

# HW9 - David Euijoon Kim - GKE (Google Kubernetes Engine)

<https://github.com/dk-davidekim/Google-Cloud-Computing.git>

## 1. Code - app\_one.py

```
BU > DS561 > Google-Cloud-Computing > hw9 > Dockerfile > ...
1 from flask import Flask, request
2 from google.cloud import storage, logging, pubsub_v1
3
4 app = Flask(__name__)
5
6 BANNED_COUNTRIES = ["North Korea", "Iran", "Cuba", "Myanmar",
7                     "Iraq", "Libya", "Syria", "Zimbabwe", "Yemen"]
8
9 @app.route('/', defaults={'path': ''}, methods=['GET', 'POST', 'PUT', 'DELETE', 'HEAD', 'CONNECT', 'OPTIONS', 'TRACE', 'PATCH'])
10 @app.route('/<path:filename>', methods=['GET', 'POST', 'PUT', 'DELETE', 'HEAD', 'CONNECT', 'OPTIONS', 'TRACE', 'PATCH'])
11 def app_one(filename):
12     logging_client = logging.Client(project='ds-561')
13     logger = logging.Client.logger(logger)
14     pub = pubsub_v1.PublisherClient()
15     path = pub.topic_path('ds-561', 'hw9')
16
17     if request.method == 'GET':
18         country = request.headers.get("X-country", "")
19
20         if country in BANNED_COUNTRIES:
21             try:
22                 data = str(("400 Forbidden from country: " + country))
23                 future = pub.publish(path, data.encode("utf-8"))
24                 message_id = future.result()
25                 logger.log_text("Message published with ID: " + str(message_id))
26             except Exception as e:
27                 logger.log_text("Publish Notification Failed: " + str(e))
28                 logger.log_text("Error Code 400: Forbidden: " + str(country))
29                 return "Permission Denied", 400
30         else:
31             try:
32                 filename = filename.replace("bu-ds561-d098-bucket/", "")
33                 storage_client = storage.Client()
34                 bucket = storage_client.bucket("bu-ds561-d098-bucket")
35                 blob = bucket.blob(filename)
36                 file_content = blob.download_as_text()
37                 logger.log_text("200: " + filename)
38                 return file_content, 200
39             except Exception as e:
40                 logger.log_text("Error Code 404: " + filename + str(e))
41                 return "File Not Found", 404
42         else:
43             logger.log_text("Error Code 501: " + request.method)
44             return "Not implemented", 501
45
46 if __name__ == "__main__":
47     app.run(host='0.0.0.0', port=8080)
```

## 2. Create Dockerfile

- Create a file named 'Dockerfile' in the same directory as 'app\_one.py'

```
BU > DS561 > Google-Cloud-Computing > hw9 > Dockerfile > ...
1 # Use an official Python runtime as a base image
2 FROM python:3.9-slim-buster
3
4 # Set the working directory in the container
5 WORKDIR /usr/src/app
6
7 # Copy the current directory contents into the container at /usr/src/app
8 COPY . .
9
10 # Install any needed packages specified in requirements.txt
11 RUN pip install --no-cache-dir -r requirements.txt
12
13 # Make port 8080 available to the world outside this container
14 EXPOSE 8080
15
16 # Define environment variable
17 ENV NAME World
18
19 # Run app.py when the container launches
20 CMD ["python", "app_one.py"]
```

### 3. Create requirements.txt

```
app_one.py U http-client.py U requirements.txt U X
BU > DS561 > Google-Cloud-Computing > hw9 > requirements.txt
1  Flask==2.2.5
2  google-cloud-storage==2.11.0
3  google-cloud-pubsub==2.18.4
4  google-cloud-logging==3.8.0
```

### 4. Directory Setup

```

└─ hw9
   ├── app_one.py
   ├── app_two.py
   ├── Dockerfile
   ├── http-client.py
   └── requirements.txt
```

### 5. Enable API

- Cloud Build
- Kubernetes Engine

### 6. Build and Push the Docker Image

1. Submit a Build - Directory containing the Dockerfile
  - a. `gcloud builds submit --tag gcr.io/[PROJECT-ID]/[IMAGE]:[TAG]`
    - i. `gcloud builds submit --tag gcr.io/ds-561/appone:1.0.0`

```
DONE
-----
ID              IMAGES                                     CREATE_TIME   STATUS   DURATION   SOURCE
f7f91a9f-ce0d-457a-8334-30a308b16824  2023-11-23T22:03:21+00:00  34S         gs://ds-561_cloudbuild/source/1700777000.36185-cbfa173732e44ee693
53ac7f3af39b4a.tgz  gcr.io/ds-561/appone:1.0.0  SUCCESS
```

## 2. Verify the Image in GCR

- a. `gcloud container images list --repository=gcr.io/[PROJECT-ID]`
  - i. `gcloud container images list --repository=gcr.io/ds-561`

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (1.767s)
gcloud container images list --repository=gcr.io/ds-561
NAME
gcr.io/ds-561/appone
```

The screenshot shows the Google Cloud Build console for project 'DS 561'. The left sidebar contains navigation links: Cloud Build, Dashboard, History (selected), Repositories, and Triggers. The main area displays the 'Build history' section with a 'STOP STREAMING BUILDS' button. A dropdown menu shows the 'Region' as 'global (non-regional)'. Below this is a table of build history entries. The first entry is highlighted, showing a successful build with status 'SUCCEEDED', build ID 'f7f91a9f', source 'Google Cloud Storage', and a duration of 33 seconds. The 'Security Insig' column has a 'VIEW' link.

Status	Build	Source	Ref	Commit	Trigger Name	Created	Duration	Security Insig
SUCCEEDED	f7f91a9f	Google Cloud Storage	-	-	-	11/23/23, 5:03 PM	33 sec	<a href="#">VIEW</a>

## 7. Create a GKE Cluster

### 1. Create cluster

*(Two ways of adding service account >> a. Workload Identity or b. Node Service Account)  
I tried Workload Identity and couldn't get it to work, so I used Node Service Account.*

- a. `gcloud container clusters create [CLUSTER_NAME] \`  
`--num-nodes=[NUMBER OF NODES] \`  
`--zone [ZONE] \`  
`--workload-pool=[PROJECT_ID].svc.id.goog`
  - i. `gcloud container clusters create hw9-cluster \`  
`--num-nodes=2 \`  
`--zone us-east1-b \`  
`--workload-pool=ds-561.svc.id.goog`
- b. `gcloud container clusters create [CLUSTER_NAME] \`  
`--service-account [SERVICE_ACCOUNT_EMAIL] \ --zone [ZONE]`
  - i. `gcloud container clusters create hw9-cluster \`  
`--service-account bu-ds561-dk98-sa@ds-561.iam.gserviceaccount.com \`  
`--num-nodes=2 \`  
`--zone us-east1-b`

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (6m 30.31s)
gcloud container clusters create hw9-cluster \
--num-nodes=2 \
--zone us-east1-b \
--workload-pool=ds-561.svc.id.goog

Default change: VPC-native is the default mode during cluster creation for versions greater than 1.21.0-gke.1500. To create advanced routes
based clusters, please pass the '--no-enable-ip-alias' flag
Default change: During creation of nodepools or autoscaling configuration changes for cluster versions greater than 1.24.1-gke.800 a default
location policy is applied. For Spot and PVM it defaults to ANY, and for all other VM kinds a BALANCED policy is used. To change the default
t values use the '--location-policy' flag.
Note: Your Pod address range ('--cluster-ipv4-cidr') can accommodate at most 1008 node(s).
Creating cluster hw9-cluster in us-east1-b... Cluster is being health-checked (master is healthy)...done.
Created [https://container.googleapis.com/v1/projects/ds-561/zones/us-east1-b/clusters/hw9-cluster].
To inspect the contents of your cluster, go to: https://console.cloud.google.com/kubernetes/workload/_gcloud/us-east1-b/hw9-cluster?project=
ds-561
kubeconfig entry generated for hw9-cluster.
NAME      LOCATION  MASTER_VERSION  MASTER_IP      MACHINE_TYPE  NODE_VERSION  NUM_NODES  STATUS
hw9-cluster  us-east1-b  1.27.3-gke.100  34.148.219.108  e2-medium     1.27.3-gke.100  2          RUNNING
```

2. Authenticate kubectl with the cluster
- a. gcloud container clusters get-credentials "hw9-cluster" --zone "us-east1-b"

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.855s)
gcloud container clusters get-credentials "hw9-cluster" --zone "us-east1-b"

Fetching cluster endpoint and auth data.
kubeconfig entry generated for hw9-cluster.
```

OVERVIEW   OBSERVABILITY   COST OPTIMIZATION

Filter   Enter property name or value   ?

<input type="checkbox"/>	Status	Name ↑	Location	Number of nodes	Total vCPUs	Total memory
<input type="checkbox"/>	✓	<a href="#">hw9-cluster</a>	us-east1-b	2	4	8 GB

VM instances

Filter   Enter property name or value   ?

<input type="checkbox"/>	Status	Name ↑	Zone	Recommendations	In use by	Internal IP	Connect
<input type="checkbox"/>	✓	<a href="#">gke-hw9-cluster-default-pool-9c2fa3b6-fxw7</a>	us-east1-b		<a href="#">gke-hw...</a> ▼	10.142.0.56 ( <a href="#">nic0</a> )	SSH ▼
<input type="checkbox"/>	✓	<a href="#">gke-hw9-cluster-default-pool-9c2fa3b6-tjcw</a>	us-east1-b		<a href="#">gke-hw...</a> ▼	10.142.0.55 ( <a href="#">nic0</a> )	SSH ▼

## 8. kubectl Command Pre-Req. for Local Usage

1. Install gke-gcloud-auth-plugin to use kubectl locally
  - a. gcloud components install gke-gcloud-auth-plugin

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.251s)
gke-gcloud-auth-plugin --version

Kubernetes v1.28.0-alpha+918af8f95e54adc06c7f33df3ab7c68bd24fc278
```

## 9. Kubernetes Security

\* ENSURE YOUR SERVICE ACCOUNT HAS THE RIGHT PERMISSIONS

1. Create a Kubernetes Service Account in Cluster
  - a. `kubectl create serviceaccount [KSA_NAME] --namespace [NAMESPACE]`
    - i. `kubectl create serviceaccount dk98-ksa`
2. Link KSA to GCloud Service Account
  - a. `kubectl annotate serviceaccount [KSA_NAME] \`  
`--namespace [NAMESPACE] \`  
`iam.gke.io/gcp-service-account=[GSA_NAME]@[PROJECT_ID].iam.gserviceaccount.com`
    - i. `kubectl annotate serviceaccount dk98-ksa \`  
`--namespace default \`  
`iam.gke.io/gcp-service-account=bu-ds561-dk98-sa@ds-561.iam.gserviceaccount.com`

```
dk98@cloudshell:~ (ds-561) $ kubectl create serviceaccount dk98-ksa
serviceaccount/dk98-ksa created
```

```
dk98@cloudshell:~ (ds-561) $ kubectl annotate serviceaccount dk98-ksa \
--namespace default \
iam.gke.io/gcp-service-account=bu-ds561-dk98-sa@ds-561.iam.gserviceaccount.com
serviceaccount/dk98-ksa annotated
```

## 10. Deploy the Image to GKE

## 1. Create a Deployment

- a. `kubectl create deployment [NAME]--image=gcr.io/[PROJECT-ID]/[IMAGE]:[TAG]`
  - i. `kubectl create deployment app-one --image=gcr.io/ds-561/appone:1.0.0`

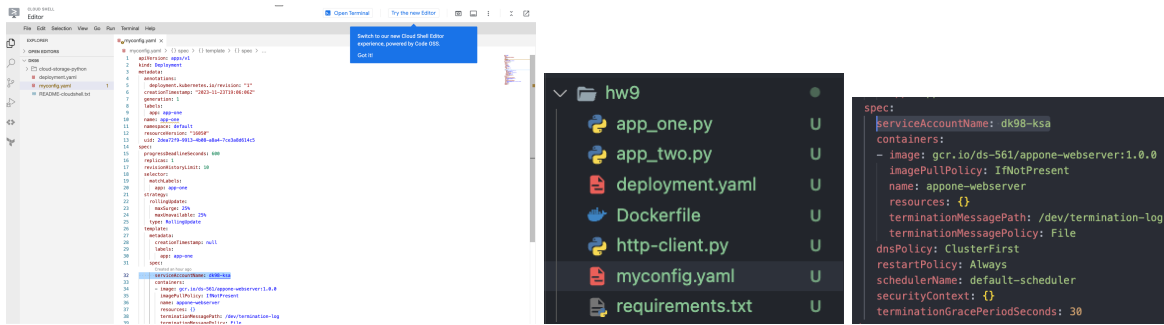
```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.46s)
kubectl create deployment app-one --image=gcr.io/ds-561/appone:1.0.0
deployment.apps/app-one created
```

## 11. Modify Deployment YAML File

### 1. Access myconfig.yaml

- a. `kubectl get deployment DEPLOYMENT_NAME -o yaml > myconfig.yaml`
  - i. `kubectl get deployment app-one -o yaml > myconfig.yaml`

### 2. Edit the myconfig.yaml file >> Add serviceAccountName: [KSA]



### 3. Apply the Updated Deployment

- a. `kubectl apply -f myconfig.yaml`

```
dk98@cloudshell:~ (ds-561) $ kubectl apply -f myconfig.yaml
deployment.apps/app-one configured
```

### 4. Verify the Update

- a. `kubectl get pods`
- b. `kubectl describe pod [POD_NAME]`

## 12. Expose your Deployment

## 1. Expose as a LoadBalancer Service

- a. `kubectl expose deployment [NAME] --type=[TYPE] --port [PORT]`
  - i. `kubectl expose deployment app-one --type=LoadBalancer --port 8080`

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.361s)
kubectl expose deployment app-one --type=LoadBalancer --port 8080
service/app-one exposed
```

## 13. IP Address

### 1. Check the Service

- a. `kubectl get services`

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.304s)
kubectl get services
```

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
app-one	LoadBalancer	10.72.13.217	34.74.73.70	8080:32269/TCP	73s
kubernetes	ClusterIP	10.72.0.1	<none>	443/TCP	42m

### 2. Access Application

- a. External-IP >> 34.74.73.70

## 14. Curl Command

### 1. 200

- a. `curl http://34.74.73.70:8080/hw2_output/1234.html`

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.688s)
curl http://34.74.73.70:8080/hw2_output/1234.html
```

```
<!DOCTYPE html>
<html>
<body>
  Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad
  minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in v
  oluptate velit esse
  cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id es
  t laborum.
<p>
<a HREF="2670.html"> This is a link </a>
```

## 2. 404

a. `curl http://34.74.73.70:8080/hw2_output/12345.html`

```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.541s)
curl http://34.74.73.70:8080/hw2_output/12345.html

File not found
```

## 3. 501

a. `curl -X POST http://34.74.73.70:8080/hw2_output/12345.html`

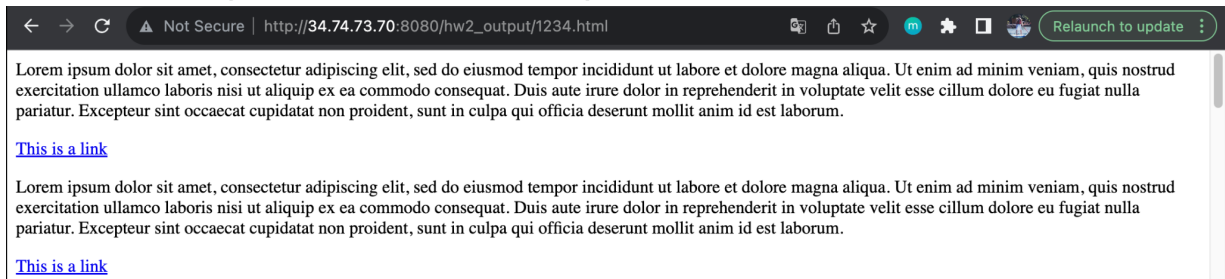
```
~/Desktop/DataScience/BU/DS561/Google-Cloud-Computing/hw9 git:(main) ±1 (0.32s)
curl -X POST http://34.74.73.70:8080/hw2_output/12345.html

Not implemented
```

## 15. Web Browser

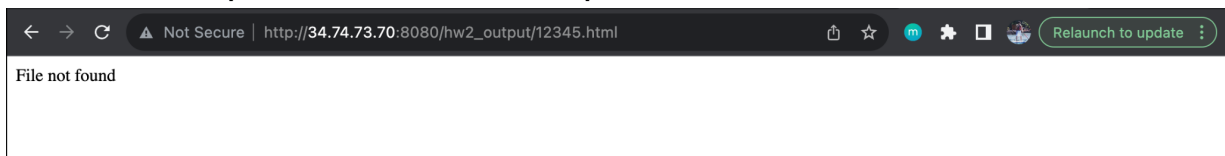
### 1. 200

a. `http://34.74.73.70:8080/hw2_output/1234.html`



### 2. 404

a. `http://34.74.73.70:8080/hw2_output/12345.html`



### 3. 501

a. `fetch('http://34.74.73.70:8080/hw2_output/1234.html', { method: 'POST' })`

```
> fetch('http://34.74.73.70:8080/hw2_output/1234.html',
{ method: 'POST' })
< ▶ Promise {<pending>}

✖ ▶ POST http://34.74.73.70:8080/hw2_output/1 VM43:1
234.html 501 (NOT IMPLEMENTED)
```



## 16. Run app\_two.py on a VM

```

app_one.py v U app_two.py v X requirements.txt v Dockerfile v
BU > DS661 > Google-Cloud-Computing > hw9 > app_two.py > ...
1 from google.cloud import pubsub_v1
2
3 def call_back(message):
4     print("Received message: (message.data.decode('utf-8'))") # Callback if message received
5     message.ack() # Print the message
6
7 sub = pubsub_v1.SubscriberClient() # SubscriberClient
8 path = sub.subscription_path('ds-561', 'app_one_two') # Subscription Path
9
10 future = sub.subscribe(path, call_back=call_back) # Subscribe to the path and callback
11 print("Listening for messages on: {}".format(path)) # Indicating that it's listening
12
13 with sub:
14     try:
15         future.result()
16     except KeyboardInterrupt:
17         future.cancel()

```

1. For VM Configuration >> Refer to HW4
  2. VM SSH - python3 app\_two.py
- ```
dk98@hw4:/home/davidekim$ python3 app_two.py
Listening for messages on: projects/ds-561/subscriptions/app_one_two
□
```

```
dk98@hw4:/home/davidekim$ python3 app_two.py
Listening for messages on: projects/ds-561/subscriptions/app_one_two
```

## 17. Run http-client.py on a VM

[illegible]

1. VM SSH
  - a. `python3 http-client.py -d 34.74.73.70 -b /bu-ds561-dk98-bucket -w hw2_output -n 500 -i 11000 -p 8080 -f`

```
dk98@hw4-2:/home/davidekim$ python3 http-client.py -d 34.74.73.70 -b /bu-ds561-dk98-bucket -w hw2 output -n 500 -i 11000 -p 8080 -f
```

```
^Cdk98@hw4:/home/davidekim$ python3 app_two.py
Listening for messages on: projects/ds-561/subscriptions/app_one_two
Received message: {'400 Forbidden from country': 'Libya'}
Received message: {'400 Forbidden from country': 'North Korea'}
Received message: {'400 Forbidden from country': 'Iran'}
Received message: {'400 Forbidden from country': 'Sudan'}
Received message: {'400 Forbidden from country': 'Syria'}
Received message: {'400 Forbidden from country': 'Iraq'}
Received message: {'400 Forbidden from country': 'Zimbabwe'}
Received message: {'400 Forbidden from country': 'Myanmar'}
Received message: {'400 Forbidden from country': 'Sudan'}
Received message: {'400 Forbidden from country': 'North Korea'}
Received message: {'400 Forbidden from country': 'Zimbabwe'}
Received message: {'400 Forbidden from country': 'Libya'}
Received message: {'400 Forbidden from country': 'Myanmar'}
Received message: {'400 Forbidden from country': 'Cuba'}
Received message: {'400 Forbidden from country': 'Zimbabwe'}
Received message: {'400 Forbidden from country': 'Syria'}
Received message: {'400 Forbidden from country': 'Iraq'}
Received message: {'400 Forbidden from country': 'Libya'}
Received message: {'400 Forbidden from country': 'Iraq'}
Received message: {'400 Forbidden from country': 'Cuba'}
Received message: {'400 Forbidden from country': 'Syria'}
Received message: {'400 Forbidden from country': 'Cuba'}
Received message: {'400 Forbidden from country': 'Zimbabwe'}
Received message: {'400 Forbidden from country': 'Iran'}
Received message: {'400 Forbidden from country': 'Iraq'}
```

## 18. GKE Monitoring

| Google Cloud DS 561 Search ( / ) for resources, docs, products, and more                                                         |        |                      |                    |            |                    |                     |                  |
|----------------------------------------------------------------------------------------------------------------------------------|--------|----------------------|--------------------|------------|--------------------|---------------------|------------------|
| GKE SEND FEEDBACK Auto refresh                                                                                                   |        |                      |                    |            |                    |                     |                  |
| ADD FILTER Cluster: hw9-cluster Namespace: default Pod: app-one-90b97849d-kcmh Container: appone RESET Configure resource tables |        |                      |                    |            |                    |                     |                  |
| Timeline Alerts Info events Warning events Time selection is Nov 23 6:35PM - 7:35PM RESET Time Span 1 hour Refine by status      |        |                      |                    |            |                    |                     |                  |
| Clusters No active alerts 0 clusters with active alerts VIEW ALL                                                                 |        |                      |                    |            |                    |                     |                  |
| Name                                                                                                                             | Alerts | Labels               | Container restarts | Error logs | CPU utilization    | Memory utilization  | Disk utilization |
| hw9-cluster                                                                                                                      | 0      | Location: us-east1-b | 1                  | 821        | 37.6% of 1.08 CPU  | 26.35% of 1.28 GiB  | 0% of 1.98 TiB   |
| Namespaces No active alerts 0 namespaces with active alerts VIEW ALL                                                             |        |                      |                    |            |                    |                     |                  |
| Name                                                                                                                             | Alerts | Labels               | Container restarts | Error logs | CPU utilization    | Memory utilization  | Disk utilization |
| default                                                                                                                          | 0      | Cluster: hw9-cluster | 0                  | 624        | 0 CPU              | 127.35 MiB          | 0% of 2.74 GiB   |
| Nodes No active alerts 0 nodes with active alerts VIEW ALL                                                                       |        |                      |                    |            |                    |                     |                  |
| Name                                                                                                                             | Alerts | Labels               | Container restarts | Error logs | CPU utilization    | Memory utilization  | Disk utilization |
| gke-hw9-cluster-default...                                                                                                       | 0      | Cluster: hw9-cluster | 0                  | 728        | 27.23% of 0.54 CPU | 26.45% of 678.2 MiB | 0% of 880.77 GiB |
| Workloads No active alerts 0 workloads with active alerts VIEW ALL                                                               |        |                      |                    |            |                    |                     |                  |
| Name                                                                                                                             | Alerts | Labels               | Container restarts | Error logs | CPU utilization    | Memory utilization  | Disk utilization |
| app-one                                                                                                                          | 0      | Cluster: hw9-cluster | 0                  | 624        | 0 CPU              | 127.35 MiB          | 0% of 2.74 GiB   |
| Kubernetes services No active alerts 0 kubernetes services with active alerts VIEW ALL                                           |        |                      |                    |            |                    |                     |                  |
| Name                                                                                                                             | Alerts | Labels               | Container restarts | Error logs | CPU utilization    | Memory utilization  | Disk utilization |
| app-one                                                                                                                          | 0      | Cluster: hw9-cluster | 0                  | 624        | 0 CPU              | 127.35 MiB          | 0% of 2.74 GiB   |
| Pods No active alerts 0 pods with active alerts VIEW ALL                                                                         |        |                      |                    |            |                    |                     |                  |
| Name                                                                                                                             | Alerts | Labels               | Container restarts | Error logs | CPU utilization    | Memory utilization  | Disk utilization |
| app-one-90b97849d-k...                                                                                                           | 0      | Cluster: hw9-cluster | 0                  | 619        | 0 CPU              | 127.35 MiB          | 0% of 2.74 GiB   |
| Containers No active alerts 0 containers with active alerts VIEW ALL                                                             |        |                      |                    |            |                    |                     |                  |
| Name                                                                                                                             | Alerts | Labels               | Container restarts | Error logs | CPU utilization    | Memory utilization  | Disk utilization |
| appone                                                                                                                           | 0      | Cluster: hw9-cluster | 0                  | 619        | 0 CPU              | 127.35 MiB          | 0% of 2.74 GiB   |

END