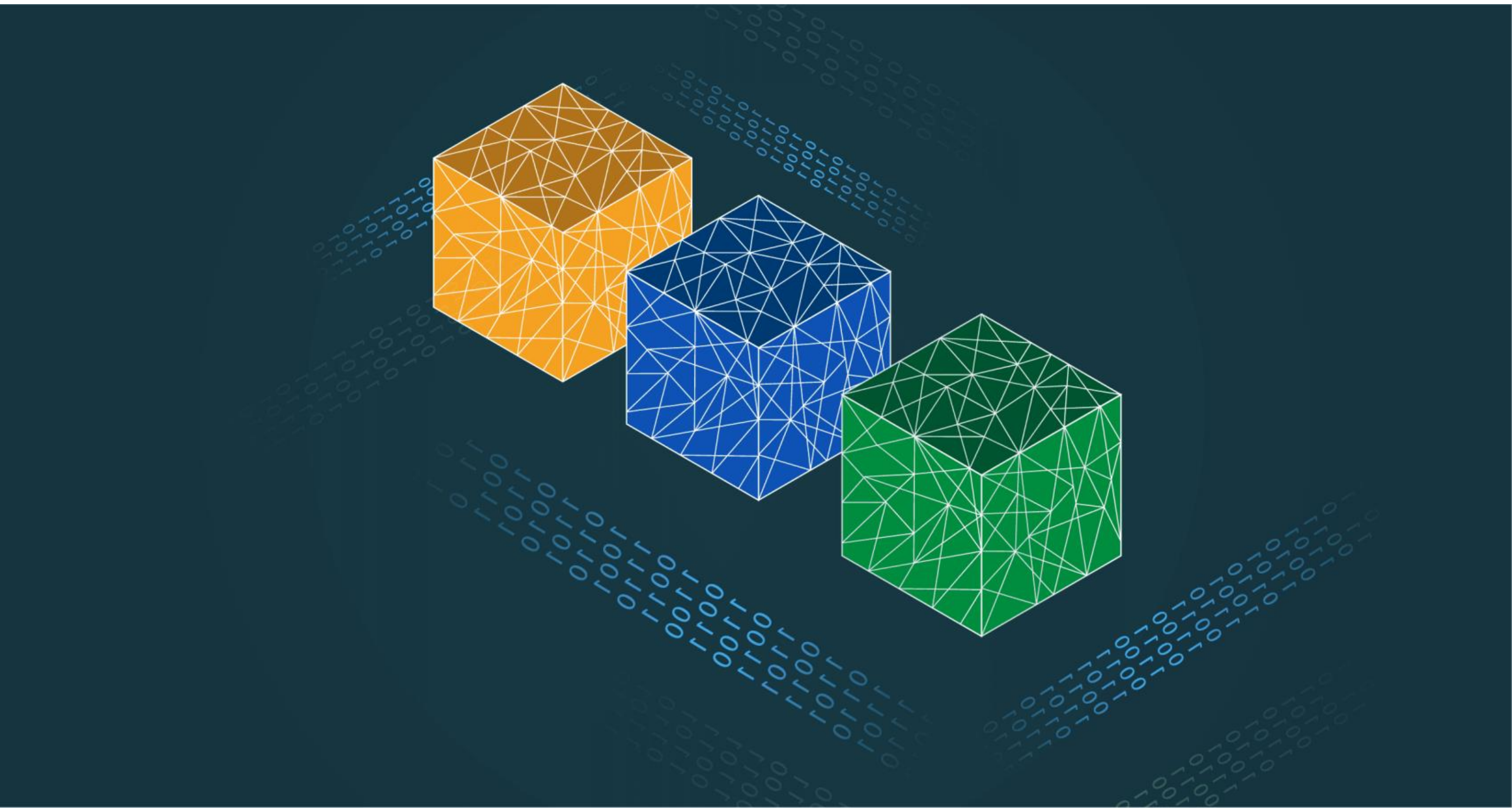
ProphetStor



Federator.ai GPU Booster Installation Guide

Federator.ai GPU Booster version 5.2.1

Installation Guide

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Contents

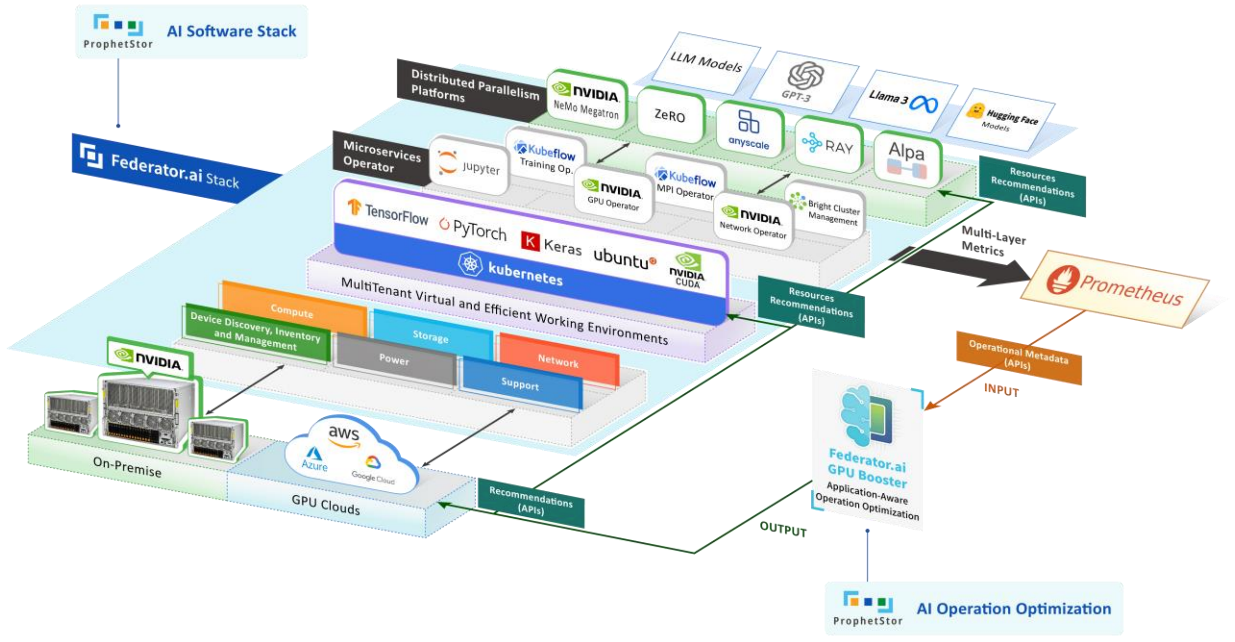
Overview

Federator.ai GPU Booster leverages advanced multi-layer correlation and machine learning technologies on Kubernetes to address the challenges of managing GPU resources in competitive AI and ML environments. Designed for MultiTenant settings, it efficiently orchestrates AI/ML workloads, particularly in large language model training.

By recommending GPU allocations to accommodate the varying demands of AI training workloads, Federator.ai GPU Booster optimizes resource usage and enhances training efficiency, enabling organizations to fully harness their AI/ML capabilities, thereby accelerating progress in the field.

Using advanced machine learning algorithms to predict application workloads, Federator.ai GPU Booster offers:

- Efficient GPU resource allocation by leveraging Multi-Instance GPU (MIG) technology to run MultiTenant training sessions in parallel, efficiently allocating the necessary resources based on ML algorithms
- Maximize total throughput by strategically reallocating GPU resources among concurrent GPU workloads
- AI-based workload prediction for containerized applications in Kubernetes
- Resource recommendations based on workload prediction, application, Kubernetes, and other related metrics
- Automatic provisioning of CPU/memory for generic Kubernetes application controllers/namespaces
- Actual cost and potential savings based on recommendations for clusters, Kubernetes applications, and Kubernetes namespaces



Federator.ai Stack Installation

Federator.ai GPU Booster runs on a Kubernetes cluster, managing GPU resources and workloads in Kubernetes clusters. To run Federator.ai GPU Booster on a GPU server and manage its Kubernetes cluster, it's essential to install a software stack on the GPU server in order to run GPU workloads and utilize Federator.ai GPU Booster for effective GPU system management. This software stack includes the Linux OS, Kubernetes, NVIDIA drivers/plugins/Operator, Prometheus, and Federator.ai GPU Booster.

The Federator.ai Stack

Federator.ai Stack is designed and developed to empower AI and ML innovations with a full suite of all-inclusive tools. Tailor-made for researchers, data scientists, and IT professionals, it takes away the pain of deploying and running your AI applications so that you can focus on breakthroughs. At the same time, we remove all the headaches of infra optimization.

If installing on a bare metal GPU server, an ISO image is provided to install the base OS. For a GPU server that has already been installed with a base OS, the Federator.ai Stack launcher script is provided for the installation process.

The following software components will be installed:

- **Base OS:** For a bare metal GPU server, boot the GPU server from the Federator.ai Stack ISO image, and an Ubuntu base OS will be installed.
- **NVIDIA GPU Driver:** NVIDIA GPU drivers and CUDA Toolkits will be installed on Ubuntu OS.
- **Kubernetes:** A Kubernetes cluster will be created if the GPU server is not part of an existing

Kubernetes cluster.

- **NVIDIA GPU Operator:** The NVIDIA GPU Operator for Kubernetes, which includes the NVIDIA device plugin, will be installed in the Kubernetes cluster.
- **Prometheus:** An open-source monitoring and altering toolkit for monitoring microservices and containers for Kubernetes will be installed if it is not already installed.
- **Federator.ai GPU Booster:** Federator.ai GPU Booster will be installed in the Kubernetes cluster.
- **AI/ML Frameworks:** (Optional) AI/ML frameworks and development toolkits will be installed in the Kubernetes cluster.

Hardware Requirements

The hardware requirements for a GPU Server are,

- **CPU:** Intel Xeon ES or above or Similar AMD CPUs
- **Memory:** Minimum of 32 GB*
- **GPU:** NVIDIA H100/A100 recommended
- **Network:** At least 1 NIC with Internet access
- **Local Storage:** 1 TB SSD recommended
- **Persistent Storage:** 500GB NFS Storage (optional)

* *Note that the memory requirement stated above is for Federator.ai GPU Booster only. To run additional AI/ML workloads, please increase memory accordingly.*

Network Accessibility

- **Internet Accessibility**: Installing a Kubernetes cluster, essential drivers/toolkits/tools, Federator.ai Stack, and GPU workloads for the PoC involves downloading software packages and workload datasets from the internet. Therefore, internet access is necessary during the installation process and the preparation of GPU workloads. However, internet access will no longer be required once the installation and preparation phases are completed.

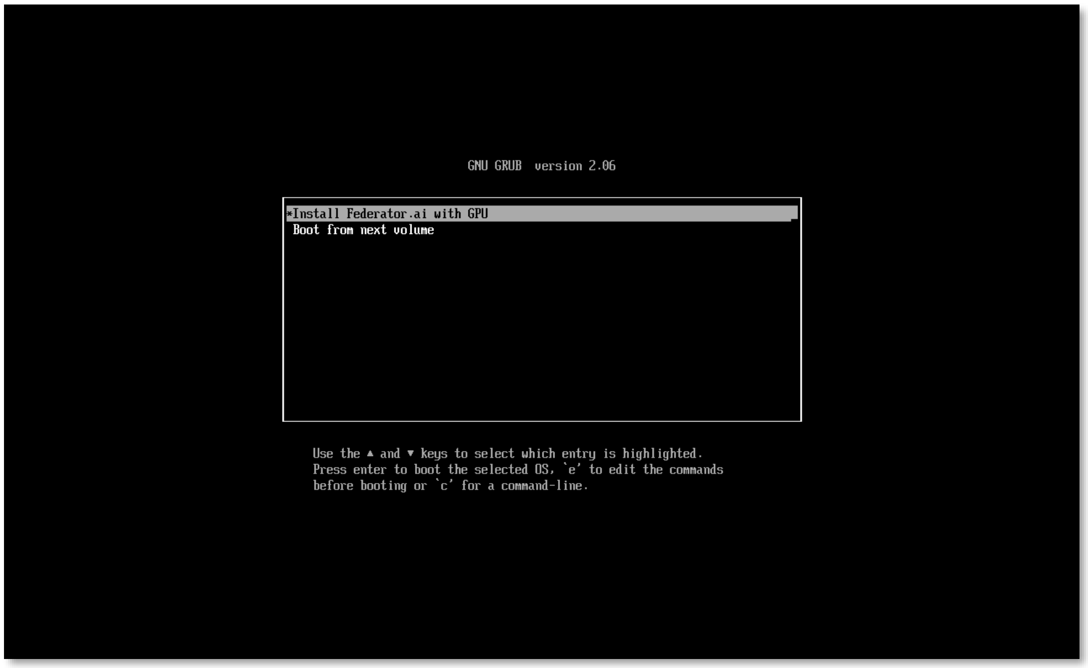
Installation Process

This section describes the procedure for installing the Federator.ai Stack on a GPU server. Following the script execution, the Federator.ai Stack (including Federator.ai GPU Booster) will be fully installed and operational.

1. If the GPU server is a bare metal system without an operating system installed, download the Federator.ai Stack ISO image, mount the ISO image to the GPU server, and boot the server from this ISO image.

```
~# curl -u <user:password> -sL -O https://public.prophetstor.com/federator.ai/gpu-booster/f8ai-stack.iso
```

   Upon booting, an Ubuntu installation wizard will guide you through the complete setup of the Linux OS.



```
GNU GRUB  version 2.06

*Install Federator.ai with GPU
 Boot from next volume

Use the ▲ and ▼ keys to select which entry is highlighted.
Press enter to boot the selected OS, `e' to edit the commands
before booting or `c' for a command-line.
```

2. If the installed GPU server is already a node in an existing Kubernetes cluster, please ensure that the "`kubectl`" command is configured and the "`kubectl get nodes`" command can run properly.

3. Download and run the Federator.ai Stack launcher script with credentials.

```
~# curl -u <user:password> -sL https://public.prophetstor.com/f8ai-stack/f8ai-stack-launcher.sh | bash
```

   The script supports installing the GPU server either as a Kubernetes control-plane node or as a worker node. It is necessary to install a control-plane node before installing and adding a worker node to the Kubernetes cluster.

   To install the GPU server as a Kubernetes control-plane node (or as an all-in-one node), answer "n" to the question:

```
Configure as Kubernetes Worker Node (y/n) [n]: n
```

Otherwise, answer "y" and provide the IP address of the control-plane node to install it as a worker node.

```
Configure as Kubernetes Worker Node (y/n) [y]: y
Kubernetes control-plane IP Address []: 172.31.2.40
```

4. This script will prompt you to enter credentials, decide whether to install NeMo.

```
Install NVIDIA NeMo Framework (y/n) [y]: n
```

The script then automates the setup, deploys everything in the Federator.ai Stack. If the GPU server is not part of an existing Kubernetes cluster, a new Kubernetes cluster will be created, together with Prometheus.

```
root@k8s-1:~# curl -u xxx:xxx -sL https://public.prophetstor.com/f8ai-stack/f8ai-stack-
launcher.sh | sh
Authentication is required to download setup files.
Username: xxx
Password:
 **************************
 ****  Running Setup   ****
 **************************

Using setup script version v1.0.0-b1024-1-g9a61eb2.
Federator.ai GPU Booster Chart Version [5.2.1-3069]:
Configure as Kubernetes Worker Node (y/n) [n]: n
Install NVIDIA NeMo Framework (y/n) [n]:

Creating configuration file .config_env.sh...
renamed '.config_env.sh.tmp' -> '.config_env.sh'
fs.inotify.max_user_instances = 1280
fs.inotify.max_user_watches = 1048576

==============================
=   Start deploying Docker   =
==============================

# Executing docker install script, commit: 0d6f72e671ba87f7aa4c6991646a1a5b9f9dae84
+ sh -c apt-get update -qq >/dev/null
```

```
 *******************************
 ****  Setup successfully   ****
 *******************************
Press <enter> key to continue ...
```

5. Once the installation is completed, a Kubernetes NodePort service (port 31012) is created to access the Federator.ai GPU Booster dashboard.

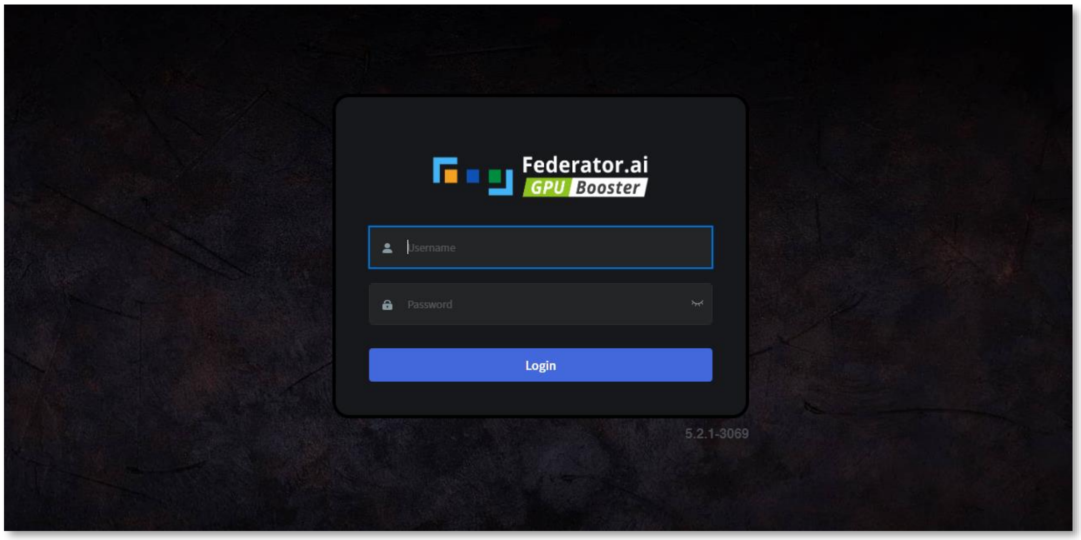
https://*<cluster-node-ip>*:31012

Federator.ai GPU Booster Dashboard Access

After a successful installation, the Fedeartor.ai GPU Booster can be accessed through the following

- **Dashboard URL**: https://*<cluster-node-ip>*:31012
- **Default Login**: Username: **admin** | Password: **admin**

This interface allows for comprehensive management and monitoring of your AI workloads.



Federator.ai GPU Booster Installation

Federator.ai GPU Booster runs on a Kubernetes cluster and can remotely manage GPU resources and workloads across multiple Kubernetes clusters. It supports installation in an existing Kubernetes cluster, whether or not it has GPU resources, by using helm chart.

Supported Platforms

- Kubernetes (K8S): 1.16 ~ 1.29
- Rancher v2.4.8, v2.5.8, v2.5.9
- OpenShift: 4.6 ~ 4.9
- VMware Tanzu

Resource Requirements

- Total resource requirements:
    - CPU: 10 cores
    - Memory: 32 GB Memory
    - Storage: 200 GB (ReadWriteOnce access mode)
- Resource requirements for the time-series database:
    - It is required to have at least one worker node with more than 3 CPU cores and 8 GB of memory available.
- Persistent volumes
    - It is strongly recommended to use persistent volumes instead of ephemeral storage to store the data in the production environment. Any data on ephemeral storage will be lost after Federator.ai GPU Booster pods are restarted.

* *If your environment for testing does not have enough CPU/memory resources to install Federator.ai GPU Booster, you can disable resource requests for Federator.ai GPU Booster by setting the installation parameter '`--set global.resourcesRequestsEnabled="false"`'.*

Installation Process

1. Add Federator.ai GPU Booster helm chart repository

```
~# helm repo add prophetstor https://prophetstor-ai.github.io/federatorai-operator-helm/
```

2. Test the helm chart repository

```
~# helm search repo federatorai-gb
```

Install Federator.ai GPU Booster helm chart with a release name (e.g., '`federatorai-gb`') in the '`federatorai`' namespace.

ⓘ *The default persistent storage class is '`default`', use '`--set global.storageClassName="<name>"`' to configure an alternative storage class.*

```
~# helm install federatorai-gb prophetstor/federatorai-gb --namespace=federatorai --create-
namespace
NAME: federatorai-gb
LAST DEPLOYED: Wed Apr  3 09:06:28 2024
NAMESPACE: federatorai
```

```
STATUS: deployed
REVISION: 1
TEST SUITE: None
NOTES:
CHART NAME: federatorai-gb
CHART VERSION: 5.2.0
APP VERSION: 5.2.0-3035

** Please be patient while the chart is being deployed **

Watch the Federator.ai GPU Booster pods status using the command:
    kubectl get pods -w --namespace federatorai -l app.kubernetes.io/part-of=federatorai-gb
```

3. Confirm Federator.ai GPU Booster pods are running and ready

```
~# kubectl get pods -n federatorai
NAME                                                  READY   STATUS    RESTARTS     AGE
alameda-ai-66d868dd55-4w96n                           1/1     Running   0            19m
alameda-ai-dispatcher-7bbdbf876d-q5hdz                1/1     Running   0            19m
alameda-datahub-f689f78db-khglg                       1/1     Running   0            19m
alameda-executor-5f64799758-b4fhn                     1/1     Running   0            19m
alameda-influxdb-0                                    1/1     Running   0            19m
alameda-notifier-5b9c8848c9-q452z                     1/1     Running   0            19m
alameda-rabbitmq-77db88b94d-4dqzv                     1/1     Running   0            19m
fedemeter-api-6ffbfc5f5c-v7fcf                        1/1     Running   0            19m
fedemeter-influxdb-0                                  1/1     Running   0            19m
federatorai-agent-c775948db-7kzp2                     1/1     Running   0            19m
federatorai-alert-detector-789f5cff-b7n6m             1/1     Running   0            19m
federatorai-alert-manager-6d55dc7f4-jtnd6             1/1     Running   0            19m
federatorai-dashboard-backend-8bc98c9c9-25w5d         1/1     Running   0            19m
federatorai-dashboard-frontend-96f466c64-bfb4v        1/1     Running   0            19m
federatorai-data-adapter-6ff6cc5b69-vdhfq             1/1     Running   0            19m
federatorai-gpu-device-plugin-2g6cd                   2/2     Running   0            19m
federatorai-postgresql-0                              1/1     Running   0            19m
federatorai-recommender-dispatcher-7869f7bb65-lv7s9   1/1     Running   0            19m
federatorai-recommender-gpu-6ddc7b469d-wql8h          1/1     Running   0            19m
federatorai-recommender-worker-686b46c8d4-8bpc4       1/1     Running   0            19m
federatorai-rest-7bf9d69d7-7bw4c                      1/1     Running   0            19m
federatorai-sys-exporter-694pk                        1/1     Running   0            19m
```

4. By default, Federator.ai GPU Booster helm chart creates a NodePort service for Federator.ai GPU Booster dashboard. If your environment does not allow creating NodePort services, you'll need to manually configure Kubernetes to expose the Federator.ai GPU Booster dashboard service ("`federatorai-dashboard-frontend`") for external access.

```
~# kubectl get svc federatorai-dashboard-frontend-public -n federatorai
NAME                                  TYPE     CLUSTER-IP    EXTERNAL-IP PORT(S)        AGE
federatorai-dashboard-frontend-public NodePort 10.110.55.157 <none>      9001:31012/TCP 9d
```

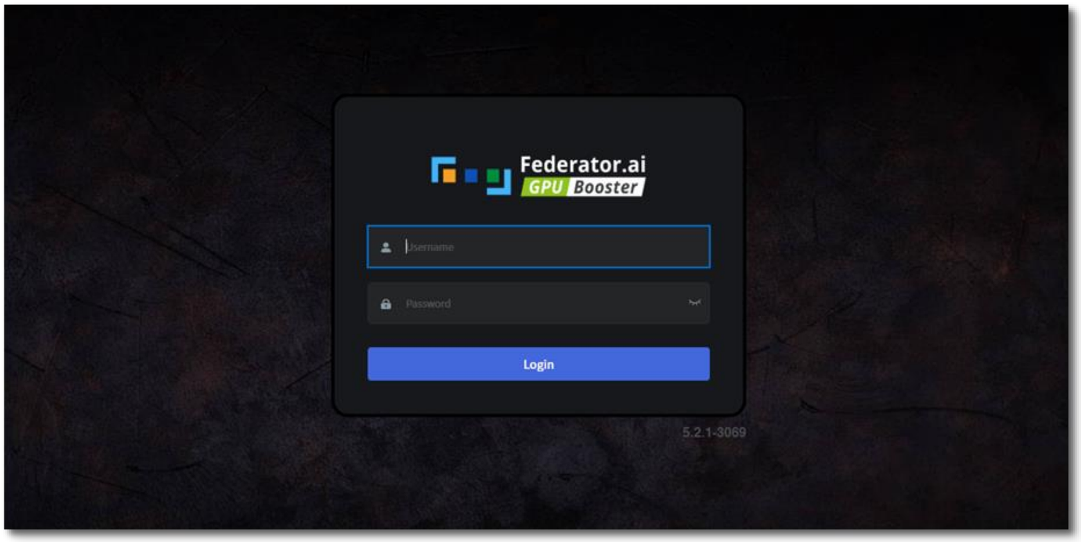
```
~# kubectl get svc federatorai-dashboard-frontend -n federatorai
NAME                            TYPE       CLUSTER-IP     EXTERNAL-IP   PORT(S)             AGE
federatorai-dashboard-frontend  ClusterIP  10.104.56.149 <none>        9000/TCP,9001/TCP   9d
```

Federator.ai GPU Booster Dashboard Access

After a successful installation, the Fedeartor.ai GPU Booster can be accessed through the following

- **Dashboard URL**: **https://*<cluster-node-ip>*:31012**
- **Default Login**: Username: **admin** | Password: **admin**

This interface allows for comprehensive management and monitoring of your AI workloads.



Federator.ai GPU Booster Addons Installation

Federator.ai GPU Booster requires an additional Prometheus metrics exporter running on each Kubernetes cluster to collect the memory usage metrics from GPU MIG devices. The additional exporter is included in the Federator.ai GPU Booster helm chart and is installed when Federator.ai GPU Booster is installed. To manage remote clusters (clusters other than the one running Federator.ai GPU Booster), the additional exporter can be installed using the Federator.ai GPU Booster Addons helm chart. The helm chart will only install the additional exporter instead of the entire Federator.ai GPU Booster.

Installation Process

1. Add Federator.ai GPU Booster helm chart repository

```
~# helm repo add prophetstor https://prophetstor-ai.github.io/federatorai-operator-helm/
```

2. Test the helm chart repository

```
~# helm search repo federatorai-gb-addons
```

3. Get the Prometheus service monitor selector label needed to configure the additional exporter. The service monitor selector label can be obtained with the following kubectl command

```
~# kubectl get prometheus -n <prometheus_namespace> -o custom-
columns=:.spec.serviceMonitorSelector.matchLabels
```

For example, if the output of the kubectl command is "`map[release:kube-prometheus-stack]`", the service monitor selector label is "`release:kube-prometheus-stack`" (where "`release`" is the key and "`kube-prometheus-stack`" is the value).

If the output of the kubectl command is empty, please refer to the document below for details on configuring the Prometheus service monitor.

https://github.com/prometheus-operator/prometheus-operator/blob/main/Documentation/troubleshooting.md#troubleshooting-servicemonitor-changes

4. Install Federator.ai GPU Booster Addons helm chart with a release name (e.g., 'federatorai-gb-addons') and the service monitor label parameter (e.g., '`--set serviceMonitor.labels.release=kube-prometheus-stack`) in the '`federatorai`' namespace.

```
~# helm install federatorai-gb-addons prophetstor/federatorai-gb-addons --
namespace=federatorai --create-namespace --set serviceMonitor.labels.release=kube-
prometheus-stack
NAME: federatorai-gb-addons
LAST DEPLOYED: Tue Aug 20 09:48:02 2024
NAMESPACE: federatorai
STATUS: deployed
REVISION: 1
TEST SUITE: None
NOTES:
CHART NAME: federatorai-gb-addons
CHART VERSION: 5.2.1+3066
APP VERSION: 5.2.1+3066

** Please be patient while the chart is being deployed **

Watch the Federator.ai pods status using the command:
    kubectl get pods -w --namespace federatorai -l app.kubernetes.io/part-of=federatorai
```

Federator.ai GPU Booster Upgrade

Upgrading Federator.ai GPU Booster from a previous version is done using the launcher script, "f8ai-stack-launcher.sh". The launcher script is designed to automatically detect the version of the existing NVIDIA device driver, NVIDIA GPU Operator, and Federator.ai GPU Booster. Upgrading the device driver and NVIDIA GPU Operator is required in order to upgrade Federator.ai GPU Booster. Otherwise, the upgrade will be aborted.

1. Download and run the Federator.ai Stack launcher script with credentials.

```
~# curl -u <user:password> -sL https://public.prophetstor.com/f8ai-stack/f8ai-stack-
launcher.sh | bash
```

2. The script will prompt the user whether or not to upgrade the NVIDIA device driver and GPU Operator. Answer "y" to start the upgrade, otherwise answer "n" to cancel the upgrade if you are concerned about upgrading the device driver and GPU Operator.

```
Update nvidia k8s device driver (y/n) [y]: y
Upgrade Federator.ai GPU Booster (y/n) [y]: y
```

```
root@k8s-1:~# curl -u xxx:xxx -sL https://public.prophetstor.com/f8ai-stack/f8ai-stack-launcher.sh | sh
Authentication is required to download setup files.
Username: xxx
Password:
Start downloading setup files ...

 **************************
 ****  Running Setup   ****
 **************************
Using setup script version v1.0.0-b1024-1-g9a61eb2.
Configure as Kubernetes Worker Node (y/n) [n]:
Hang tight while we grab the latest from your chart repositories...
...Successfully got an update from the "prophetstor" chart repository
...Successfully got an update from the "nvidia" chart repository
...Successfully got an update from the "prometheus-community" chart repository
Update Complete. Happy Helming!
Update nvidia k8s device driver (y/n) [y]: y
Upgrade Federator.ai GPU Booster (y/n) [y]: y
Federator.ai GPU Booster Chart Version [5.2.1-3069]:

Creating configuration file .config_env.sh...
renamed '.config_env.sh.tmp' -> '.config_env.sh'

    INFO: Keep using the existing Kubernetes cluster (kubernetes-admin@f8m1).

 ===================================
 =   Start deploying GPU Operator  =
 ===================================
*******************************
 ****  Setup successfully   ****
 *******************************

Press <enter> key to continue ..
```

Uninstallation

- Uninstall/Delete the Federator.ai GPU Booster release (e.g., ‘`federatorai-gb`‘)

```
~# helm ls --all-namespaces
~# helm delete federatorai-gb --namespace=federatorai
```

- Uninstall/Delete the Federator.ai GPU Booster Addons release (e.g., ‘`federatorai-gb-addons`‘)

```
~# helm ls --all-namespaces
~# helm delete federatorai-gb-addons --namespace=federatorai
```