

Lab 4: Introduction to Kubernetes on Google Cloud using GKE Screenshots

Lab Task 1:

This task requires setting up a Google Kubernetes Engine (GKE) environment and deploying a sample application.

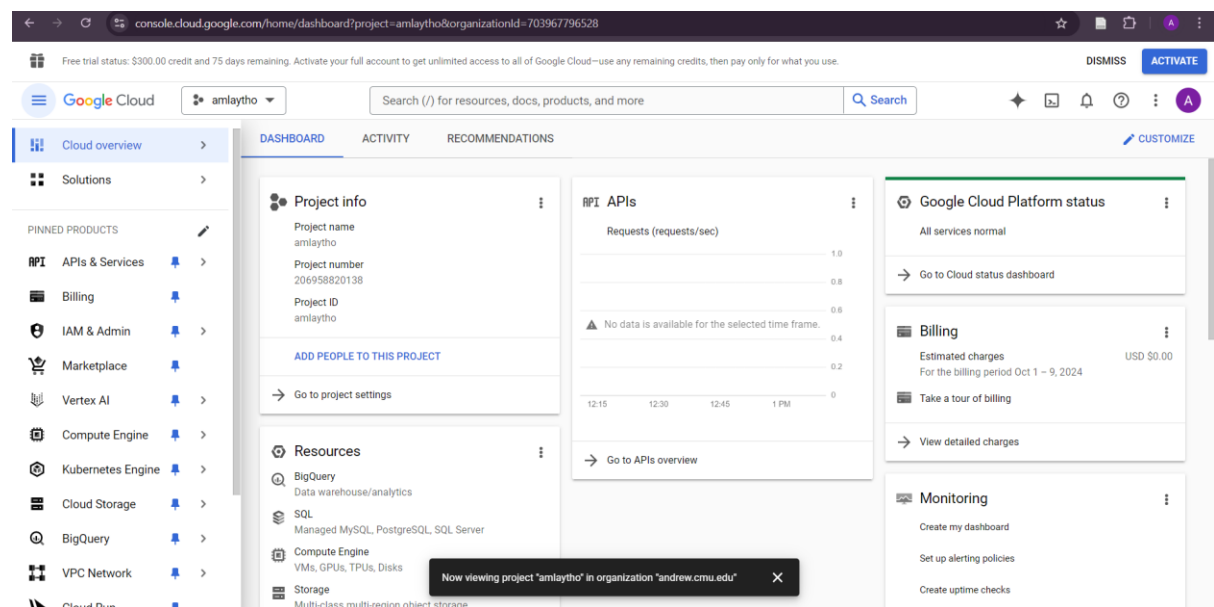


Figure 1: New Project created and saved in the students' folder under Andrew.cmu.edu organization.

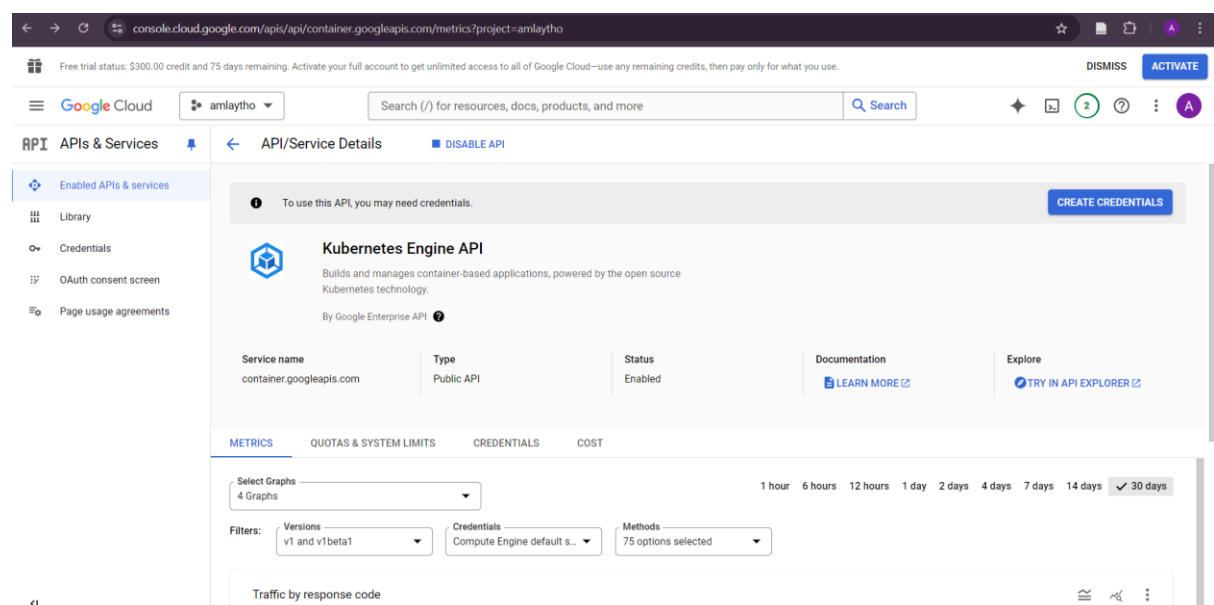


Figure 2: Kubernetes Engine Enabled.

```

Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to amlaytho.
Use "gcloud config set project [PROJECT ID]" to change to a different project.
amlaytho@cloudshell:~ (amlaytho)$ gcloud config set project amlaytho
Updated property [core/project].
amlaytho@cloudshell:~ (amlaytho)$ gcloud container clusters get-credentials model --zone us-west1-a --project amlaytho
Fetching cluster endpoint and auth data.
kubeconfig entry generated for model.
amlaytho@cloudshell:~ (amlaytho)$ kubectl get nodes
NAME                                STATUS    ROLES    AGE   VERSION
gke-node-default-pool-1df51aaa-w5bb Ready    <none>   49m   v1.30.4-gke.1348000
amlaytho@cloudshell:~ (amlaytho)$

```

Figure 3: Node 1 Cluster created successfully.

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl apply -f platform/kube/bookinfo.yaml
service/details created
serviceaccount/bookinfo-details created
deployment.apps/details-v1 created
service/ratings created
serviceaccount/bookinfo-ratings created
deployment.apps/ratings-v1 created
service/reviews created
serviceaccount/bookinfo-reviews created
deployment.apps/reviews-v1 created
deployment.apps/reviews-v2 created
deployment.apps/reviews-v3 created
service/productpage created
serviceaccount/bookinfo-productpage created
deployment.apps/productpage-v1 created

```

Figure 4: Deploying the application using kubectl.

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get service

```

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
details	ClusterIP	34.118.232.170	<none>	9080/TCP	2m30s
kubernetes	ClusterIP	34.118.224.1	<none>	443/TCP	26h
productpage	ClusterIP	34.118.227.175	<none>	9080/TCP	2m23s
ratings	ClusterIP	34.118.232.19	<none>	9080/TCP	2m28s
reviews	ClusterIP	34.118.233.145	<none>	9080/TCP	2m26s

Figure 5: Kubectl services

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl patch svc productpage -p '{"spec": {"type": "LoadBalancer"}}'
service/productpage patched
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get service

```

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
details	ClusterIP	34.118.232.170	<none>	9080/TCP	6m10s
kubernetes	ClusterIP	34.118.224.1	<none>	443/TCP	26h
productpage	LoadBalancer	34.118.227.175	<pending>	9080:32157/TCP	6m3s
ratings	ClusterIP	34.118.232.19	<none>	9080/TCP	6m8s
reviews	ClusterIP	34.118.233.145	<none>	9080/TCP	6m6s

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get service

```

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
details	ClusterIP	34.118.232.170	<none>	9080/TCP	7m30s
kubernetes	ClusterIP	34.118.224.1	<none>	443/TCP	26h
productpage	LoadBalancer	34.118.227.175	34.168.133.160	9080:32157/TCP	7m23s
ratings	ClusterIP	34.118.232.19	<none>	9080/TCP	7m28s
reviews	ClusterIP	34.118.233.145	<none>	9080/TCP	7m26s

Figure 6: Service/Product patched and External IP address obtained.

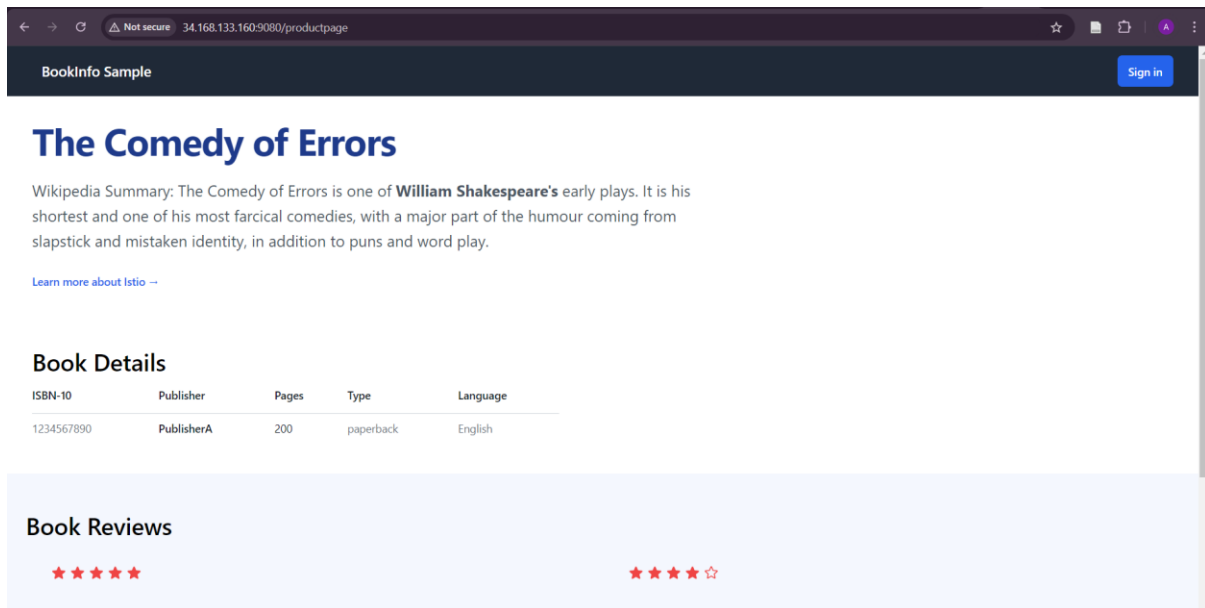


Figure 7: Product Page

Services in Kubernetes are used to group a set of pods and define how to access them. Pods have temporary IP addresses, but services give them a stable endpoint for communication. Services also balance traffic among the pods, so no single pod gets overloaded with requests. There are different types of services, like:

- ClusterIP (the default), which exposes the service only within the cluster, allowing pods to communicate with each other.
- NodePort, which makes the service available externally through a specific port on each node in the cluster.
- LoadBalancer, which provides an external IP address using a cloud provider's load balancer (like Google Cloud's GKE).

Deployments are higher-level Kubernetes objects that manage the pods. They ensure the correct number of pods are always running and allow for smooth updates to the app without any downtime. If your deployment specifies that three copies (replicas) of your app should be running, Kubernetes will make sure that three pods are always active. If one pod stops working, the deployment will automatically create a new one to replace it.

Pods are the smallest units in Kubernetes and run one or more containers that make up your application. Each pod has its own IP address and shares the same network environment. When someone sends a request to the app, Kubernetes routes it to one of the containers inside a pod. Different pods can run different parts of your app, like the frontend, backend, or individual services. Pods aren't meant to last forever. If one pod fails, Kubernetes shuts it down and starts a new one.

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get service
NAME          TYPE          CLUSTER-IP      EXTERNAL-IP      PORT(S)          AGE
details        ClusterIP      34.118.232.170   <none>           9080/TCP         11m
kubernetes     ClusterIP      34.118.224.1     <none>           443/TCP          26h
productpage     LoadBalancer   34.118.227.175   34.168.133.160   9080:32157/TCP   11m
ratings         ClusterIP      34.118.232.19    <none>           9080/TCP         11m
reviews         ClusterIP      34.118.233.145   <none>           9080/TCP         11m
⊗ asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl describe ratings
error: the server doesn't have a resource type "ratings"
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl describe svc ratings
Name:          ratings
Namespace:      default
Labels:         app=ratings
                service=ratings
Annotations:    cloud.google.com/neg: {"ingress":true}
Selector:       app=ratings
Type:           ClusterIP
IP Family Policy: SingleStack
IP Families:    IPv4
IP:             34.118.232.19
IPs:            34.118.232.19
Port:           http 9080/TCP
TargetPort:     9080/TCP
Endpoints:      10.44.0.15:9080
Session Affinity: None
Events:
  Type    Reason  Age   From              Message
  ----    -
  Normal  ADD     14m   sc-gateway-controller  default/ratings_

```

Figure

8: Kubectl get services and describe <services>

```

● asnath@AssynathJr:~/AIops_Labs/istio-master/samples/bookinfo$ kubectl get deployment
NAME          READY   UP-TO-DATE   AVAILABLE   AGE
details-v1    1/1     1             1            18m
productpage-v1 1/1     1             1            18m
ratings-v1     1/1     1             1            18m
reviews-v1     1/1     1             1            18m
reviews-v2     1/1     1             1            18m
reviews-v3     1/1     1             1            18m
● asnath@AssynathJr:~/AIops_Labs/istio-master/samples/bookinfo$ kubectl describe deployment ratings-v1
Name:          ratings-v1
Namespace:     default
CreationTimestamp: Thu, 10 Oct 2024 18:57:39 +0300
Labels:        app=ratings
               version=v1
Annotations:   deployment.kubernetes.io/revision: 1
Selector:      app=ratings,version=v1
Replicas:      1 desired | 1 updated | 1 total | 1 available | 0 unavailable
StrategyType:  RollingUpdate
MinReadySeconds: 0
RollingUpdateStrategy: 25% max unavailable, 25% max surge
Pod Template:
  Labels:        app=ratings
               version=v1
  Service Account: bookinfo-ratings
  Containers:
    ratings:
      Image:        docker.io/istio/examples-bookinfo-ratings-v1:1.20.2
      Port:         9080/TCP
      Host Port:    0/TCP
      Environment:  <none>
      Mounts:       <none>
      Volumes:      <none>
      Node-Selectors: <none>
      Tolerations:  <none>
  Conditions:
    Type           Status  Reason
    ----           -
    Available      True    MinimumReplicasAvailable
    Progressing    True    NewReplicaSetAvailable
OldReplicaSets: <none>
NewReplicaSet:  ratings-v1-794744f5fd (1/1 replicas created)
Events:
  Type           Reason             Age   From           Message
  ----           -
  Normal         ScalingReplicaSet  19m   deployment-controller Scaled up replica set ratings-v1-794744f5fd to 1

```

Figure 9: Kubectl get and describe Deployments (Ratings)

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get pod
NAME                                READY   STATUS    RESTARTS   AGE
details-v1-6cd6d9df6b-9jnsr        1/1     Running   0           21m
productpage-v1-57ffb6658c-f4gvb    1/1     Running   0           21m
ratings-v1-794744f5fd-dd4jp        1/1     Running   0           21m
reviews-v1-67896867f4-tqzvc        1/1     Running   0           21m
reviews-v2-86d5db4bd6-2fv5c        1/1     Running   0           21m
reviews-v3-77947c4c78-7qmm1        1/1     Running   0           21m
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl describe pod ratings-v1
Name:                                ratings-v1-794744f5fd-dd4jp
Namespace:                           default
Priority:                              0
Service Account:                       bookinfo-ratings
Node:                                  gke-node1-default-pool-1df51aaa-w5bb/10.138.0.3
Start Time:                           Thu, 10 Oct 2024 18:57:39 +0300
Labels:                                app=ratings
                                         pod-template-hash=794744f5fd
                                         version=v1
Annotations:                           <none>
Status:                                Running
IP:                                    10.44.0.15
IPs:
  IP:                                  10.44.0.15
Controlled By:                         ReplicaSet/ratings-v1-794744f5fd
Containers:
  ratings:
    Container ID:                       containerd://4dc3cc3555f1004e581c14b6b08ea95805270e8cffc222dc40064b185d730db2
    Image:                              docker.io/istio/examples-bookinfo-ratings-v1:1.20.2
    Image ID:                           docker.io/istio/examples-bookinfo-ratings-v1@sha256:5cb3947d8967a887d9f1eeadda4ae06f5bfa29342b0155ae4
    Port:                                9080/TCP
    Host Port:                           0/TCP
    State:                               Running
      Started:                           Thu, 10 Oct 2024 18:58:00 +0300
    Ready:                               True
    Restart Count:                        0
    Environment:                         <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-cc2gg (ro)
Type:                                Status
PodReadyToStartContainers             True
Initialized                           True
Ready                                  True
ContainersReady                       True
PodScheduled                           True
Volumes:
  kube-api-access-cc2gg:
    Type:                               Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:              3607
    ConfigMapName:                       kube-root-ca.crt
    ConfigMapOptional:                   <nil>
    DownwardAPI:                         true
    QoS Class:                           BestEffort
    Node-Selectors:                       <none>
    Tolerations:                         node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                                           node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason      Age    From          Message
  ----     -
Normal    Scheduled   21m    default-scheduler    Successfully assigned default/ratings-v1-794744f5fd-dd4jp to gke-node1-default-pool-1df51aaa-w5bb
Normal    Pulling     21m    kubelet         Pulling image "docker.io/istio/examples-bookinfo-ratings-v1:1.20.2"
Normal    Pulled      21m    kubelet         Successfully pulled image "docker.io/istio/examples-bookinfo-ratings-v1:1.20.2" in 18.913s (18.913s including waiting). Image size: 80756104 bytes.
Normal    Created     21m    kubelet         Created container ratings
Normal    Started     21m    kubelet         Started container ratings

```

Figure 10: Kubectl get and describe pods.

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl logs ratings-v1-794744f5fd-dd4jp
Server listening on: http://0.0.0.0:9080
GET /ratings/0

```

Figure 11: Checking the ratings.

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl scale deployment ratings-v1 --replicas=2
deployment.apps/ratings-v1 scaled
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get deployment ratings-v1
NAME          READY   UP-TO-DATE   AVAILABLE   AGE
ratings-v1    2/2     2            2           30m
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get pod
NAME                                READY   STATUS    RESTARTS   AGE
details-v1-6cd6d9df6b-9jnsr        1/1     Running   0          33m
productpage-v1-57ffb6658c-f4gvb    1/1     Running   0          32m
ratings-v1-794744f5fd-dd4jp        1/1     Running   0          32m
ratings-v1-794744f5fd-pbppq        1/1     Running   0          3m1s
reviews-v1-67896867f4-tqzvc        1/1     Running   0          32m
reviews-v2-86d5db4bd6-2fv5c        1/1     Running   0          32m
reviews-v3-77947c4c78-7qmm1        1/1     Running   0          32m
○ asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ █

```

Figure 12: Scaling ratings v1

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl logs ratings-v1-794744f5fd-pbppq
Server listening on: http://0.0.0.0:9080
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl scale deployment ratings-v1 --replicas=1
deployment.apps/ratings-v1 scaled
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get deployment
NAME          READY   UP-TO-DATE   AVAILABLE   AGE
details-v1    1/1     1            1           35m
productpage-v1 1/1     1            1           35m
ratings-v1    1/1     1            1           35m
reviews-v1    1/1     1            1           35m
reviews-v2    1/1     1            1           35m
reviews-v3    1/1     1            1           35m
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ kubectl get pod
NAME                                READY   STATUS    RESTARTS   AGE
details-v1-6cd6d9df6b-9jnsr        1/1     Running   0          35m
productpage-v1-57ffb6658c-f4gvb    1/1     Running   0          35m
ratings-v1-794744f5fd-dd4jp        1/1     Running   0          35m
reviews-v1-67896867f4-tqzvc        1/1     Running   0          35m
reviews-v2-86d5db4bd6-2fv5c        1/1     Running   0          35m
reviews-v3-77947c4c78-7qmm1        1/1     Running   0          35m
○ asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo$ █

```

Figure 13: Scaling back to 1

Lab Task 2:

In this task, you need to modify the productpage.html file of the Bookinfo application by adding new text in specific HTML blocks. Then, build and push the updated Docker image to the Docker Hub repository.

```

● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo/src/productpage$ docker image ls
REPOSITORY          TAG          IMAGE ID          CREATED          SIZE
amlaytho/productpage latest       4c8b70e270c2     45 minutes ago  190MB
assynath/productpage latest       4c8b70e270c2     45 minutes ago  190MB
● asnath@AssynathJr:~/AIOps_Labs/istio-master/samples/bookinfo/src/productpage$ docker push assynath/productpage:latest
The push refers to repository [docker.io/assynath/productpage]
56a3250274d3: Pushed
5f70bf18a086: Pushed
4b33ffdb8e87f: Pushed
a296bfd4005c: Pushed
51ce03c70b7e: Pushed
86f876bdbb72: Pushed
3de52dd0fe2a: Pushed
555969890791: Pushed
29c583eda821: Pushed
415b3d2d4221: Pushed
3271906bfb0f: Pushed
6fdc32920d25: Pushed
41aaeb647441: Pushed
95ac61d1a52e: Pushed
da5d55102092: Pushed
fb1bd2fc5282: Pushed
latest: digest: sha256:e3460bb1f19d552db45f8671cab5de7d444876d0721e9170aa0162c01f5feeaf size: 3668

```

Figure 14: Pushing to the docker hub repository

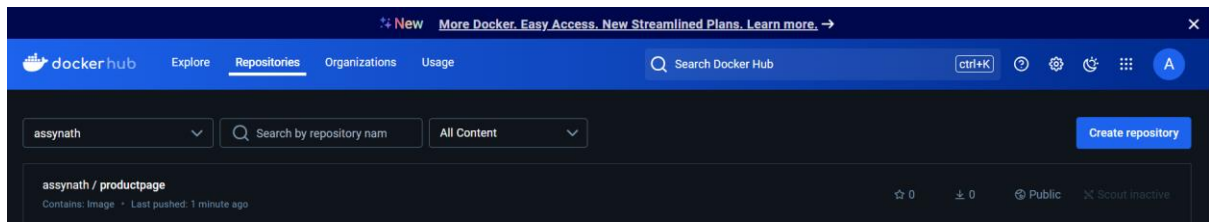


Figure 15: Successfully pushed to the Docker Hub

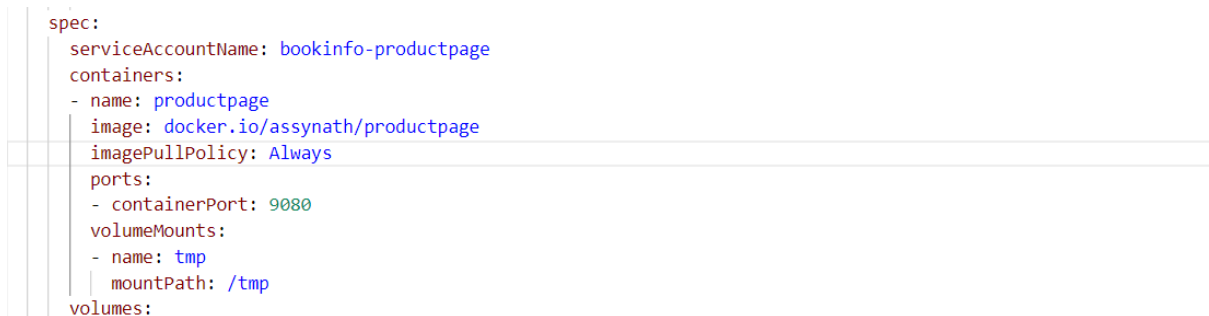


Figure 16: Changing the image name

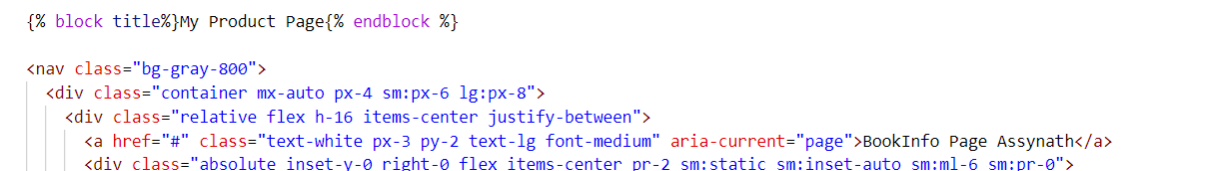


Figure 17: Changing the product page HTML titles

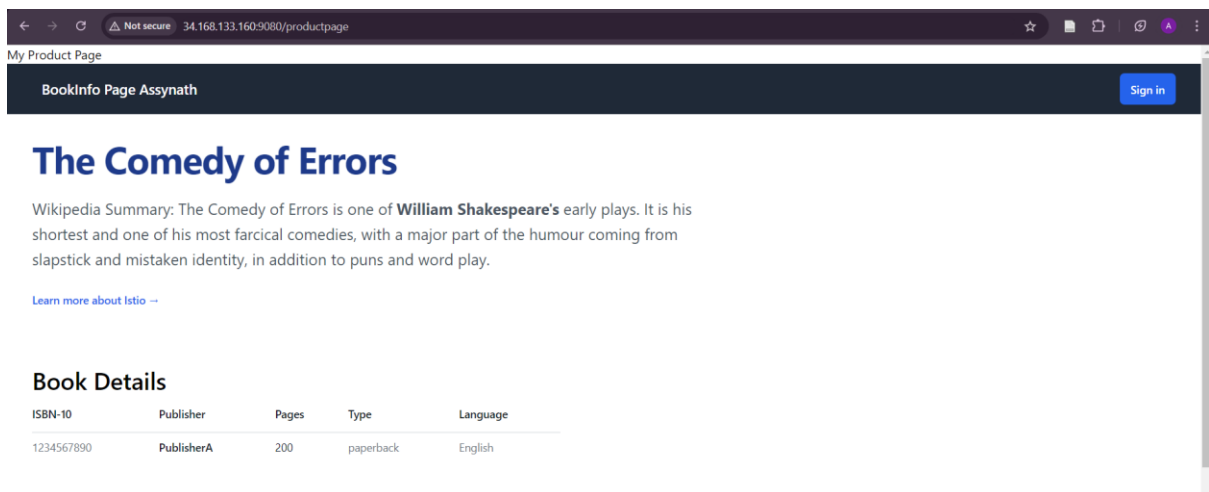


Figure 18: Changed browser title as required.


```

● asnath@AssynathJr:~/AIops_Labs/istio-master/samples/bookinfo$ kubectl describe pods productpage-v1-67674794c7-9lcd9
Name:                productpage-v1-67674794c7-9lcd9
Namespace:           default
Priority:             0
Service Account:     bookinfo-productpage
Node:                gke-node1-default-pool-1df51aaa-w5bb/10.138.0.3
Start Time:          Thu, 10 Oct 2024 20:45:29 +0300
Labels:              app=productpage
                    pod-template-hash=67674794c7
                    version=v1
Annotations:         prometheus.io/path: /metrics
                    prometheus.io/port: 9080
                    prometheus.io/scrape: true
Status:              Running
IP:                  10.44.0.21
IPs:                 IP: 10.44.0.21
Controlled By:       ReplicaSet/productpage-v1-67674794c7
Containers:
  productpage:
    Container ID:   containerd://44c73d1bbcf11bdfc9b7b59be32ed4a1ec820194ea20d8b47883cc3fffc7f8b0
    Image:          docker.io/assynath/productpage
    Image ID:       docker.io/assynath/productpage@sha256:e3460bb1f19d552db45f8671cab5de7d444876d0721e9170aa0162c01f5feeaf
    Port:           9080/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Thu, 10 Oct 2024 20:45:36 +0300
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /tmp from tmp (rw)
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-bp8fl (ro)
Conditions:
  Type                     Status
  PodReadyToStartContainers True
  Initialized              True
  Ready                    True
  ContainersReady          True

```

Figure 19: New image has been replaced with new one from docker hub

Lab Task3:

To add Prometheus monitoring and a Grafana panel for the Bookinfo ProductPage, you'll first check the Python source code to identify the Prometheus metric emitted on the /metrics endpoint.

```
request_result_counter = Counter('request_result', 'Results of requests', ['destination_app', 'response_code'])
```

Figure 20: Observed metrics at productpage.py

```

- job_name: "BookInfo"
  static_configs:
    - targets: ['34.168.133.160:9080']

```

Figure 21: Configure.yml

edited

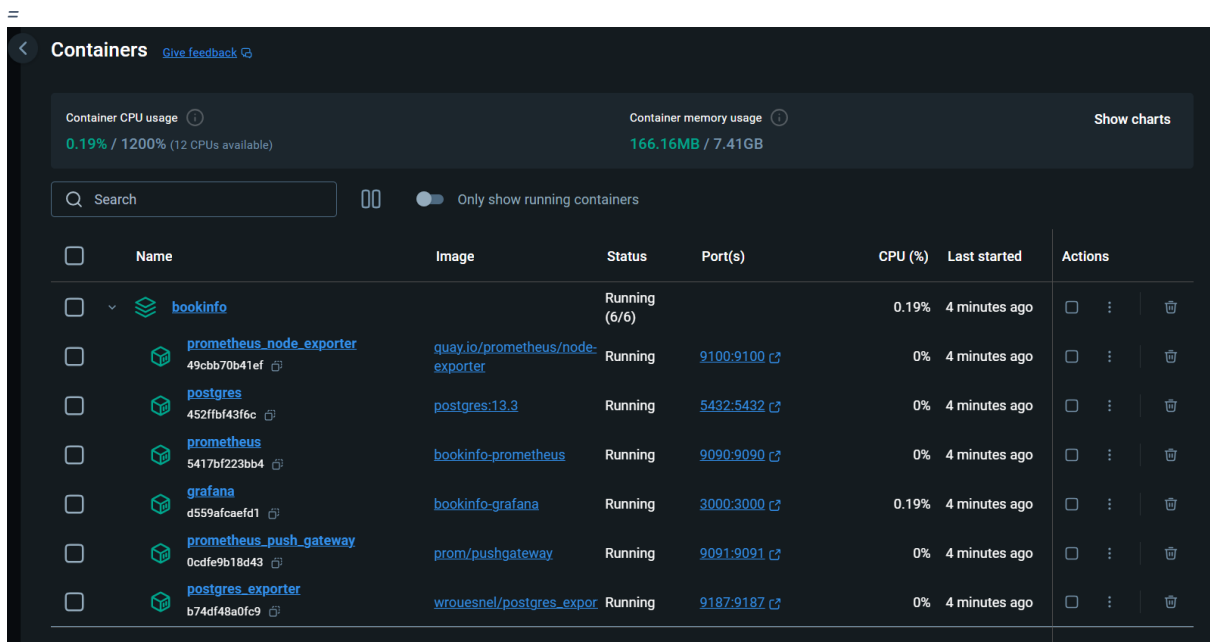


Figure 22: Docker composed containers

[+] Running 7/7

```

✓ Network bookinfo_default          Created
✓ Container prometheus_push_gateway Started
✓ Container grafana                 Started
✓ Container postgres                Started
✓ Container prometheus_node_exporter Started
✓ Container prometheus              Started
✓ Container postgres_exporter       Started

```

asnath@AssynathJr:~/AIops_Labs/istio-master/samples/bookinfo\$

Figure 23: Starting the containers at Docker desktop.

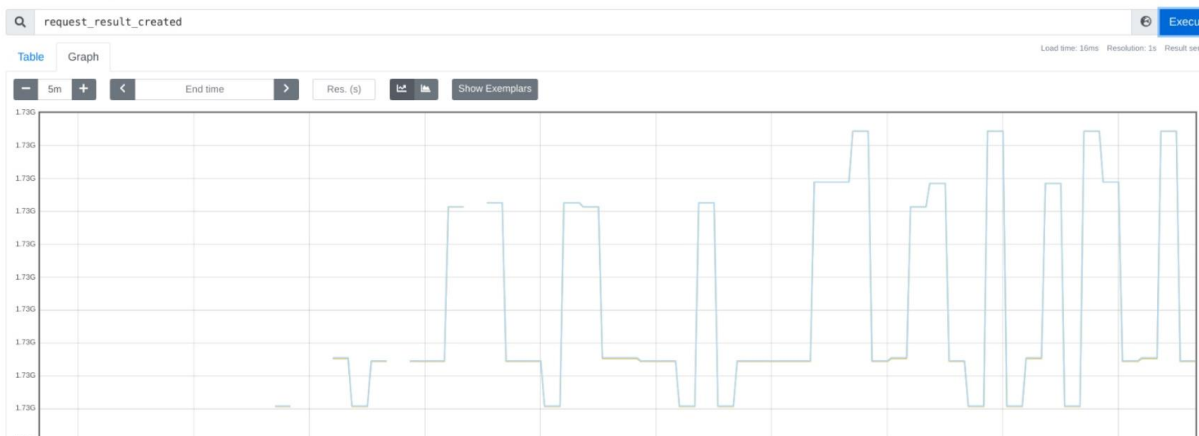


Figure 24: Request result created on Prometheus

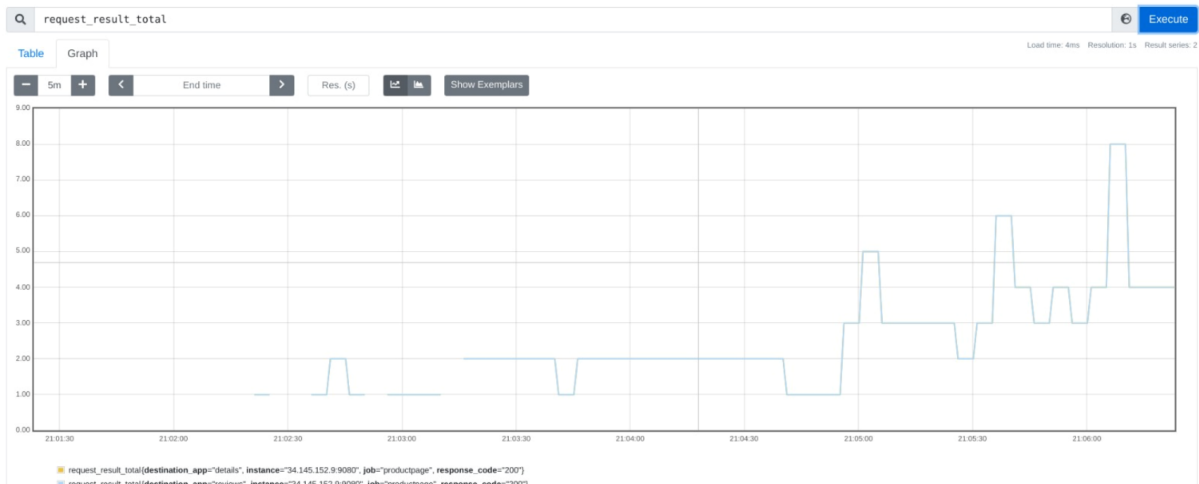


Figure 25: Request result total on Prometheus



Figure 26: Metrics on Grafana

```

● asnath@AssynathJr:~/AIOPS_Labs/istio-master/samples/bookinfo$ docker ps
CONTAINER ID   IMAGE                                COMMAND                  CREATED        STATUS        PORTS                               NAMES
b74df48a0fc9   wrouesnel/postgres_exporter        "/postgres_exporter"    34 minutes ago Up 34 minutes 0.0.0.0:9187->9187/tcp              postgres_exporter
49cbb70b41ef   quay.io/prometheus/node-exporter    "/bin/node_exporter"    34 minutes ago Up 34 minutes 0.0.0.0:9100->9100/tcp              prometheus_node_exporter
452ffb43fec    postgres:13.3                      "docker-entrypoint.s..." 34 minutes ago Up 34 minutes 0.0.0.0:5432->5432/tcp              postgres
5417bf223bb4   bookinfo-prometheus                "/bin/prometheus --c..." 34 minutes ago Up 34 minutes 0.0.0.0:9090->9090/tcp              prometheus
d559afcaef01   bookinfo-grafana                   "/run.sh"               34 minutes ago Up 34 minutes 0.0.0.0:3000->3000/tcp              grafana
0cdf9b18d43    prom/pushgateway                   "/bin/pushgateway"      34 minutes ago Up 34 minutes 0.0.0.0:9091->9091/tcp              prometheus_push_gateway

```

Figure 27: Containers running at docker.

```

● asnath@AssynathJr:~/AIOPS_Labs/istio-master/samples/bookinfo/platform/kube$ kubectl delete -f bookinfo.yaml # from bookinfo/platform/kube dir
service "details" deleted
serviceaccount "bookinfo-details" deleted
deployment.apps "details-v1" deleted
service "ratings" deleted
serviceaccount "bookinfo-ratings" deleted
deployment.apps "ratings-v1" deleted
service "reviews" deleted
serviceaccount "bookinfo-reviews" deleted
deployment.apps "reviews-v1" deleted
deployment.apps "reviews-v2" deleted
deployment.apps "reviews-v3" deleted
service "productpage" deleted
serviceaccount "bookinfo-productpage" deleted
deployment.apps "productpage-v1" deleted
● asnath@AssynathJr:~/AIOPS_Labs/istio-master/samples/bookinfo/platform/kube$

```

Figure 28: Cluster deleted.

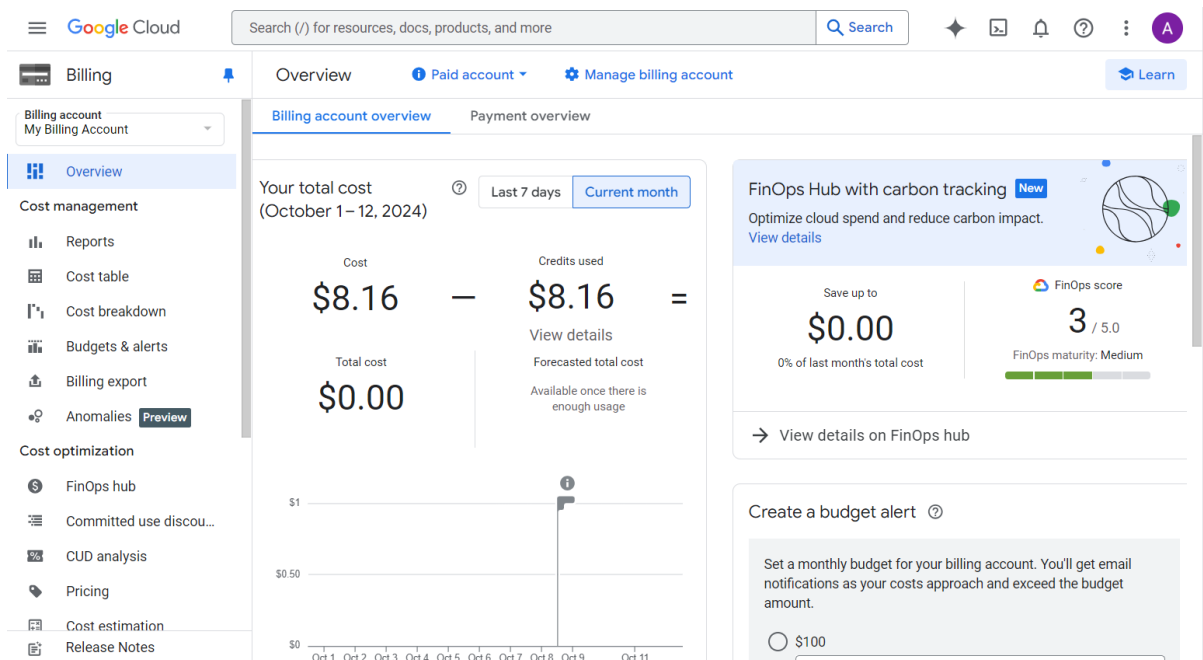


Figure 29: Billing Overview

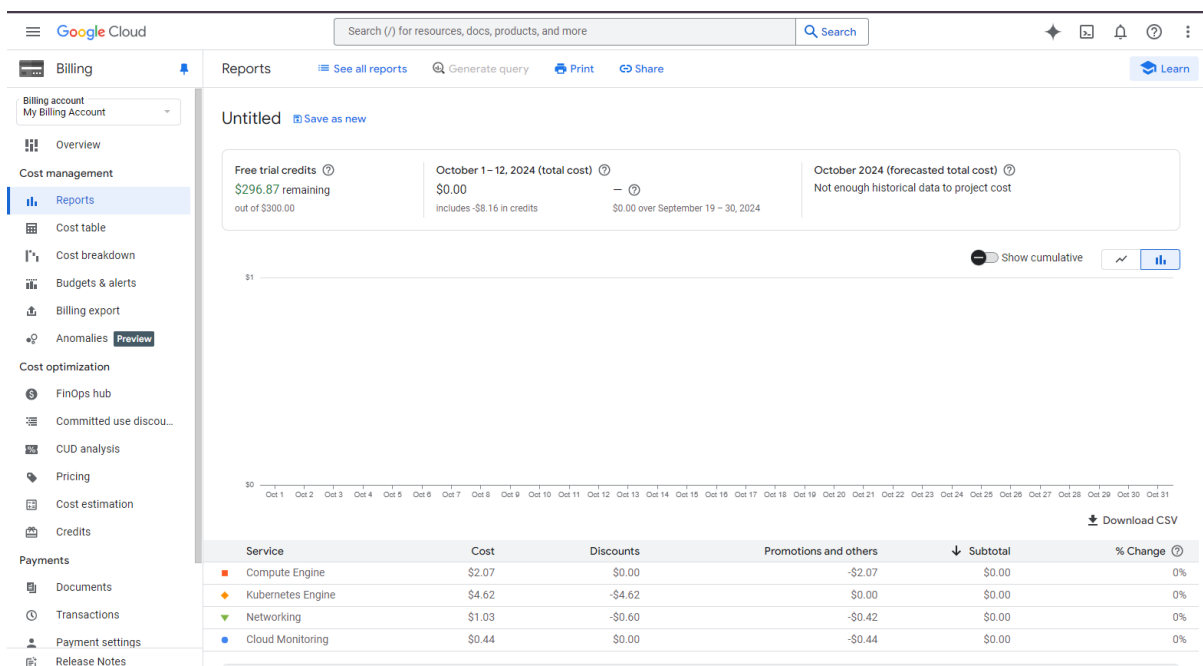


Figure 30: Billing Report

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Compute Engine

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Disks

Every Compute Engine VM instance is attached to at least one disk as a boot disk and for persistent storage. A persistent disk can be a standard (HDD) or a solid-state (SSD) drive. You can also attach an ephemeral local SSD for high-performance I/O.

CREATE DISK

TAKE THE QUICKSTART

Figure 31: Empty Disks