Red Hat OpenShift AI Self-Managed 2.22

Getting started with Red Hat OpenShift AI Self-Managed

Learn how to work in an OpenShift AI environment

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Legal Notice

Abstract

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CHAPTER 1. OVERVIEW

Red Hat OpenShift AI is an artificial intelligence (AI) platform that provides tools to rapidly train, serve, and monitor machine learning (ML) models onsite, in the public cloud, or at the edge.

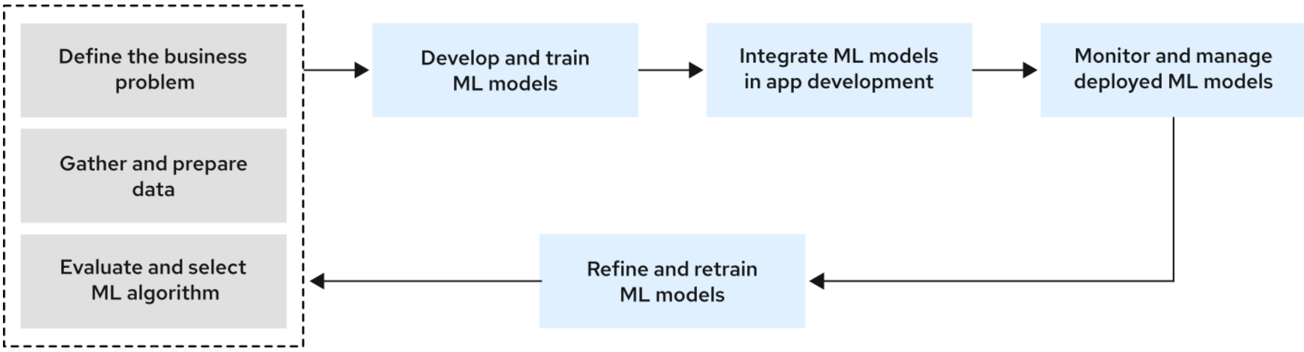
OpenShift AI provides a powerful AI/ML platform for building AI-enabled applications. Data scientists and MLOps engineers can collaborate to move from experiment to production in a consistent environment quickly.

You can deploy OpenShift AI on any supported version of OpenShift, whether on-premise, in the cloud, or in disconnected environments. For details on supported versions, see Red Hat OpenShift AI: Supported Configurations.

1.1. DATA SCIENCE WORKFLOW

For the purpose of getting you started with OpenShift AI, the following figure illustrates a simplified data science workflow. The real world process of developing ML models is an iterative one.

Figure 1.1. Simplified data science workflow



The simplified data science workflow for predictive AI use cases includes the following tasks:

- Defining your business problem and setting goals to solve it.
- Gathering, cleaning, and preparing data. Data often has to be federated from a range of sources, and exploring and understanding data plays a key role in the success of a data science project.
- Evaluating and selecting ML models for your business use case.
- Train models for your business use case by tuning model parameters based on your set of training data. In practice, data scientists train a range of models, and compare performance while considering tradeoffs such as time and memory constraints.
- Integrate models into an application, including deployment and testing. After model training, the next step of the workflow is production. Data scientists are often responsible for putting the model in production and making it accessible so that a developer can integrate the model into an application.
- Monitor and manage deployed models. Depending on the organization, data scientists, data engineers, or ML engineers must monitor the performance of models in production, tracking prediction and performance metrics.

- Refine and retrain models. Data scientists can evaluate model performance results and refine models to improve outcome by excluding or including features, changing the training data, and modifying other configuration parameters.

1.2. ABOUT THIS GUIDE

This guide assumes you are familiar with data science and ML Ops concepts. It describes the following tasks to get you started with using OpenShift AI:

- Log in to the OpenShift AI dashboard
- Create a data science project
- If you have data stored in Object Storage, configure a connection to more easily access it
- Create a workbench and choose an IDE, such as JupyterLab or code-server, for your data scientist development work
- Learn where to get information about the next steps:
  - Developing and training a model
  - Automating the workflow with pipelines
  - Implementing distributed workloads
  - Testing your model
  - Deploying your model
  - Monitoring and managing your model

See also OpenShift AI tutorial: Fraud detection example . It provides step-by-step guidance for using OpenShift AI to develop and train an example model in JupyterLab, deploy the model, and refine the model by using automated pipelines.

1.3. GLOSSARY OF COMMON TERMS

This glossary defines common terms for Red Hat OpenShift AI.

accelerator

In high-performance computing, a specialized circuit that is used to take some of the computational load from the CPU, increasing the efficiency of the system. For example, in deep learning, GPU-accelerated computing is often employed to offload part of the compute workload to a GPU while the main application runs off the CPU.

artificial intelligence (AI)

The capability to acquire, process, create and apply knowledge in the form of a model to make predictions, recommendations or decisions.

bias detection

The process of calculating fairness metrics to detect when AI models are delivering unfair outcomes based on certain attributes.

custom resource (CR)

A resource implemented through the Kubernetes CustomResourceDefinition API. A custom resource is distinct from the built-in Kubernetes resources, such as the pod and service resources. Every CR is part of an API group.

custom resource definition (CRD)

In Red Hat OpenShift, a custom resource definition (CRD) defines a new, unique object **Kind** in the cluster and lets the Kubernetes API server handle its entire lifecycle.

connections

A configuration that stores the parameters required to connect to an S3-compatible object storage, database or OCI-compliant container registry from a data science project.

connection type

The type of external source to connect to from a data science project, such as an OCI-compliant container registry, S3-compatible object storage, or Uniform Resource Identifiers (URIs).

data science pipelines

A workflow engine that is used by data scientists and AI engineers to automate pipelines, such as model training and evaluation pipelines. Data science pipelines also includes experiment tracking capabilities, artifact storage, and versioning.

data science project

An OpenShift project for organizing data science work. Each project is scoped to its own Kubernetes namespace.

disconnected environment

An environment on a restricted network that does not have an active connection to the internet.

distributed workloads

Data science workloads that are run simultaneously across multiple nodes in an OpenShift cluster.

fine-tuning

The process of adapting a pre-trained model to perform a specific task by conducting additional training. Fine tuning may involve (1) updating the model’s existing parameters, known as full fine tuning, or (2) updating a subset of the model’s existing parameters or adding new parameters to the model and training them while freezing the model’s existing parameters, known as parameter-efficient fine tuning.

graphics processing unit (GPU)

A specialized processor designed to rapidly manipulate and alter memory to accelerate the creation of images in a frame buffer intended for output to a display. GPUs are heavily utilized in machine learning due to their parallel processing capabilities.

inference

The process of using a trained AI model to generate predictions or conclusions based on the input data provided to the model.

inference server

A server that performs inference. Inference servers feed the input requests through a machine learning model and return an output.

large language model (LLM)

A language model with a large number of parameters, trained on a large quantity of text.

machine learning (ML)

A branch of artificial intelligence (AI) and computer science that focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving the accuracy of AI models.

model

In a machine learning context, a set of functions and algorithms that have been trained and tested on a data set to provide predictions or decisions.

model registry

A central repository containing metadata related to machine learning models from inception to deployment. The metadata ranges from high-level information such as the deployment environment and project origins, to intricate details like training hyperparameters, performance metrics, and deployment events.

model server

A container that hosts a machine learning model, exposes an API to handle incoming requests, performs inference, and returns model predictions.

model-serving runtime

A component or framework that helps create model servers for deploying machine learning models and build APIs optimized for inference.

MLOps

The practice for collaboration between data scientists and operations professionals to help manage the production machine learning (or deep learning) lifecycle. MLOps looks to increase automation and improve the quality of production ML while also focusing on business and regulatory requirements. It involves model development, training, validation, deployment, monitoring, and management and uses methods like CI/CD.

notebook interface

An interactive document that contains executable code, descriptive text for that code, and the results of any code that is run.

object storage

A method of storing data, typically used in the cloud, in which data is stored as discrete units, or objects, in a storage pool or repository that does not use a file hierarchy but that stores all objects at the same level.

OpenShift Container Platform cluster

A group of physical machines that contains the controllers, pods, services, and configurations required to build and run containerized applications.

persistent storage

A persistent volume that retains files, models or other artifacts across components such as model deployments, data science pipelines and workbenches.

persistent volume claim (PVC)

A persistent volume claim (PVC) is a request for storage in the cluster by a user.

quantization

A method of compressing foundation model weights to speed up inferencing and reduce memory needs.

serving

The process of hosting a trained machine learning model as a network-accessible service. Real-world applications can send inference requests to the service by using a REST or gRPC API and receive predictions.

ServingRuntime

A custom resource definition (CRD) that defines the templates for pods that can serve one or more particular model formats. Each ServingRuntime CRD defines key information such as the container image of the runtime and a list of the model formats that the runtime supports. Other configuration settings for the runtime can be conveyed through environment variables in the container specification. It also dynamically loads and unloads models from disk into memory on demand and exposes a gRPC service endpoint to serve inferencing requests for loaded models.

vLLM

A high-throughput and efficient inference engine for running large-language models that integrates with popular models and frameworks.

workbench

An isolated environment for development and experimentation with ML models. Workbenches typically contain integrated development environments (IDEs), such as JupyterLab, RStudio, and Visual Studio Code.

workbench image

An image that includes preinstalled tools and libraries that you need for model development. Includes an IDE for developing your machine learning (ML) models.

YAML

A human-readable data-serialization language. It is commonly used for configuration files and in applications where data is being stored or transmitted.

CHAPTER 2. LOGGING IN TO OPENSHIFT AI

After you install OpenShift AI, log in to the OpenShift AI dashboard so that you can set up your development and deployment environment.

Prerequisites

- You know the OpenShift AI identity provider and your login credentials.
  - If you are a data scientist, data engineer, or ML engineer, your administrator must provide you with the OpenShift AI instance URL, for example:

    ```
    https://rhoai-dashboard-redhat-oai-
    applications.apps.example.abc1.p1.openshiftapps.com/
    ```

- You have the latest version of one of the following supported browsers:
  - Google Chrome
  - Mozilla Firefox
  - Safari

Procedure

1. Browse to the OpenShift AI instance URL and click **Log in with OpenShift**.
   - If you have access to OpenShift, you can browse to the OpenShift web console and click the **Application Launcher** ( ) → **Red Hat OpenShift AI**.
2. Click the name of your identity provider, for example, **GitHub**,**Google**, or your company's single sign-on method.
3. Enter your credentials and click **Log in** (or equivalent for your identity provider).

Verification

- The OpenShift AI dashboard opens on the **Home** page.

2.1. VIEWING INSTALLED OPENSHIFT AI COMPONENTS

In the Red Hat OpenShift AI dashboard, you can view a list of the installed OpenShift AI components, their corresponding source (upstream) components, and the versions of the installed components.

Prerequisites

- OpenShift AI is installed in your OpenShift cluster.

Procedure

1. Log in to the OpenShift AI dashboard.
2. In the top navigation bar, click the help icon ( ) and then select **About**.

Verification

The **About** page shows a list of the installed OpenShift AI components along with their corresponding upstream components and upstream component versions.

Additional resources

- Installing and managing Red Hat OpenShift AI components

CHAPTER 3. CREATING A DATA SCIENCE PROJECT

To implement a data science workflow, you must create a project. In OpenShift, a project is a Kubernetes namespace with additional annotations, and is the main way that you can manage user access to resources. A project organizes your data science work in one place and also allows you to collaborate with other developers and data scientists in your organization.

Within a project, you can add the following functionality:

- Connections so that you can access data without having to hardcode information like endpoints or credentials.
- Workbenches for working with and processing data, and for developing models.
- Deployed models so that you can test them and then integrate them into intelligent applications. Deploying a model makes it available as a service that you can access by using an API.
- Pipelines for automating your ML workflow.

Prerequisites

- You have logged in to Red Hat OpenShift AI.
- If you are using OpenShift AI groups, you are part of the user group or admin group (for example, **rhoai-users** or **rhoai-admins**) in OpenShift.
- You have the appropriate roles and permissions to create projects.

Procedure

1. From the OpenShift AI dashboard, select **Data science projects**.
   The **Data science projects** page shows a list of projects that you can access. For each user-requested project in the list, the **Name** column shows the project display name, the user who requested the project, and the project description.
2. Click **Create project**.
3. In the **Create project** dialog, update the **Name** field to enter a unique display name for your project.
4. Optional: If you want to change the default resource name for your project, click **Edit resource name**.
   The resource name is what your resource is labeled in OpenShift. Valid characters include lowercase letters, numbers, and hyphens (-). The resource name cannot exceed 30 characters, and it must start with a letter and end with a letter or number.

   Note: You cannot change the resource name after the project is created. You can edit only the display name and the description.
5. Optional: In the **Description** field, provide a project description.
6. Click **Create**.

Verification

- A project details page opens. From this page, you can add connections, create workbenches, configure pipelines, and deploy models.

CHAPTER 4. CREATING A WORKBENCH AND SELECTING AN IDE

A workbench is an isolated area where you can examine and work with ML models. You can also work with data and run programs, for example to prepare and clean data. While a workbench is not required if, for example, you only want to service an existing model, one is needed for most data science workflow tasks, such as writing code to process data or training a model.

When you create a workbench, you specify an image (an IDE, packages, and other dependencies). Supported IDEs include JupyterLab, code-server, and RStudio (Technology Preview).

The IDEs are based on a server-client architecture. Each IDE provides a server that runs in a container on the OpenShift cluster, while the user interface (the client) is displayed in your web browser. For example, the Jupyter workbench runs in a container on the Red Hat OpenShift cluster. The client is the JupyterLab interface that opens in your web browser on your local computer. All of the commands that you enter in JupyterLab are executed by the workbench. Similarly, other IDEs like code-server or RStudio Server provide a server that runs in a container on the OpenShift cluster, while the user interface is displayed in your web browser. This architecture allows you to interact through your local computer in a browser environment, while all processing occurs on the cluster. The cluster provides the benefits of larger available resources and security because the data being processed never leaves the cluster.

In a workbench, you can also configure connections (to access external data for training models and to save models so that you can deploy them) and cluster storage (for persisting data). Workbenches within the same project can share models and data through object storage with the data science pipelines and model servers.

For data science projects that require data retention, you can add container storage to the workbench you are creating.

Within a project, you can create multiple workbenches. When to create a new workbench depends on considerations, such as the following:

- The workbench configuration (for example, CPU, RAM, or IDE). If you want to avoid editing the configuration of an existing workbench's configuration to accommodate a new task, you can create a new workbench instead.

- Separation of tasks or activities. For example, you might want to use one workbench for your Large Language Models (LLM) experimentation activities, another workbench dedicated to a demo, and another workbench for testing.

4.1. ABOUT WORKBENCH IMAGES

A workbench image is optimized with the tools and libraries that you need for model development. You can use the provided workbench images or an OpenShift AI administrator can create custom workbench images adapted to your needs.

To provide a consistent, stable platform for your model development, many provided workbench images contain the same version of Python. Most workbench images available on OpenShift AI are pre-built and ready for you to use immediately after OpenShift AI is installed or upgraded.

For information about Red Hat support of workbench images and packages, see Red Hat OpenShift AI: Supported Configurations.

The following table lists the workbench images that are installed with Red Hat OpenShift AI by default.

If the preinstalled packages that are provided in these images are not sufficient for your use case, you have the following options:

- Install additional libraries after launching a default image. This option is good if you want to add libraries on an ad hoc basis as you develop models. However, it can be challenging to manage the dependencies of installed libraries and your changes are not saved when the workbench restarts.
- Create a custom image that includes the additional libraries or packages. For more information, see Creating custom workbench images.

IMPORTANT

Workbench images denoted with **(Technology Preview)** in this table are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using Technology Preview features in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process. For more information about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope.

Table 4.1. Default workbench images

Image name	Description
CUDA	If you are working with compute-intensive data science models that require GPU support, use the Compute Unified Device Architecture (CUDA) workbench image to gain access to the NVIDIA CUDA Toolkit. Using this toolkit, you can optimize your work by using GPU-accelerated libraries and optimization tools.
Standard Data Science	Use the Standard Data Science workbench image for models that do not require TensorFlow or PyTorch. This image contains commonly-used libraries to assist you in developing your machine learning models.
TensorFlow	TensorFlow is an open source platform for machine learning. With TensorFlow, you can build, train and deploy your machine learning models. TensorFlow contains advanced data visualization features, such as computational graph visualizations. It also allows you to easily monitor and track the progress of your models.
PyTorch	PyTorch is an open source machine learning library optimized for deep learning. If you are working with computer vision or natural language processing models, use the Pytorch workbench image.
Minimal Python	If you do not require advanced machine learning features, or additional resources for compute-intensive data science work, you can use the Minimal Python image to develop your models.
TrustyAI	Use the TrustyAI workbench image to leverage your data science work with model explainability, tracing, and accountability, and runtime monitoring. See the TrustyAI Explainability repository for some example Jupyter notebooks.

Image name	Description
code-server	With the code-server workbench image, you can customize your workbench environment to meet your needs using a variety of extensions to add new languages, themes, debuggers, and connect to additional services. Enhance the efficiency of your data science work with syntax highlighting, auto-indentation, and bracket matching, as well as an automatic task runner for seamless automation. For more information, see code-server in GitHub. NOTE: Elyra-based pipelines are not available with the code-server workbench image.
RStudio Server (Technology preview)	Use the RStudio Server workbench image to access the RStudio IDE, an integrated development environment for R, a programming language for statistical computing and graphics. For more information, see the RStudio Server site. To use the **RStudio Server** workbench image, you must first build it by creating a secret and triggering the BuildConfig, and then enable it in the OpenShift AI UI by editing the **rstudio-rhel9** image stream. For more information, seeBuilding the RStudio Server workbench images. IMPORTANT **Disclaimer:** Red Hat supports managing workbenches in OpenShift AI. However, Red Hat does not provide support for the RStudio software. RStudio Server is available through https://rstudio.org/ and is subject to RStudio licensing terms. Review the licensing terms before you use this sample workbench.

Image name	Description
CUDA - RStudio Server (Technology Preview)	Use the CUDA - RStudio Server workbench image to access the RStudio IDE and NVIDIA CUDA Toolkit. RStudio is an integrated development environment for R, a programming language for statistical computing and graphics. With the NVIDIA CUDA toolkit, you can optimize your work using GPU-accelerated libraries and optimization tools. For more information, see the RStudio Server site. To use the **CUDA - RStudio Server** workbench image, you must first build it by creating a secret and triggering the BuildConfig, and then enable it in the OpenShift AI UI by editing the **cuda-rstudio-rhel9** image stream. For more information, seeBuilding the RStudio Server workbench images. IMPORTANT **Disclaimer:** Red Hat supports managing workbenches in OpenShift AI. However, Red Hat does not provide support for the RStudio software. RStudio Server is available through https://rstudio.org/ and is subject to RStudio licensing terms. Review the licensing terms before you use this sample workbench. The **CUDA - RStudio Server** workbench image contains NVIDIA CUDA technology. CUDA licensing information is available at https://docs.nvidia.com/cuda/. Review the licensing terms before you use this sample workbench.
ROCm	Use the ROCm workbench image to run AI and machine learning workloads on AMD GPUs in OpenShift AI. It includes ROCm libraries and tools optimized for high-performance GPU acceleration, supporting custom AI workflows and data processing tasks. Use this image integrating additional frameworks or dependencies tailored to your specific AI development needs.
ROCm-PyTorch	Use the ROCm-PyTorch workbench image to optimize PyTorch workloads on AMD GPUs in OpenShift AI. It includes ROCm-accelerated PyTorch libraries, enabling efficient deep learning training, inference, and experimentation. This image is designed for data scientists working with PyTorch-based workflows, offering integration with GPU scheduling.
ROCm-TensorFlow	Use the ROCm-TensorFlow workbench image to optimize TensorFlow workloads on AMD GPUs in OpenShift AI. It includes ROCm-accelerated TensorFlow libraries to support high-performance deep learning model training and inference. This image simplifies TensorFlow development on AMD GPUs and integrates with OpenShift AI for resource scaling and management.

4.2. BUILDING THE RSTUDIO SERVER WORKBENCH IMAGES

IMPORTANT

The **RStudio Server** and **CUDA - RStudio Server** workbench images are currently available in Red Hat OpenShift AI as Technology Preview features.

NOTE

The RStudio Server workbench images are currently unavailable for disconnected environments.

Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process.

For more information about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope.

Red Hat OpenShift AI includes the following RStudio Server workbench images:

- **RStudio Server workbench image**
  With the **RStudio Server** workbench image, you can access the RStudio IDE, an integrated development environment for the R programming language. R is used for statistical computing and graphics to support data analysis and predictions.

  IMPORTANT

  Disclaimer: Red Hat supports managing workbenches in OpenShift AI. However, Red Hat does not provide support for the RStudio software. RStudio Server is available through rstudio.org and is subject to their licensing terms. You should review their licensing terms before you use this sample workbench.

- **CUDA - RStudio Server workbench image**
  With the **CUDA - RStudio Server** workbench image, you can access the RStudio IDE and NVIDIA CUDA Toolkit. The RStudio IDE is an integrated development environment for the R programming language for statistical computing and graphics. With the NVIDIA CUDA toolkit, you can enhance your work by using GPU-accelerated libraries and optimization tools.

  IMPORTANT

  Disclaimer: Red Hat supports managing workbenches in OpenShift AI. However, Red Hat does not provide support for the RStudio software. RStudio Server is available through rstudio.org and is subject to their licensing terms. You should review their licensing terms before you use this sample workbench.

  The **CUDA - RStudio Server** workbench image contains NVIDIA CUDA technology. CUDA licensing information is available in the CUDA Toolkit documentation. You should review their licensing terms before you use this sample workbench.

To use the **RStudio Server** and **CUDA - RStudio Server** workbench images, you must first build them by creating a secret and triggering the **BuildConfig**, and then enable them in the OpenShift AI UI by editing the **rstudio-rhel9** and **cuda-rstudio-rhel9** image streams.

Prerequisites

- Before starting the RStudio Server build process, you have at least 1 CPU and 2Gi memory available for **rstudio-server-rhel9**, and 1.5 CPUs and 8Gi memory available for **cuda-rstudio-server-rhel9** on your cluster.
- You are logged in to your OpenShift cluster.
- You have the **cluster-admin** role in OpenShift.
- You have an active Red Hat Enterprise Linux (RHEL) subscription.

Procedure

1. Create a secret with Subscription Manager credentials. These are usually your Red Hat Customer Portal username and password.
   Note: The secret must be named **rhel-subscription-secret**, and its **USERNAME** and **PASSWORD** keys must be in capital letters.

   ```
   oc create secret generic rhel-subscription-secret --from-literal=USERNAME=<username> --from-literal=PASSWORD=<password> -n redhat-ods-applications
   ```

2. Start the build:
   a. To start the lightweight RStudio Server build:

   ```
   oc start-build rstudio-server-rhel9 -n redhat-ods-applications --follow
   ```

   b. To start the CUDA-enabled RStudio Server build, trigger the **cuda-rstudio-server-rhel9** BuildConfig:

   ```
   oc start-build cuda-rstudio-server-rhel9 -n redhat-ods-applications --follow
   ```

3. Confirm that the build process has completed successfully using the following command. Successful builds appear as **Complete**.

   ```
   oc get builds -n redhat-ods-applications
   ```

4. After the builds complete successfully, use the following commands to make the workbench images available in the OpenShift AI UI.
   a. To enable the RStudio Server workbench image:

   ```
   oc label -n redhat-ods-applications imagestream rstudio-rhel9 opendatahub.io/notebook-image='true'
   ```

   b. To enable the CUDA - RStudio Server workbench image:

   ```
   oc label -n redhat-ods-applications imagestream cuda-rstudio-rhel9 opendatahub.io/notebook-image='true'
   ```

▪

Verification

- You can see **RStudio Server** and **CUDA - RStudio Server** images on the **Applications → Enabled** menu in the Red Hat OpenShift AI dashboard.
- You can see **R Studio Server** or **CUDA - RStudio Server** in the **Data science projects → Workbenches → Create workbench → Notebook image → Image selection** dropdown list.

4.3. CREATING A WORKBENCH

When you create a workbench, you specify an image (an IDE, packages, and other dependencies). You can also configure connections, cluster storage, and add container storage.

Prerequisites

- You have logged in to Red Hat OpenShift AI.
- If you use OpenShift AI groups, you are part of the user group or admin group (for example, **rhoai-users** or **rhoai-admins**) in OpenShift.
- You have created a project.
- If you created a Simple Storage Service (S3) account outside of Red Hat OpenShift AI and you want to create connections to your existing S3 storage buckets, you have the following credential information for the storage buckets:
  - Endpoint URL
  - Access key
  - Secret key
  - Region
  - Bucket name

  For more information, see Working with data in an S3-compatible object store .

Procedure

1. From the OpenShift AI dashboard, click **Data science projects**.
   The **Data science projects** page opens.
2. Click the name of the project that you want to add the workbench to.
   A project details page opens.
3. Click the **Workbenches** tab.
4. Click **Create workbench**.
   The **Create workbench** page opens.
5. In the **Name** field, enter a unique name for your workbench.

6. Optional: If you want to change the default resource name for your workbench, click **Edit resource name**.
   The resource name is what your resource is labeled in OpenShift. Valid characters include lowercase letters, numbers, and hyphens (-). The resource name cannot exceed 30 characters, and it must start with a letter and end with a letter or number.

   Note: You cannot change the resource name after the workbench is created. You can edit only the display name and the description.

7. Optional: In the **Description** field, enter a description for your workbench.

8. In the **Workbench image** section, complete the fields to specify the workbench image to use with your workbench.
   From the **Image selection** list, select a workbench image that suits your use case. A workbench image includes an IDE and Python packages (reusable code). If project-scoped images exist, the **Image selection** list includes subheadings to distinguish between global images and project-scoped images.

   Optionally, click **View package information** to view a list of packages that are included in the image that you selected.

   If the workbench image has multiple versions available, select the workbench image version to use from the **Version selection** list. To use the latest package versions, Red Hat recommends that you use the most recently added image.

   > **NOTE**
   >
   > You can change the workbench image after you create the workbench.

9. In the **Deployment size** section, select one of the following options, depending on whether the hardware profiles feature is enabled.

   > **IMPORTANT**
   >
   > The hardware profiles feature is currently available in Red Hat OpenShift AI 2.22 as a Technology Preview feature. Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process.
   >
   > For more information about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope.

   - If the hardware profiles feature is not enabled:
     a. From the **Container size** list, select the appropriate size for the size of the model that you want to train or tune.
        For example, to run the example fine-tuning job described in Fine-tuning a model by using Kubeflow Training, select **Medium**.
     b. From the **Accelerator** list, select a suitable accelerator profile for your workbench.

If project-scoped accelerator profiles exist, the **Accelerator** list includes subheadings to distinguish between global accelerator profiles and project-scoped accelerator profiles.

- If the hardware profiles feature is enabled:
  a. From the **Hardware profile** list, select a suitable hardware profile for your workbench. If project-scoped hardware profiles exist, the **Hardware profile** list includes subheadings to distinguish between global hardware profiles and project-scoped hardware profiles.

     The hardware profile specifies the number of CPUs and the amount of memory allocated to the container, setting the guaranteed minimum (request) and maximum (limit) for both.

  b. If you want to change the default values, click **Customize resource requests and limit** and enter new minimum (request) and maximum (limit) values.

IMPORTANT

By default, the hardware profiles feature is not enabled: hardware profiles are not shown in the dashboard navigation menu or elsewhere in the user interface. In addition, user interface components associated with the deprecated accelerator profiles functionality are still displayed. To show the **Settings → Hardware profiles** option in the dashboard navigation menu, and the user interface components associated with hardware profiles, set the **disableHardwareProfiles** value to **false** in the **OdhDashboardConfig** custom resource (CR) in OpenShift. For more information about setting dashboard configuration options, see Customizing the dashboard.

10. Optional: In the **Environment variables** section, select and specify values for any environment variables.
    Setting environment variables during the workbench configuration helps you save time later because you do not need to define them in the body of your workbenches, or with the IDE command line interface.

    If you are using S3-compatible storage, add these recommended environment variables:

    - **AWS_ACCESS_KEY_ID** specifies your Access Key ID for Amazon Web Services.
    - **AWS_SECRET_ACCESS_KEY** specifies your Secret access key for the account specified in **AWS_ACCESS_KEY_ID**.

    OpenShift AI stores the credentials as Kubernetes secrets in a protected namespace if you select **Secret** when you add the variable.

11. In the **Cluster storage** section, configure the storage for your workbench. Select one of the following options:
    - **Create new persistent storage** to create storage that is retained after you shut down your workbench. Complete the relevant fields to define the storage:
      a. Enter a **name** for the cluster storage.
      b. Enter a **description** for the cluster storage.

c. Select a **storage class** for the cluster storage.

> **NOTE**
>
> You cannot change the storage class after you add the cluster storage to the workbench.

d. For storage classes that support multiple access modes, select an **Access mode** to define how the volume can be accessed. For more information, see About persistent storage.
Only the access modes that have been enabled for the storage class by your cluster and OpenShift AI administrators are visible.

e. Under **Persistent storage size**, enter a new size in gibibytes or mebibytes.

- **Use existing persistent storage** to reuse existing storage and select the storage from the **Persistent storage** list.

12. Optional: You can add a connection to your workbench. A connection is a resource that contains the configuration parameters needed to connect to a data source or sink, such as an object storage bucket. You can use storage buckets for storing data, models, and pipeline artifacts. You can also use a connection to specify the location of a model that you want to deploy.
In the **Connections** section, use an existing connection or create a new connection:

- Use an existing connection as follows:

  a. Click **Attach existing connections**.

  b. From the **Connection** list, select a connection that you previously defined.

- Create a new connection as follows:

  a. Click **Create connection**. The **Add connection** dialog appears.

  b. From the **Connection type** drop-down list, select the type of connection. The **Connection details** section appears.

  c. If you selected **S3 compatible object storage** in the preceding step, configure the connection details:

     i. In the **Connection name** field, enter a unique name for the connection.

     ii. Optional: In the **Description** field, enter a description for the connection.

     iii. In the **Access key** field, enter the access key ID for the S3-compatible object storage provider.

     iv. In the **Secret key** field, enter the secret access key for the S3-compatible object storage account that you specified.

     v. In the **Endpoint** field, enter the endpoint of your S3-compatible object storage bucket.

     vi. In the **Region** field, enter the default region of your S3-compatible object storage account.

     vii. In the **Bucket** field, enter the name of your S3-compatible object storage bucket.

viii. Click **Create**.

d. If you selected **URI** in the preceding step, configure the connection details:

i. In the **Connection name** field, enter a unique name for the connection.

ii. Optional: In the **Description** field, enter a description for the connection.

iii. In the **URI** field, enter the Uniform Resource Identifier (URI).

iv. Click **Create**.

13. Click **Create workbench**.

Verification

- The workbench that you created appears on the **Workbenches** tab for the project.
- Any cluster storage that you associated with the workbench during the creation process appears on the **Cluster storage** tab for the project.
- The **Status** column on the **Workbenches** tab displays a status of **Starting** when the workbench server is starting, and **Running** when the workbench has successfully started.
- Optional: Click the open icon () to open the IDE in a new window.

CHAPTER 5. NEXT STEPS

The following product documentation provides more information on how to develop, test, and deploy data science solutions with OpenShift AI.

Try the end-to-end tutorial

OpenShift AI tutorial - Fraud detection example

Step-by-step guidance to complete the following tasks with an example fraud detection model:

- Explore a pre-trained fraud detection model by using a Jupyter notebook.
- Deploy the model by using OpenShift AI model serving.
- Refine and train the model by using automated pipelines.

Develop and train a model in your workbench IDE

Working in your data science IDE

Learn how to access your workbench IDE (JupyterLab, code-server, or RStudio Server).

For the JupyterLab IDE, learn about the following tasks:

- Creating and importing Jupyter notebooks
- Using Git to collaborate on Jupyter notebooks
- Viewing and installing Python packages
- Troubleshooting common problems

Automate your ML workflow with pipelines

Working with data science pipelines

Enhance your data science projects on OpenShift AI by building portable machine learning (ML) workflows with data science pipelines, by using Docker containers. Use pipelines for continuous retraining and updating of a model based on newly received data.

Deploy and test a model

Serving models

Deploy your ML models on your OpenShift cluster to test and then integrate them into intelligent applications. When you deploy a model, it is available as a service that you can access by using API calls. You can return predictions based on data inputs that you provide through API calls.

Monitor and manage models

Serving models

The Red Hat OpenShift AI service includes model deployment options for hosting the model on Red Hat OpenShift Dedicated or Red Hat Openshift Service on AWS for integration into an external application.

Add accelerators to optimize performance

Working with accelerators

If you work with large data sets, you can use accelerators, such as NVIDIA GPUs, AMD GPUs, and Intel Gaudi AI accelerators, to optimize the performance of your data science models in OpenShift AI. With accelerators, you can scale your work, reduce latency, and increase productivity.

Implement distributed workloads for higher performance

Working with distributed workloads
Implement distributed workloads to use multiple cluster nodes in parallel for faster, more efficient data processing and model training.

Explore extensions

Working with connected applications
Extend your core OpenShift AI solution with integrated third-party applications. Several leading AI/ML software technology partners, including Starburst, Intel AI Tools, and IBM are also available through Red Hat Marketplace.

5.1. ADDITIONAL RESOURCES

In addition to product documentation, Red Hat provides a rich set of learning resources for OpenShift AI and supported applications.

On the **Resources** page of the OpenShift AI dashboard, you can use the category links to filter the resources for various stages of your data science workflow. For example, click the **Model serving** category to display resources that describe various methods of deploying models. Click **All items** to show the resources for all categories.

For the selected category, you can apply additional options to filter the available resources. For example, you can filter by type, such as how-to articles, quick starts, or tutorials; these resources provide the answers to common questions.

For information about Red Hat OpenShift AI support requirements and limitations, see Red Hat OpenShift AI: Supported Configurations.