudo systemctl start kubelet
   sudo systemctl status kubelet
   ```
5. If the kubelet service is unsuccessful, view the logs for the kubelet by running the following command:

   ```
   sudo journalctl -e -u kubelet
   ```
6. Exit maintenance by running the following command:

   ```
   kubectl uncordon 9.111.255.122
   ```

Gather IBM Visual Insights logs and contact support

Sometimes you cannot solve a problem by troubleshooting the symptoms. In such cases, you must collect diagnostic data and contact support.

Collecting and inspecting data before you open a problem management record (PMR) can help you to answer the following questions:

- Do the symptoms match any known problems? If so, has a fix or workaround been published?
- Can the problem be identified and resolved without a code fix?
- When does the problem occur?

To gather logs for support, follow these steps:

1. Collect logs from the IBM Visual Insights application.
   - **Standalone installation**:
     - **Collect the vision-service log**: The most useful logs to debug an issue with the application are the **`vision-service`** logs. Run this command to collect the logs from the `vision-service` pod, and output them to a log file that includes a timestamp in the file name for reference:

       ```
       sudo /opt/ibm/vision/bin/kubectl logs `sudo /opt/ibm/vision/bin/kubectl get pods -o
       custom-columns=NAME:.metadata.name | grep vision-service` > ./vision-service-`date +%d
       %m%Y-%H%M%S`.log
       ```
     - **Collect all logs**:

Run the **sudo /opt/ibm/vision/bin/collect_logs.sh** script. The directory where the log file is saved is listed in the **INFO: FFDC Collected** section, as shown in the following example:

```
[ INFO ] Collecting Visual Insights Logs in Parallel...

[ INFO ] Collecting Visual Insights Application Logs...

[ INFO ] Collecting Visual Insights Infrastructure Logs...

/opt/ibm/vision /var/log/vision/vision.logs.18_20_22_Feb_27_2020

/var/log/vision/vision.logs.18_20_22_Feb_27_2020

[ INFO ] Collecting configuration information...

[ INFO ] Collecting System Details...

[ INFO ] Collecting Platform Logs...

[ INFO ] FFDC Collected below:

-rw-r--r--. 1 root root 5895480 Feb 27 18:20 /var/log/vision/
vision.logs.18_20_22_Feb_27_2020.tgz
```

The log files to provide are generated here: `/var/log/vision`.

- **IBM Cloud Private installation**:

  a. Enable the **kubectl** command. For instructions, see this topic in the IBM Cloud Private Knowledge Center: Accessing your IBM® Cloud private cluster by using the kubectl CLI.

  b. **Collect all logs** from the IBM Visual Insights pods using the <*release_name*> specified when installing/deploying:

  ```
  kubectl get pods > /tmp/kubectl_pod_status.txt
  for i in $(kubectl get pods -o name | grep <release_name>); do
    kubectl logs $i > /tmp/kubectl_logs_$i.txt
    kubectl describe pods $i > /tmp/kubectl_describe_pods_$i.txt
  done
  kubectl describe deploy > /tmp/kubectl_deploy.txt
  kubectl describe configmap > /tmp/kubectl_cm.txt
  ```

  The log files to provide are generated here: **/tmp/kubectl_logs***.

  c. **Collect the vision-service log**: The most useful logs to debug an issue with the application are the **vision-service** logs. Run this command to collect the logs from the `vision-service` pod, and output them to a log file that includes a timestamp in the file name for reference:

  ```
  sudo /opt/ibm/vision/bin/kubectl logs `sudo /opt/ibm/vision/bin/kubectl get pods -o
  custom-columns=NAME:.metadata.name | grep vision-service` > ./vision-service-`date +%d
  %m%Y-%H%M%S`.log
  ```

2. Optionally, you can obtain the logs for a single pod of the application.

   a. Use the `kubectl get pods` command to view the running pods for the application. See "kubectl.sh get pods" on page 51. For example:

   ```
   $ /opt/ibm/vision/bin/kubectl.sh get pods
   NAME                                         READY   STATUS    RESTARTS   AGE
   vision-elasticsearch-59fcb48446-q64zc        1/1     Running   0          4h49m
   vision-fpga-device-plugin-w7gb7              1/1     Running   0          4h49m
   vision-keycloak-7c88568f56-zcc9c             1/1     Running   0          4h49m
   vision-logstash-ff888487c-6vnzt              1/1     Running   0          4h49m
   vision-mongodb-7cb5cdf54b-krpc8              1/1     Running   0          4h49m
   vision-postgres-8cf756958-6d8gz              1/1     Running   0          4h49m
   vision-service-86c6f58d7b-947md              1/1     Running   0          4h49m
   vision-taskanaly-558c7644c8-ww6kw            1/1     Running   0          4h49m
   vision-ui-76f8bc46b-btwps                    1/1     Running   0          4h49m
   vision-video-microservice-7d5dd58969-9lr4p   1/1     Running   0          4h49m
   ```

b. Run the following command, where <*pod-name*> is obtained from the `kubectl.sh get pods` command:

```
kubectl.sh logs <pod-name> > <outputfile>
```

For example, using the above output, to collect logs in the file vision-service.log, run the command:

```
$ kubectl.sh logs vision-service-5588ffdffc-cnq8h > vision-service.log
```

3. Submit the problem to IBM Support in one of the following ways:
   - Online through the IBM Support Portal: http://www.ibm.com/mysupport/: You can open, update, and view all of your service requests from the Service Request portlet on the Service Request web page.
   - By phone: For the phone number to call in your region, see the Directory of worldwide contacts web page: http://www.ibm.com/planetwide/.

Getting fixes from Fix Central

You can use Fix Central to find the fixes that are recommended by IBM Support for various products, including IBM Visual Insights. With Fix Central, you can search, select, order, and download fixes for your system with a choice of delivery options. A IBM Visual Insights product fix might be available to resolve your problem.

To find and install fixes:

1. Obtain the tools that are required to get the fix. If it is not installed, obtain your product update installer. You can download the installer from Fix Central: http://www.ibm.com/support/fixcentral.

   This site provides download, installation, and configuration instructions for the update installer.

   Note: For more information about how to obtain software fixes, from the Fix Central page, click **Getting started with Fix Central**, then click the Software tab.
2. Under **Find product**, type "IBM Visual Insights" in the **Product selector** field.
3. Select IBM Visual Insights. For **Installed version**, select **All**. For **Platform**, select the appropriate platform or select **All**, then click **Continue**.
4. Identify and select the fix that is required, then click **Continue**.
5. Download the fix. When you download the file, ensure that the name of the maintenance file is not changed, either intentionally or by the web browser or download utility.
6. Stop IBM Visual Insights by using this script:

   ```
   sudo /opt/ibm/vision/bin/vision-stop.sh
   ```
7. Install the RPM that was downloaded by running this command:

   ```
   sudo yum install ./<fixpack-rpmfile>.rpm
   ```
8. Log in as root or with sudo privileges, then load the images provided in the TAR file that was downloaded by running this script:

   ```
   sudo /opt/ibm/vision/bin/load_images.sh ./<fixpack-tarfile>.tar
   ```
9. Start IBM Visual Insights by running the following script. You must read and accept the license agreement that is displayed before you can use IBM Visual Insights.

   ```
   sudo /opt/ibm/vision/bin/vision-start.sh
   ```

Contacting IBM Support

IBM Support provides assistance with product defects, answers FAQs, and helps users resolve problems with the product.

After trying to find your answer or solution by using other self-help options such as technotes, you can contact IBM Support. Before contacting IBM Support, your company or organization must have an active IBM software maintenance agreement (SWMA), and you must be authorized to submit problems to IBM. For information about the types of available software support, see the Support portfolio topic in the "*Software Support Handbook*".

To determine what versions of the product are supported, refer to the Software lifecycle page.

To contact IBM Support about a problem:

1. Define the problem, gather background information, and determine the severity of the problem.

   For software support information, see the Getting IBM support topic in the *Software Support Handbook*.
2. Gather diagnostic information.
3. Submit the problem to IBM Support in one of the following ways:
   - Using IBM Support Assistant (ISA):
   - Online through the IBM Support Portal: You can open, update, and view all of your service requests on the Service Request page.
   - By phone: For the phone number to call in your region, see the Directory of worldwide contacts web page.

If the problem that you submit is for a software defect or for missing or inaccurate documentation, IBM Support creates an Authorized Program Analysis Report (APAR). The APAR describes the problem in detail. Whenever possible, IBM Support provides a workaround that you can implement until the APAR is resolved and a fix is delivered. IBM publishes resolved APARs on the IBM Support website daily, so that other users who experience the same problem can benefit from the same resolution.

Chapter 16. Notices

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Chapter 17. IBM Visual Insights 1.2.0 Release Notes®

Requirements

For hardware and software requirements, see the Chapter 3, “Planning for IBM Visual Insights,” on page 17 topic.

Installing

You can install IBM Visual Insights stand-alone or IBM Visual Insights with IBM Cloud Private. For more information, see the Chapter 5, “Installing, upgrading, and uninstalling IBM Visual Insights,” on page 25 topic.

Limitations

Following are some limitations for IBM Visual Insights 1.2.0:

- IBM Visual Insights uses an entire GPU when you are training a dataset. Multiple GoogleNet or Faster R-CNN models can be deployed to a single GPU. Other types of models take an entire GPU when deployed. For details about other differences between model types, see “Model functionality” on page 12.

  The number of active GPU tasks (model training and deployment) that you can run at the same time depends on the number of GPUs on your server. You must verify that there are enough available GPUs on the system for the desired workload. The number of available GPUs is displayed on the user interface.
- You cannot install IBM Visual Insights stand-alone on a system that already has any of these products installed:
  - IBM Data Science Experience (DSX)
  - IBM Cloud Private
  - IBM Watson Studio Local Edition
  - Any other Kubernetes based applications

Notices

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