Kubeflow Deployment

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This section describes the tasks that you must complete to deploy Kubeflow in your Kubernetes cluster.

Prerequisites

Before you perform the deployment exercise that is outlined in this section, we assume that you have already performed the following tasks:

1. You already have a working Kubernetes cluster, and you are running a version of Kubernetes that is supported by Kubeflow. For a list of supported versions, see the official Kubeflow documentation.
2. You have already installed and configured NetApp Trident in your Kubernetes cluster as outlined in Trident Deployment and Configuration.

Set Default Kubernetes StorageClass

Before you deploy Kubeflow, you must designate a default StorageClass within your Kubernetes cluster. The Kubeflow deployment process attempts to provision new persistent volumes using the default StorageClass. If no StorageClass is designated as the default StorageClass, then the deployment fails. To designate a default StorageClass within your cluster, perform the following task from the deployment jump host. If you have already designated a default StorageClass within your cluster, then you can skip this step.

1. Designate one of your existing StorageClasses as the default StorageClass. The example commands that follow show the designation of a StorageClass named `ontap-ai- flexvols-retain` as the default StorageClass.

The `ontap-nas-flexgroup` Trident Backend type has a minimum PVC size that is fairly large. By default, Kubeflow attempts to provision PVCs that are only a few GBs in size. Therefore, you should not designate a StorageClass that utilizes the `ontap-nas-flexgroup` Backend type as the default StorageClass for the purposes of Kubeflow deployment.

```
$ kubectl get sc
NAME                                  PROVISIONER             AGE
ontap-ai-flexgroups-retain            csi.trident.netapp.io   25h
ontap-ai-flexgroups-retain-iface1     csi.trident.netapp.io   25h
ontap-ai-flexgroups-retain-iface2     csi.trident.netapp.io   25h
ontap-ai-flexvols-retain              csi.trident.netapp.io   3s
$ kubectl patch storageclass ontap-ai-flexvols-retain -p '{"metadata":
{"annotations":{"storageclass.kubernetes.io/is-default-class":"true"}}}'
storageclass.storage.k8s.io/ontap-ai-flexvols-retain patched
$ kubectl get sc
NAME                                   PROVISIONER             AGE
ontap-ai-flexgroups-retain             csi.trident.netapp.io   25h
ontap-ai-flexgroups-retain-iface1      csi.trident.netapp.io   25h
ontap-ai-flexgroups-retain-iface2      csi.trident.netapp.io   25h
ontap-ai-flexvols-retain (default)     csi.trident.netapp.io   54s
```

Use NVIDIA DeepOps to Deploy Kubeflow

NetApp recommends using the Kubeflow deployment tool that is provided by NVIDIA DeepOps. To deploy Kubeflow in your Kubernetes cluster using the DeepOps deployment tool, perform the following tasks from the deployment jump host.

Alternatively, you can deploy Kubeflow manually by following the installation instructions in the official Kubeflow documentation

1. Deploy Kubeflow in your cluster by following the Kubeflow deployment instructions on the NVIDIA DeepOps GitHub site.
2. Note down the Kubeflow Dashboard URL that the DeepOps Kubeflow deployment tool outputs.

```
$ ./scripts/k8s/deploy_kubeflow.sh -x
…
INFO[0007] Applied the configuration Successfully!
filename="cmd/apply.go:72"
Kubeflow app installed to: /home/ai/kubeflow
It may take several minutes for all services to start. Run 'kubectl get
pods -n kubeflow' to verify
To remove (excluding CRDs, istio, auth, and cert-manager), run:
./scripts/k8s_deploy_kubeflow.sh -d
To perform a full uninstall : ./scripts/k8s_deploy_kubeflow.sh -D
Kubeflow Dashboard (HTTP NodePort): http://10.61.188.111:31380
```

3. Confirm that all pods deployed within the Kubeflow namespace show a `STATUS` of `Running` and confirm that no components deployed within the namespace are in an error state. It may take several minutes for all pods to start.

```
$ kubectl get all -n kubeflow
NAME                                                        READY
STATUS    RESTARTS   AGE
pod/admission-webhook-bootstrap-stateful-set-0              1/1
Running   0          95s
pod/admission-webhook-deployment-6b89c84c98-vrtbh           1/1
Running   0          91s
pod/application-controller-stateful-set-0                   1/1
Running   0          98s
pod/argo-ui-5dcf5d8b4f-m2wn4                                1/1
Running   0          97s
pod/centraldashboard-cf4874ddc-7hcr8                        1/1
Running   0          97s
pod/jupyter-web-app-deployment-685b455447-gjhh7             1/1
Running   0          96s
pod/katib-controller-88c97d85c-kgq66                        1/1
Running   1          95s
pod/katib-db-8598468fd8-5jw2c                               1/1
Running   0          95s
pod/katib-manager-574c8c67f9-wtrf5                          1/1
Running   1          95s
pod/katib-manager-rest-778857c989-fjbzn                     1/1
Running   0          95s
pod/katib-suggestion-bayesianoptimization-65df4d7455-qthmw  1/1
Running   0          94s
pod/katib-suggestion-grid-56bf69f597-98vwn                  1/1
Running   0          94s
pod/katib-suggestion-hyperband-7777b76cb9-9v6dq             1/1
Running   0          93s
pod/katib-suggestion-nasrl-77f6f9458c-2qzxq                 1/1
Running   0          93s
pod/katib-suggestion-random-77b88b5c79-l64j9                1/1
Running   0          93s
pod/katib-ui-7587c5b967-nd629                               1/1
Running   0          95s
pod/metacontroller-0                                        1/1
Running   0          96s
pod/metadata-db-5dd459cc-swzkm                              1/1
Running   0          94s
pod/metadata-deployment-6cf77db994-69fk7                    1/1
Running   3          93s
pod/metadata-deployment-6cf77db994-mpbjt                    1/1
Running   3          93s
pod/metadata-deployment-6cf77db994-xg7tz                    1/1
Running   3          94s
pod/metadata-ui-78f5b59b56-qb6kr                            1/1
```

```
Running   0          94s
pod/minio-758b769d67-llvdr                                        1/1
Running   0          91s
pod/ml-pipeline-5875b9db95-g8t2k                                  1/1
Running   0          91s
pod/ml-pipeline-persistenceagent-9b69ddd46-bt9r9                  1/1
Running   0          90s
pod/ml-pipeline-scheduledworkflow-7b8d756c76-7x56s                1/1
Running   0          90s
pod/ml-pipeline-ui-79ffd9c76-fcwpd                                1/1
Running   0          90s
pod/ml-pipeline-viewer-controller-deployment-5fdc87f58-b2t9r      1/1
Running   0          90s
pod/mysql-657f87857d-l5k9z                                        1/1
Running   0          91s
pod/notebook-controller-deployment-56b4f59bbf-8bvnr               1/1
Running   0          92s
pod/profiles-deployment-6bc745947-mrdkh                           2/2
Running   0          90s
pod/pytorch-operator-77c97f4879-hmlrv                             1/1
Running   0          92s
pod/seldon-operator-controller-manager-0                          1/1
Running   1          91s
pod/spartakus-volunteer-5fdfddb779-l7qkm                          1/1
Running   0          92s
pod/tensorboard-6544748d94-nh8b2                                  1/1
Running   0          92s
pod/tf-job-dashboard-56f79c59dd-6w59t                             1/1
Running   0          92s
pod/tf-job-operator-79cbfd6dbc-rb58c                              1/1
Running   0          91s
pod/workflow-controller-db644d554-cwrnb                           1/1
Running   0          97s
NAME                                                 TYPE
CLUSTER-IP      EXTERNAL-IP   PORT(S)             AGE
service/admission-webhook-service                    ClusterIP
10.233.51.169   <none>        443/TCP             97s
service/application-controller-service               ClusterIP
10.233.4.54     <none>        443/TCP             98s
service/argo-ui                                      NodePort
10.233.47.191   <none>        80:31799/TCP        97s
service/centraldashboard                             ClusterIP
10.233.8.36     <none>        80/TCP              97s
service/jupyter-web-app-service                      ClusterIP
10.233.1.42     <none>        80/TCP              97s
service/katib-controller                             ClusterIP
```

```
10.233.25.226   <none>        443/TCP             96s
service/katib-db                                    ClusterIP
10.233.33.151   <none>        3306/TCP            97s
service/katib-manager                               ClusterIP
10.233.46.239   <none>        6789/TCP            96s
service/katib-manager-rest                          ClusterIP
10.233.55.32    <none>        80/TCP              96s
service/katib-suggestion-bayesianoptimization       ClusterIP
10.233.49.191   <none>        6789/TCP            95s
service/katib-suggestion-grid                       ClusterIP
10.233.9.105    <none>        6789/TCP            95s
service/katib-suggestion-hyperband                  ClusterIP
10.233.22.2     <none>        6789/TCP            95s
service/katib-suggestion-nasrl                      ClusterIP
10.233.63.73    <none>        6789/TCP            95s
service/katib-suggestion-random                     ClusterIP
10.233.57.210   <none>        6789/TCP            95s
service/katib-ui                                    ClusterIP
10.233.6.116    <none>        80/TCP              96s
service/metadata-db                                 ClusterIP
10.233.31.2     <none>        3306/TCP            96s
service/metadata-service                            ClusterIP
10.233.27.104   <none>        8080/TCP            96s
service/metadata-ui                                 ClusterIP
10.233.57.177   <none>        80/TCP              96s
service/minio-service                               ClusterIP
10.233.44.90    <none>        9000/TCP            94s
service/ml-pipeline                                 ClusterIP
10.233.41.201   <none>        8888/TCP,8887/TCP   94s
service/ml-pipeline-tensorboard-ui                  ClusterIP
10.233.36.207   <none>        80/TCP              93s
service/ml-pipeline-ui                              ClusterIP
10.233.61.150   <none>        80/TCP              93s
service/mysql                                       ClusterIP
10.233.55.117   <none>        3306/TCP            94s
service/notebook-controller-service                 ClusterIP
10.233.10.166   <none>        443/TCP             95s
service/profiles-kfam                               ClusterIP
10.233.33.79    <none>        8081/TCP            92s
service/pytorch-operator                            ClusterIP
10.233.37.112   <none>        8443/TCP            95s
service/seldon-operator-controller-manager-service  ClusterIP
10.233.30.178   <none>        443/TCP             92s
service/tensorboard                                 ClusterIP
10.233.58.151   <none>        9000/TCP            94s
service/tf-job-dashboard                            ClusterIP
```

```
10.233.4.17     <none>        80/TCP              94s
service/tf-job-operator                             ClusterIP
10.233.60.32    <none>        8443/TCP            94s
service/webhook-server-service                      ClusterIP
10.233.32.167   <none>        443/TCP             87s
NAME                                                          READY   UP-
TO-DATE   AVAILABLE   AGE
deployment.apps/admission-webhook-deployment                  1/1     1
1           97s
deployment.apps/argo-ui                                       1/1     1
1           97s
deployment.apps/centraldashboard                              1/1     1
1           97s
deployment.apps/jupyter-web-app-deployment                    1/1     1
1           97s
deployment.apps/katib-controller                              1/1     1
1           96s
deployment.apps/katib-db                                      1/1     1
1           97s
deployment.apps/katib-manager                                 1/1     1
1           96s
deployment.apps/katib-manager-rest                            1/1     1
1           96s
deployment.apps/katib-suggestion-bayesianoptimization         1/1     1
1           95s
deployment.apps/katib-suggestion-grid                         1/1     1
1           95s
deployment.apps/katib-suggestion-hyperband                    1/1     1
1           95s
deployment.apps/katib-suggestion-nasrl                        1/1     1
1           95s
deployment.apps/katib-suggestion-random                       1/1     1
1           95s
deployment.apps/katib-ui                                      1/1     1
1           96s
deployment.apps/metadata-db                                   1/1     1
1           96s
deployment.apps/metadata-deployment                           3/3     3
3           96s
deployment.apps/metadata-ui                                   1/1     1
1           96s
deployment.apps/minio                                         1/1     1
1           94s
deployment.apps/ml-pipeline                                   1/1     1
1           94s
deployment.apps/ml-pipeline-persistenceagent                  1/1     1
```

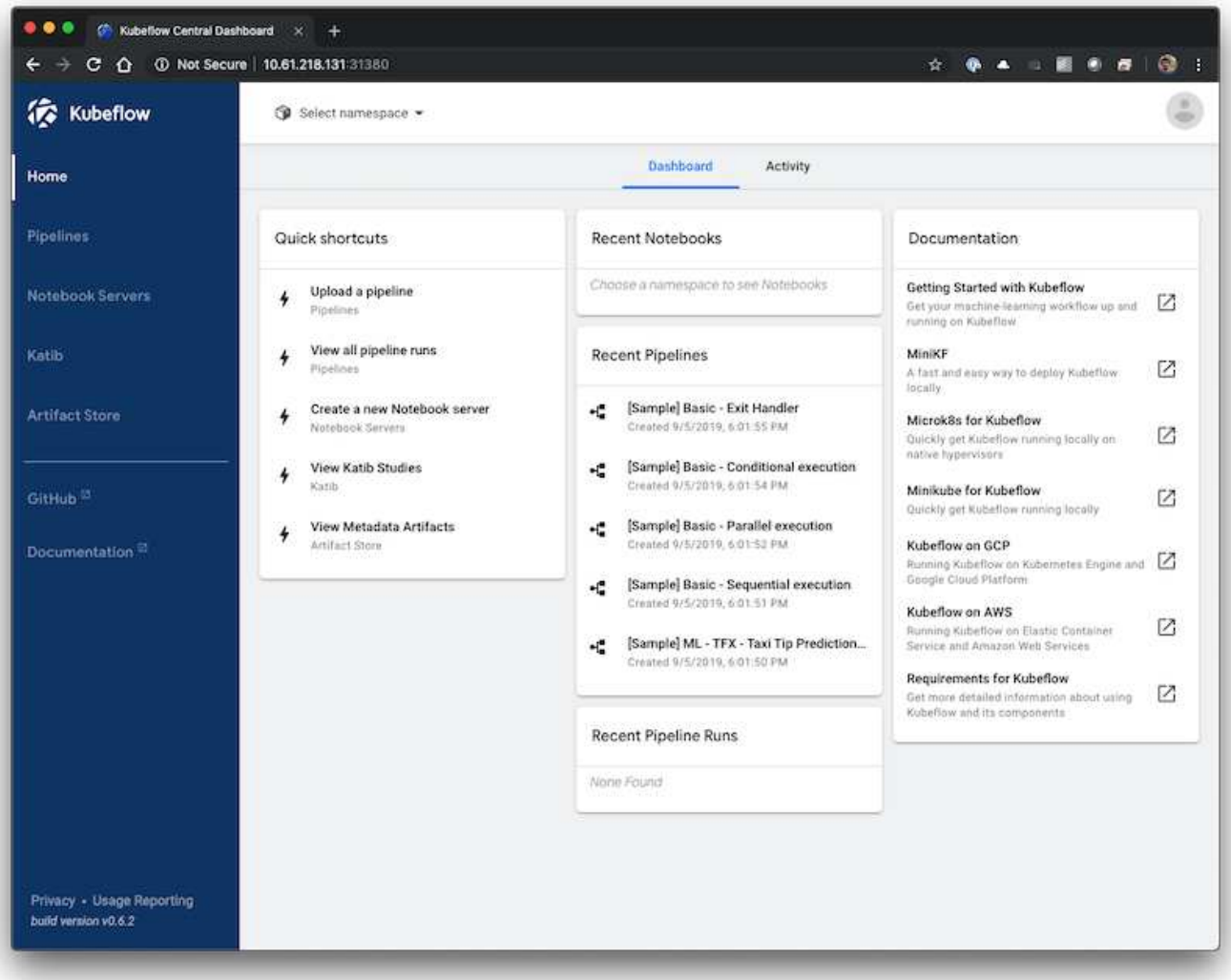
```
1           93s
deployment.apps/ml-pipeline-scheduledworkflow              1/1     1
1           93s
deployment.apps/ml-pipeline-ui                             1/1     1
1           93s
deployment.apps/ml-pipeline-viewer-controller-deployment   1/1     1
1           93s
deployment.apps/mysql                                      1/1     1
1           94s
deployment.apps/notebook-controller-deployment             1/1     1
1           95s
deployment.apps/profiles-deployment                        1/1     1
1           92s
deployment.apps/pytorch-operator                           1/1     1
1           95s
deployment.apps/spartakus-volunteer                        1/1     1
1           94s
deployment.apps/tensorboard                                1/1     1
1           94s
deployment.apps/tf-job-dashboard                           1/1     1
1           94s
deployment.apps/tf-job-operator                            1/1     1
1           94s
deployment.apps/workflow-controller                        1/1     1
1           97s
NAME
DESIRED   CURRENT   READY   AGE
replicaset.apps/admission-webhook-deployment-6b89c84c98              1
1         1       97s
replicaset.apps/argo-ui-5dcf5d8b4f                                  1
1         1       97s
replicaset.apps/centraldashboard-cf4874ddc                           1
1         1       97s
replicaset.apps/jupyter-web-app-deployment-685b455447                1
1         1       97s
replicaset.apps/katib-controller-88c97d85c                           1
1         1       96s
replicaset.apps/katib-db-8598468fd8                                  1
1         1       97s
replicaset.apps/katib-manager-574c8c67f9                             1
1         1       96s
replicaset.apps/katib-manager-rest-778857c989                        1
1         1       96s
replicaset.apps/katib-suggestion-bayesianoptimization-65df4d7455     1
1         1       95s
replicaset.apps/katib-suggestion-grid-56bf69f597                     1
```

```
1         1       95s
replicaset.apps/katib-suggestion-hyperband-7777b76cb9                1
1         1       95s
replicaset.apps/katib-suggestion-nasrl-77f6f9458c                     1
1         1       95s
replicaset.apps/katib-suggestion-random-77b88b5c79                    1
1         1       95s
replicaset.apps/katib-ui-7587c5b967                                   1
1         1       96s
replicaset.apps/metadata-db-5dd459cc                                  1
1         1       96s
replicaset.apps/metadata-deployment-6cf77db994                        3
3         3       96s
replicaset.apps/metadata-ui-78f5b59b56                                1
1         1       96s
replicaset.apps/minio-758b769d67                                      1
1         1       93s
replicaset.apps/ml-pipeline-5875b9db95                                1
1         1       93s
replicaset.apps/ml-pipeline-persistenceagent-9b69ddd46                1
1         1       92s
replicaset.apps/ml-pipeline-scheduledworkflow-7b8d756c76              1
1         1       91s
replicaset.apps/ml-pipeline-ui-79ffd9c76                              1
1         1       91s
replicaset.apps/ml-pipeline-viewer-controller-deployment-5fdc87f58    1
1         1       91s
replicaset.apps/mysql-657f87857d                                      1
1         1       92s
replicaset.apps/notebook-controller-deployment-56b4f59bbf             1
1         1       94s
replicaset.apps/profiles-deployment-6bc745947                         1
1         1       91s
replicaset.apps/pytorch-operator-77c97f4879                           1
1         1       94s
replicaset.apps/spartakus-volunteer-5fdfddb779                        1
1         1       94s
replicaset.apps/tensorboard-6544748d94                                1
1         1       93s
replicaset.apps/tf-job-dashboard-56f79c59dd                           1
1         1       93s
replicaset.apps/tf-job-operator-79cbfd6dbc                            1
1         1       93s
replicaset.apps/workflow-controller-db644d554                         1
1         1       97s
NAME                                                          READY   AGE
```

```
statefulset.apps/admission-webhook-bootstrap-stateful-set   1/1     97s
statefulset.apps/application-controller-stateful-set        1/1     98s
statefulset.apps/metacontroller                             1/1     98s
statefulset.apps/seldon-operator-controller-manager         1/1     92s
$ kubectl get pvc -n kubeflow
NAME             STATUS   VOLUME
CAPACITY   ACCESS MODES   STORAGECLASS               AGE
katib-mysql      Bound    pvc-b07f293e-d028-11e9-9b9d-00505681a82d
10Gi       RWO            ontap-ai-flexvols-retain   27m
metadata-mysql   Bound    pvc-b0f3f032-d028-11e9-9b9d-00505681a82d
10Gi       RWO            ontap-ai-flexvols-retain   27m
minio-pv-claim   Bound    pvc-b22727ee-d028-11e9-9b9d-00505681a82d
20Gi       RWO            ontap-ai-flexvols-retain   27m
mysql-pv-claim   Bound    pvc-b2429afd-d028-11e9-9b9d-00505681a82d
20Gi       RWO            ontap-ai-flexvols-retain   27m
```

4. In your web browser, access the Kubeflow central dashboard by navigating to the URL that you noted down in step 2.

   The default username is `admin@kubeflow.org`, and the default password is `12341234`. To create additional users, follow the instructions in the official Kubeflow documentation.



Next: Example Kubeflow Operations and Tasks.

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