
CSCI 5409 - CLOUD COMPUTING

KUBERNETES ASSIGNMENT

STEPS FOR INITIAL SETUP

- **Create and Execute a terraform file that provisions a Google Kubernetes Engine Cluster on GCP by running the following commands**

terraform init (initialises the terraform backend)

terraform apply (applies the terraform plan)

terraform destroy (to delete the cluster for cleanup)

- **Create and Execute the deployment, persistent volume claim and load balancer service YAML file for setting up the containers inside the newly provisioned GKE cluster**

kubectl apply -f k8s-pvc.yaml (creates the persistent volume)

kubectl apply -f k8s-deployment.yaml (creates the pod and claims the persistent volume)

kubectl apply -f k8s-service.yaml (creates the load balancer service)

- **This sets up the Kubernetes cluster and starts the container within it**
-

TERRAFORM FILE

create-gke.tf(Deleted) ×

k8s-deployment.yaml(Deleted)

app.py(Deleted)

calculateAPI.py(Deleted)

cloudbuild.yaml(Deleted) .../k8s-container-1

cloudbuild



create-gke.tf

```
1 terraform {
2     required_providers {
3         google = {
4             source = "hashicorp/google"
5             version = "3.81.0"
6         }
7     }
8 }
9 provider "google" {
10     credentials = file("/home/ishansharma1320/csci-5409-s23-f8c4f33c3999.json")
11     project      = "csci-5409-s23"
12     region       = "us-central1"
13 }
14 resource "google_container_cluster" "primary" {
15     name          = "k8s-assignment-gke"
16     location       = "us-central1"
17     remove_default_node_pool = true
18     initial_node_count = 1
19 }
20 resource "google_container_node_pool" "k8s-node-pool" {
21     name          = "k8s-assignment-node-pool"
22     cluster       = google_container_cluster.primary.name
23     location       = google_container_cluster.primary.location
24     node_count     = 1
25
26     node_config {
27         machine_type = "e2-micro"
28         disk_size_gb = 10
29         disk_type     = "pd-standard"
30         image_type     = "COS_CONTAINERD"
31     }
32 }
33 output "cluster_endpoint" {
34     value = google_container_cluster.primary.endpoint
35 }
```

K8S PV FILE

(Deleted) .../k8s-container-1

cloudbuild.yaml(Deleted) .../k8s-container-2

k8s-service.yaml(Deleted)

k8s-pvc.yaml(Deleted) X



k8s-pvc.yaml

```
1  apiVersion: v1
2  kind: PersistentVolumeClaim
3  metadata:
4    name: k8s-pvc
5  spec:
6    accessModes:
7      - ReadWriteOnce
8    resources:
9      requests:
10       storage: 1Gi
```

cloudbuild.yaml(Deleted) .../k8s-container-2

K8S DEPLOYMENT FILE

k8s-deployment.yaml

```
1  apiVersion: apps/v1
2  kind: Deployment
3  metadata:
4    | name: k8s-assignment-deployment
5  spec:
6    selector:
7      matchLabels:
8        | app: k8s
9    template:
10     metadata:
11       labels:
12         | app: k8s
13     spec:
14       volumes:
15         - name: k8s-shared-volume
16           persistentVolumeClaim:
17             | claimName: k8s-pvc
18       containers:
19         - name: container-1
20           image: us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-1
21           ports:
22             - containerPort: 6000
23           volumeMounts:
24             - name: k8s-shared-volume
25               | mountPath: /usr/files/
26         - name: container-2
27           image: us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2
28           ports:
29             - containerPort: 7000
30           volumeMounts:
31             - name: k8s-shared-volume
32               | mountPath: /usr/files/
33
```

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: k8s-assignment-deployment
spec:
  selector:
    matchLabels:
      app: k8s
  template:
    metadata:
      labels:
        app: k8s
    spec:
      volumes:
        - name: k8s-shared-volume
          persistentVolumeClaim:
            claimName: k8s-pvc
      containers:
        - name: container-1
          image: us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-1
          ports:
            - containerPort: 6000
          volumeMounts:
            - name: k8s-shared-volume
              mountPath: /usr/files/
        - name: container-2
          image: us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2
          ports:
            - containerPort: 7000
          volumeMounts:
            - name: k8s-shared-volume
              mountPath: /usr/files/
```

K8S SERVICE FILE

ed) .../k8s-container-1

cloudbuild.yaml(Deleted) .../k8s-container-2

k8s-service.yaml(Deleted) ×

k8s-pvc.yaml(Deleted)



k8s-service.yaml

```
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: k8s-lb-service
5  spec:
6    type: LoadBalancer
7    selector:
8      app: k8s
9    ports:
10     - protocol: TCP
11       port: 80
12       targetPort: 6000
13     name: http
```

apiVersion: v1
kind: Service
metadata:
 name: k8s-lb-service
spec:
 type: LoadBalancer
 selector:
 app: k8s
 ports:
 - protocol: TCP
 port: 80
 targetPort: 6000
 name: http

CI/CD PIPELINE FOR FUTURE UPDATES

➤ **The CI/CD Pipeline is built for each container using a combination of the following:**

- 1. GCP Cloud Source Repository**
- 2. GCP Cloud Build**
- 3. GCP Artifact Registry**

➤ **The pipeline gets triggered when a push is made to the main branch and contains the following steps:**

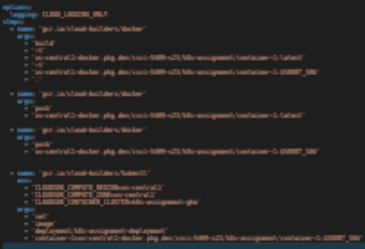
- 1. Builds the image with a unique SHORT_SHA (environment variable) and “latest” tags**
 - 2. Pushes the image to GCP Artifact Registry with both tags**
 - 3. Updates the newly built image in Kubernetes given the name of the deployment and the container name reference**
-

CLOUD BUILD FOR CONTAINER 1



k8s-container-1 > cloudbuild.yaml

```
1  options:
2    logging: CLOUD_LOGGING_ONLY
3  steps:
4    - name: 'gcr.io/cloud-builders/docker'
5      args:
6        - 'build'
7        - '-t'
8        - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-1:latest'
9        - '-t'
10       - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-1:$SHORT_SHA'
11       - '.'
12
13     - name: 'gcr.io/cloud-builders/docker'
14       args:
15         - 'push'
16         - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-1:latest'
17
18     - name: 'gcr.io/cloud-builders/docker'
19       args:
20         - 'push'
21         - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-1:$SHORT_SHA'
22
23
24     - name: 'gcr.io/cloud-builders/kubectl'
25       env:
26         - 'CLOUDSDK_COMPUTE_REGION=us-central1'
27         - 'CLOUDSDK_COMPUTE_ZONE=us-central1'
28         - 'CLOUDSDK_CONTAINER_CLUSTER=k8s-assignment-gke'
29       args:
30         - 'set'
31         - 'image'
32         - 'deployment/k8s-assignment-deployment'
33         - 'container-1=us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-1:$SHORT_SHA'
34
```



CLOUD BUILD FOR CONTAINER 2

ks-deployment.yaml(Deleted)

app.py(Deleted)

calculateAPI.py(Deleted)

cloudbuild.yaml(Deleted) .../k8s-container-1

cloudbuild.yaml(Deleted) .../k8s-container-2



k8s-container-2 > cloudbuild.yaml

```
1  options:
2    logging: CLOUD_LOGGING_ONLY
3  steps:
4    - name: 'gcr.io/cloud-builders/docker'
5      args:
6        - 'build'
7        - '-t'
8        - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:latest'
9        - '-t'
10       - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:$SHORT_SHA'
11       - '.'
12
13    - name: 'gcr.io/cloud-builders/docker'
14      args:
15        - 'push'
16        - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:latest'
17
18    - name: 'gcr.io/cloud-builders/docker'
19      args:
20        - 'push'
21        - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:$SHORT_SHA'
22
23
24    - name: 'gcr.io/cloud-builders/kubectl'
25      env:
26        - 'CLOUDSDK_COMPUTE_REGION=us-central1'
27        - 'CLOUDSDK_COMPUTE_ZONE=us-central1'
28        - 'CLOUDSDK_CONTAINER_CLUSTER=k8s-assignment-gke'
29      args:
30        - 'set'
31        - 'image'
32        - 'deployment/k8s-assignment-deployment'
33        - 'container-2=us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:$SHORT_SHA'
```

```
cloudbuild.yaml
# Build configuration for the k8s-assignment-deployment
name: 'k8s-assignment-deployment'
steps:
  # Build the Docker image
  - name: 'gcr.io/cloud-builders/docker'
    args:
      - 'build'
      - '-t'
      - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:latest'
      - '-t'
      - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:$SHORT_SHA'
      - '.'
    id: 'build'

  # Push the Docker image to the registry
  - name: 'gcr.io/cloud-builders/docker'
    args:
      - 'push'
      - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:latest'
    id: 'push-latest'

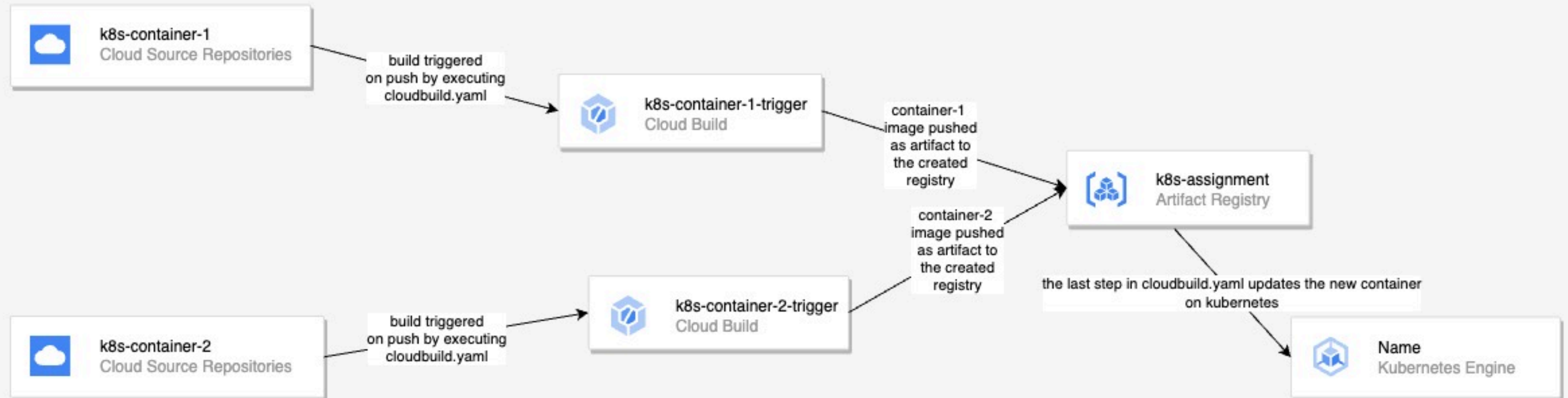
  - name: 'gcr.io/cloud-builders/docker'
    args:
      - 'push'
      - 'us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:$SHORT_SHA'
    id: 'push-sha'

  # Deploy the image to the Kubernetes cluster
  - name: 'gcr.io/cloud-builders/kubectl'
    env:
      - 'CLOUDSDK_COMPUTE_REGION=us-central1'
      - 'CLOUDSDK_COMPUTE_ZONE=us-central1'
      - 'CLOUDSDK_CONTAINER_CLUSTER=k8s-assignment-gke'
    args:
      - 'set'
      - 'image'
      - 'deployment/k8s-assignment-deployment'
      - 'container-2=us-central1-docker.pkg.dev/csci-5409-s23/k8s-assignment/container-2:$SHORT_SHA'
    id: 'deploy'
```

CI/CD PIPELINE

CI/CD Pipeline

 Google Cloud Platform



LIVE DEMO
