Handson Kubeflow (0)

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Minimum system requirements

The Kubernetes cluster must meet the following minimum requirements:

- Your cluster must include at least one worker node with a minimum of:
  - 4 CPU
  - 50 GB storage
  - 12 GB memory
- The recommended Kubernetes version is 1.14. Kubeflow has been validated and tested on Kubernetes 1.14.
  - Your cluster must run at least Kubernetes version 1.11.
  - Kubeflow **does not work** on Kubernetes 1.16.
  - Older versions of Kubernetes may not be compatible with the latest Kubeflow versions. The following matrix provides information about compatibility between Kubeflow and Kubernetes versions.

Kubernetes Versions	Kubeflow 0.4	Kubeflow 0.5	Kubeflow 0.6	Kubeflow 0.7
1.11	**compatible**	**compatible**	incompatible	incompatible
1.12	**compatible**	**compatible**	incompatible	incompatible
1.13	**compatible**	**compatible**	incompatible	incompatible
1.14	**compatible**	**compatible**	**compatible**	**compatible**
1.15	incompatible	**compatible**	**compatible**	**compatible**
1.16	incompatible	incompatible	incompatible	incompatible

vm on GCP (1)

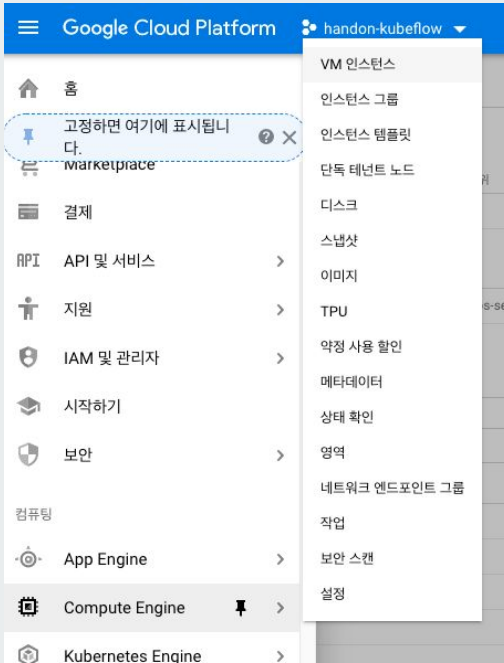
kubeflow가 설치될 kubernetes 환경은 google Cloud의 custom vm에서 microk8s 아니면 kubernetes 1.15버전을 사용합니다.

https://cloud.google.com/

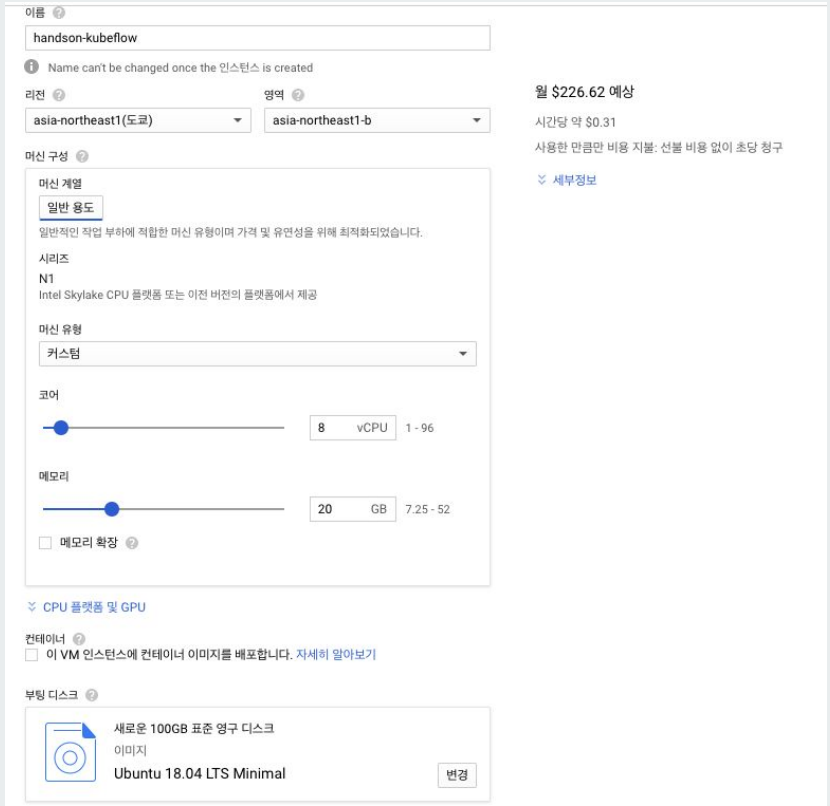
핸즈온용 VM 인스턴스 사양 :
8 CPU
20GB Memory
100gb,
Ubuntu 18.04 minimal

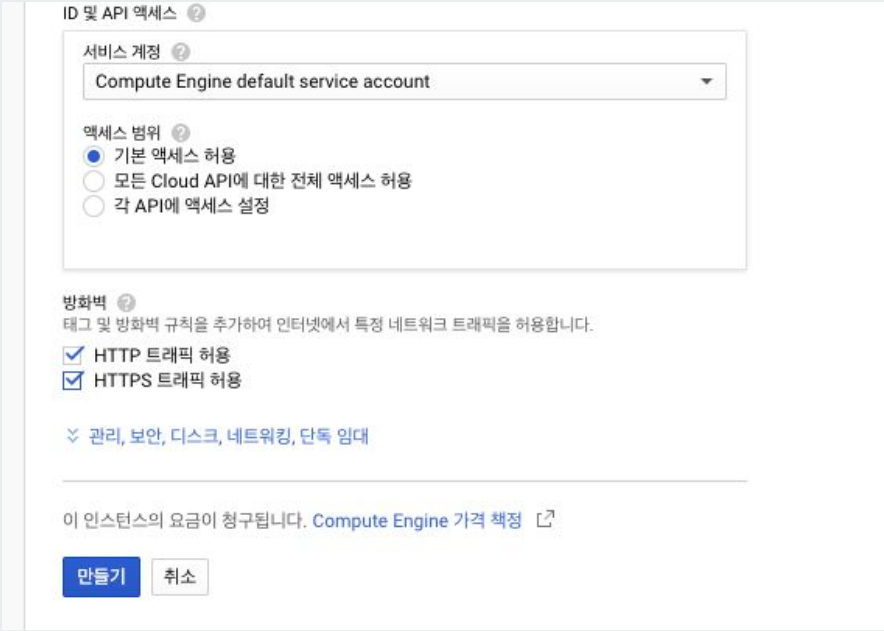
(approx. 0.31$/hour)

핸즈온 끝나시면 꼭 VM 삭제 부탁드립니다..



vm on GCP (2)



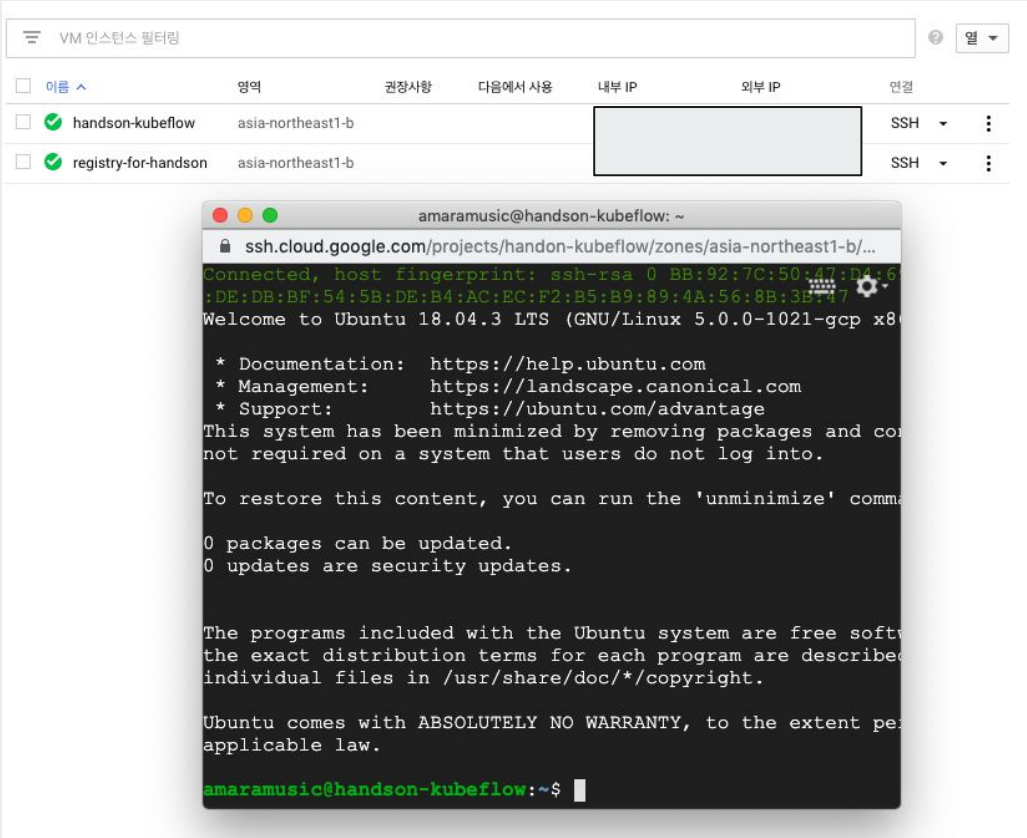


방화벽 설정에서 HTTP/HTTPS 트래픽 허용을 체크!

vm on GCP (3)

생성후 ssh를 눌러 콘솔 창을 엽니다.

vm on GCP (4)


VM 인스턴스 필터링
열
이름
영역
권장사항
다음에서 사용
내부 IP
외부 IP
연결
handson-kubeflow
asia-northeast1-b
SSH
registry-for-handson
asia-northeast1-b
SSH
amaramusic@handson-kubeflow: ~
ssh.cloud.google.com/projects/handon-kubeflow/zones/asia-northeast1-b/...
Connected, host fingerprint: ssh-rsa 0 BB:92:7C:50:47:D4:6
:DE:DB:BF:54:5B:DE:B4:AC:EC:F2:B5:B9:89:4A:56:8B:3B:47
Welcome to Ubuntu 18.04.3 LTS (GNU/Linux 5.0.0-1021-gcp x8
* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage
This system has been minimized by removing packages and co
not required on a system that users do not log into.
To restore this content, you can run the 'unminimize' comma
0 packages can be updated.
0 updates are security updates.
The programs included with the Ubuntu system are free softw
the exact distribution terms for each program are describe
individual files in /usr/share/doc/*/copyright.
Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent pe
applicable law.
amaramusic@handson-kubeflow:~$

microk8s

Install microk8s

```
# in vm
$ sudo apt-get update
$ sudo apt-get install -y git snap vim docker.io
$ sudo gpasswd -a $USER docker | newgrp docker
$ sudo snap install microk8s --classic --channel=1.13/stable
$ sudo usermod -a -G microk8s ${USER}

# re login
# add alias to profile
alias k=microk8s.kubectl
alias kubectl=microk8s.kubectl
$ k get no
$ sudo microk8s.kubectl config view --raw > $HOME/.kube/config

# for hostpath-provisioner
$ microk8s.enable storage dns
```

1. Deploying Kubeflow on Existing Clusters

by kubernetes 1.15 (1)

```
$ apt-get update
### docker-ce install , 18.09
https://docs.docker.com/install/linux/docker-ce/ubuntu/
$ sudo apt-get install -y apt-transport-https ca-certificates curl gnupg-agent software-properties-common
$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
$ sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"
$ sudo apt-get update
$ sudo apt-get install -y docker-ce=5:18.09.9~3-0~ubuntu-bionic docker-ce-cli=5:18.09.9~3-0~ubuntu-bionic containerd.io vim

######## be root! - experimental…

$ cat > /etc/docker/daemon.json <<EOF
{
  "exec-opts": ["native.cgroupdriver=systemd"],
  "log-driver": "json-file",
  "log-opts": {
    "max-size": "100m"
  },
  "storage-driver": "overlay2"
}
EOF
$ mkdir -p /etc/systemd/system/docker.service.d
$ systemctl daemon-reload
$ systemctl restart docker
```

1. Deploying Kubeflow on Existing Clusters

by kubernetes 1.15 - nvidiadocker

OPTIONAL:::: install nvidia-driver and install nvidia-docker for gpu -> https://hiseon.me/linux/ubuntu/install_nvidia_driver/ https://jybaek.tistory.com/796

```
$ release="ubuntu"$(lsb_release -sr | sed -e "s/\.//g")
$ sudo apt install sudo gnupg
$ sudo apt-key adv --fetch-keys "http://developer.download.nvidia.com/compute/cuda/repos/"$release"/x86_64/7fa2af80.pub"
$ sudo sh -c 'echo "deb http://developer.download.nvidia.com/compute/cuda/repos/'$release'/x86_64 /" > /etc/apt/sources.list.d/nvidia-cuda.list'
$ sudo sh -c 'echo "deb http://developer.download.nvidia.com/compute/machine-learning/repos/'$release'/x86_64 /" > /etc/apt/sources.list.d/nvidia-machine-learning.list'
$ sudo apt update

$ apt-cache search nvidia
$ sudo apt-get install -y nvidia-XXX
$ sudo apt-get install -y dkms nvidia-modprobe

$ reboot
$ sudo cat /proc/driver/nvidia/version | nvidia-smi

$ curl -s -L https://nvidia.github.io/nvidia-docker/gpgkey | sudo apt-key add -
$ distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
$ curl -s -L https://nvidia.github.io/nvidia-docker/$distribution/nvidia-docker.list | sudo tee /etc/apt/sources.list.d/nvidia-docker.list
$ sudo apt-get update
## if docker 19.03 이후는 https://github.com/NVIDIA/nvidia-docker/tree/master#upgrading-with-nvidia-docker2-deprecated 참조
$ sudo apt-get install -y nvidia-docker2
$ sudo vi /etc/docker/daemon.json
  "default-runtime": "nvidia",
   "runtimes": {
       "nvidia": {
           "path": "/usr/bin/nvidia-container-runtime",
           "runtimeArgs": []
       }
   }
# then reboot docker….
$ sudo docker run --runtime=nvidia --rm nvidia/cuda nvidia-smi
```

1. Deploying Kubeflow on Existing Clusters

by kubernetes 1.15 (2)

install kubernetes
- https://kubernetes.io/docs/setup/production-environment/tools/kubeadm/create-cluster-kubeadm/
- https://vitux.com/install-and-deploy-kubernetes-on-ubuntu/

```
$ curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add
$ sudo apt-add-repository "deb http://apt.kubernetes.io/ kubernetes-xenial main"
$ sudo apt-get install -y kubelet=1.15.5-00 kubeadm=1.15.5-00 kubectl=1.15.5-00
$ sudo apt-mark hold kubelet kubeadm kubectl
$ sudo sysctl net.bridge.bridge-nf-call-iptables=1
$ sudo kubeadm init --pod-network-cidr=192.168.0.0/16
$ mkdir -p $HOME/.kube
$ sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
$ sudo chown $(id -u):$(id -g) $HOME/.kube/config
$ kubectl taint nodes --all node-role.kubernetes.io/master-
$ kubectl apply -f https://docs.projectcalico.org/v3.8/manifests/calico.yaml
```

install storage Class - named local-path
```
$ kubectl apply -f https://raw.githubusercontent.com/rancher/local-path-provisioner/master/deploy/local-path-storage.yaml
```

set default storage class
```
$ kubectl patch storageclass local-path -p '{"metadata": {"annotations":{"storageclass.kubernetes.io/is-default-class":"true"}}}'
```

OPTIONAL: Install nvidia-gpu-plugin, installed nvidia-docker2
```
$ kubectl create -f https://raw.githubusercontent.com/NVIDIA/k8s-device-plugin/1.0.0-beta4/nvidia-device-plugin.yml
```

OPTIONAL : install nfs-client-provisioner, ReadManyWrite를 위해 로컬의 볼륨을 nfs로 설정하여 등록합니다.
https://github.com/helm/charts/tree/master/stable/nfs-client-provisioner#configuration
https://vitux.com/install-nfs-server-and-client-on-ubuntu/

```
mojokb@ubuntu:~$ k get po -n kube-system
NAME                                   READY   STATUS    RESTARTS   AGE
coredns-5c98db65d4-2zbfz               1/1     Running   1          29m
coredns-5c98db65d4-gp2r2               1/1     Running   1          29m
etcd-ubuntu                            1/1     Running   1          29m
kube-apiserver-ubuntu                  1/1     Running   1          28m
kube-controller-manager-ubuntu         1/1     Running   1          28m
kube-flannel-ds-amd64-j72js            1/1     Running   1          29m
kube-proxy-6whpx                       1/1     Running   1          29m
kube-scheduler-ubuntu                  1/1     Running   1          28m
nvidia-device-plugin-daemonset-j67wr   1/1     Running   0          53s
mojokb@ubuntu:~$
```

Deploy kubeflow (1)

https://www.kubeflow.org/docs/started/k8s/overview/#community-maintained

kubeflow는 community maintained 버젼을 사용합니다.
0.7.0이 나왔습니다!
(https://docs.google.com/document/d/13fv-D0m40v1ugE1Pt8kXe0T7xA5MSS1yno3dUK732r8/edit#heading=h.s5sf36exyj4f)

https://github.com/kubeflow/kubeflow/releases/tag/v0.7.0

```
$ wget https://github.com/kubeflow/kubeflow/releases/download/v0.7.0/kfctl_v0.7.0_linux.tar.gz
$ tar -xvf kfctl_v0.7.0_linux.tar.gz
$ sudo mv kfctl /usr/bin
$ export KF_NAME=handson-kubeflow
$ export BASE_DIR=/home/${USER}
$ export KF_DIR=${BASE_DIR}/${KF_NAME}
$ export
CONFIG_URI="https://raw.githubusercontent.com/kubeflow/manifests/v0.7-branch/kfdef/kfctl_k8s_istio.0.7.0.yaml"
```

Deploy kubeflow (2)

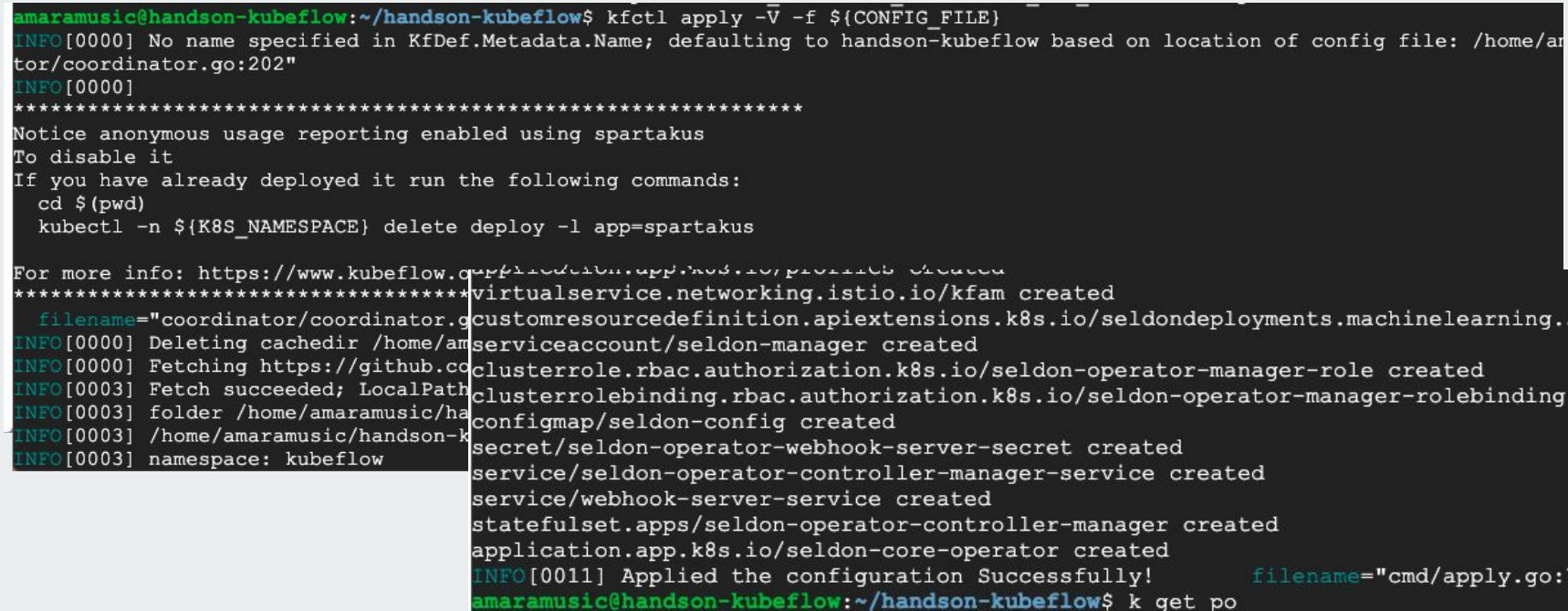
```
$ mkdir -p ${KF_DIR}
$ cd ${KF_DIR}
$ kfctl build -V -f ${CONFIG_URI}
```

```
amaramusic@handson-kubeflow:~/handson-kubeflow$ kfctl build -V -f ${CONFIG_URI}
INFO[0000] Downloading https://raw.githubusercontent.com/kubeflow/manifests/v0.7-branch/kfdef/kfctl_k8s_istio.0.7.0.yam
INFO[0000] Downloading https://raw.githubusercontent.com/kubeflow/manifests/v0.7-branch/kfdef/kfctl_k8s_istio.0.7.0.yam
70"
INFO[0000] App directory /home/amaramusic/handson-kubeflow already exists  filename="coordinator/coordinator.go:274"
INFO[0000] Writing KfDef to kfctl_k8s_istio.0.7.0.yaml   filename="coordinator/coordinator.go:277"
INFO[0000] No name specified in KfDef.Metadata.Name; defaulting to handson-kubeflow based on location of config file: /
rdinator/coordinator.go:202"
INFO[0000]                                                                                                          :340"
************************************************************                                                        :340"
Notice anonymous usage reporting enabled using spartakus                                                            :340"
To disable it                                                                                                       :340"
If you have already deployed it run the following commands:                                                         :340"
  cd $(pwd)                                                                                                         :340"
  kubectl -n ${K8S_NAMESPACE} delete deploy -l app=spartakus                                                        :340"

For more info: https://www.kubeflow.org/docs/other-guides/usage-reporting/                                          :340"
************************************************************                                                        :340"
  filename="coordinator/coordinator.go:120"                                                                         :340"
INFO[0000] Creating directory /home/amaramusic/handson-kubeflow/.cache  filename="kfconfig/types.go:437"            :340"
INFO[0000] Fetching https://github.com/kubeflow/manifests/archive/v0.7-branch.tar.gz to /home/amaramusic/handson-kubefl:340"
INFO[0002] Fetch succeeded; LocalPath /home/amaramusic/handson-kubeflow/.cache/manifests/manifests-0.7-branch  filename
INFO[0002] Processing application: istio-crds                filename="kustomize/kustomize.go:340"                  stomize.go:34
INFO[0002] Processing application: profiles                  filename="kustomize/kustomize.go:340"
INFO[0002] Processing application: seldon-core-operator      filename="kustomize/kustomize.go:340"
amaramusic@handson-kubeflow:~/handson-kubeflow$
```

Deploy kubeflow (3)

$ export CONFIG_FILE=${KF_DIR}/kfctl_k8s_istio.0.7.0.yaml
$ kfctl apply -V -f ${CONFIG_FILE}



1. Deploying Kubeflow on Existing Clusters

Troubleshoot.

설치 도중에 중단되면 istio가 설치된 상태이기 때문에 재 설치를 하게되면 istio가 충돌이 납니다.
istio namespace를 삭제 하고 다시 설치를 진행하시면 됩니다.

```
clusterrbacconfig.rbac.istio.io/default unchanged
WARN[0073] Encountered error during apply:  (kubeflow.error): Code 500 with message: Apply.Run  Error [error when cre
 unable to create new content in namespace kubeflow because it is being terminated, error when creating "/tmp/kout269
reate new content in namespace kubeflow because it is being terminated, error when creating "/tmp/kout269852104": ser
new content in namespace kubeflow because it is being terminated, error when creating "/tmp/kout269852104": serviceen
e new content in namespace kubeflow because it is being terminated, error when creating "/tmp/kout269852104": virtual
ntent in namespace kubeflow because it is being terminated, error when creating "/tmp/kout269852104": virtualservices
ntent in namespace kubeflow because it is being terminated, error when creating "/tmp/kout269852104": virtualservices
mespace kubeflow because it is being terminated]  filename="kustomize/kustomize.go:183"
WARN[0073] Will retry in 17 seconds.                  filename="kustomize/kustomize.go:184"
clusterrole.rbac.authorization.k8s.io/kubeflow-istio-admin configured
clusterrole.rbac.authorization.k8s.io/kubeflow-istio-edit unchanged
clusterrole.rbac.authorization.k8s.io/kubeflow-istio-view unchanged
clusterrbacconfig.rbac.istio.io/default unchanged
WARN[0090] Encountered error during apply:  (kubeflow.error): Code 500 with message: Apply.Run  Error [error when cre
 unable to create new content in namespace kubeflow because it is being terminated, error when creating "/tmp/kout246
reate new content in namespace kubeflow because it is being terminated, error when creating "/tmp/kout246805585": ser
new content in namespace kubeflow because it is being terminated, error when creating "/tmp/kout246805585": serviceen
```

https://github.com/kubeflow/kubeflow/issues/4199#issuecomment-541452810

Deploy kubeflow (4)

$ kubectl get po -n kubeflow

```
amaramusic@handson:~/handson-kubeflow$ k get po -n kubeflow
NAME                                                READY   STATUS    RESTARTS   AGE
admission-webhook-bootstrap-stateful-set-0          0/1     Pending   0          10s
admission-webhook-deployment-78d899bf68-ncsh4       0/1     Pending   0          10s
application-controller-stateful-set-0               0/1     Pending   0          11s
argo-ui-55b859f7d7-tkzp4                            0/1     Pending   0          11s
centraldashboard-75474d6f94-9tgwl                   0/1     Pending   0          10s
jupyter-web-app-deployment-6c8f4c8997-9817c         0/1     Pending   0          10s
katib-controller-7ddd4c8b8c-4zl4d                   0/1     Pending   0          5s
katib-db-7b679f6f8c-g7dtr                           0/1     Pending   0          5s
katib-manager-84c4fb876b-2gxnx                      0/1     Pending   0          5s
katib-ui-5d454c75c7-s454q                           0/1     Pending   0          5s
kfserving-controller-manager-0                      0/2     Pending   0          8s
metadata-db-5dd459cc-zp7th                          0/1     Pending   0          10s
metadata-deployment-b745d8bcf-gp8jt                 0/1     Pending   0          10s
metadata-deployment-b745d8bcf-rscfd                 0/1     Pending   0          10s
metadata-envoy-deployment-7ccf5c4f74-xxmlc          0/1     Pending   0          10s
metadata-grpc-deployment-6496f66c8c-6g2vb           0/1     Pending   0          9s
metadata-grpc-deployment-6496f66c8c-9mld8           0/1     Pending   0          9s
metadata-ui-78f5b59b56-4rvjk                        0/1     Pending   0          9s
minio-6f48db9cc4-hgjxz                              0/1     Pending   0          4s
ml-pipeline-844645fd-w7g27                          0/1     Pending   0          5s
ml-pipeline-ml-pipeline-visualizationserver-865894f5f7-hj7cz   0/1     Pending   0          3s
ml-pipeline-persistenceagent-66f89b56d9-ffm2n       0/1     Pending   0          4s
ml-pipeline-scheduledworkflow-57445ddf88-xtzcw      0/1     Pending   0          3s
ml-pipeline-ui-5c64b6c666-vvw59                     0/1     Pending   0          4s
ml-pipeline-viewer-controller-deployment-7cc8d77468-6j4vg      0/1     Pending   0          3s
mysql-749f87bff5-tgsjf                              0/1     Pending   0          4s
notebook-controller-deployment-6c887454f7-frc4b     0/1     Pending   0          9s
profiles-deployment-bd576fd8f-4b4wf                 0/2     Pending   0          3s
pytorch-operator-84c58df794-wnqw9                   0/1     Pending   0          9s
seldon-operator-controller-manager-0                0/1     Pending   0          6s
spartakus-volunteer-9768df654-ckbxk                 0/1     Pending   0          7s
tensorboard-6544748d94-46hhb                        0/1     Pending   0          6s
tf-job-operator-db676465c-hxcnf                     0/1     Pending   0          6s
workflow-controller-676484d796-gsr4w                0/1     Pending   0          11s
amaramusic@handson:~/handson-kubeflow$
```

```
amaramusic@handson-kubeflow:~/handson-kubeflow$ k get po -n kubeflow
NAME                                                READY   STATUS    RESTARTS   AGE
admission-webhook-bootstrap-stateful-set-0          1/1     Running   0          9m48s
admission-webhook-deployment-78d899bf68-w2bld       1/1     Running   0          8m16s
application-controller-stateful-set-0               1/1     Running   0          9m49s
argo-ui-55b859f7d7-7zhfl                            1/1     Running   0          9m48s
centraldashboard-75474d6f94-fb68r                   1/1     Running   0          9m48s
jupyter-web-app-deployment-6c8f4c8997-22fw8         1/1     Running   0          9m47s
katib-controller-7ddd4c8b8c-9p7jl                   1/1     Running   1          9m43s
katib-db-7b679f6f8c-s2x7r                           1/1     Running   0          9m43s
katib-manager-84c4fb876b-44fxk                      1/1     Running   2          9m43s
katib-ui-5d454c75c7-d5pgk                           1/1     Running   0          9m42s
kfserving-controller-manager-0                      2/2     Running   1          9m45s
metadata-db-5dd459cc-gh8l9                          1/1     Running   0          9m47s
metadata-deployment-b745d8bcf-c7ljj                 1/1     Running   0          9m47s
metadata-deployment-b745d8bcf-hn87w                 1/1     Running   0          9m47s
metadata-envoy-deployment-7ccf5c4f74-7gmzv          1/1     Running   0          9m47s
metadata-grpc-deployment-6496f66c8c-fmwsw           1/1     Running   4          9m47s
metadata-grpc-deployment-6496f66c8c-jbf5s           1/1     Running   4          9m47s
metadata-ui-78f5b59b56-p4fp8                        1/1     Running   0          9m47s
minio-6f48db9cc4-rvbb6                              1/1     Running   0          9m42s
ml-pipeline-844645fd-629zm                          1/1     Running   0          9m42s
ml-pipeline-ml-pipeline-visualizationserver-865894f5f7-2ndt9   1/1     Running   0          9m41s
ml-pipeline-persistenceagent-66f89b56d9-sg5gn       1/1     Running   0          9m42s
ml-pipeline-scheduledworkflow-57445ddf88-pp58r      1/1     Running   0          9m41s
ml-pipeline-ui-5c64b6c666-fwgdb                     1/1     Running   0          9m41s
ml-pipeline-viewer-controller-deployment-7cc8d77468-k25qn      1/1     Running   0          9m41s
mysql-749f87bff5-l8gwg                              1/1     Running   0          9m42s
notebook-controller-deployment-6c887454f7-c2df2     1/1     Running   0          9m46s
profiles-deployment-bd576fd8f-v9bwx                 2/2     Running   0          9m40s
pytorch-operator-84c58df794-jrqfr                   1/1     Running   0          9m46s
seldon-operator-controller-manager-0                1/1     Running   1          9m42s
spartakus-volunteer-9768df654-2jjgg                 1/1     Running   0          9m44s
tensorboard-6544748d94-g2tp6                        1/1     Running   0          9m44s
tf-job-operator-db676465c-s98mm                     1/1     Running   0          9m44s
workflow-controller-676484d796-r9q81                1/1     Running   0          9m48s
amaramusic@handson-kubeflow:~/handson-kubeflow$
```

모든 컨테이너가 다 올라가는데 10분 정도 걸립니다.

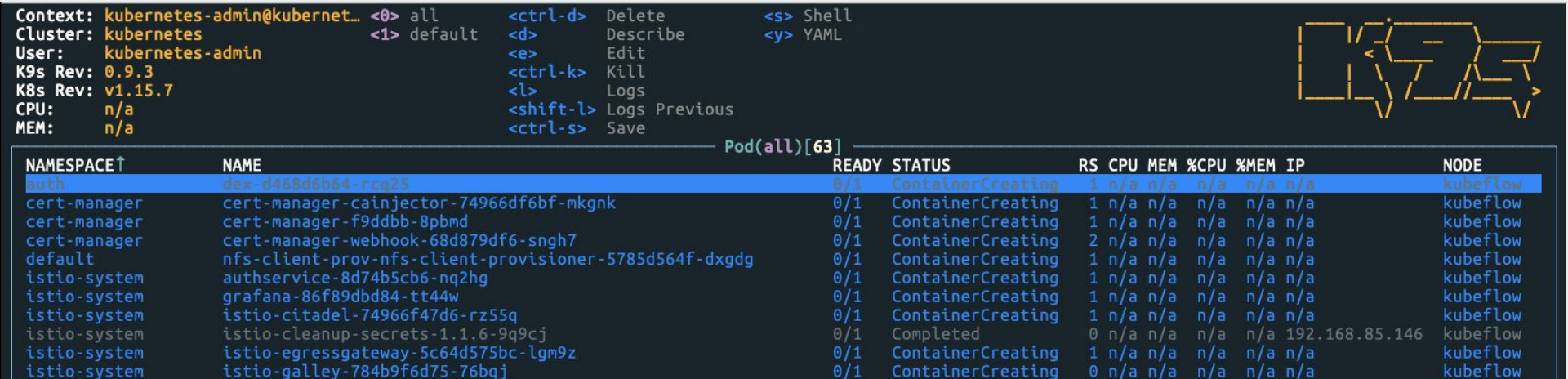
1. Deploying Kubeflow on Existing Clusters

k9s

https://github.com/derailed/k9s

# from release ver.
$ wget https://github.com/derailed/k9s/releases/download/0.9.3/k9s_0.9.3_Linux_x86_64.tar.gz

# from brew
$ brew install derailed/k9s/k9s



Kubeflow Dashboard (1)

# istio에 설치된 ingressgateway port를 확인
$ k get svc -n istio-system

```
istio-galley             ClusterIP   10.101.35.228    <none>        443/TCP,15014/TCP,9901/TCP
                                     42m
istio-ingressgateway     NodePort    10.105.19.36     <none>        15020:30186/TCP,80:31380/TCP,443:31390/TCP,31400:31400/TCP,15029:30580/TCP,15030:32573/
32363/TCP,15032:31217/TCP,15443:30641/TCP   42m
istio-pilot              ClusterIP   10.108.12.33     <none>        15010/TCP,15011/TCP,8080/TCP,15014/TCP
                                     42m
```

(gcp일 경우) 여기서 확인된 31380, 31390을 vm의 네트워크 세부정보 - 방화벽에 추가 해줍니다.

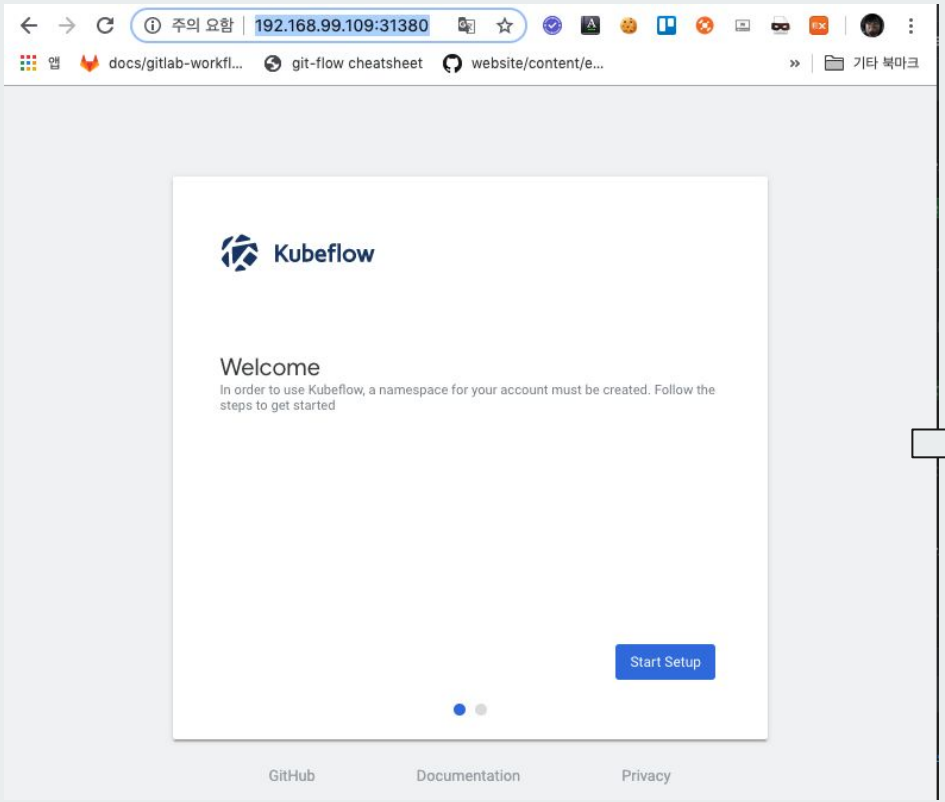
Kubeflow Dashboard (2)

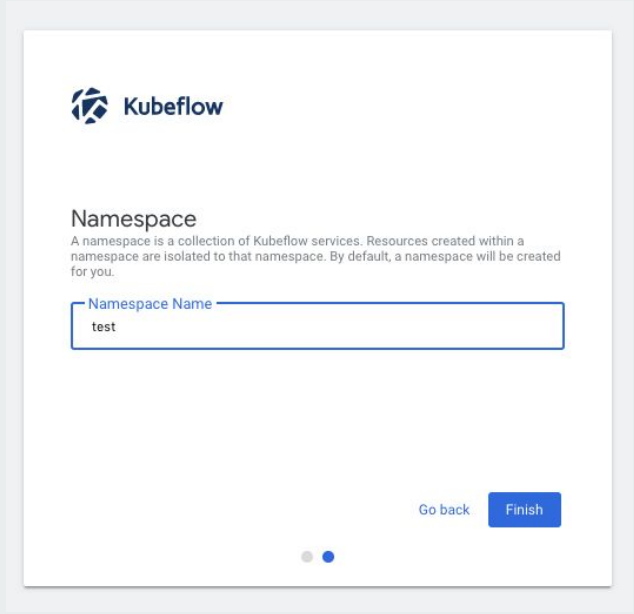
브라우저에서 {vm IP}:31380로 접속하면,

user 생성을 위한 automatic profile creations이 진행됩니다.

여기선 test 로 생성합니다.
(test라는 namespace 와 profile이 생성됩니다.)

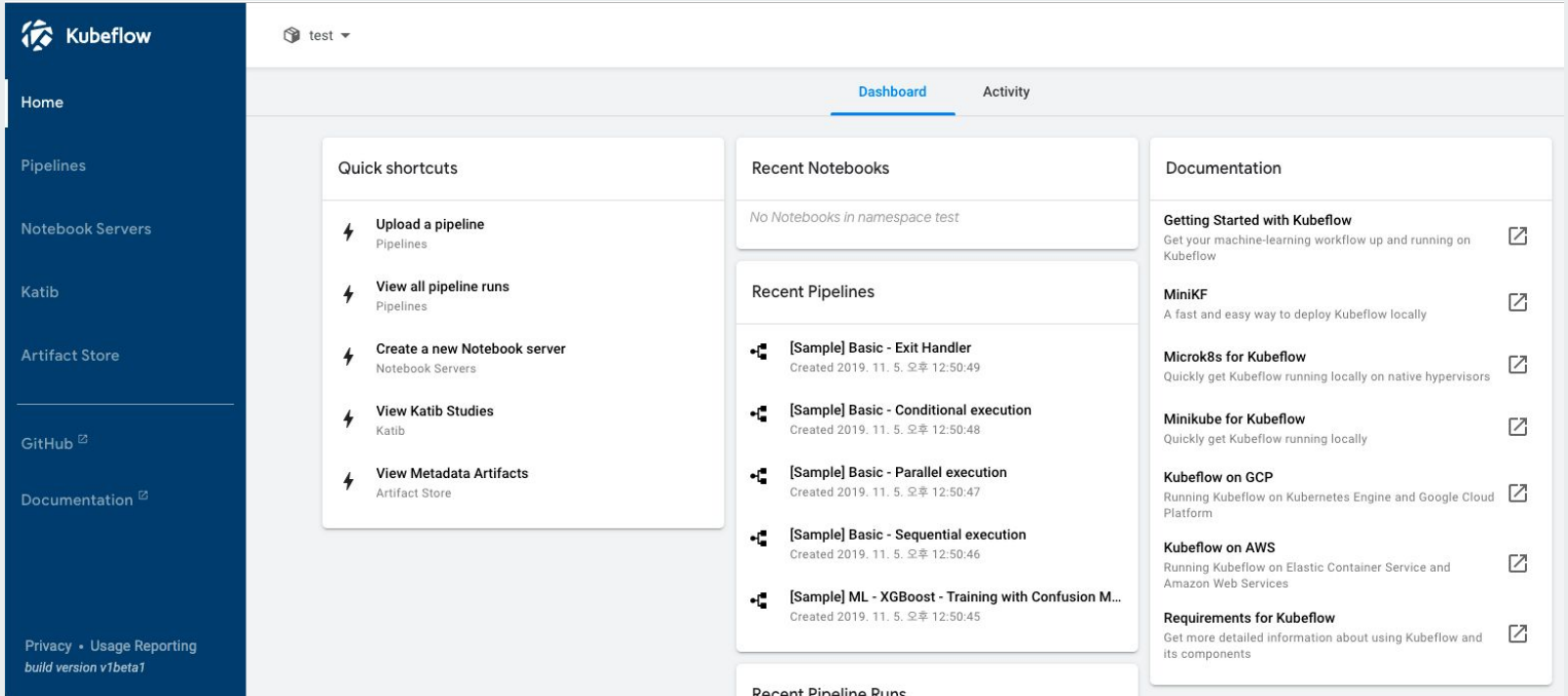
Kubeflow Dashboard (3)





Kubeflow Dashboard (4)

profile을 정의 하고 나면 대쉬보드를 확인 하실 수 있습니다!



Container Registry for kubeflow (1)

Local registry in kubernetes

쿠버네티스에서 local registry를 deploy하는 방법입니다.
kubernetest svc가 제공하는 domain을 레지스트리 도메인으로 사용합니다.

https://github.com/mojokb/handson-kubeflow/blob/master/registry/kubeflow-registry-deploy.yaml
https://github.com/mojokb/handson-kubeflow/blob/master/registry/kubeflow-registry-svc.yaml

registry url : kubeflow-registry.default.svc.cluster.local:30000

클러스터 호스트에서 lookup 될 수 있게 /etc/hosts 에서도 추가해 줍니다.

```
127.0.0.1 localhost kubeflow-registry.default.svc.cluster.local
```

Container Registry for kubeflow (2)

External registry

공인인증서가 적용된 registry가 있다면 사용하시면 되고, docker-hub를 사용하셔도 좋습니다!
레지스트리를 사용하기 위해서 만드신 프로필의 서비스어카운트에 imagePullSecrets 정보를 등록합니다.
여기선 예제로 registry.zipsacoding.com * 을 사용합니다.

```
# in cluster
$ docker login registry.zipsacoding.com

$ kubectl create secret generic regcred --from-file=.dockerconfigjson=/home/amaramusic/.docker/config.json \
--type=kubernetes.io/dockerconfigjson -n test

$ kubectl patch serviceaccount default -p '{"imagePullSecrets": [{"name": "regcred"}]}' -n test
$ kubectl patch serviceaccount default-editor -p '{"imagePullSecrets": [{"name": "regcred"}]}' -n test
$ kubectl patch serviceaccount default-viewer -p '{"imagePullSecrets": [{"name": "regcred"}]}' -n test
```

또한 노트북에서 .docker/config.json 파일도 생성해줍니다. (Notebook 생성 후 작업)
config.json 의 내용을 노트북의 /home/jovyan/.docker/config.json 로 옮겨줍니다.

* registry.zipsacoding.com : handson을 위해 만든 프라이빗 레지스트리입니다 .

More questions? Let’s talk!

kubeflow.slack.com#kubeflow-korea-chat