NVIDIA AI Enterprise

Quick Start Guide

QSG-10396-001 _v2.3 | October 2022

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About this Guide

NVIDIA AI Enterprise Quick Start Guide provides minimal instructions for installing and configuring NVIDIA AI Enterprise on a single node and for configuring a Cloud License Service (CLS) instance. If you need complete instructions, are using multiple nodes, or are using Delegated License Service (DLS) instances to serve licenses, refer to *NVIDIA AI Enterprise User Guide* and *NVIDIA License System User Guide*.

Chapter 1. Getting NVIDIA AI Enterprise

After your order for NVIDIA AI Enterprise is processed, you will receive an order confirmation message from NVIDIA. This message contains information that you need for getting NVIDIA AI Enterprise from the NVIDIA Licensing Portal. To log in to the NVIDIA Licensing Portal, you must have an NVIDIA Enterprise Account.

1.1. Before You Begin

Before following the procedures in this guide, ensure that the following prerequisites are met:

- You have a server platform that is capable of hosting your chosen hypervisor and NVIDIA GPUs that support NVIDIA AI Enterprise.
- One or more NVIDIA GPUs that support NVIDIA AI Enterprise is installed in your server platform.
- A supported virtualization software stack is installed according to the instructions in the software vendor's documentation.
- A virtual machine (VM) running a supported guest operating system (OS) is configured in your chosen hypervisor.

For information about supported hardware and software, and any known issues for this release of NVIDIA AI Enterprise, refer to *NVIDIA AI Enterprise Release Notes*.

1.2. Your Order Confirmation Message

After your order for NVIDIA AI Enterprise is processed, you will receive an order confirmation message to which your NVIDIA Entitlement Certificate is attached.

Thank you for your software and/or services order!

Please find enclosed your Entitlement Certificate for the Software and/or Services products you ordered.

Please refer to the attached Entitlement Certificate to register for your software and services.

The following is your order information:

PO Number	NVIDIA Sales Order	NVIDIA Delivery Number

Questions?
NVIDIA Enterprise Support contact information can be found here https://www.NVIDIA.com/en-us/support/enterprise/

Your NVIDIA Entitlement Certificate contains your product activation keys.

NVIDIA Corporation
2788 San Tomas Expressway
SANTA CLARA CA 95051
USA

NVIDIA® Entitlement Certificate
This certificate serves as evidence that NVIDIA has entitled you for the following product(s).

End Customer ( )

NVIDIA Delivery	
Entitlement Date	16 AUG 2021
PO Number	
NVIDIA Sales Order	

No	Entitlement Description	Quantity	Sales Type	Term	Start Date	End Date
1	NVIDIA AI Enterprise Subscription License and Support per CPU Socket PAK ID	2 EA	Initial	3 Years	16 AUG 2021	15 AUG 2024

Please follow the instructions provided in the following section to register your entitlements.

Thank you for your order!

Your NVIDIA Entitlement Certificate also provides instructions for using the certificate.

NOTICE

HOW TO USE THIS CERTIFICATE

Registration Instructions

Please refer to your NVIDIA AI Enterprise Quick Start Guide for information on how to get started, including additional instructions on how to register for your entitlement.

Sales Type: Initial

Already have NVIDIA AI Enterprise entitlements? Please Login.

New to NVIDIA AI Enterproise entitlements? Please register and follow instructions on the registration page.

You will get an email to set up your password for the NVIDIA Application Hub.

After you have successfully registered, please wait for up to 2 business days for a second email to be sent to you to set up your profile and log into the NVIDIA GPU Cloud (NGC) to access your NVIDIA AI Enterprise software in the NGC Enterprise Catalog.

You can also click here if you wish to contact NVIDIA Enterprise Support or access the NVIDIA Support Portal or the NVIDIA Licensing Portal to view your NVIDIA AI Enterprise entitlements.

Questions?
NVIDIA Enterprise Support contact information can be found here.

Rights and restrictions on the use, transfer and copying of the Software are set forth in corresponding product's NVIDIA End User License Agreement. Rights and restrictions on the use of Services are set forth in NVIDIA's corresponding service program's End User Terms and Conditions.

1.3. NVIDIA Enterprise Account Requirements

To get NVIDIA AI Enterprise, you must have a suitable NVIDIA Enterprise Account for accessing your licenses.

Note: For a Support, Upgrade, and Maintenance Subscription (SUMS) renewal, you should already have a suitable NVIDIA Enterprise Account and this requirement should already be met. However, if you have an account that was created for an evaluation license and you want to access licenses that you purchased, you must repeat the registration process.

- If you do not have an account, follow the **Register** link in the instructions for using the certificate to create your account. For details, refer to Creating your NVIDIA Enterprise Account.
- If you have an account that was created for an evaluation license and you want to access licenses that you purchased, follow the **Register** link in the instructions for using the certificate to create an account for your **purchased** licenses. You can choose to create

a separate account for your purchased licenses or link your existing account for an evaluation license to the account for your purchased licenses.

- To create a separate account for your purchased licenses, follow the instructions in Creating your NVIDIA Enterprise Account, specifying a different e-mail address than the address with which you created your existing account.
- To link your existing account for an evaluation license to the account for your purchased licenses, follow the instructions in Linking an Evaluation Account to an NVIDIA Enterprise Account for Purchased Licenses, specifying the e-mail address with which you created your existing account.

- If you already have a suitable NVIDIA Enterprise Account for accessing your licenses, follow the **Login** link in the instructions for using the certificate to log in to the NVIDIA Enterprise Application Hub, go to the NVIDIA Licensing Portal, and download your NVIDIA AI Enterprise. For details, refer to Downloading NVIDIA AI Enterprise.

1.4. Creating your NVIDIA Enterprise Account

If you do not have an NVIDIA Enterprise Account, you must create an account to be able to log in to the NVIDIA Licensing Portal.

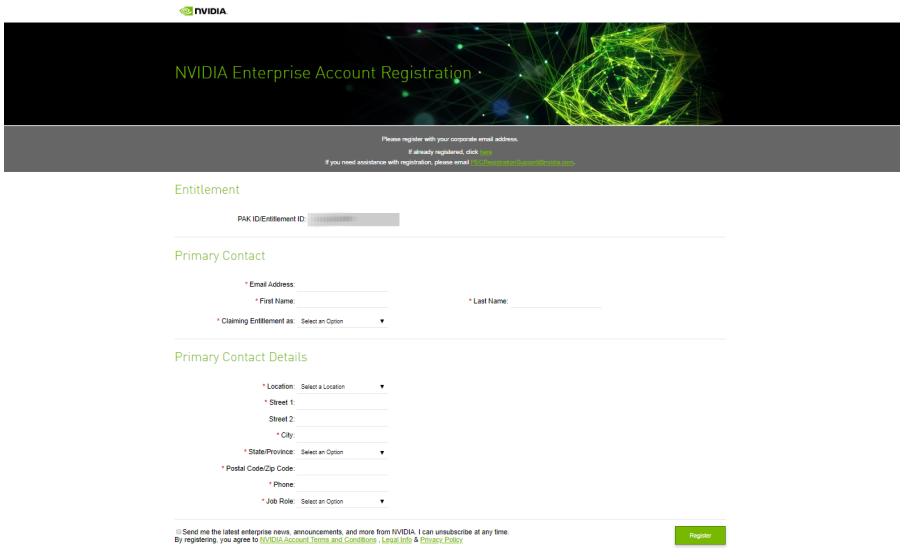
If you already have an account, skip this task and go to Downloading NVIDIA AI Enterprise.

However, if you have an account that was created for an evaluation license and you want to access licenses that you purchased, you must repeat the registration process when you receive your purchased licenses. You can choose to create a separate account for your purchased licenses or link your existing account for an evaluation license to the account for your purchased licenses.

- To create a separate account for your purchased licenses, perform this task, specifying a different e-mail address than the address with which you created your existing account.
- To link your existing account for an evaluation license to the account for your purchased licenses, follow the instructions in Linking an Evaluation Account to an NVIDIA Enterprise Account for Purchased Licenses, specifying the e-mail address with which you created your existing account.

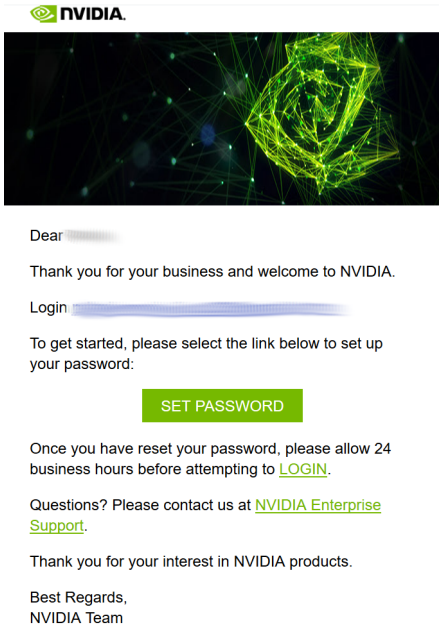
Before you begin, ensure that you have your order confirmation message.

1. In the instructions for using your NVIDIA Entitlement Certificate, follow the **Register** link.
2. Fill out the form on the **NVIDIA Enterprise Account Registration** page and click **Register**.



A message confirming that an account has been created appears, and an e-mail instructing you to set your NVIDIA password is sent to the e-mail address you provided.

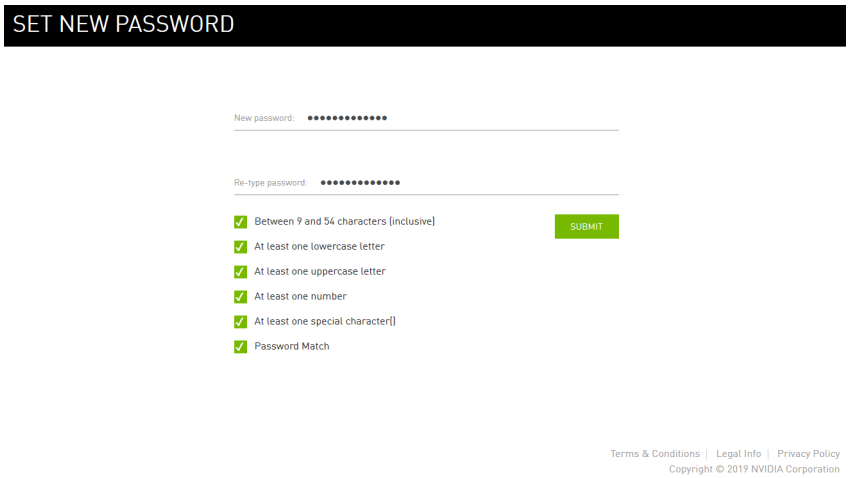
3. Open the e-mail instructing you to set your password and click **SET PASSWORD**.



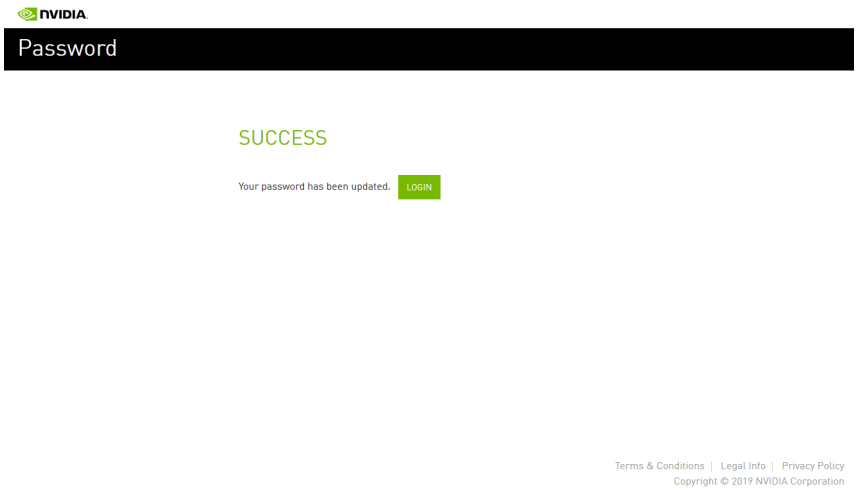
Note: After you have set your password during the initial registration process, you will be able to log in to your account within 15 minutes. However, it may take up to 24 business hours for your entitlement to appear in your account.

For your account security, the **SET PASSWORD** link in this e-mail is set to expire in 24 hours.

4. Enter and re-enter your new password, and click **SUBMIT**.



A message confirming that your password has been set successfully appears.



You are then automatically directed to log in to the NVIDIA Licensing Portal with your new password.

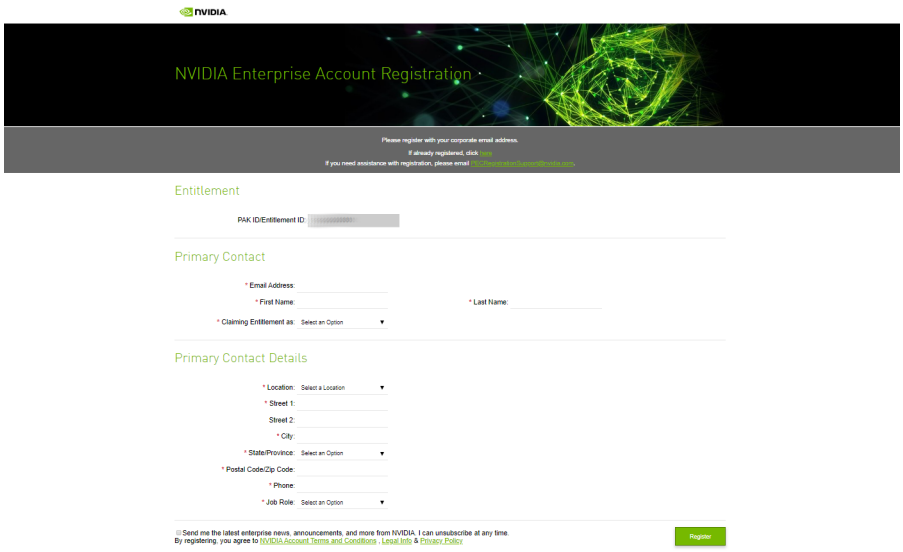
1.5. Linking an Evaluation Account to an NVIDIA Enterprise Account for Purchased Licenses

If you have an account that was created for an evaluation license, you must repeat the registration process when you receive your purchased licenses. To link your existing account

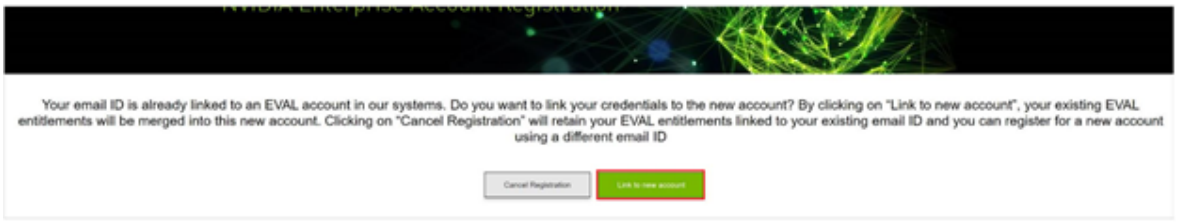
for an evaluation license to the account for your purchased licenses, register for an NVIDIA Enterprise Account with the e-mail address with which you created your existing account.

If you want to create a separate account for your purchased licenses, follow the instructions in Creating your NVIDIA Enterprise Account, specifying a different e-mail address than the address with which you created your existing account.

1. In the instructions for using the NVIDIA Entitlement Certificate **for your purchased licenses**, follow the **Register** link.
2. Fill out the form on the **NVIDIA Enterprise Account Registration** page, specifying the e-mail address with which you created your existing account, and click **Register**.



3. When a message stating that your e-mail address is already linked to an evaluation account is displayed, click **LINK TO NEW ACCOUNT**.

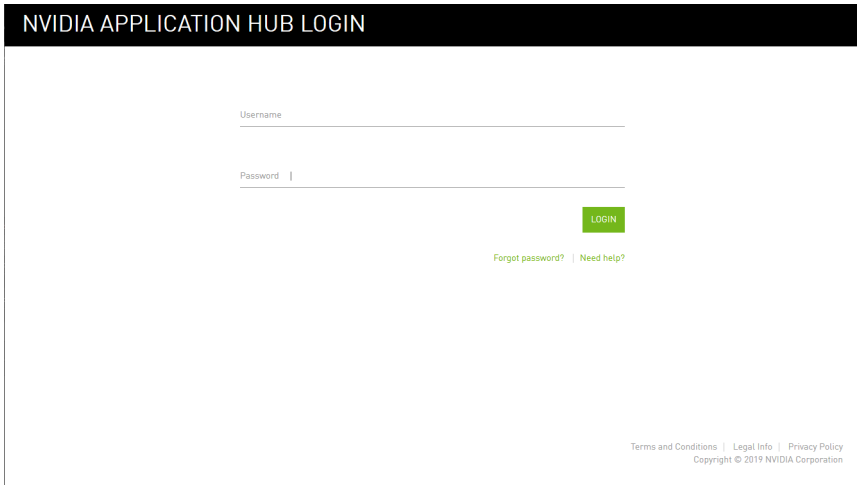


Log in to the NVIDIA Licensing Portal with the credentials for your existing account.

1.6. Downloading NVIDIA AI Enterprise

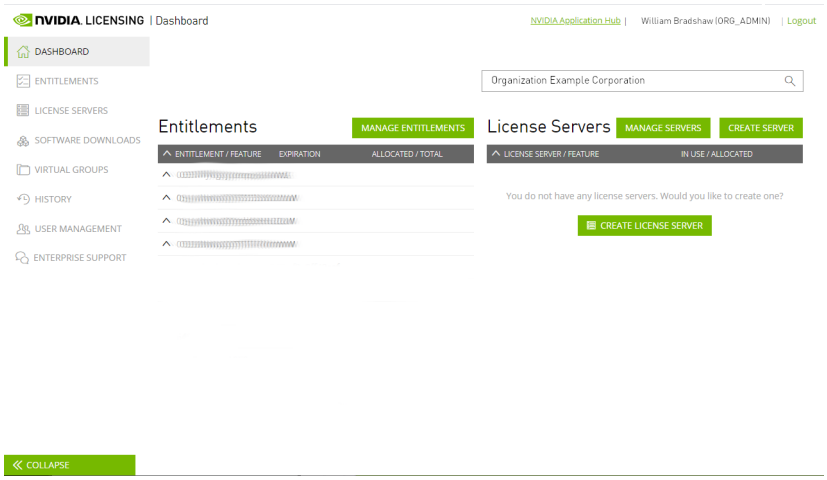
Before you begin, ensure that you have your order confirmation message and have created an NVIDIA Enterprise Account.

1. Visit the NVIDIA Enterprise Application Hub by following the **Login** link in the instructions for using your NVIDIA Entitlement Certificate or when prompted after setting the password for your NVIDIA Enterprise Account.
2. When prompted, provide your e-mail address and password, and click **LOGIN**.



3. On the **NVIDIA APPLICATION HUB** page that opens, click **NVIDIA LICENSING PORTAL**.

   The NVIDIA Licensing Portal dashboard page opens.



> **Note:** Your entitlement might not appear on the NVIDIA Licensing Portal dashboard page until 24 business hours after you set your password during the initial registration process.

4. In the NVIDIA Licensing Portal dashboard page opens, click the down arrow next to each entitlement listed to view details of the NVIDIA AI Enterprise that you purchased.

5. In the left navigation pane of the NVIDIA Licensing Portal dashboard, click **SOFTWARE DOWNLOADS**.
6. On the **Product Download** page that opens, set the **Product Family** option to **NVAIE** and follow the **Download** link for NVIDIA AI Enterprise.
7. When prompted to accept the license for the software that you are downloading, click **AGREE & DOWNLOAD**.
8. When the browser asks what it should do with the file, select the option to save the file.

   After the download starts, a pop-up window opens for you to download any additional software that you might need for your NVIDIA AI Enterprise deployment.
9. In the pop-up window, follow the links to download any additional software that you need for your NVIDIA AI Enterprise deployment.
   a). If you are using Delegated License Service (DLS) instances to serve licenses, follow the link to DLS 1.0 for your chosen hypervisor, for example, **DLS 1.0 for VMware vSphere**.

   For information about installing and configuring DLS instances, refer to *NVIDIA License System User Guide*.

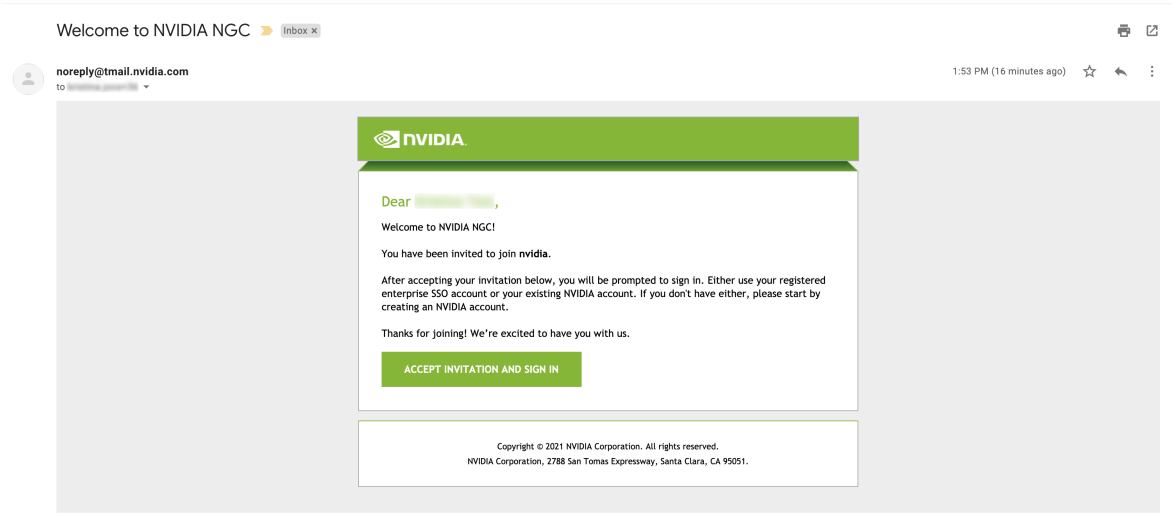
Chapter 2. Accessing the Enterprise Catalog and the NGC Private Registry

2.1. The Enterprise Catalog

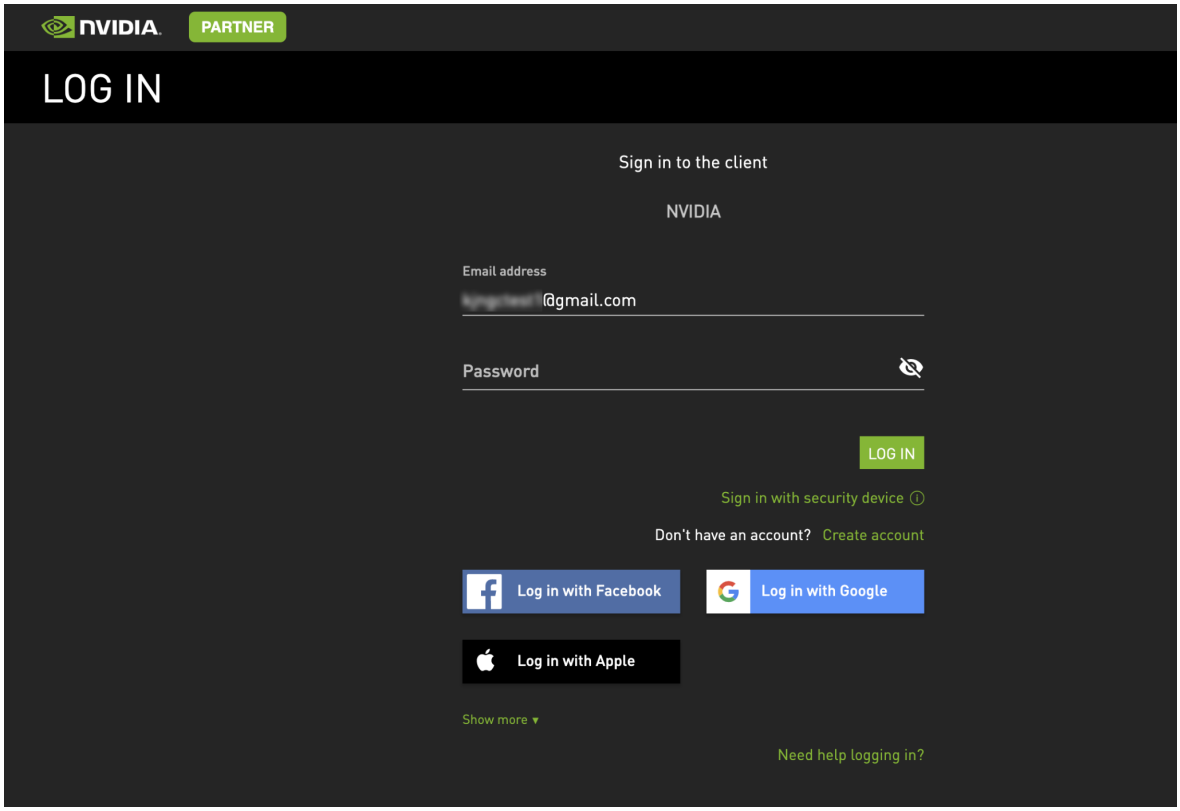
The NVIDIA AI Enterprise Software Suite is distributed through the Enterprise Catalog. After you access the Enterprise Catalog, you will see the NVIDIA AI Enterprise Software Suite collection. Detailed documentation makes it easy to utilize the software, and if additional support is required, users can submit the ticket directly from the portal.

2.1.1. Setting Up Your Access to the Enterprise Catalog

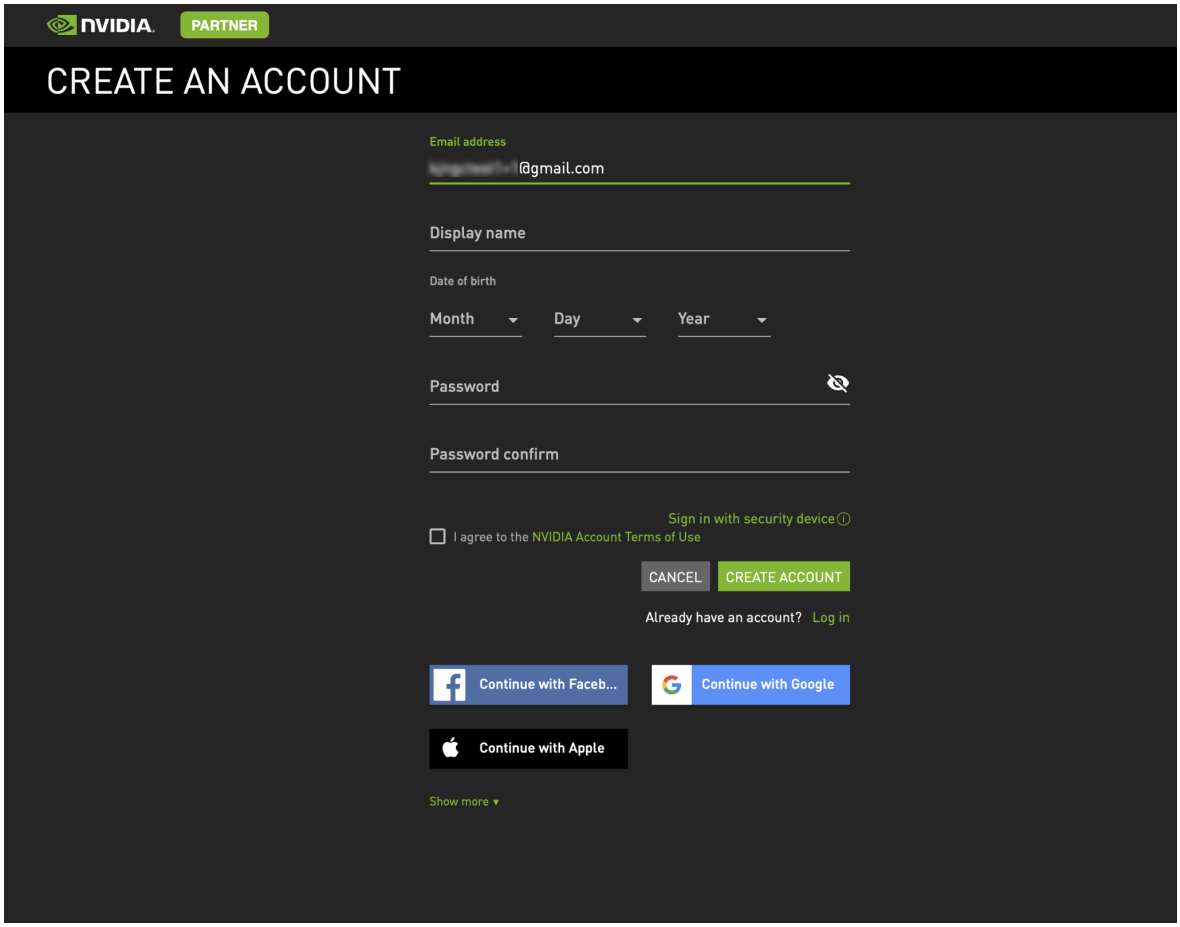
1. After your access was set up, you will receive a welcome email that invites you to continue the login process. Click on **Activate Account**.



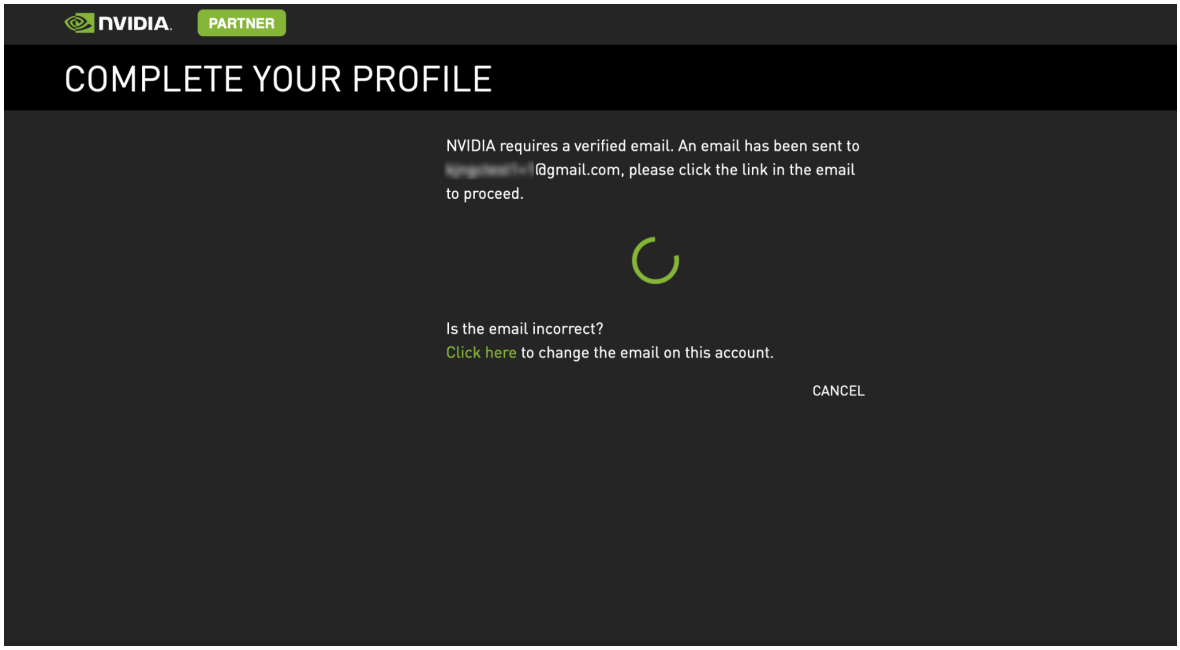
2. Click on **Create Account** to create a new NVIDIA account. *If you already have an existing NVIDIA account linked to this email address, login here.*



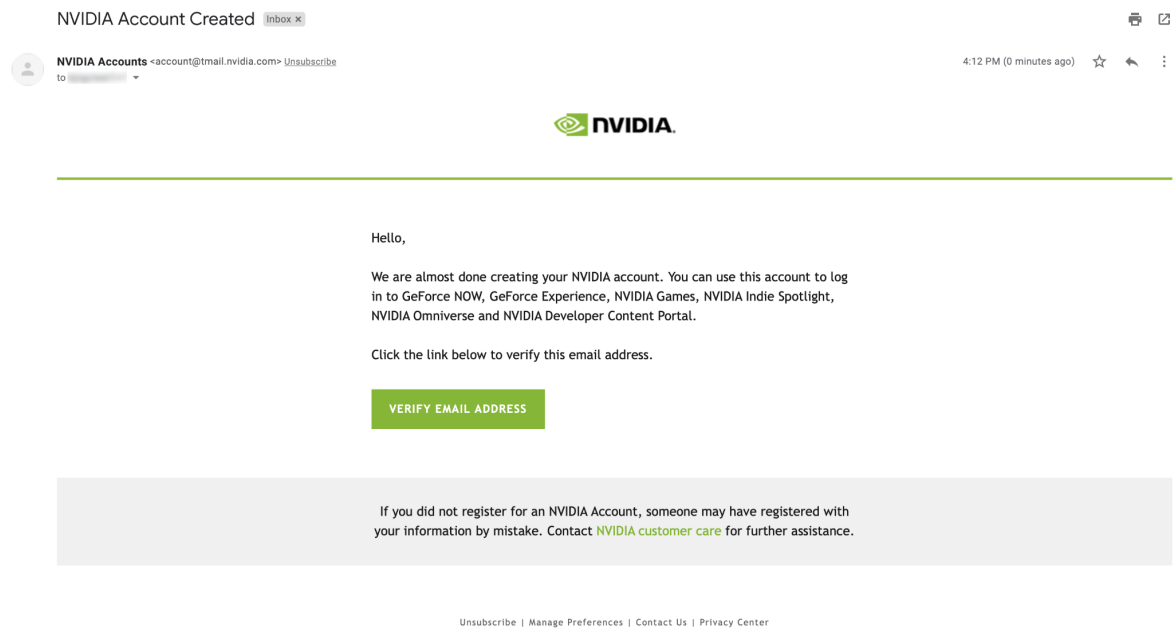
3. Provide account details and accept the NVIDIA Account Terms of Use. Click on **Create Account**.



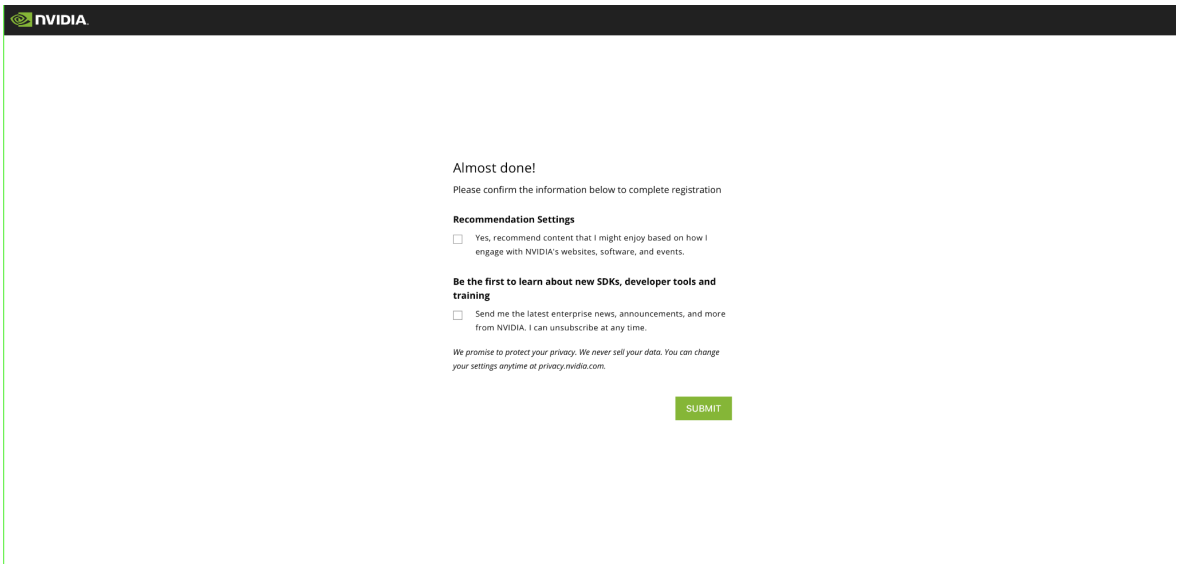
4. To complete your profile, you are asked to verify your account.



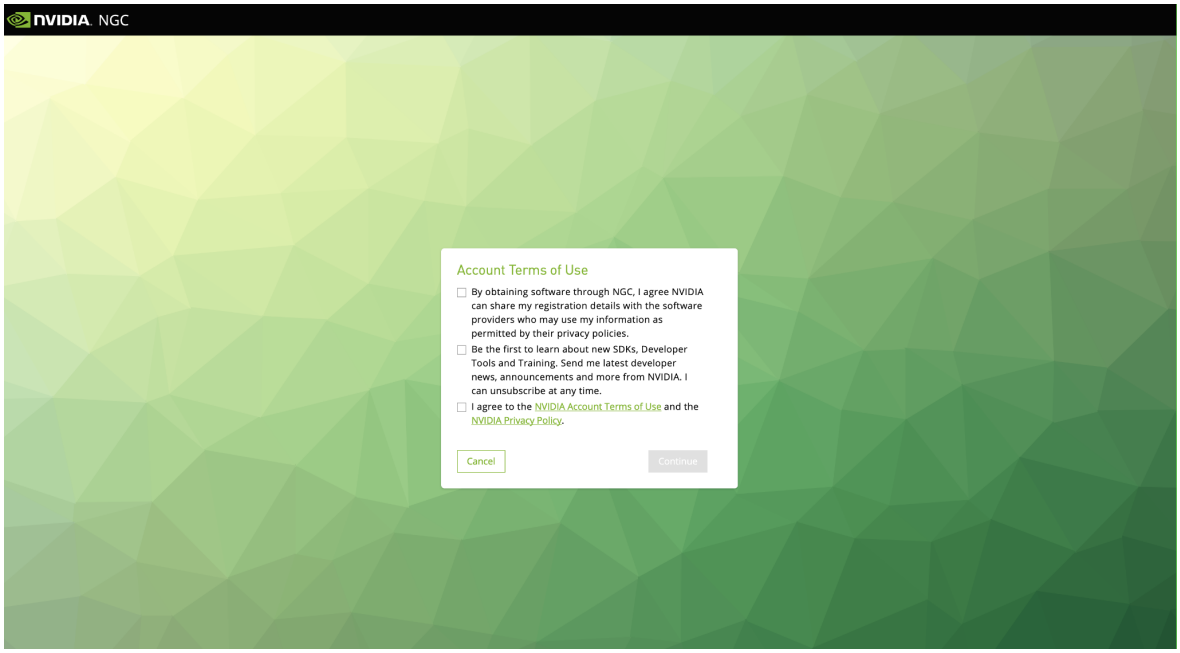
5. Go to your email inbox, open the "NVIDIA Account Created" email, and click on **Verify Email Address**.



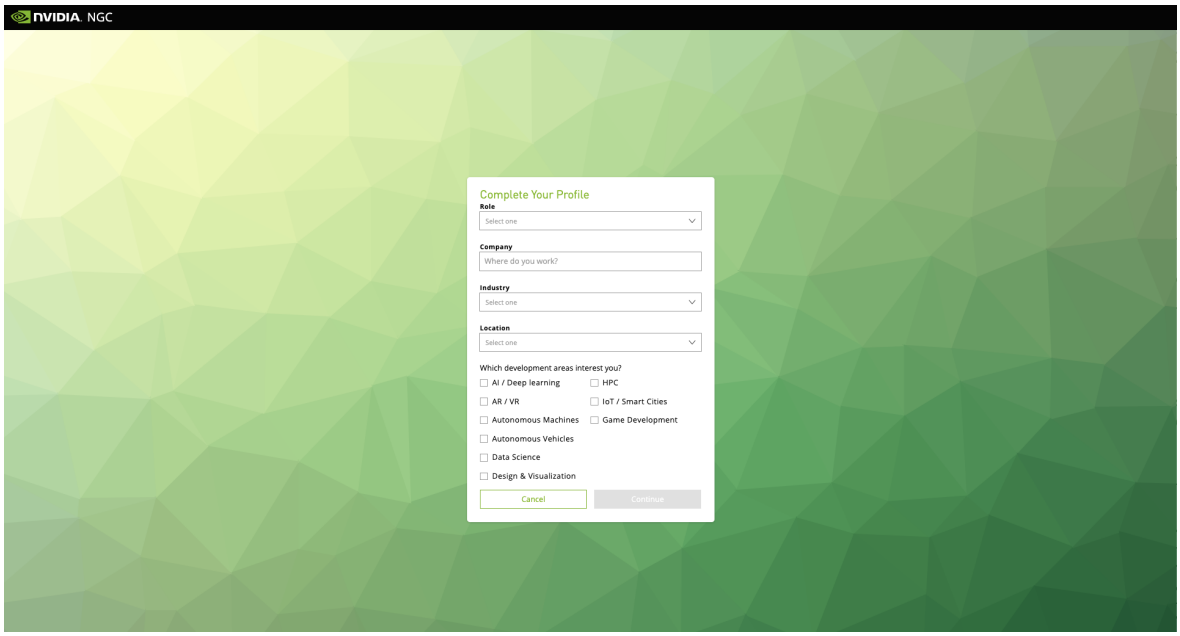
6. You are redirected to the following screen. Set your recommendation settings. Click **Submit**.



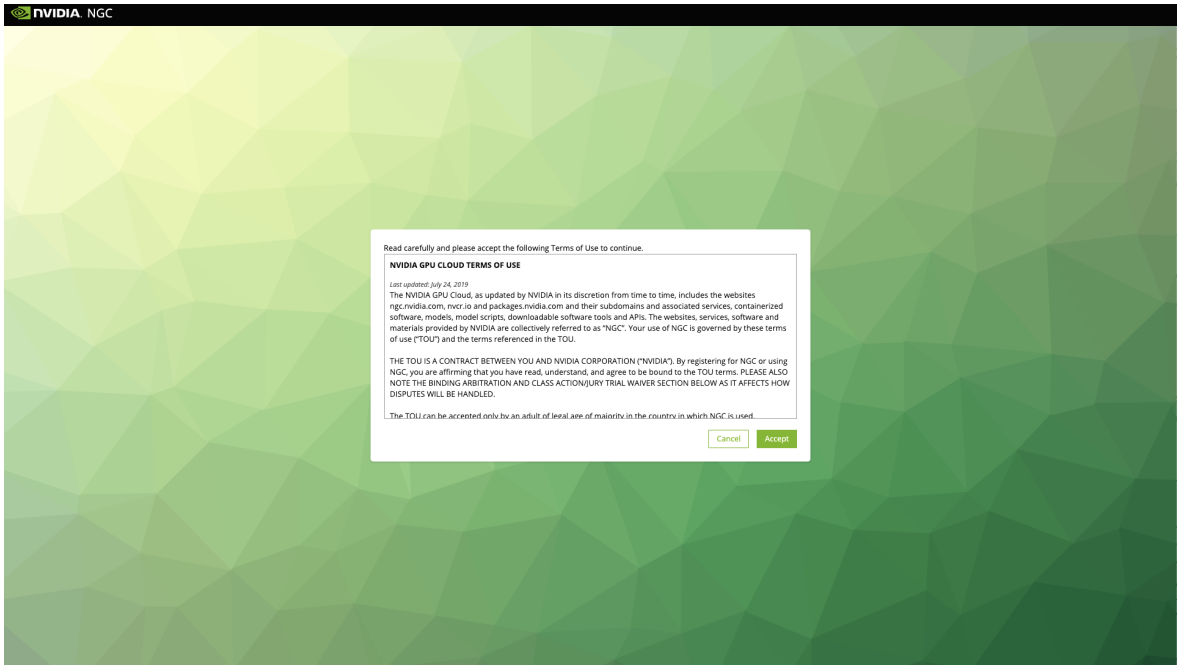
7. Review and accept the **NVIDIA Account Terms of Use** and the **NVIDIA Privacy Policy**.



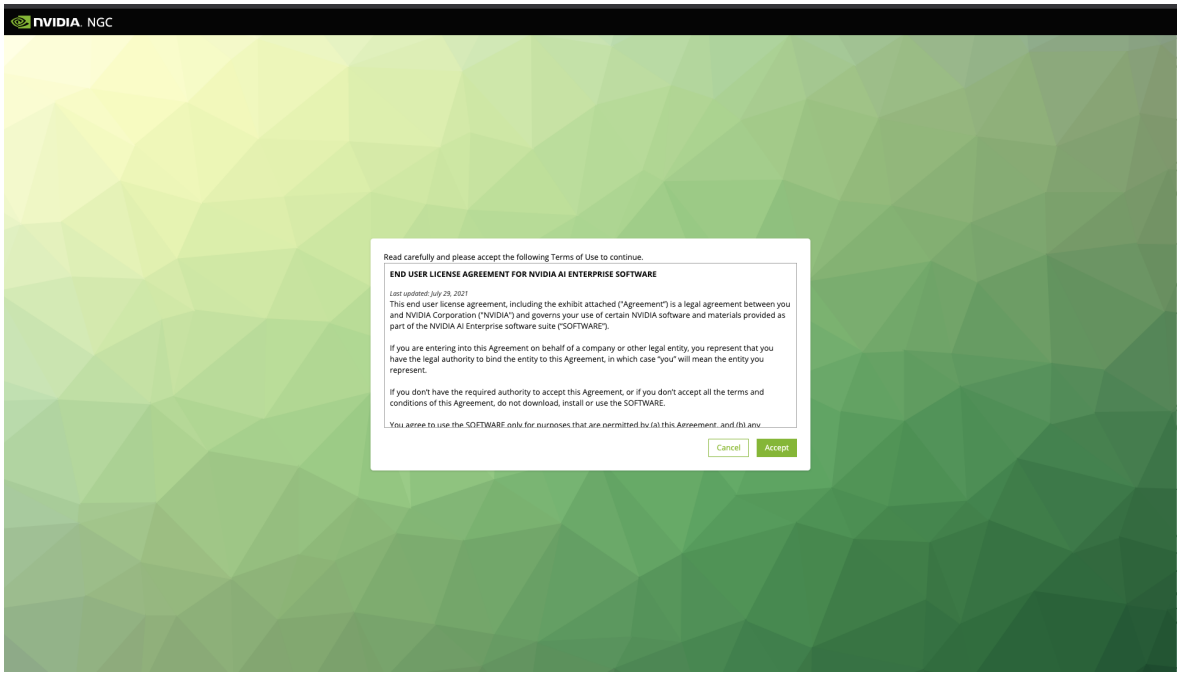
8. Complete your profile by providing the information below. Click **Continue**.



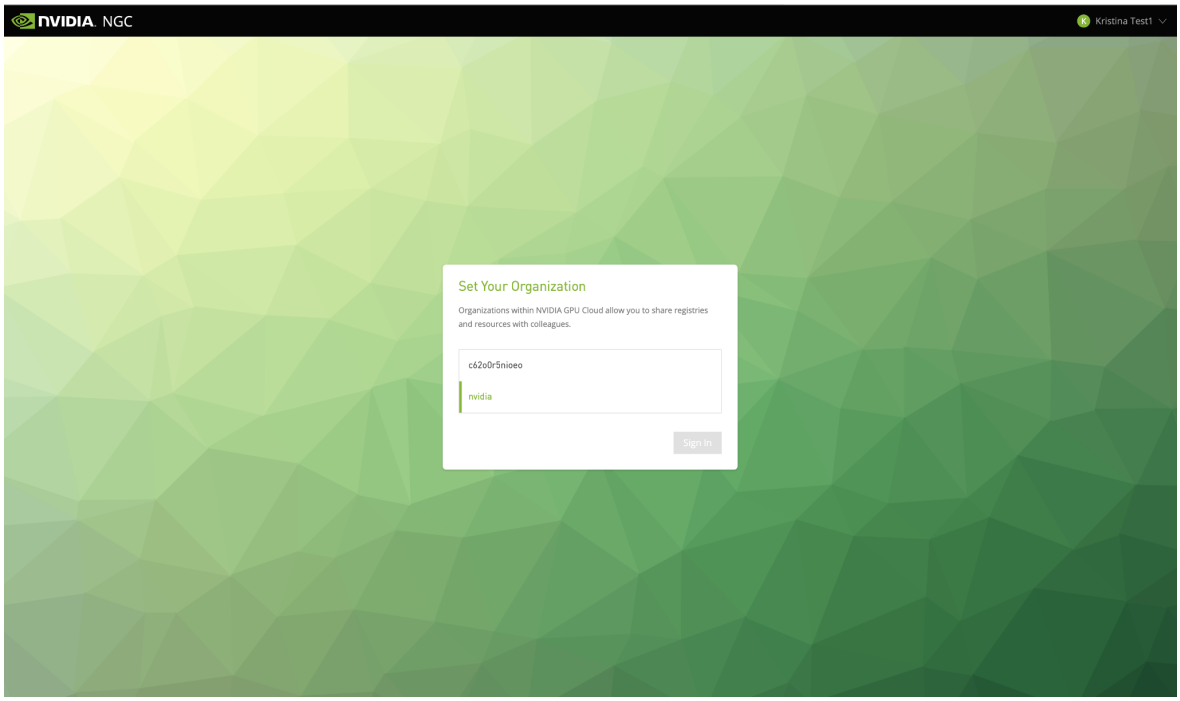
9. Review and **Accept** the NVIDIA GPU Cloud Terms of Use and Consent.



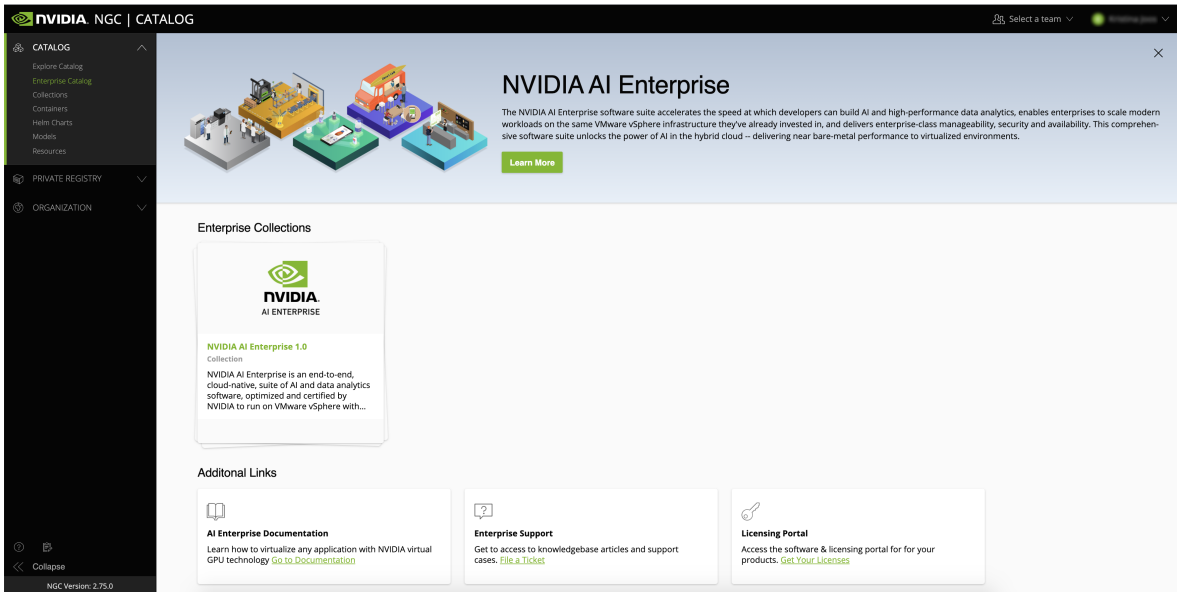
10. Review and **Accept** the NVIDIA AI Enterprise Terms of Use.



11. If asked, set your organization. The name of your organization was defined while setting up your Private Registry. Click **Sign In**.



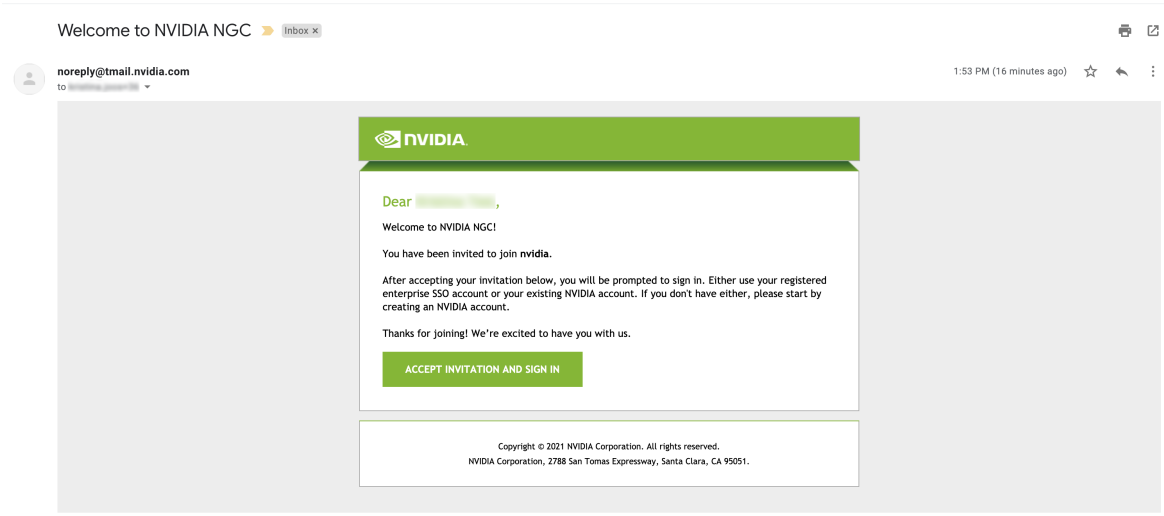
12. Welcome to the Enterprise Catalog.



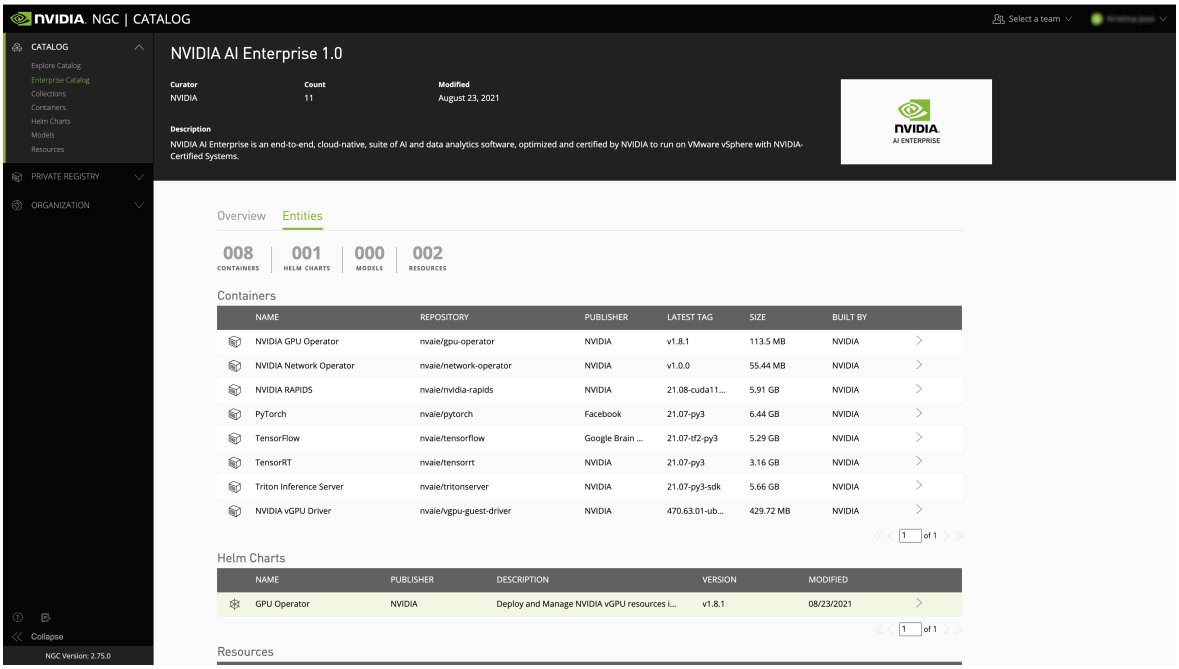
2.1.2. Downloading Software from the Enterprise Catalog

2.1.2.1. Accessing the NVIDIA AI Enterprise Collection

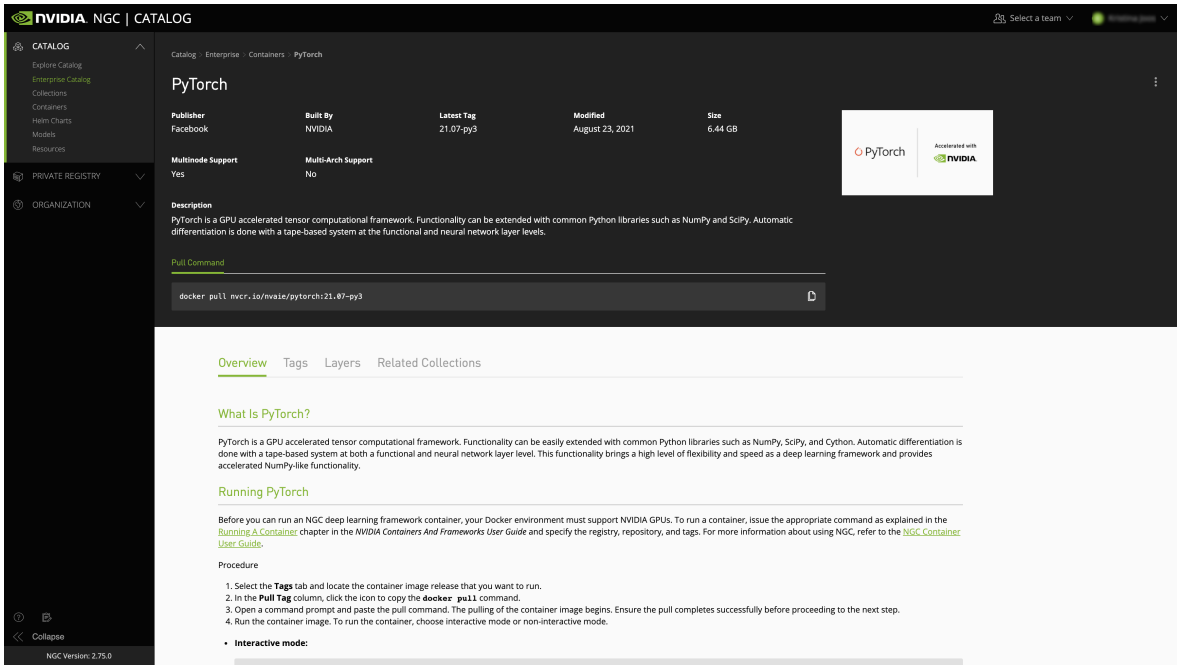
1. Go to https://ngc.nvidia.com/catalog/enterprise and, if prompted, log in. Click on the **NVIDIA AI Enterprise Collection**.



2. Click on the **Entities** tab to review all the software assets part of the NVIDIA AI Enterprise stack.



3. Click on the software asset you are interested in to learn more or download the software in the entities view.



2.1.2.2. Container Images

To pull AI and data science containers using Docker, follow these steps within the VM:

1. Generate your API key.
2. Access the Enterprise Catalog Container Registry.
   a). Log in to the NGC container registry.
   ```
   sudo docker login nvcr.io
   ```
   b). When prompted for your username, enter the text `$oauthtoken`.
   ```
   Username: $oauthtoken
   ```
   c). When prompted for your password, enter your NGC API key.
   ```
   Password: my-api-key
   ```
3. For each AI or data science application that you are interested in, load the container.
   ```
   sudo docker pull nvcr.io/nvaie/tensorflow:21.02-tf2-py3
   ```

2.1.2.3. Helm Charts

1. Go to the Enterprise Catalog.
2. Click on the NVIDIA AI Enterprise Collection.
3. Go to the Entities tab and select the Helm chart you are interested in.
4. Here is how you download a Helm chart from the Enterprise Catalog.

2.1.2.4. Resources

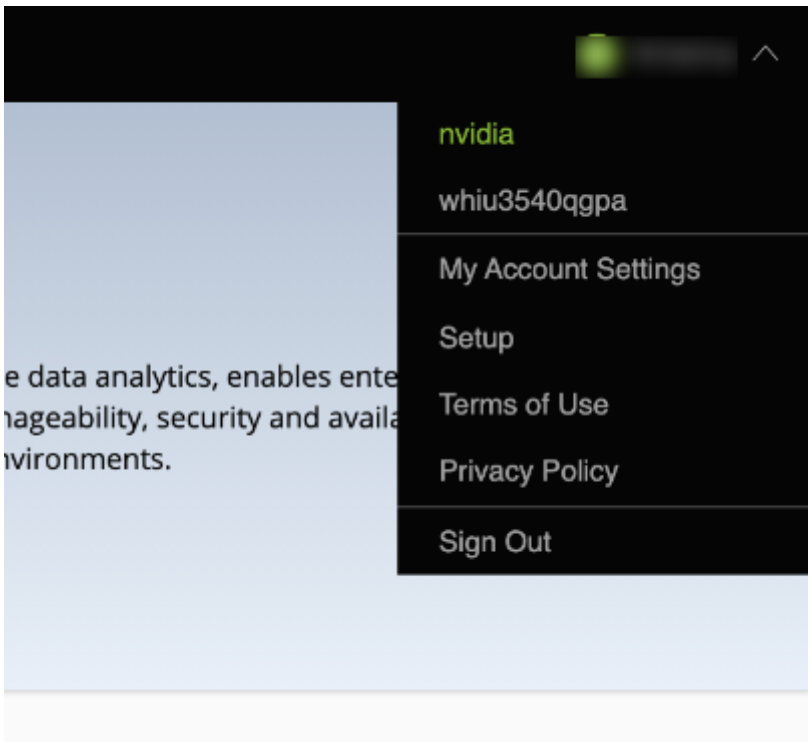
1. Go to the Enterprise Catalog.
2. Click on the NVIDIA AI Enterprise Collection.

3. Go to the Entities tab and select the Resource you are interested in. You can either download the Resource directly from the UI or use the displayed `wget` or CLI commands.

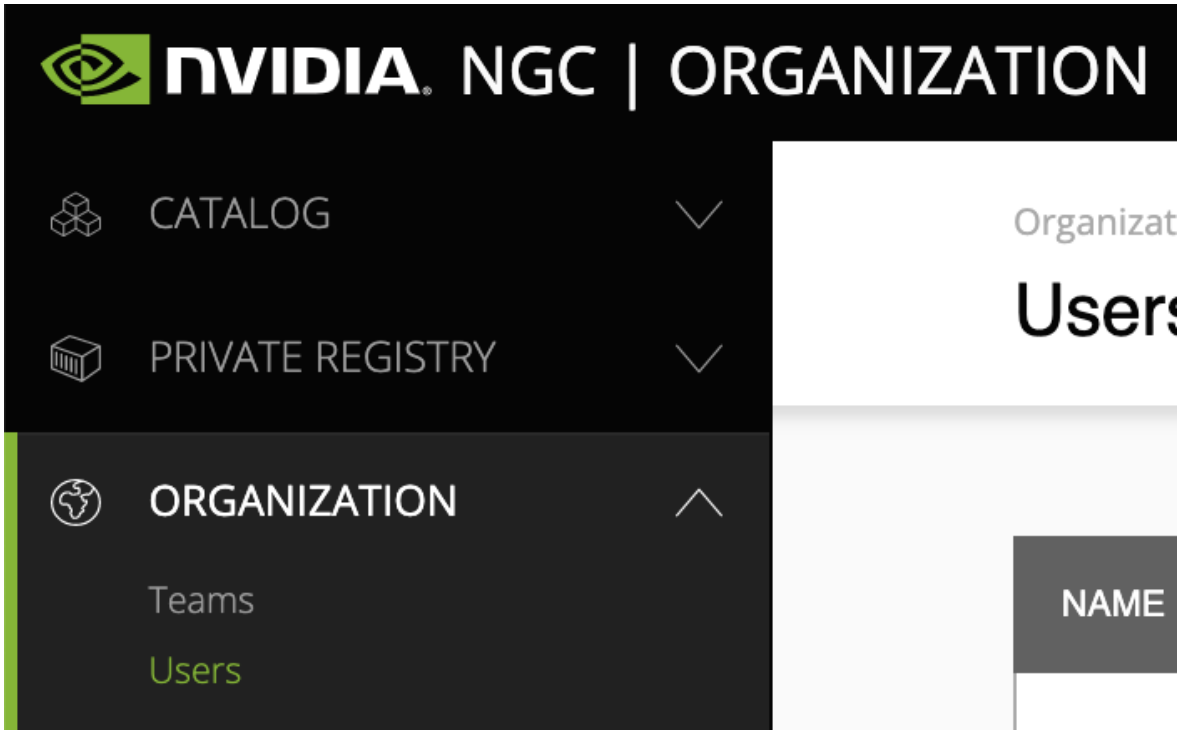
2.1.3. Adding Additional Users from Your Organization to the Enterprise Catalog (Admins Only)

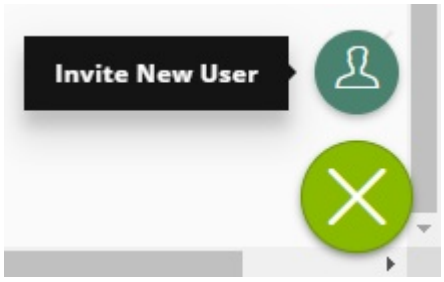
As an admin, you are responsible for giving members of your organization access to the Enterprise Catalog.

1. Make sure you are signed in.
2. Make sure to select your company's organization from the user menu on the top right.

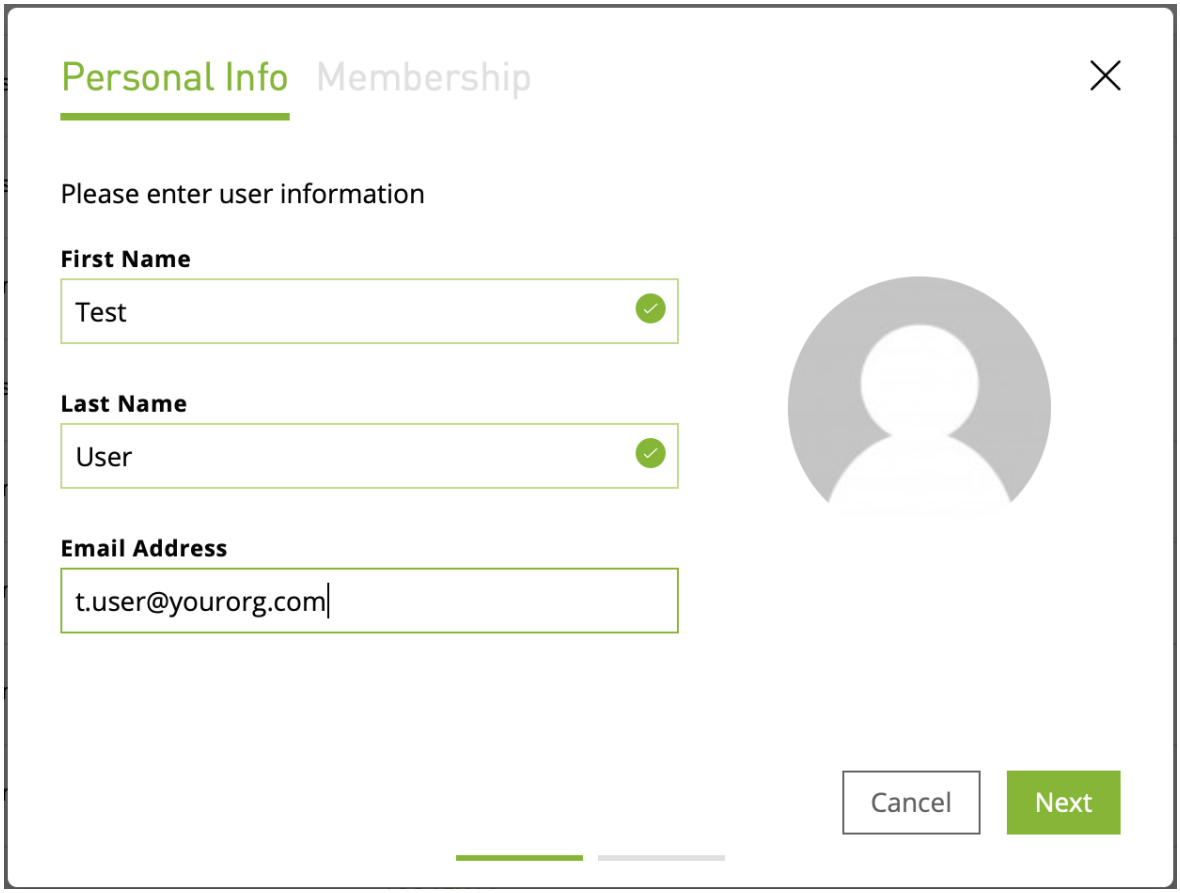


3. On the left side menu, select **Organization** and click on **Users**, then click the + icon at the bottom of the screen and then click the **Invite New User** icon.

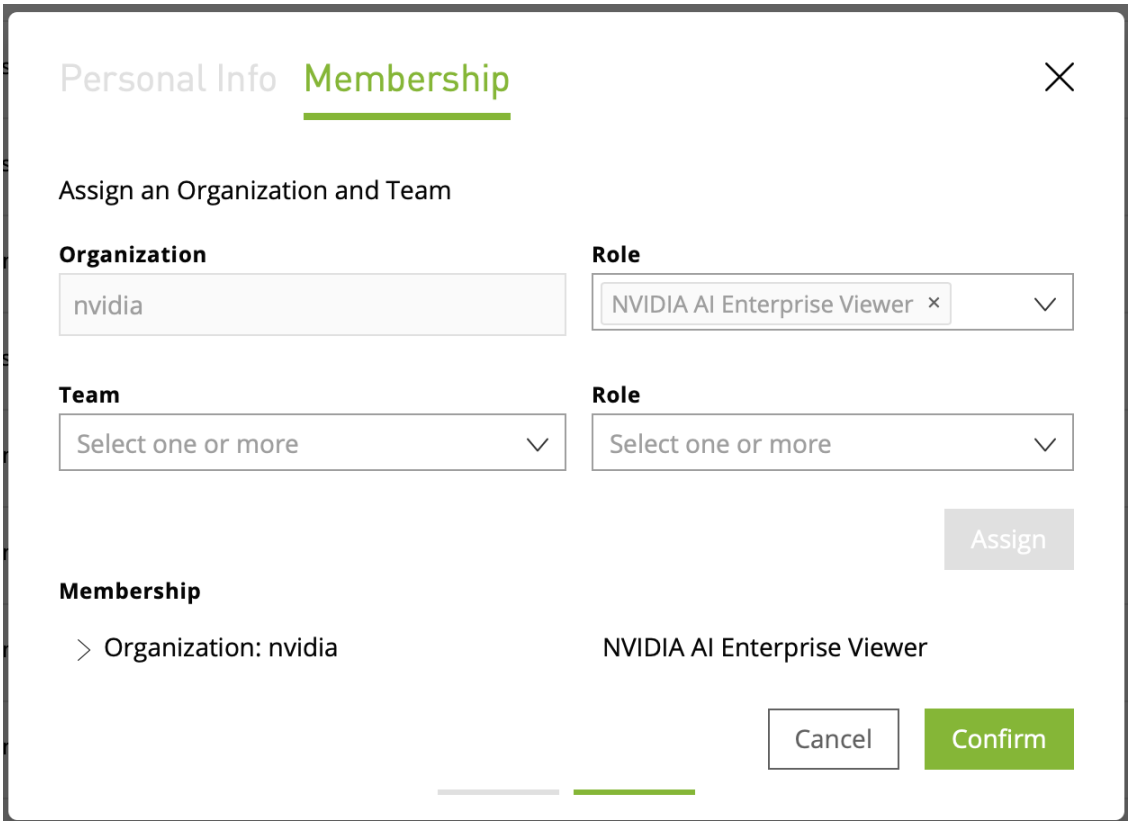




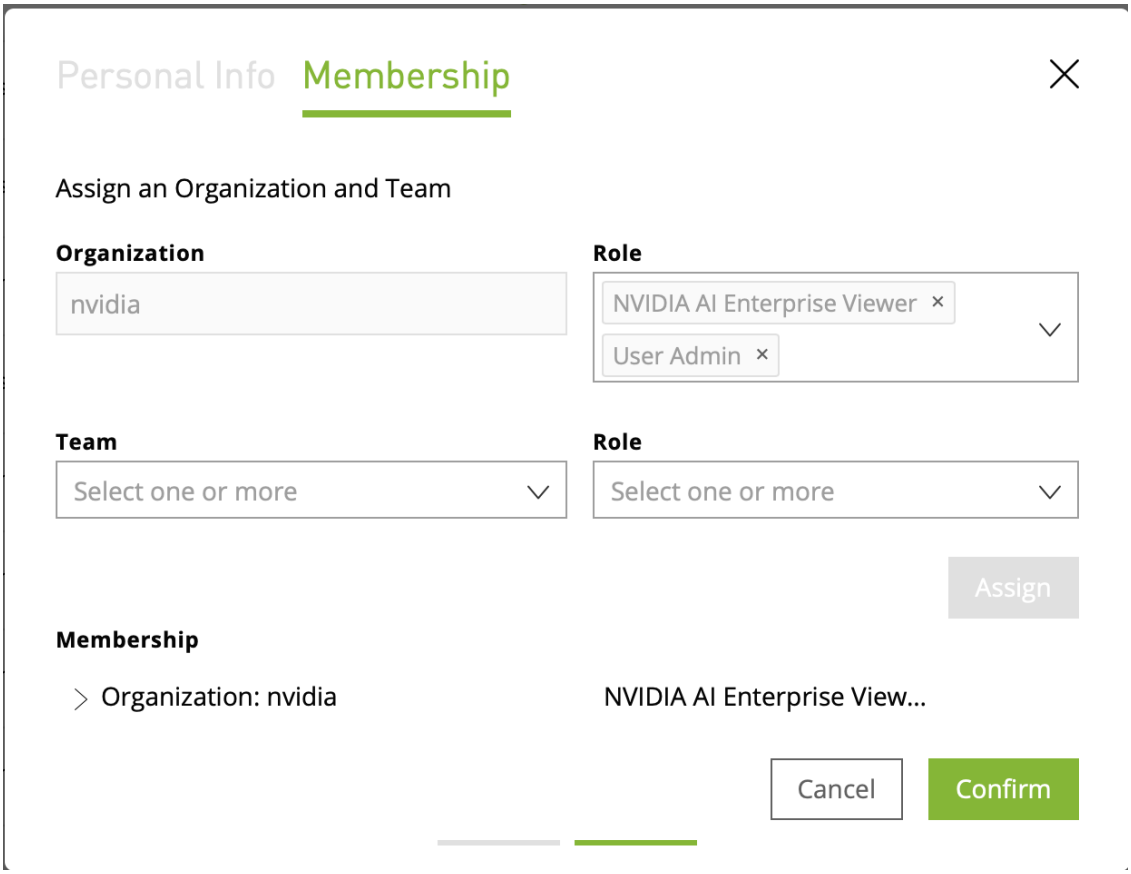
4. Provide the name and email address of the user you would like to add.



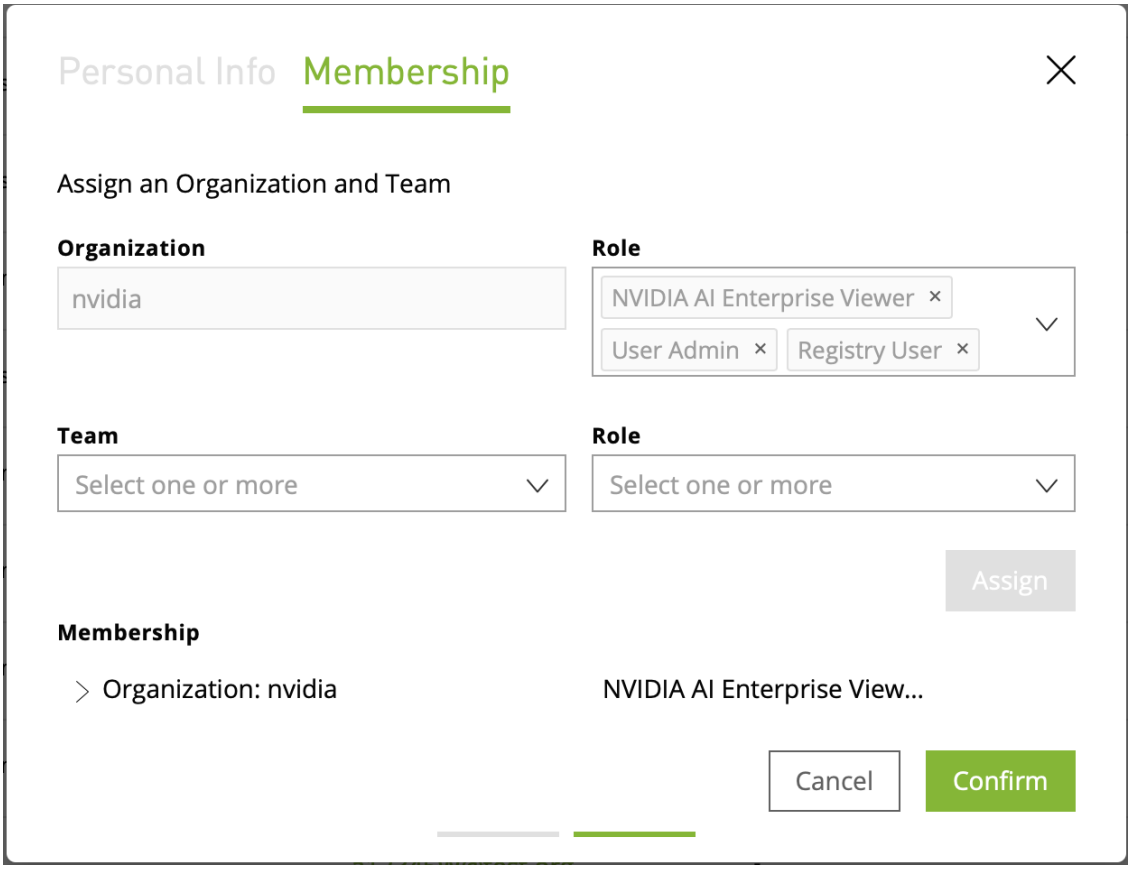
5. Provision user roles for the new user:
   a). To give the new user access to the entities in the Enterprise Catalog, provide them with the user role **NVIDIA AI Enterprise Viewer**.



b). To make them an admin that can add additional users to the Enterprise Catalog, provision the user roles: **NVIDIA AI Enterprise Viewer** and **User Admin**.



c). To give the user access to your organization's Private Registry, see Accessing Your NGC Private Registry. Provisioning access to the Enterprise Catalog and your organization's Private Registry can be done in one or two steps.



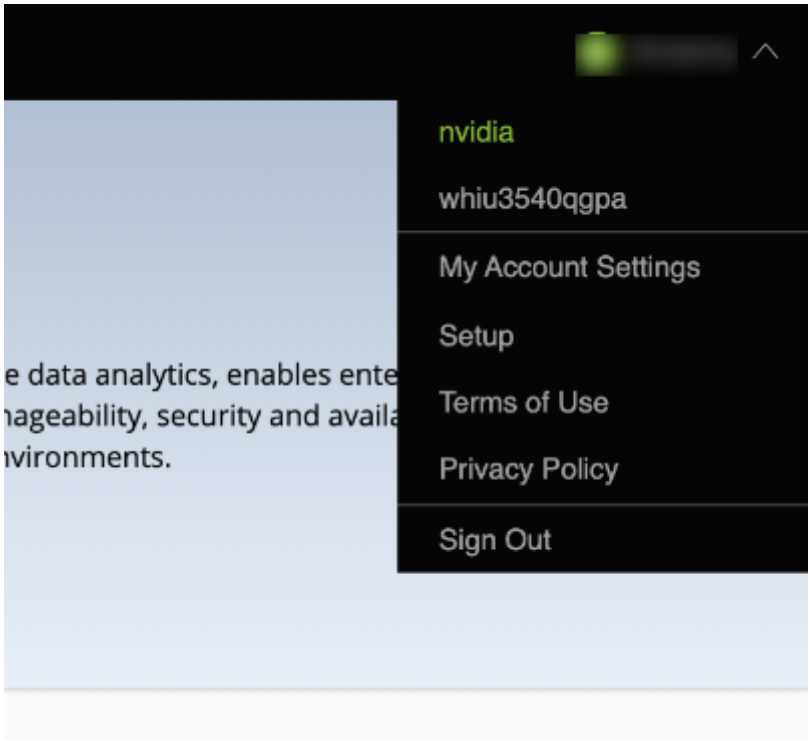
2.2. The NGC Private Registry

As an NVIDIA AI Enterprise user, you have exclusive access to your organization's own NGC Private Registry, which gives authorized users within your organization privileges to store your company's proprietary software and tools, including custom models, frameworks, and helm charts, in one location.

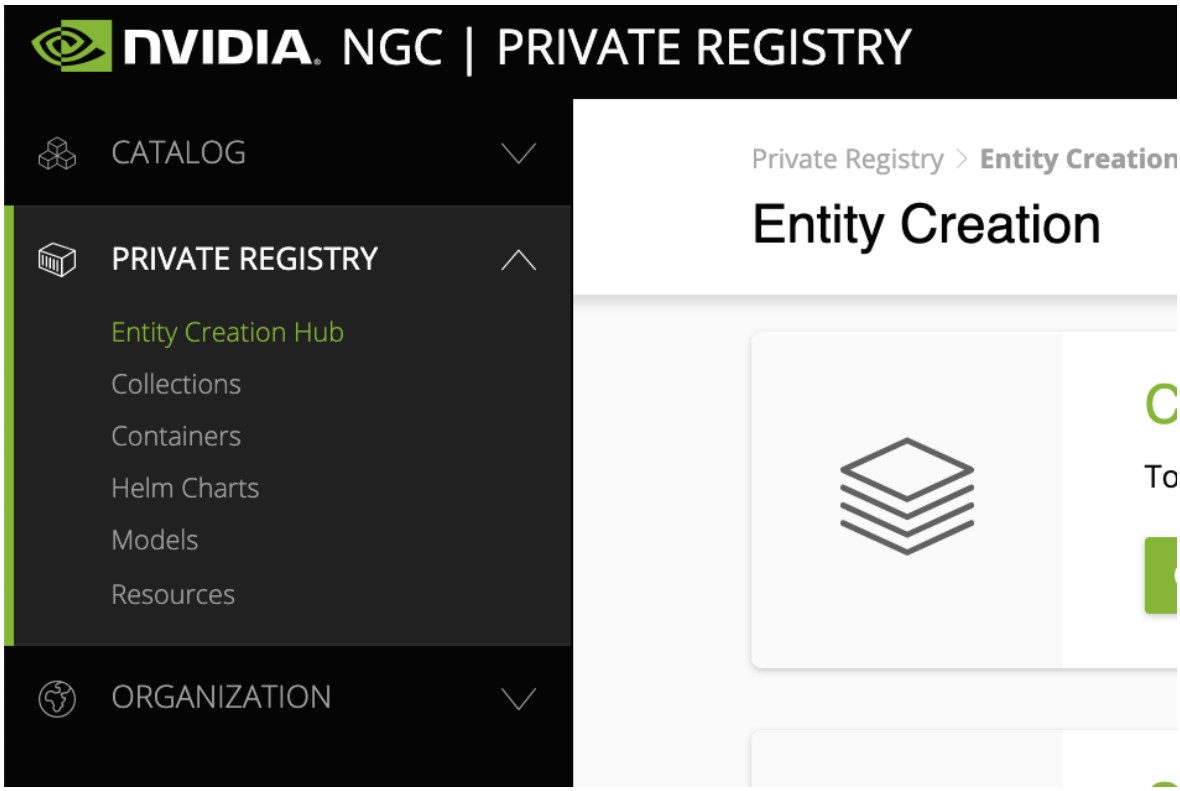
The complete NGC Private Registry user guide can be found here.

2.2.1. Accessing Your NGC Private Registry

1. To access your NGC Private Registry, sign in with your NGC Account.
2. In the top right corner, click your user account icon and select the **orgname**.



3. To view artifacts in your NGC Private Registry, select **Private Registry** in the left-hand menu.



4. You can access the content of the NGC Private Registry by selecting one of the entity types (Collections, Containers, Helm Charts, Models, Resources).
5. To upload entities to your NGC Private Registry, click on **Entity Creation Hub**.

2.2.2. Managing Teams and Users

As an admin, you can add users to your organization's NGC Private Registry and create teams within the NGC Private Registry.

Before adding users and teams, familiarize yourself with the following definitions of each role here.

2.2.2.1. Creating Teams

Creating teams allows users to share images within a team while keeping them invisible to other teams in the same organization. Only organization administrators can create teams.

Here is how you create a team.

2.2.2.2. Creating Users

As the organization administrator, you must create user accounts to allow others to use the NGC container registry within the organization.

Here is how you create a new user.

Chapter 3. Installing Your NVIDIA AI Enterprise License Server and License Files

The NVIDIA License System is used to serve a pool of floating licenses to licensed NVIDIA software products. The NVIDIA License System is configured with licenses obtained from the NVIDIA Licensing Portal.

Note: These instructions cover only the configuration of a Cloud License Service (CLS) instance. If you need complete instructions or are using Delegated License Service (DLS) instances to serve licenses, refer to *NVIDIA License System User Guide*.

3.1. Introduction to NVIDIA Software Licensing

To activate licensed functionalities, a licensed client leases a software license served over the network from an NVIDIA License System service instance when the client is booted. The license is returned to the service instance when the licensed client is shut down.

3.2. Creating a License Server on the NVIDIA Licensing Portal

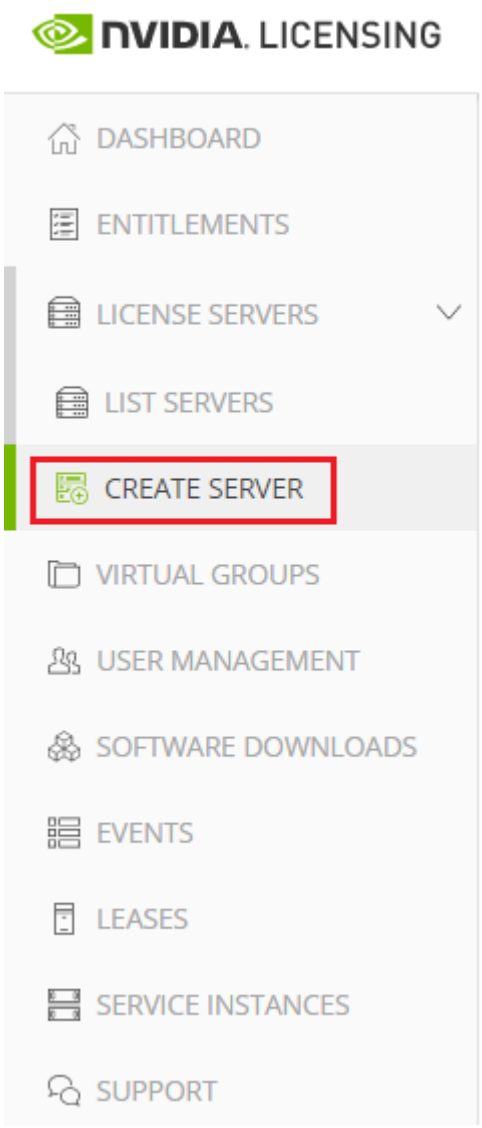
To be able to allot licenses to an NVIDIA License System instance, you must create at least one license server on the NVIDIA Licensing Portal. Creating a license server defines the set of licenses to be allotted.

1. In the NVIDIA Licensing Portal, navigate to the organization or virtual group for which you want to create the license server.
   a). If you are not already logged in, log in to the NVIDIA Enterprise Application Hub and click **NVIDIA LICENSING PORTAL** to go to the NVIDIA Licensing Portal.

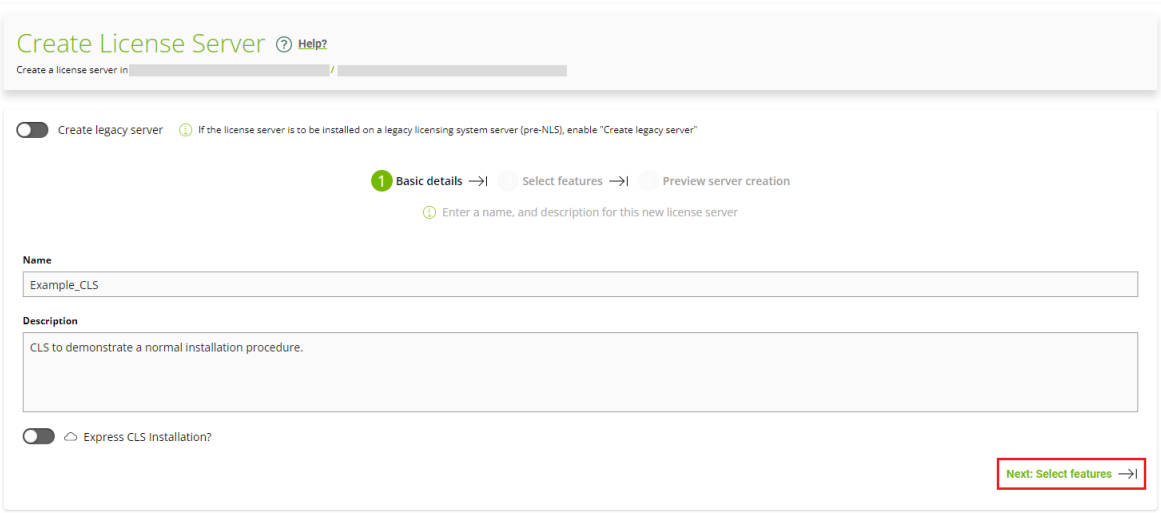
b). **Optional:** If your assigned roles give you access to multiple virtual groups, click **View settings** at the top right of the page and in the **My Info** window that opens, select the virtual group from the **Virtual Group** drop-down list, and close the **My Info** window.

If no license servers have been created for your organization or virtual group, the NVIDIA Licensing Portal dashboard displays a message asking if you want to create a license server.

2. In the left navigation pane of the NVIDIA Licensing Portal dashboard, expand **LICENSE SERVER** and click **CREATE SERVER**. The Create License Server wizard is started.



The **Create License Server** wizard opens.



3. On the **Basic details** page of the wizard, provide the details of your license server.
   a). Ensure that the **Create legacy server** option is **not** set.

   Setting this option creates a legacy NVIDIA AI Enterprise license server, **not** a license server for NVIDIA License System.

   b). In the **Server Name** field, enter your choice of name for the license server.

   c). In the **Description** field, enter a text description of the license server.

   This description is required and will be displayed on the details page for the license server that you are creating.

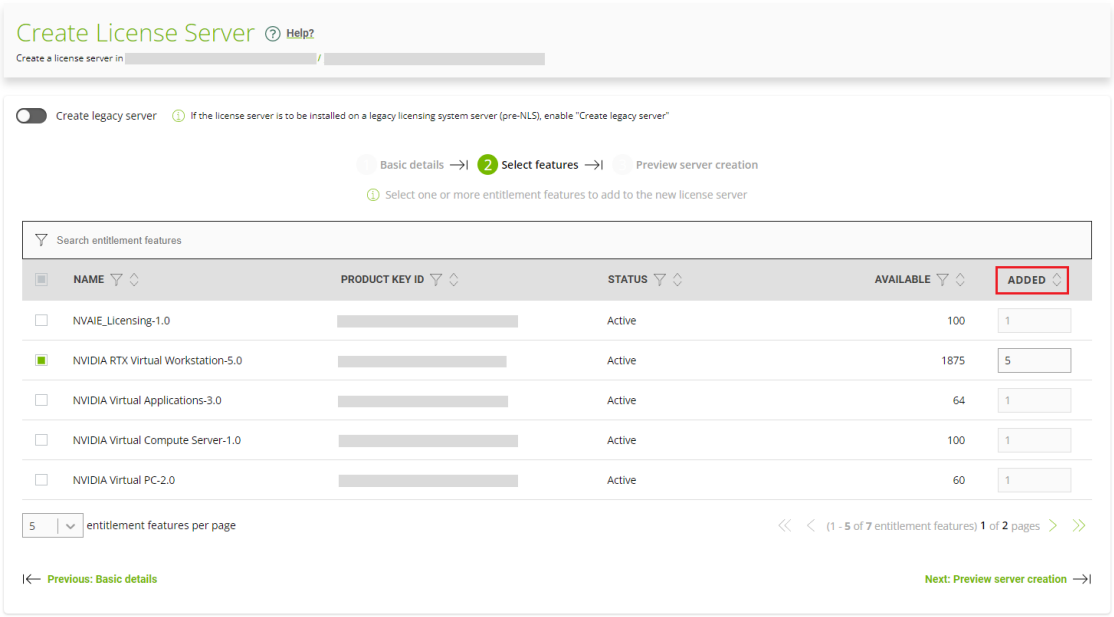
   d). **Optional:** If you want NVIDIA License System to automatically bind the license server to and install it on the default CLS instance, select the **Express CLS Installation?** option.

   e). Click **Next: Select features**.
4. On the **Select features** page of the wizard, add the licenses for the products that you want to allot to this license server.

   For each product, add the licenses as follows:

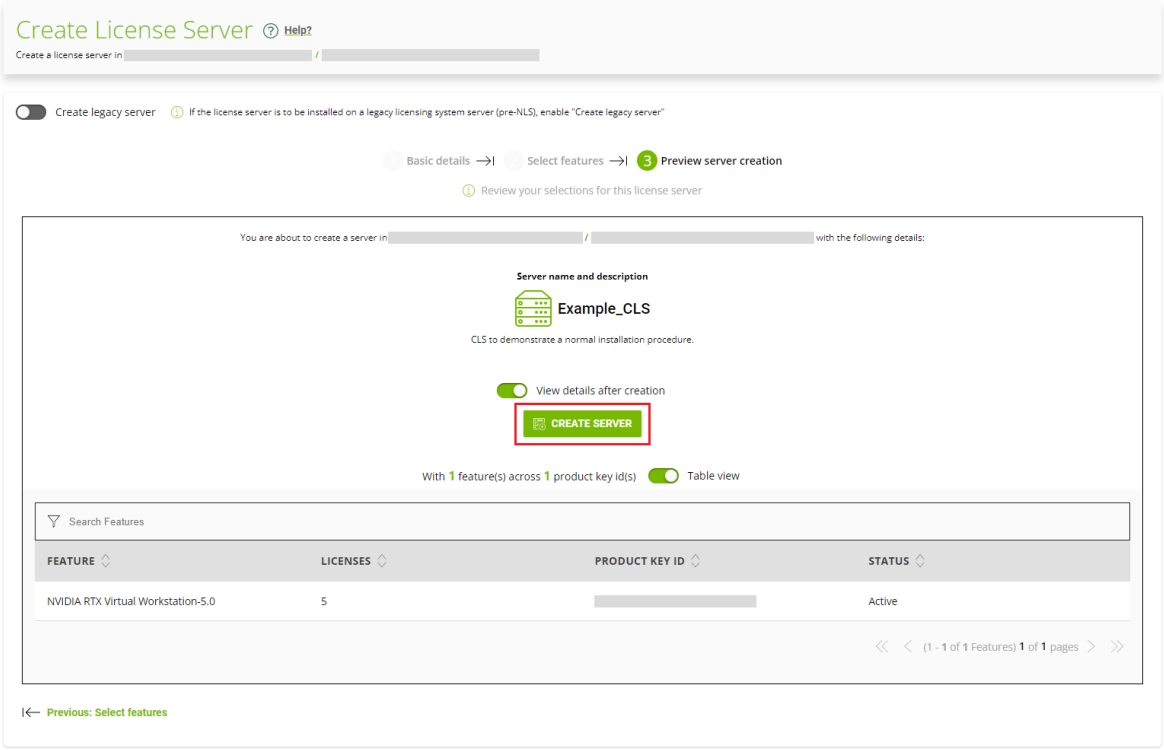
   a). In the list of products, select the product for which you want to add licenses.

   b). In the text-entry field in the **ADDED** column, enter the number of licenses for the product that you want to add.



c). Click **Next: Preview server creation**.

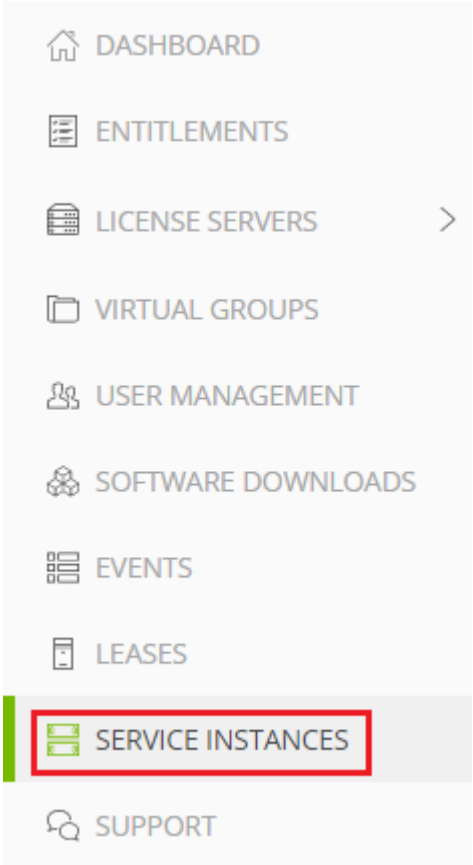
5. On the **Preview server creation** page, click **CREATE SERVER**.



3.3. Creating a CLS Instance on the NVIDIA Licensing Portal

When you create a CLS instance, the instance is automatically registered with the NVIDIA Licensing Portal. This task is only necessary if you are not using the default CLS instance.

1. If you are not already logged in, log in to the NVIDIA Enterprise Application Hub and click **NVIDIA LICENSING PORTAL** to go to the NVIDIA Licensing Portal.
2. In the left navigation pane of the NVIDIA Licensing Portal dashboard, click **SERVICE INSTANCES**.



3. On the Service Instances page, from the **Actions** menu, choose **Create cloud (CLS) instance**.

   The **Create cloud (CLS) instance** pop-up window opens.
4. Provide the details of your cloud service instance.
   a). In the **Name** field, enter your choice of name for the service instance.
   b). In the **Description** field, enter a text description of the service instance.

This description is required and will be displayed on the **Service Instances** page when the entry for service instance that you are creating is expanding.

5. Click **CREATE CLS INSTANCE**.

After creating a CLS instance on the NVIDIA Licensing Portal, follow the instructions in Binding a License Server to a Service Instance.

3.4. Binding a License Server to a Service Instance

Binding a license server to a service instance ensures that licenses on the server are available only from that service instance. As a result, the licenses are available only to the licensed clients that are served by the service instance to which the license server is bound.

You can bind multiple license servers to the same CLS instance but only one license server to the same DLS instance. If you want to use a different license server than the license server that was originally bound to a DLS instance, free the license sever as explained in #unique_29.

This task is necessary only if you are not using the default CLS instance.

1. In the NVIDIA Licensing Portal, navigate to the organization or virtual group to which the **license server** belongs.
   a). If you are not already logged in, log in to the NVIDIA Enterprise Application Hub and click **NVIDIA LICENSING PORTAL** to go to the NVIDIA Licensing Portal.
   b). **Optional:** If your assigned roles give you access to multiple virtual groups, click **View settings** at the top right of the page and in the **My Info** window that opens, select the virtual group from the **Virtual Group** drop-down list, and close the **My Info** window.
2. In the left navigation pane of the NVIDIA Licensing Portal dashboard, expand **LICENSE SERVERS** and click **LIST SERVERS**.
3. In the list of license servers on the **License Servers** page that opens, from the **Actions** menu for the license server, choose **Bind**.
4. In the **Bind Service Instance** pop-up window that opens, select the service instance to which you want to bind the license server and click **BIND**.
   The **Bind Service Instance** pop-up window confirms that the license server has been bound to the service instance.

After a license server has been bound to a service instance, the license server is freed from the service instance when the service instance is deleted. You can also free a license sever as explained in #unique_29.

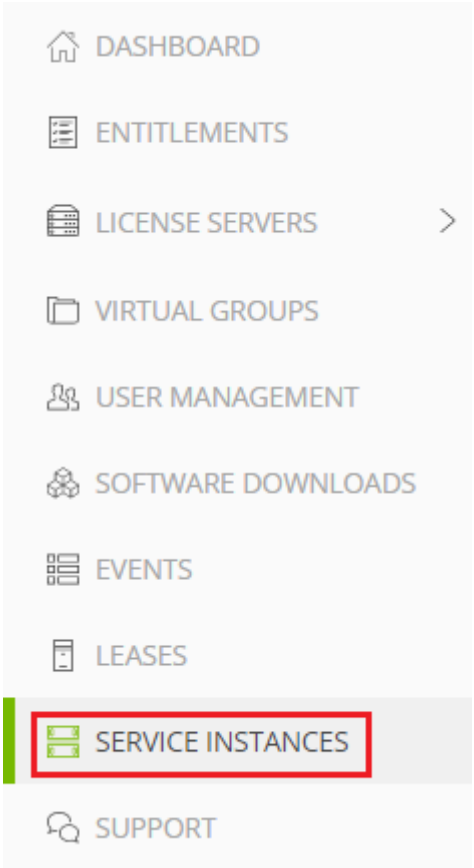
3.5. Installing a License Server on a CLS Instance

This task is necessary only if you are not using the default CLS instance.

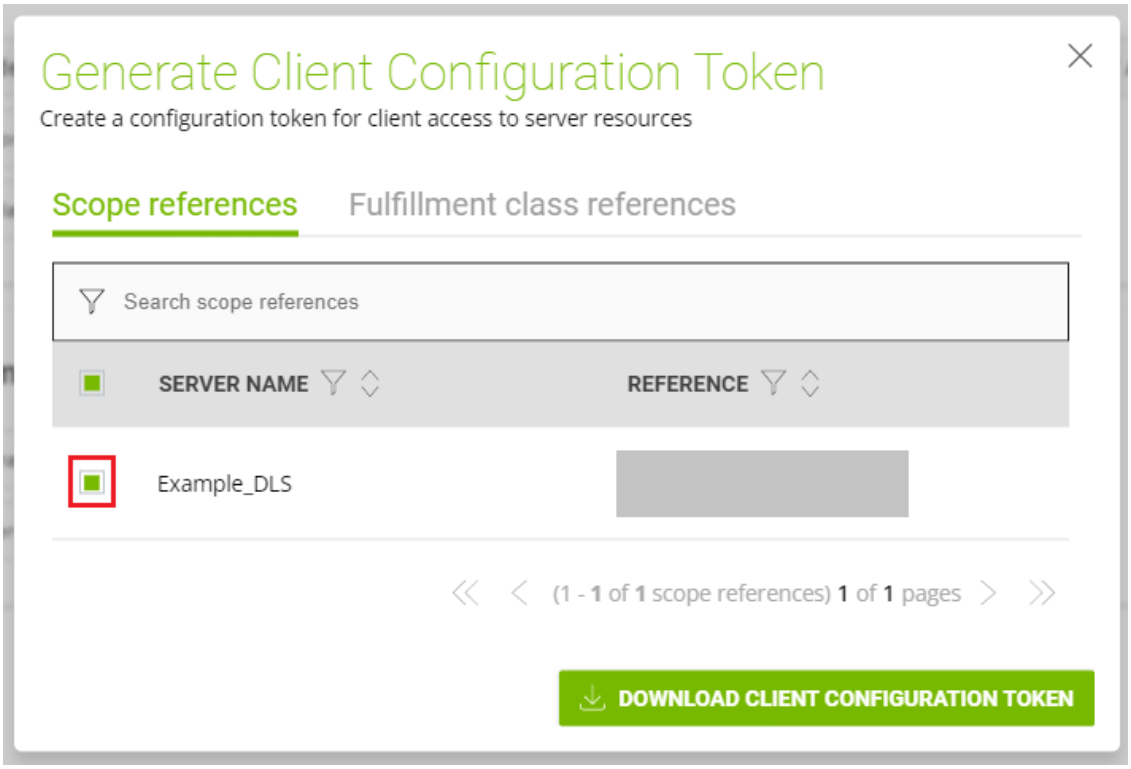
1. In the NVIDIA Licensing Portal, navigate to the organization or virtual group for which you want to install the license server.
   a). If you are not already logged in, log in to the NVIDIA Enterprise Application Hub and click **NVIDIA LICENSING PORTAL** to go to the NVIDIA Licensing Portal.
   b). **Optional:** If your assigned roles give you access to multiple virtual groups, click **View settings** at the top right of the page and in the My Info window that opens, select the virtual group from the **Virtual Group** drop-down list, and close the **My Info** window.
2. In the left navigation pane of the NVIDIA Licensing Portal dashboard, expand **LICENSE SERVER** and click **LIST SERVERS**.
3. In the list of license servers on the **License Servers** page that opens, click the name of the license server that you want to install.
4. In the **License Server Details** page that opens, from the **Actions** menu, choose **Install**.
5. In the **Install License Server** pop-up window that opens, click **INSTALL SERVER**.

3.6. Generating a Client Configuration Token for a CLS Instance

1. Log in to the NVIDIA Enterprise Application Hub and click **NVIDIA LICENSING PORTAL** to go to the NVIDIA Licensing Portal.
2. If your assigned roles give you access to multiple virtual groups, select the virtual group for which you are managing licenses from the list of virtual groups at the top right of the NVIDIA Licensing Portal dashboard.
3. In the left navigation pane, click **SERVICE INSTANCES**.



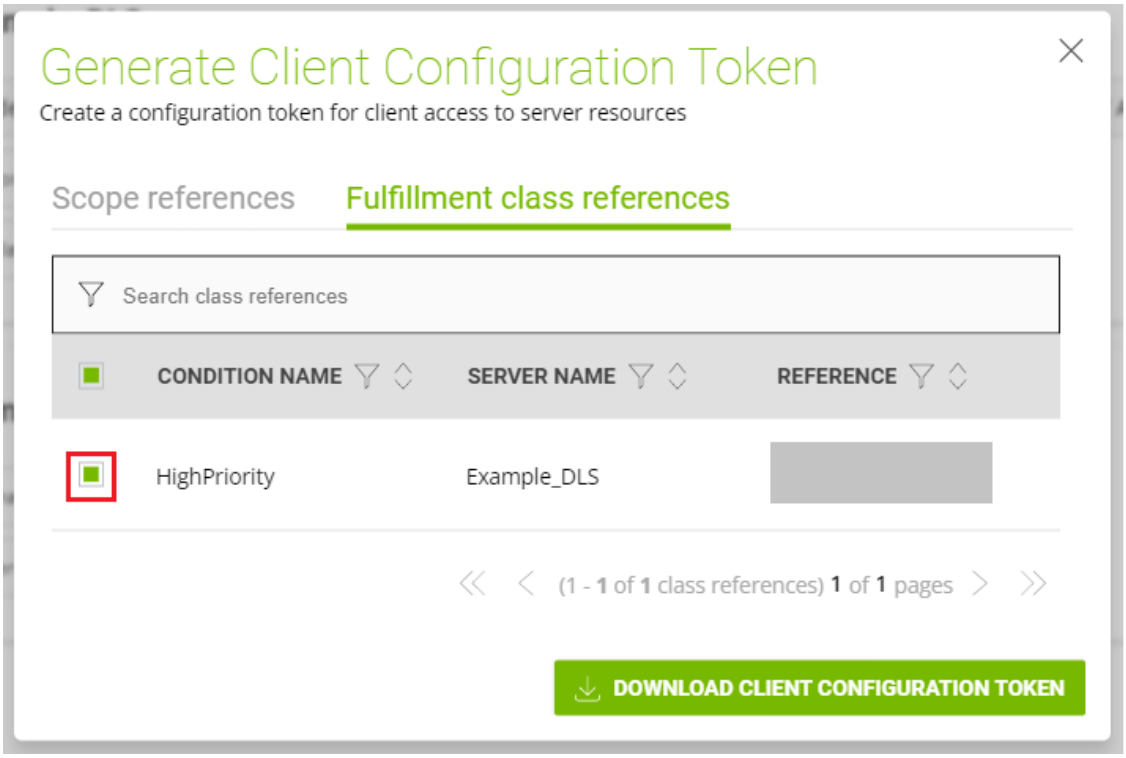
4. On the Service Instances page that opens, from the **Actions** menu for the CLS instance for which you want to generate a client configuration token, choose **Generate client configuration token**.
5. In the **Generate Client Configuration Token** pop-up window that opens, select the references that you want to include in the client configuration token.
   a). From the list of scope references, select the scope references that you want to include.



You must select **at least one** scope reference.

Each scope reference specifies the license server that will fulfil a license request.

b). **Optional:** Click the **Fulfillment class references** tab, and from the list of fulfillment class references, select the fulfillment class references that you want to include.



Including fulfillment class references is optional.

c). Click **DOWNLOAD CLIENT CONFIGURATION TOKEN**.

A file named `client_configuration_token_`*`mm-dd-yyyy-hh-mm-ss`*`.tok` is saved to your default downloads folder.

Chapter 4. Installing and Configuring NVIDIA vGPU Manager

Before installing and configuring NVIDIA vGPU Manager, ensure that a VM running a supported guest OS is configured in your chosen hypervisor.

The factory settings of some supported GPU boards are incompatible with NVIDIA AI Enterprise. Before configuring NVIDIA AI Enterprise on these GPU boards, you must configure the boards to change these settings.

4.1. Switching the Mode of a GPU that Supports Multiple Display Modes

Some GPUs support displayless and display-enabled modes but must be used in NVIDIA AI Enterprise deployments in displayless mode.

The GPUs listed in the following table support multiple display modes. As shown in the table, some GPUs are supplied from the factory in displayless mode, but other GPUs are supplied in a display-enabled mode.

GPU	Mode as Supplied from the Factory
NVIDIA A40	Displayless
NVIDIA RTX A5000	Display enabled
NVIDIA RTX A5500	Display enabled
NVIDIA RTX A6000	Display enabled

A GPU that is supplied from the factory in displayless mode, such as the NVIDIA A40 GPU, might be in a display-enabled mode if its mode has previously been changed.

To change the mode of a GPU that supports multiple display modes, use the `displaymodeselector` tool, which you can request from the NVIDIA Display Mode Selector Tool page on the NVIDIA Developer website.

Note:

Only the following GPUs support the `displaymodeselector` tool:

- NVIDIA A40

- NVIDIA RTX A5000
- NVIDIA RTX A5500
- NVIDIA RTX A6000

Other GPUs that support NVIDIA AI Enterprise do not support the `displaymodeselector` tool and, unless otherwise stated, do not require display mode switching.

4.2. Installing the NVIDIA Virtual GPU Manager on VMware vSphere

For all supported VMware vSphere releases, the NVIDIA Virtual GPU Manager package is distributed as a software component in a ZIP archive.
Before you begin, ensure that the following prerequisites are met:

- The ZIP archive that contains NVIDIA AI Enterprise has been downloaded from the NVIDIA Licensing Portal.
- The NVIDIA Virtual GPU Manager package has been extracted from the downloaded ZIP archive.

1. Copy the NVIDIA Virtual GPU Manager package file to the ESXi host.
2. Put the ESXi host into maintenance mode.
   ```
   $ esxcli system maintenanceMode set --enable true
   ```
3. Run the `esxcli` command to install the NVIDIA Virtual GPU Manager from the package file.
   ```
   $ esxcli software vib install -d /vmfs/volumes/datastore/software-component.zip
   ```
   datastore
   The name of the VMFS datastore to which you copied the software component.
   software-component
   The name of the file that contains the NVIDIA Virtual GPU Manager package in the form of a software component. Ensure that you specify the file that was extracted from the downloaded ZIP archive. For example, for VMware vSphere 7.0.2, *software-component* is **`NVD.NVIDIA_bootbank_NVIDIA-VMware_510.85.03-1OEM.702.0.0.8169922-offline_bundle-build-number`**.
4. Exit maintenance mode.
   ```
   $ esxcli system maintenanceMode set --enable false
   ```
5. Reboot the ESXi host.
   ```
   $ reboot
   ```
6. Verify that the NVIDIA kernel driver can successfully communicate with the physical GPUs in your system by running the `nvidia-smi` command without any options.
   ```
   $ nvidia-smi
   ```
   If successful, the `nvidia-smi` command lists all the GPUs in your system.

4.3. Disabling and Enabling ECC Memory

Some GPUs that support NVIDIA AI Enterprise support error correcting code (ECC) memory with NVIDIA vGPU. ECC memory improves data integrity by detecting and handling double-bit errors. However, not all GPUs, vGPU types, and hypervisor software versions support ECC memory with NVIDIA vGPU.

On GPUs that support ECC memory with NVIDIA vGPU, ECC memory is supported with C-series and Q-series vGPUs, but not with A-series and B-series vGPUs. Although A-series and B-series vGPUs start on physical GPUs on which ECC memory is enabled, enabling ECC with vGPUs that do not support it might incur some costs.

On physical GPUs that do not have HBM2 memory, the amount of frame buffer that is usable by vGPUs is reduced. All types of vGPU are affected, not just vGPUs that support ECC memory.

The effects of enabling ECC memory on a physical GPU are as follows:

- ECC memory is exposed as a feature on all supported vGPUs on the physical GPU.
- In VMs that support ECC memory, ECC memory is enabled, with the option to disable ECC in the VM.
- ECC memory can be enabled or disabled for individual VMs. Enabling or disabling ECC memory in a VM does not affect the amount of frame buffer that is usable by vGPUs.

GPUs based on the Pascal GPU architecture and later GPU architectures support ECC memory with NVIDIA vGPU. To determine whether ECC memory is enabled for a GPU, run **`nvidia-smi -q`** for the GPU.

Tesla M60 and M6 GPUs support ECC memory when used without GPU virtualization, but NVIDIA vGPU does not support ECC memory with these GPUs. In graphics mode, these GPUs are supplied with ECC memory disabled by default.

Some hypervisor software versions do not support ECC memory with NVIDIA vGPU.

If you are using a hypervisor software version or GPU that does not support ECC memory with NVIDIA vGPU and ECC memory is enabled, NVIDIA vGPU fails to start. In this situation, you must ensure that ECC memory is disabled on all GPUs if you are using NVIDIA vGPU.

4.3.1. Disabling ECC Memory

If ECC memory is unsuitable for your workloads but is enabled on your GPUs, disable it. You must also ensure that ECC memory is disabled on all GPUs if you are using NVIDIA vGPU with a hypervisor software version or a GPU that does not support ECC memory with NVIDIA vGPU. If your hypervisor software version or GPU does not support ECC memory and ECC memory is enabled, NVIDIA vGPU fails to start.

Where to perform this task depends on whether you are changing ECC memory settings for a physical GPU or a vGPU.

- For a physical GPU, perform this task from the hypervisor host.

- For a vGPU, perform this task from the VM to which the vGPU is assigned.

> **Note:** ECC memory must be enabled on the physical GPU on which the vGPUs reside.

Before you begin, ensure that NVIDIA Virtual GPU Manager is installed on your hypervisor. If you are changing ECC memory settings for a vGPU, also ensure that the NVIDIA AI Enterprise graphics driver is installed in the VM to which the vGPU is assigned.

1. Use `nvidia-smi` to list the status of all physical GPUs or vGPUs, and check for ECC noted as enabled.

```
# nvidia-smi -q

==============NVSMI LOG==============

Timestamp                           : Mon Aug 22 18:36:45 2022
Driver Version                      : 510.85.03

Attached GPUs                       : 1
GPU 0000:02:00.0

[...]

    Ecc Mode
        Current                     : Enabled
        Pending                     : Enabled

[...]
```

2. Change the ECC status to off for each GPU for which ECC is enabled.
   - If you want to change the ECC status to off for all GPUs on your host machine or vGPUs assigned to the VM, run this command:

     ```
     # nvidia-smi -e 0
     ```
   - If you want to change the ECC status to off for a specific GPU or vGPU, run this command:

     ```
     # nvidia-smi -i id -e 0
     ```

     id is the index of the GPU or vGPU as reported by `nvidia-smi`.

     This example disables ECC for the GPU with index `0000:02:00.0`.

     ```
     # nvidia-smi -i 0000:02:00.0 -e 0
     ```
3. Reboot the host or restart the VM.
4. Confirm that ECC is now disabled for the GPU or vGPU.

```
# nvidia–smi –q

==============NVSMI LOG==============

Timestamp                           : Mon Aug 22 18:37:53 2022
Driver Version                      : 510.85.03

Attached GPUs                       : 1
GPU 0000:02:00.0
[...]

    Ecc Mode
        Current                     : Disabled
        Pending                     : Disabled

[...]
```

4.3.2. Enabling ECC Memory

If ECC memory is suitable for your workloads and is supported by your hypervisor software and GPUs, but is disabled on your GPUs or vGPUs, enable it.

Where to perform this task depends on whether you are changing ECC memory settings for a physical GPU or a vGPU.

- For a physical GPU, perform this task from the hypervisor host.
- For a vGPU, perform this task from the VM to which the vGPU is assigned.

Note: ECC memory must be enabled on the physical GPU on which the vGPUs reside.

Before you begin, ensure that NVIDIA Virtual GPU Manager is installed on your hypervisor. If you are changing ECC memory settings for a vGPU, also ensure that the NVIDIA AI Enterprise graphics driver is installed in the VM to which the vGPU is assigned.

1. Use `nvidia-smi` to list the status of all physical GPUs or vGPUs, and check for ECC noted as disabled.

```
# nvidia-smi -q

==============NVSMI LOG==============

Timestamp                           : Mon Aug 22 18:36:45 2022
Driver Version                      : 510.85.03

Attached GPUs                       : 1
GPU 0000:02:00.0

[...]

    Ecc Mode
        Current                     : Disabled
        Pending                     : Disabled

[...]
```

2. Change the ECC status to on for each GPU or vGPU for which ECC is enabled.
   - If you want to change the ECC status to on for all GPUs on your host machine or vGPUs assigned to the VM, run this command:

     ```
     # nvidia-smi -e 1
     ```
   - If you want to change the ECC status to on for a specific GPU or vGPU, run this command:

     ```
     # nvidia-smi -i id -e 1
     ```

     id is the index of the GPU or vGPU as reported by `nvidia-smi`.

     This example enables ECC for the GPU with index `0000:02:00.0`.

     ```
     # nvidia-smi -i 0000:02:00.0 -e 1
     ```
3. Reboot the host or restart the VM.
4. Confirm that ECC is now enabled for the GPU or vGPU.

```
# nvidia–smi –q

==============NVSMI LOG==============
```

```
Timestamp                                 : Mon Aug 22 18:37:53 2022
Driver Version                            : 510.85.03

Attached GPUs                             : 1
GPU 0000:02:00.0
[...]

    Ecc Mode
        Current                           : Enabled
        Pending                           : Enabled

[...]
```

4.4. Changing the Default Graphics Type in VMware vSphere

Before changing the default graphics type, ensure that the ESXi host is running and that all VMs on the host are powered off.

1. Log in to vCenter Server by using the vSphere Web Client.
2. In the navigation tree, select your ESXi host and click the **Configure** tab.
3. From the menu, choose **Graphics** and then click the **Host Graphics** tab.
4. On the **Host Graphics** tab, click **Edit**.
5. In the **Edit Host Graphics Settings** dialog box that opens, select **Shared Direct** and click **OK**.

   After you click OK, the default graphics type changes to Shared Direct.
6. Click the **Graphics Devices** tab to verify the configured type of each physical GPU on which you want to configure vGPU.

   The configured type of each physical GPU must be Shared Direct. For any physical GPU for which the configured type is Shared, change the configured type as follows:

   a). On the **Graphics Devices** tab, select the physical GPU and click the **Edit icon**.

   b). In the **Edit Graphics Device Settings** dialog box that opens, select **Shared Direct** and click **OK**.
7. Restart the ESXi host **or** stop and restart `nv-hostengine` on the ESXi host.

   To stop and restart `nv-hostengine`, perform these steps:

   a). Stop `nv-hostengine`.

   ```
   [root@esxi:~] nv-hostengine -t
   ```

   b). Wait for 1 second to allow `nv-hostengine` to stop.

   c). Start `nv-hostengine`.

   ```
   [root@esxi:~] nv-hostengine -d
   ```
8. In the **Graphics Devices** tab of the VMware vCenter Web UI, confirm that the active type and the configured type of each physical GPU are Shared Direct.

4.5. Configuring a vSphere VM with NVIDIA vGPU

CAUTION: Output from the VM console in the VMware vSphere Web Client is not available for VMs that are running vGPU. Make sure that you have installed an alternate means of accessing the VM (such as VMware Horizon or a VNC server) before you configure vGPU.

VM console in vSphere Web Client will become active again once the vGPU parameters are removed from the VM's configuration.

1. Open the vCenter Web UI.
2. In the vCenter Web UI, right-click the VM and choose **Edit Settings**.
3. Click the **Virtual Hardware** tab.
4. In the **New device** list, select **Shared PCI Device** and click **Add**.
   The **PCI device** field should be auto-populated with **`NVIDIA GRID vGPU`**.
5. From the **GPU Profile** drop-down menu, choose the type of vGPU you want to configure and click **OK**.
6. Ensure that VMs running vGPU have all their memory reserved:
   a). Select **Edit virtual machine settings** from the vCenter Web UI.
   b). Expand the **Memory** section and click **Reserve all guest memory (All locked)**.

After you have configured a vSphere VM with a vGPU, start the VM. VM console in vSphere Web Client is not supported in this vGPU release. Therefore, use VMware Horizon or VNC to access the VM's desktop.

Chapter 5. Installing and Licensing NVIDIA AI Enterprise Components Required in a Guest VM

5.1. Installing the NVIDIA AI Enterprise Graphics Driver on Ubuntu from a Debian Package

The NVIDIA AI Enterprise graphics driver for Ubuntu is distributed as a Debian package file. This task requires `sudo` privileges.

1. Copy the NVIDIA AI Enterprise Linux driver package, for example `nvidia-linux-grid-510_510.85.02_amd64.deb`, to the guest VM where you are installing the driver.
2. Log in to the guest VM as a user with `sudo` privileges.
3. Open a command shell and change to the directory that contains the NVIDIA AI Enterprise Linux driver package.
4. From the command shell, run the command to install the package.

   ```
   $ sudo apt-get install ./nvidia-linux-grid-510_510.85.02_amd64.deb
   ```
5. Verify that the NVIDIA driver is operational.
   a). Reboot the system and log in.
   b). After the system has rebooted, confirm that you can see your NVIDIA vGPU device in the output from the `nvidia-smi` command.

   ```
   $ nvidia-smi
   ```

5.2. Configuring a Licensed Client

To use an NVIDIA AI Enterprise licensed product, each client system to which a physical or virtual GPU is assigned must be able to obtain a license from the NVIDIA License System. A

client system can be a VM that is configured with NVIDIA vGPU, a VM that is configured for GPU pass through, or a physical host to which a physical GPU is assigned in a bare-metal deployment.

Before configuring a licensed client, ensure that the following prerequisites are met:

- The NVIDIA AI Enterprise graphics driver is installed on the client.
- The client configuration token that you want to deploy on the client has been created from the NVIDIA Licensing Portal or the DLS as explained in Generating a Client Configuration Token for a CLS Instance.
- The ports in your firewall or proxy to allow HTTPS traffic between the service instance and the licensed client must be open. The ports that must be open in your firewall or proxy depend on whether the service instance is a CLS instance or a DLS instance:
  - For a CLS instance, ports 443 and 80 must be open.
  - For a DLS instance, ports 443, 80, 8081, and 8082 must be open.

The graphics driver creates a default location in which to store the client configuration token on the client. You can specify a custom location for the client configuration token by adding a registry value on Windows or by setting a configuration parameter on Linux. By specifying a shared network location that is mounted locally on the client, you can simplify the deployment of the same client configuration token on multiple clients. Instead of copying the client configuration token to each client individually, you can keep only one copy in the shared network location.

The process for configuring a licensed client is the same for CLS and DLS instances but depends on the OS that is running on the client.

5.2.1. Configuring a Licensed Client on Linux

Perform this task from the client.

1. As root, open the file `/etc/nvidia/gridd.conf` in a plain-text editor, such as `vi`.

   ```
   $ sudo vi /etc/nvidia/gridd.conf
   ```

   Note: You can create the `/etc/nvidia/gridd.conf` file by copying the supplied template file `/etc/nvidia/gridd.conf.template`.

2. Add the `FeatureType` configuration parameter to the file `/etc/nvidia/gridd.conf` on a new line as `FeatureType="value"`.

   value depends on the type of the GPU assigned to the licensed client that you are configuring.

GPU Type	Value
NVIDIA vGPU	1. NVIDIA AI Enterprise automatically selects the correct type of license based on the vGPU type.
Physical GPU	The feature type of a GPU in pass-through mode or a bare-metal deployment: - 0: NVIDIA Virtual Applications

GPU Type	Value
	▶ 2: NVIDIA RTX Virtual Workstation ▶ 4: NVIDIA Virtual Compute Server

This example shows how to configure a licensed Linux client for NVIDIA Virtual Compute Server.

```
# /etc/nvidia/gridd.conf.template - Configuration file for NVIDIA Grid Daemon
…
# Description: Set Feature to be enabled
# Data type: integer
# Possible values:
# 0 => for unlicensed state
# 1 => for NVIDIA vGPU
# 2 => for NVIDIA RTX Virtual Workstation
# 4 => for NVIDIA Virtual Compute Server
FeatureType=4
...
```

3. **Optional:** If you want store the client configuration token in a custom location, add the `ClientConfigTokenPath` configuration parameter to the file `/etc/nvidia/gridd.conf` on a new line as `ClientConfigTokenPath="`*`path`*`"`

   path
   The full path to the directory in which you want to store the client configuration token for the client. By default, the client searches for the client configuration token in the `/etc/nvidia/ClientConfigToken/` directory.

   By specifying a shared network directory that is mounted locally on the client, you can simplify the deployment of the same client configuration token on multiple clients. Instead of copying the client configuration token to each client individually, you can keep only one copy in the shared network directory.

   This example shows how to configure a licensed Linux client to search for the client configuration token in the `/mnt/nvidia/ClientConfigToken/` directory. This directory is a mount point on the client for a shared network directory.

```
# /etc/nvidia/gridd.conf.template - Configuration file for NVIDIA Grid Daemon
…
ClientConfigTokenPath=/mnt/nvidia/ClientConfigToken/
...
```

4. Save your changes to the `/etc/nvidia/gridd.conf` file and close the file.
5. If you are storing the client configuration token in a custom location, create the directory in which you want to store the client configuration token.

   If the directory is a shared network directory, ensure that it is mounted locally on the client at the path specified in the `ClientConfigTokenPath` configuration parameter.

   If you are storing the client configuration token in the default location, omit this step. The default directory in which the client configuration token is stored is created automatically after the graphics driver is installed.
6. Copy the client configuration token to the directory in which you want to store the client configuration token.

   Ensure that this directory contains only the client configuration token that you want to deploy on the client and no other files or directories. If the directory contains more than

one client configuration token, the client uses the newest client configuration token in the directory.

- If you want to store the client configuration token in the default location, copy the client configuration token to the `/etc/nvidia/ClientConfigToken` directory.
- If you want to store the client configuration token in a custom location, copy the token to the directory that you created in the previous step.

7. Ensure that the file access modes of the client configuration token allow the owner to read, write, and execute the token, and the group and others only to read the token.
   a). Determine the current file access modes of the client configuration token.
   ```
   # ls -l client-configuration-token-directory
   ```
   b). If necessary, change the mode of the client configuration token to 744.
   ```
   # chmod 744 client-configuration-token-directory/client_configuration_token_*.tok
   ```
   client-configuration-token-directory
   The directory to which you copied the client configuration token in the previous step.
8. Restart the `nvidia-gridd` service.

The NVIDIA service on the client should now automatically obtain a license from the CLS or DLS instance.

After a Linux licensed client has been configured, options for configuring licensing for a network-based license server are no longer available in **NVIDIA X Server Settings**.

5.2.2. Verifying the NVIDIA AI Enterprise License Status of a Licensed Client

After configuring a client with an NVIDIA AI Enterprise license, verify the license status by displaying the licensed product name and status.

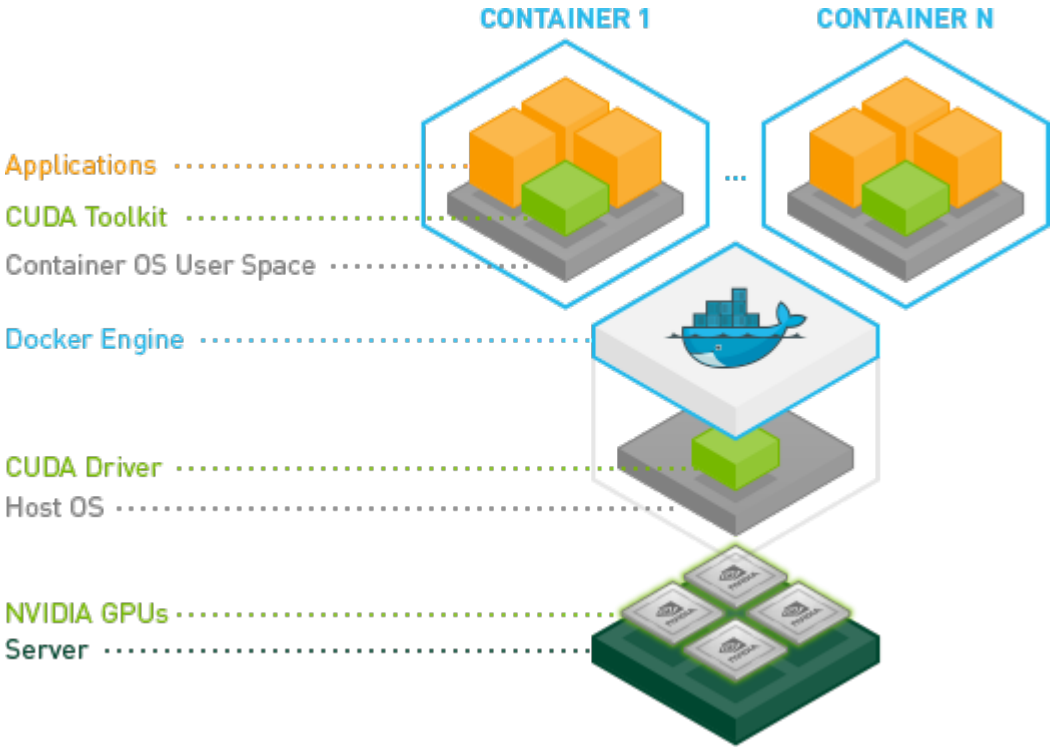
To verify the license status of a licensed client, run `nvidia-smi` with the `-q` or `--query` option. If the product is licensed, the expiration date is shown in the license status.

```
nvidia-smi -q
==============NVSMI LOG==============

Timestamp                           : Wed Mar 31 01:49:28 2020
Driver Version                      : 440.88
CUDA Version                        : 10.0

Attached GPUs                       : 1
GPU 00000000:00:08.0
    Product Name                    : Tesla T4
    Product Brand                   : Grid
    Display Mode                    : Enabled
    Display Active                  : Disabled
    Persistence Mode                : N/A
    Accounting Mode                 : Disabled
    Accounting Mode Buffer Size     : 4000
    Driver Model
        Current                     : WDDM
        Pending                     : WDDM
    Serial Number                   : 0334018000638
    GPU UUID                        : GPU-ba2310b6-95d1-802b-f96f-5865410fe517
    Minor Number                    : N/A
    VBIOS Version                   : 90.04.21.00.01
```

```
    MultiGPU Board                    : No
    Board ID                          : 0x8
    GPU Part Number                   : 699-2G183-0200-100
    Inforom Version
        Image Version                 : G183.0200.00.02
        OEM Object                    : 1.1
        ECC Object                    : 5.0
        Power Management Object       : N/A
    GPU Operation Mode
        Current                       : N/A
        Pending                       : N/A
    GPU Virtualization Mode
        Virtualization mode           : Pass-Through
    vGPU Software Licensed Product
        Product Name                  : NVIDIA Virtual Compute Server
        License Status                : Licensed (Expiry: 2021-11-13 18:29:59 GMT)
    …
    …
```

5.3. Installing NVIDIA Container Toolkit

Use NVIDIA Container Toolkit to build and run GPU accelerated Docker containers. The toolkit includes a container runtime library and utilities to configure containers to use NVIDIA GPUs automatically.



Ensure that the following software is installed in the guest VM:

- Docker 20.10 for your Linux distribution. For instructions, refer to Install Docker Engine on Ubuntu in the Docker product manuals.

- The NVIDIA AI Enterprise graphics driver. For instructions, refer to Installing the NVIDIA AI Enterprise Graphics Driver on Ubuntu from a Debian Package.

Note: You do **not** need to install NVIDIA CUDA Toolkit on the hypervisor host.

1. Set up the GPG key and configure `apt` to use NVIDIA Container Toolkit packages in the file `/etc/apt/sources.list.d/nvidia-docker.list`.

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

2. Download information from all configured sources about the latest versions of the packages and install the `nvidia-container-toolkit` package.

```
$ sudo apt-get update && sudo apt-get install -y nvidia-container-toolkit
```

3. Restart the Docker service.

```
$ sudo systemctl restart docker
```

5.4. Verifying the Installation of NVIDIA Container Toolkit

1. Run the `nvidia-smi` command contained in the latest official NVIDIA CUDA Toolkit image.

```
$ docker run --gpus all nvidia/cuda:11.0-base nvidia-smi
```

2. Start a GPU-enabled container on any two available GPUs.

```
$ docker run --gpus 2 nvidia/cuda:11.0-base nvidia-smi
```

3. Start a GPU-enabled container on two specific GPUs identified by their index numbers.

```
$ docker run --gpus '"device=1,2"' nvidia/cuda:10.0-base nvidia-smi
```

4. Start a GPU-enabled container on two specific GPUs with one GPU identified by its UUID and the other GPU identified by its index number.

```
$ docker run --gpus '"device=UUID-ABCDEF,1"' nvidia/cuda:11.0-base nvidia-smi
```

5. Specify a GPU capability for the container.

```
$ docker run --gpus all,capabilities=utility nvidia/cuda:11.0-base nvidia-smi
```

5.5. Installing Software Distributed as Container Images

The NGC container images accessed through the NVIDIA Enterprise Catalog includes the AI and data science applications, frameworks, and software in the infrastructure optimization and cloud native deployment layers. Each container image for an AI and data science application or framework contains the entire user-space software stack that is required to run the application or framework; namely, the CUDA libraries, cuDNN, any required Magnum IO components, TensorRT, and the framework.

Ensure that you have completed the following tasks in *NGC Private Registry User Guide*:

- Generating Your NGC API Key
- Accessing the NGC Container Registry

Perform this task from the VM.

For each AI or data science application that you are interested in, load the container as explained in Uploading an NVIDIA Container Image onto Your System in *NGC Private Registry User Guide*.

The following table lists the Docker `pull` command for downloading the container for each application or framework.

Application or Framework	Docker `pull` Command
NVIDIA TensorRT	`docker pull nvcr.io/nvaie/tensorrt-1-1:22.09-nvaie2.2-py3`
NVIDIA Triton Inference Server	`docker pull nvcr.io/nvaie/tritonserver:22.09-py3-sdk`
NVIDIA Triton Inference Server	`docker pull nvcr.io/nvaie/tritonserver-1-1:22.09-py3-min`
NVIDIA Triton Inference Server	`docker pull nvcr.io/nvaie/tritonserver-1-1:22.09-py3`
PyTorch	`docker pull nvcr.io/nvaie/pytorch-1-1:22.09-py3`
RAPIDS	`docker pull nvcr.io/nvaie/nvidia-rapids-1-1:22.10-cuda11.4-ubuntu20.04-py3.8`
TensorFlow 1	`docker pull nvcr.io/nvaie/tensorflow-1-1:22.09-tf1-py3`
TensorFlow 2	`docker pull nvcr.io/nvaie/tensorflow-1-1:22.09-tf2-py3`

Other Software	Docker `pull` Command
GPU Operator	`docker pull nvcr.io/nvaie/gpu-operator-1-1:v22.9.0`
Network Operator	`docker pull nvcr.io/nvaie/network-operator-1-1:v1.3.0`
vGPU Guest Driver, Ubuntu	`docker pull nvcr.io/nvaie/vgpu-guest-driver-1-1:510.85.02-ubuntu20.04`

5.6. Running ResNet-50 with TensorRT

1. Launch the NVIDIA TensorRT container image on all vGPUs in interactive mode, specifying that the container will be deleted when it is stopped.
   ```
   $ sudo docker run --gpus all -it --rm nvcr.io/nvaie/tensorrt:21.07-py3
   ```
2. From within the container runtime, change to the directory that contains test data for the ResNet-50 convolutional neural network.
   ```
   # cd /workspace/tensorrt/data/resnet50
   ```
3. Run the ResNet-50 convolutional neural network with FP32, FP16, and INT8 precision and confirm that each test is completed with the result `PASSED`.

   a). To run ResNet-50 with the default FP32 precision, run this command:

```
# trtexec --duration=90 --workspace=1024 --percentile=99 --avgRuns=100 \
--deploy=ResNet50_N2.prototxt --batch=1 --output=prob
```

b). To run ResNet-50 with FP16 precision, add the `--fp16` option:

```
# trtexec --duration=90 --workspace=1024 --percentile=99 --avgRuns=100 \
--deploy=ResNet50_N2.prototxt --batch=1 --output=prob --fp16
```

c). To run ResNet-50 with INT8 precision, add the `--int8` option:

```
# trtexec --duration=90 --workspace=1024 --percentile=99 --avgRuns=100 \
--deploy=ResNet50_N2.prototxt --batch=1 --output=prob --int8
```

4. Press **Ctrl**+**P**, **Ctrl**+**Q** to exit the container runtime and return to the Linux command shell.

5.7. Running ResNet-50 with TensorFlow

1. Launch the **TensorFlow 1** container image on all vGPUs in interactive mode, specifying that the container will be deleted when it is stopped.

```
$ sudo docker run --gpus all -it --rm \
nvcr.io/nvaie/tensorflow:21.07-tf1-py3
```

2. From within the container runtime, change to the directory that contains test data for `cnn` example.

```
# cd /workspace/nvidia-examples/cnn
```

3. Run the ResNet-50 training test with FP16 precision.

```
# python resnet.py --layers 50 -b 64 -i 200 -u batch --precision fp16
```

4. Confirm that all operations on the application are performed correctly and that a set of results is reported when the test is completed.
5. Press **Ctrl**+**P**, **Ctrl**+**Q** to exit the container runtime and return to the Linux command shell.

Chapter 6. Additional Information

The following table provides links to additional information about each application or framework in NVIDIA AI Enterprise.

Application or Framework	Additional Information
TensorFlow	▶ TensorFlow Release Notes ▶ TensorFlow User Guide
PyTorch	PyTorch Release Notes
NVIDIA Triton Inference Server	Triton Inference Server Documentation on Github
NVIDIA TensorRT	NVIDIA TensorRT Documentation
RAPIDS	RAPIDS Docs on the RAPIDS project site

Other Software	Additional Information
NVIDIA GPU Operator	NVIDIA GPU Operator Documentation
NVIDIA Network Operator	NVIDIA Network Operator Documentation

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