Cloud Computing

Assignment 3

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17.11.24

Introduction

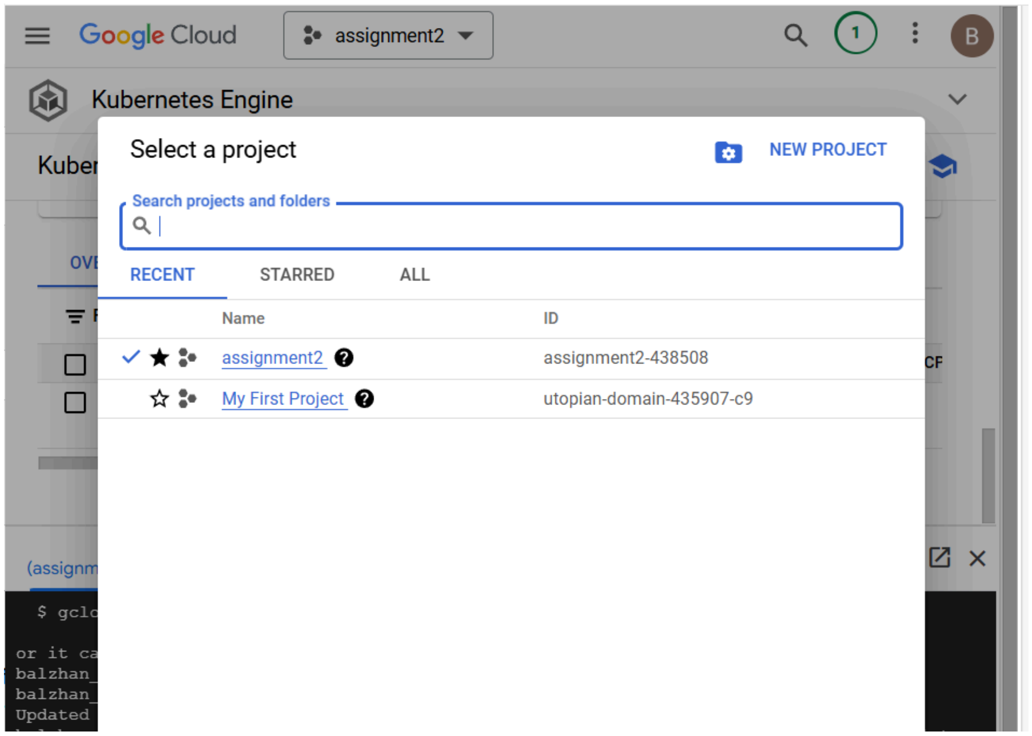
In this set of exercises, we will explore essential components of Google Cloud Platform (GCP) that are critical for building, managing, and securing cloud applications. We will focus on Identity and Access Management (IAM), Google Kubernetes Engine (GKE), App Engine, and Cloud Functions. Through practical tasks, we will learn how to manage user access and permissions using IAM, deploy containerized applications on GKE, and create serverless applications using App Engine and Cloud Functions. These tools are essential for cloud computing and application development as they help ensure security, scalability, and efficient resource management.

IAM allows us to control access to resources by assigning roles to different users, while GKE helps us manage containerized applications in a highly scalable environment. App Engine and Cloud Functions simplify the deployment of applications by handling the infrastructure automatically, allowing developers to focus on writing code. By completing these exercises, we will gain hands-on experience with the core features of GCP, which are important for building secure, scalable, and maintainable cloud applications in real-world scenarios.

Identity and Security Management

Exercise 1: Setting Up IAM Roles

The Google cloud project



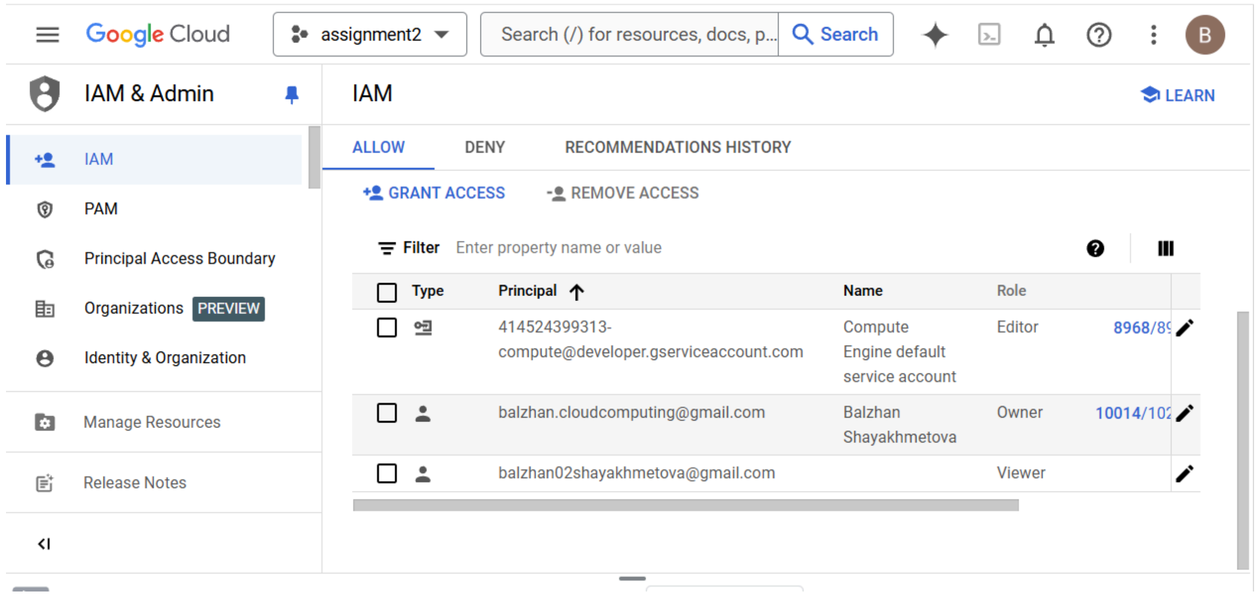
Name	ID
assignment2	assignment2-438508
My First Project	utopian-domain-435907-c9

Document roles and their associated permissions to ensure clarity and compliance:

Role	Description	Permissions
Viewer	View-only access to project resources	resourcemanager.projects.get, storage.buckets.list, compute.instances.list
Editor	Full control over resources, except IAM	Viewer permissions + resourcemanager.projects.update, compute.instances.create, storage.buckets.create
Owner	Full control, including IAM and billing	Editor permissions + resourcemanager.projects.setIamPolicy, billing.accounts.get, billing.accounts.update

Custom	Fine-grained permissions for specific needs	Define custom roles by selecting specific permissions from IAM Permissions List.

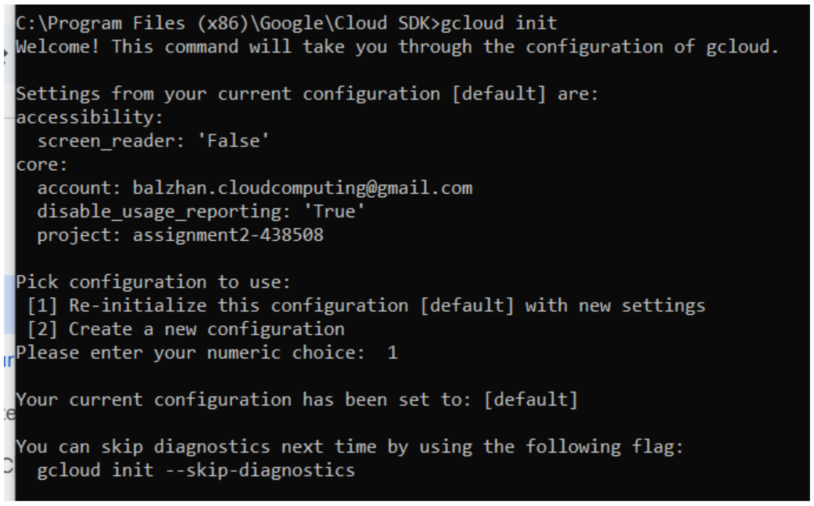
The configured roles of the project in my current project



Type	Principal	Name	Role	
	414524399313-compute@developer.gserviceaccount.com	Compute Engine default service account	Editor	8968/8
	balzhan.cloudcomputing@gmail.com	Balzhan Shayakhmetova	Owner	10014/102
	balzhan02shayakhmetova@gmail.com		Viewer	

Exercise 2: Service Accounts

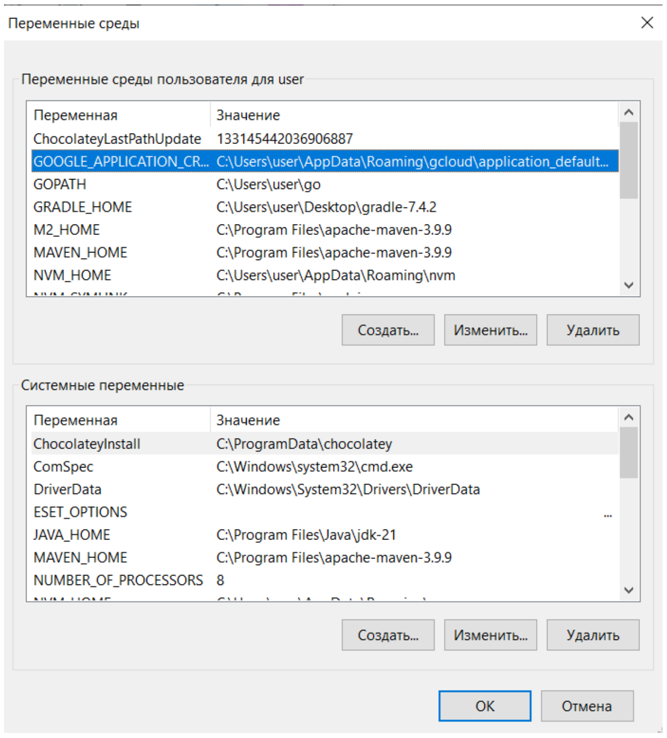
1. Initializing the google cloud cli in Image 2



```
C:\Program Files (x86)\Google\Cloud SDK>gcloud init
Welcome! This command will take you through the configuration of gcloud.

Settings from your current configuration [default] are:
accessibility:
  screen_reader: 'False'
core:
  account: balzhan.cloudcomputing@gmail.com
  disable_usage_reporting: 'True'
  project: assignment2-438508

Pick configuration to use:
 [1] Re-initialize this configuration [default] with new settings
 [2] Create a new configuration
Please enter your numeric choice:  1

Your current configuration has been set to: [default]

You can skip diagnostics next time by using the following flag:
  gcloud init --skip-diagnostics
```

Image 2: Initialization of the gcloud

2. Setting up global variables in Image 3



Переменные среды

Переменные среды пользователя для user

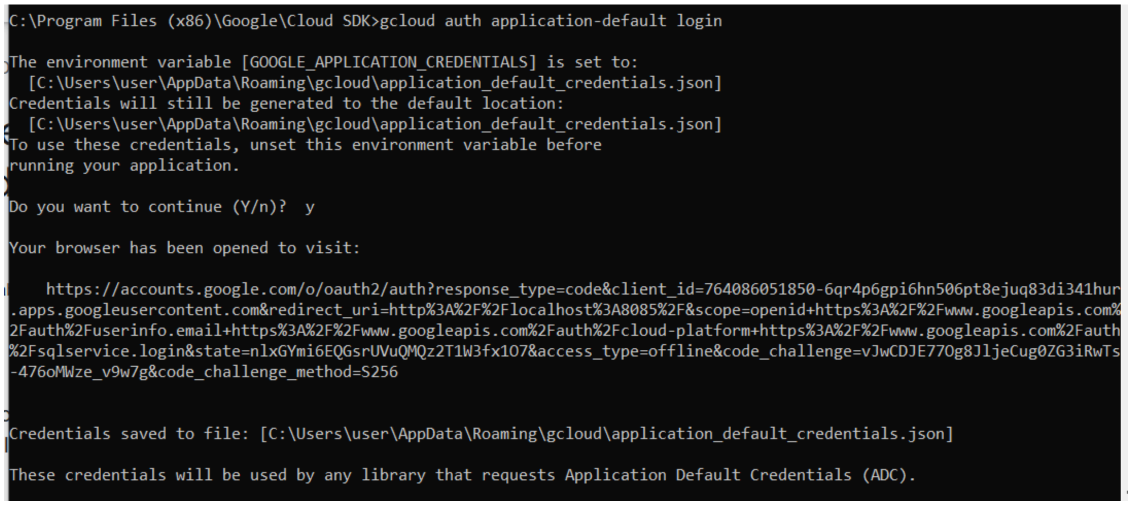
Переменная	Значение
ChocolateyLastPathUpdate	133145442036906887
GOOGLE_APPLICATION_CR...	C:\Users\user\AppData\Roaming\gcloud\application_default...
GOPATH	C:\Users\user\go
GRADLE_HOME	C:\Users\user\Desktop\gradle-7.4.2
M2_HOME	C:\Program Files\apache-maven-3.9.9
MAVEN_HOME	C:\Program Files\apache-maven-3.9.9
NVM_HOME	C:\Users\user\AppData\Roaming\nvm

Системные переменные

Переменная	Значение
ChocolateyInstall	C:\ProgramData\chocolatey
ComSpec	C:\Windows\system32\cmd.exe
DriverData	C:\Windows\System32\Drivers\DriverData
ESET_OPTIONS	...
JAVA_HOME	C:\Program Files\Java\jdk-21
MAVEN_HOME	C:\Program Files\apache-maven-3.9.9
NUMBER_OF_PROCESSORS	8

Image 3: System Properties Advanced

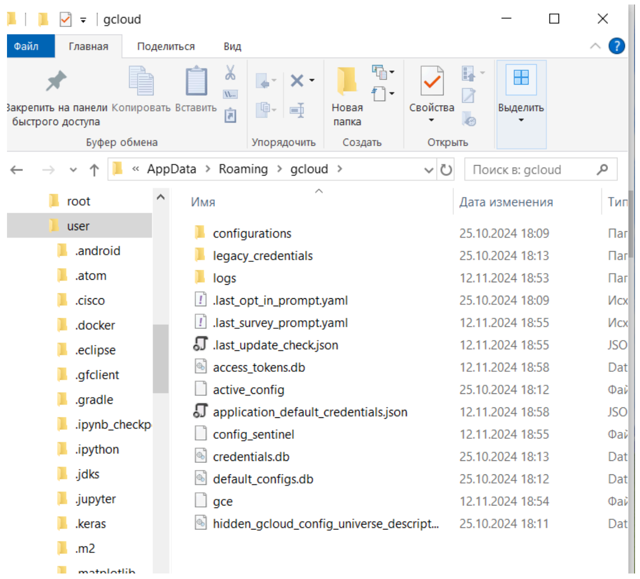
3. Creating local authentication credentials in Image 4



```
C:\Program Files (x86)\Google\Cloud SDK>gcloud auth application-default login

The environment variable [GOOGLE_APPLICATION_CREDENTIALS] is set to:
  [C:\Users\user\AppData\Roaming\gcloud\application_default_credentials.json]
Credentials will still be generated to the default location:
  [C:\Users\user\AppData\Roaming\gcloud\application_default_credentials.json]
To use these credentials, unset this environment variable before
running your application.

Do you want to continue (Y/n)?  y

Your browser has been opened to visit:

    https://accounts.google.com/o/oauth2/auth?response_type=code&client_id=764086051850-6qr4p6gpi6hn506pt8ejuq83di341hur
.apps.googleusercontent.com&redirect_uri=http%3A%2F%2Flocalhost%3A8085%2F&scope=openid+https%3A%2F%2Fwww.googleapis.com%
2Fauth%2Fuserinfo.email+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fcloud-platform+https%3A%2F%2Fwww.googleapis.com%2Fauth
%2Fsqlservice.login&state=nlxGYmi6EQGsrUVuQMQz2T1W3fx1O7&access_type=offline&code_challenge=vJwCDJE77Og8JljeCug0ZG3iRwTs
-476oMWze_v9w7g&code_challenge_method=S256


Credentials saved to file: [C:\Users\user\AppData\Roaming\gcloud\application_default_credentials.json]

These credentials will be used by any library that requests Application Default Credentials (ADC).
```

Image 4: Creating application default credentials

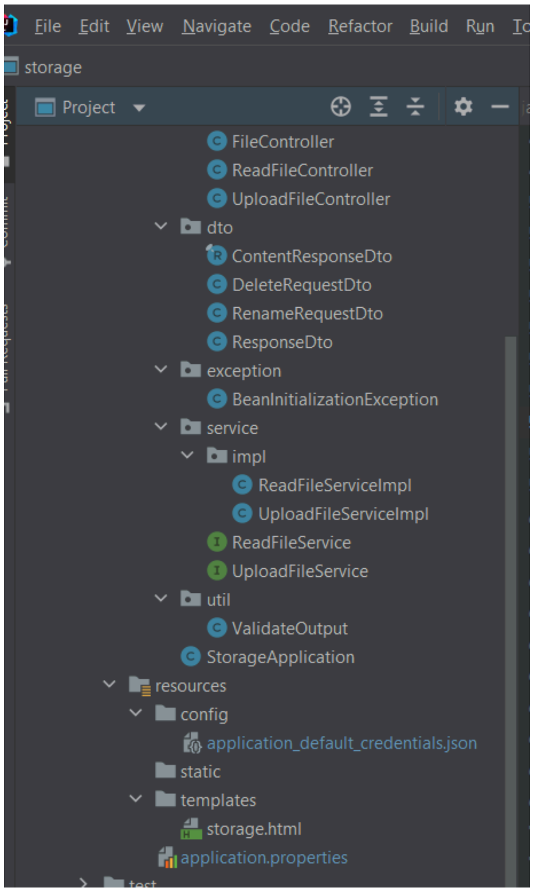
4. The generated api is in the configured path in Image 5



Имя	Дата изменения	Тип
configurations	25.10.2024 18:09	Пап
legacy_credentials	25.10.2024 18:13	Пап
logs	12.11.2024 18:53	Пап
.last_opt_in_prompt.yaml	25.10.2024 18:09	Исх
.last_survey_prompt.yaml	12.11.2024 18:55	Исх
.last_update_check.json	12.11.2024 18:55	JSO
access_tokens.db	12.11.2024 18:58	Dat
active_config	25.10.2024 18:12	Фай
application_default_credentials.json	12.11.2024 18:58	JSO
config_sentinel	12.11.2024 18:55	Фай
credentials.db	25.10.2024 18:13	Dat
default_configs.db	25.10.2024 18:12	Dat
gce	12.11.2024 18:54	Фай
hidden_gcloud_config_universe_descript...	25.10.2024 18:11	Dat

Image 5: The file in the created path

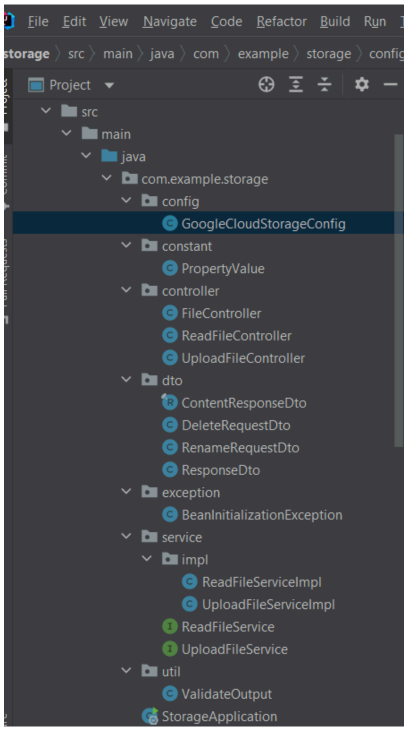
6. Setting up in Java project in resources/config folder corresponding file in Image 6



```
            FileController
            ReadFileController
            UploadFileController
        dto
            ContentResponseDto
            DeleteRequestDto
            RenameRequestDto
            ResponseDto
        exception
            BeanInitializationException
        service
            impl
                ReadFileServiceImpl
                UploadFileServiceImpl
            ReadFileService
            UploadFileService
        util
            ValidateOutput
        StorageApplication
    resources
        config
            application_default_credentials.json
        static
        templates
            storage.html
        application.properties
```

Image 6: File in the project file location

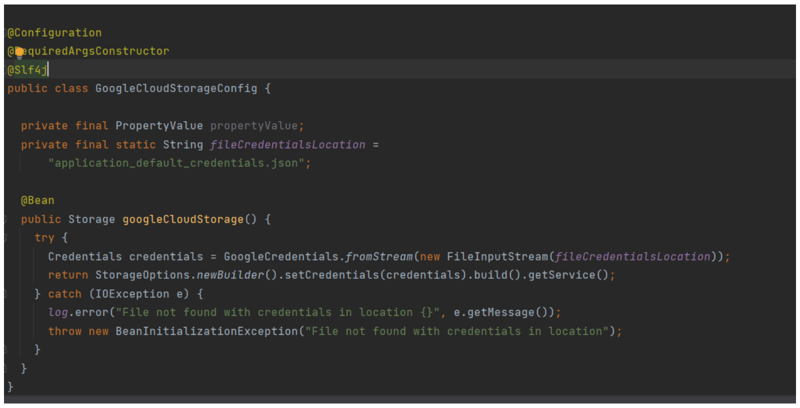
7. Project structure of the backend in Image 7


File Edit View Navigate Code Refactor Build Run
storage 〉 src 〉 main 〉 java 〉 com 〉 example 〉 storage 〉 config
Project

```
src
  main
    java
      com.example.storage
        config
          GoogleCloudStorageConfig
        constant
          PropertyValue
        controller
          FileController
          ReadFileController
          UploadFileController
        dto
          ContentResponseDto
          DeleteRequestDto
          RenameRequestDto
          ResponseDto
        exception
          BeanInitializationException
        service
          impl
            ReadFileServiceImpl
            UploadFileServiceImpl
          ReadFileService
          UploadFileService
        util
          ValidateOutput
        StorageApplication
```

Image 7: Structure of the backend

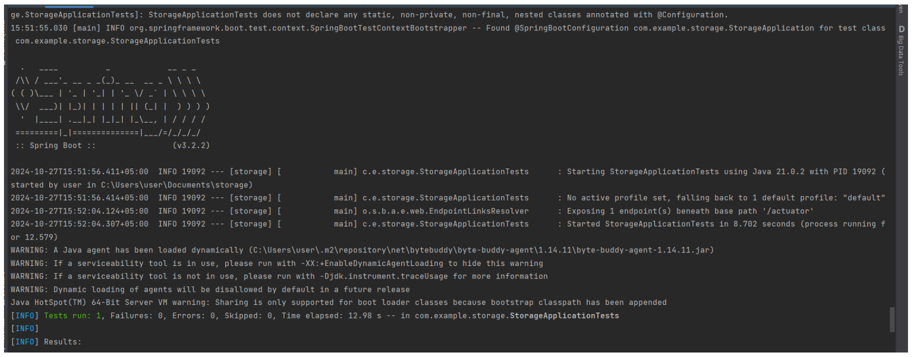
8. The google storage configuration bean in Image 8



```java
@Configuration
@RequiredArgsConstructor
@Slf4j
public class GoogleCloudStorageConfig {

  private final PropertyValue propertyValue;
  private final static String fileCredentialsLocation =
      "application_default_credentials.json";

  @Bean
  public Storage googleCloudStorage() {
    try {
      Credentials credentials = GoogleCredentials.fromStream(new FileInputStream(fileCredentialsLocation));
      return StorageOptions.newBuilder().setCredentials(credentials).build().getService();
    } catch (IOException e) {
      log.error("File not found with credentials in location {}", e.getMessage());
      throw new BeanInitializationException("File not found with credentials in location");
    }
  }
}
```

Image 8: Configuration bean creation

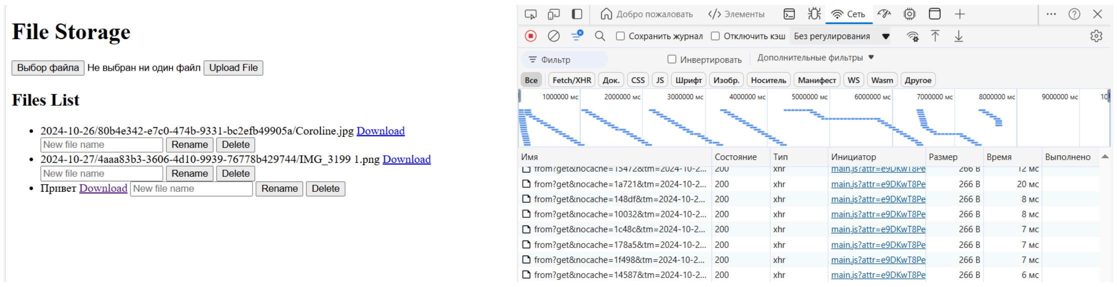
9. Successful run of the application in Image 9



```
ge.StorageApplicationTests]: StorageApplicationTests does not declare any static, non-private, non-final, nested classes annotated with @Configuration.
15:51:55.030 [main] INFO org.springframework.boot.test.context.SpringBootTestContextBootstrapper -- Found @SpringBootConfiguration com.example.storage.StorageApplication for test class
 com.example.storage.StorageApplicationTests

  .   ____          _            __ _ _
 /\\ / ___'_ __ _ _(_)_ __  __ _ \ \ \ \
( ( )\___ | '_ | '_| | '_ \/ _` | \ \ \ \
 \\/  ___)| |_)| | | | | || (_| |  ) ) ) )
  '  |____| .__|_| |_|_| |_\__, | / / / /
 =========|_|==============|___/=/_/_/_/
 :: Spring Boot ::                (v3.2.2)

2024-10-27T15:51:56.411+05:00  INFO 19092 --- [storage] [           main] c.e.storage.StorageApplicationTests      : Starting StorageApplicationTests using Java 21.0.2 with PID 19092 (
started by user in C:\Users\user\Documents\storage)
2024-10-27T15:51:56.414+05:00  INFO 19092 --- [storage] [           main] c.e.storage.StorageApplicationTests      : No active profile set, falling back to 1 default profile: "default"
2024-10-27T15:52:04.124+05:00  INFO 19092 --- [storage] [           main] o.s.b.a.e.web.EndpointLinksResolver      : Exposing 1 endpoint(s) beneath base path '/actuator'
2024-10-27T15:52:04.307+05:00  INFO 19092 --- [storage] [           main] c.e.storage.StorageApplicationTests      : Started StorageApplicationTests in 8.702 seconds (process running f
or 12.579)
WARNING: A Java agent has been loaded dynamically (C:\Users\user\.m2\repository\net\bytebuddy\byte-buddy-agent\1.14.11\byte-buddy-agent-1.14.11.jar)
WARNING: If a serviceability tool is in use, please run with -XX:+EnableDynamicAgentLoading to hide this warning
WARNING: If a serviceability tool is not in use, please run with -Djdk.instrument.traceUsage for more information
WARNING: Dynamic loading of agents will be disallowed by default in a future release
Java HotSpot(TM) 64-Bit Server VM warning: Sharing is only supported for boot loader classes because bootstrap classpath has been appended
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 12.98 s -- in com.example.storage.StorageApplicationTests
[INFO]
[INFO] Results:
```

Image 9: Successful run of the application

10. Frontend of the application in Image 10



File Storage

Выбор файла Не выбран ни один файл Upload File

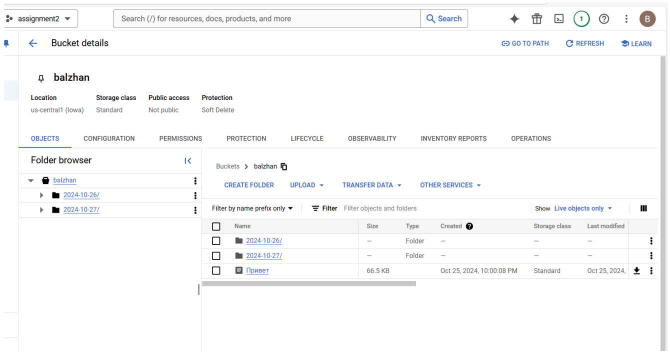
Files List

- 2024-10-26/80b4e342-e7c0-474b-9331-bc2efb49905a/Coroline.jpg Download
  New file name Rename Delete
- 2024-10-27/4aaa83b3-3606-4d10-9939-76778b429744/IMG_3199 1.png Download
  New file name Rename Delete
- Привет Download New file name Rename Delete

Имя	Состояние	Тип	Инициатор	Размер	Время	Выполнено
from?get&nocache=15472&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	12 мс	
from?get&nocache=1a721&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	20 мс	
from?get&nocache=148df&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	8 мс	
from?get&nocache=10032&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	8 мс	
from?get&nocache=1c48c&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	7 мс	
from?get&nocache=178a5&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	7 мс	
from?get&nocache=1f498&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	7 мс	
from?get&nocache=14587&tm=2024-10-2...	200	xhr	main.js?attr=e9DKwT8Pe	266 B	6 мс	

Image 10: Frontend

11. Bucket structure organisation in Image 11



balzhan

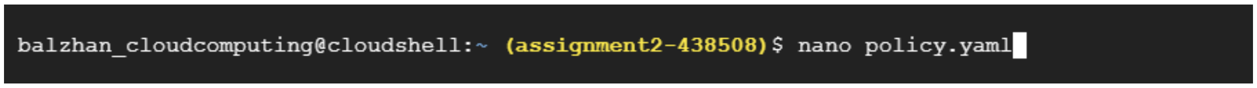
Location	Storage class	Public access	Protection
us-central1 (Iowa)	Standard	Not public	Soft Delete

Name	Size	Type	Created	Storage class	Last modified
2024-10-26/	—	Folder	—	—	—
2024-10-27/	—	Folder	—	—	—
Привет	66.5 KB		Oct 25, 2024, 10:00:08 PM	Standard	Oct 25, 2024,

Image 11: Bucket in GC

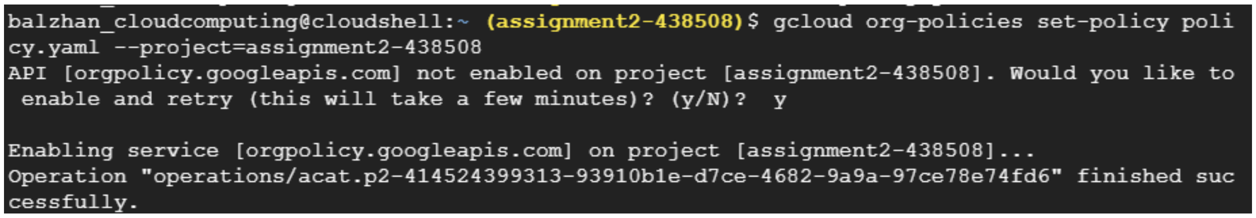
Exercise 3: Organization Policies

Set the Restriction at the Organization Level in policy.yaml file



```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ nano policy.yaml
```

Set the Restriction at the Project Level:



```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ gcloud org-policies set-policy poli
cy.yaml --project=assignment2-438508
API [orgpolicy.googleapis.com] not enabled on project [assignment2-438508]. Would you like to
 enable and retry (this will take a few minutes)? (y/N)?  y

Enabling service [orgpolicy.googleapis.com] on project [assignment2-438508]...
Operation "operations/acat.p2-414524399313-93910b1e-d7ce-4682-9a9a-97ce78e74fd6" finished suc
cessfully.
```

Document the applied policy, its scope, and the expected impact:

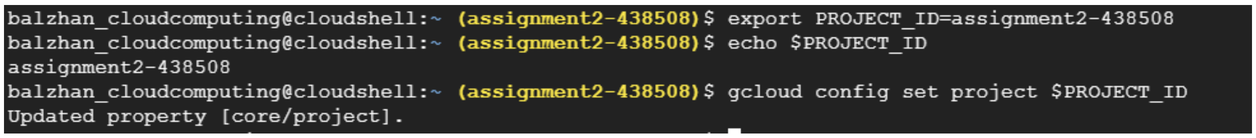
Policy Name	Description	Scope	Enforcement
compute.vmExternalIpAccess	Restricts creation of VMs with external IP addresses	Organization/Project	Deny All

---

Google Kubernetes Engine (GKE)

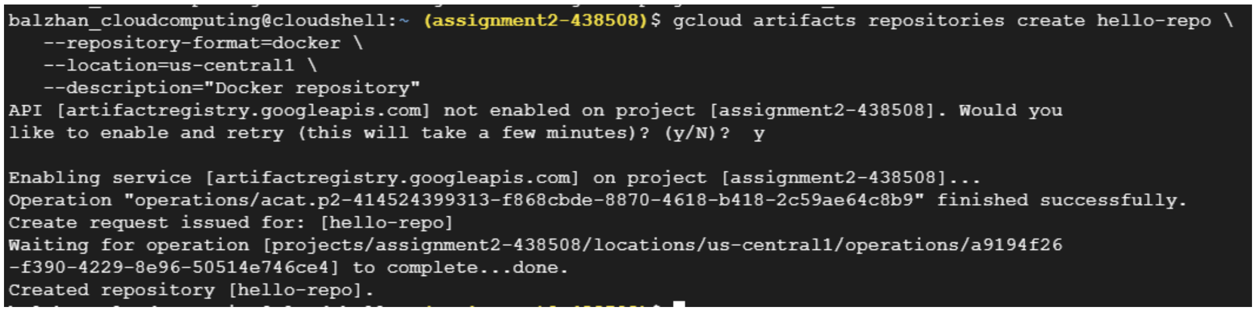
Exercise 4: Deploying a Simple Application

Set up a GKE cluster using the Google Cloud Console



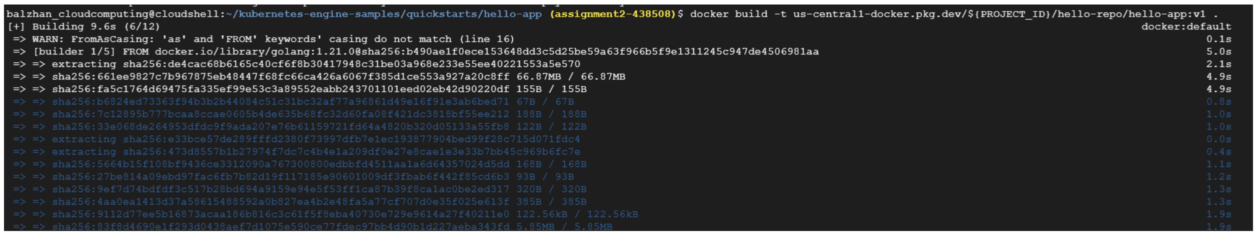
```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ export PROJECT_ID=assignment2-438508
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ echo $PROJECT_ID
assignment2-438508
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ gcloud config set project $PROJECT_ID
Updated property [core/project].
```

Create the hello-repo repository with the following command:



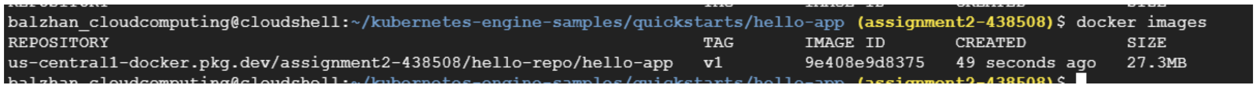
```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ gcloud artifacts repositories create hello-repo \
   --repository-format=docker \
   --location=us-central1 \
   --description="Docker repository"
API [artifactregistry.googleapis.com] not enabled on project [assignment2-438508]. Would you
like to enable and retry (this will take a few minutes)? (y/N)?  y

Enabling service [artifactregistry.googleapis.com] on project [assignment2-438508]...
Operation "operations/acat.p2-414524399313-f868cbde-8870-4618-b418-2c59ae64c8b9" finished successfully.
Create request issued for: [hello-repo]
Waiting for operation [projects/assignment2-438508/locations/us-central1/operations/a9194f26
-f390-4229-8e96-50514e746ce4] to complete...done.
Created repository [hello-repo].
```

Build and tag the Docker image for hello-app:



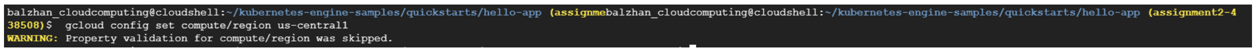
```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$ docker build -t us-central1-docker.pkg.dev/${PROJECT_ID}/hello-repo/hello-app:v1 .
[+] Building 9.6s (6/12)                                                                                                                 docker:default
 => WARN: FromAsCasing: 'as' and 'FROM' keywords' casing do not match (line 16)                                                                    0.1s
 => [builder 1/5] FROM docker.io/library/golang:1.21.0@sha256:b490ae1f0ece153648dd3c5d25be59a63f966b5f9e1311245c947de4506981aa                   5.0s
 => => extracting sha256:de4cac68b6165c40cf6f8b30417948c31be03a968e233e55ee40221553a5e570                                                          2.1s
 => => sha256:661ee9827c7b967875eb48447f68fc66ca426a6067f385d1ce553a927a20c8ff 66.87MB / 66.87MB                                                   4.9s
 => => sha256:fa5c1764d69475fa335ef99e53c3a89552eabb243701101eed02eb42d90220df 155B / 155B                                                         4.9s
 => => sha256:b6824ed73363f94b3b2b44084c51c31bc32af77a96861d49e16f91e3ab6bed71 67B / 67B                                                           0.8s
 => => sha256:7c12895b777bcaa8ccae0605b4de635b68fc32d60fa08f421dc3818bf55ee212 188B / 188B                                                         1.0s
 => => sha256:33e068de264953dfdc9f9ada207e76b61159721fd64a4820b320d05133a55fb8 122B / 122B                                                         1.0s
 => => extracting sha256:e33bce57de289fffd2380f73997dfb7e1ec193877904bed99f28c715d071fdc4                                                          0.0s
 => => extracting sha256:473d8557b1b27974f7dc7c4b4e1a209df0e27e8cae1e3e33b7bb45c969b6fc7e                                                          0.4s
 => => sha256:5664b15f108bf9436ce3312090a767300800edbbfd4511aa1a6d64357024d5dd 168B / 168B                                                         1.1s
 => => sha256:27be814a09ebd97fac6fb7b82d19f117185e90601009df3fbab6f442f85cd6b3 93B / 93B                                                           1.2s
 => => sha256:9ef7d74bdfdf3c517b28bd694a9159e94e5f53ff1ca87b39f8ca1ac0be2ed317 320B / 320B                                                         1.3s
 => => sha256:4aa0ea1413d37a58615488592a0b827ea4b2e48fa5a77cf707d0e35f025e613f 385B / 385B                                                         1.3s
 => => sha256:9112d77ee5b16873acaa186b816c3c61f5f8eba40730e729e9614a27f40211e0 122.56kB / 122.56kB                                                 1.9s
 => => sha256:83f8d4690e1f293d0438aef7d1075e590ce77fdec97bb4d90b1d227aeba343fd 5.85MB / 5.85MB                                                     1.9s
```

Run the docker images command to verify that the build was successful:



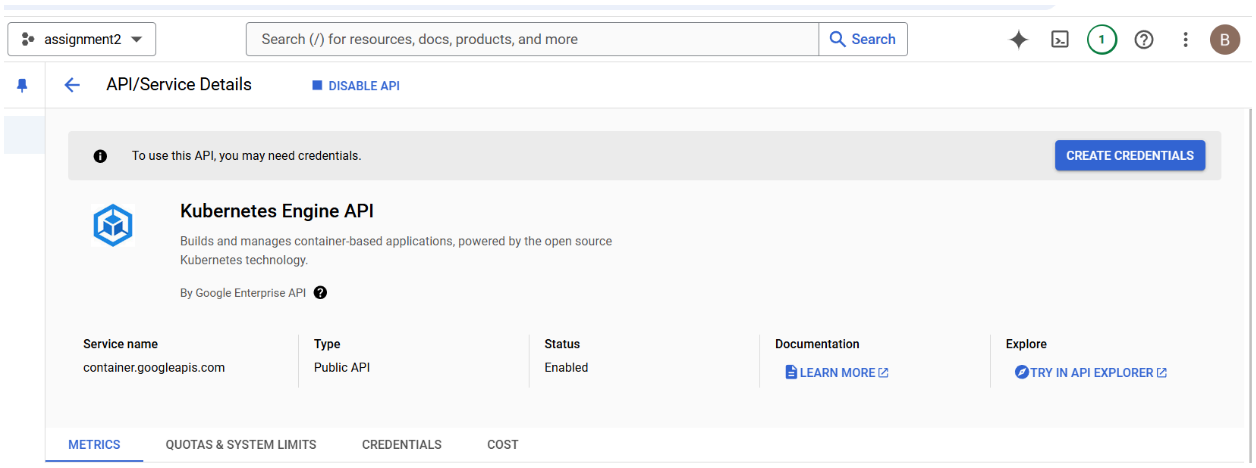
```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$ docker images
REPOSITORY                                                        TAG       IMAGE ID       CREATED          SIZE
us-central1-docker.pkg.dev/assignment2-438508/hello-repo/hello-app   v1        9e408e9d8375   49 seconds ago   27.3MB
```

Set your Compute Engine region:



```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignmebalzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-4
38508)$  gcloud config set compute/region us-central1
WARNING: Property validation for compute/region was skipped.
```

Enabling API



To use this API, you may need credentials.

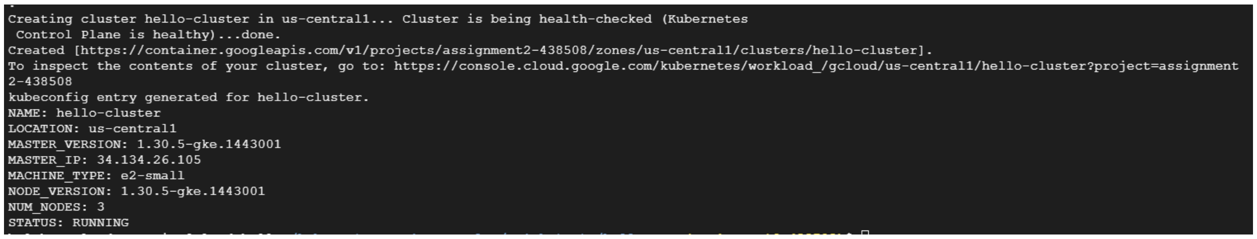
Kubernetes Engine API

Builds and manages container-based applications, powered by the open source Kubernetes technology.

By Google Enterprise API

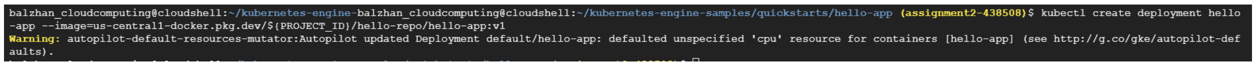
Service name	Type	Status	Documentation	Explore
container.googleapis.com	Public API	Enabled	LEARN MORE	TRY IN API EXPLORER

Create a cluster named hello-cluster:



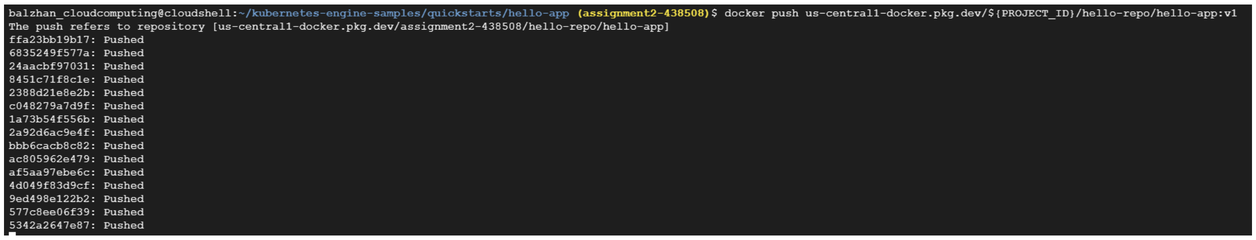
```
Creating cluster hello-cluster in us-central1... Cluster is being health-checked (Kubernetes
 Control Plane is healthy)...done.
Created [https://container.googleapis.com/v1/projects/assignment2-438508/zones/us-central1/clusters/hello-cluster].
To inspect the contents of your cluster, go to: https://console.cloud.google.com/kubernetes/workload_/gcloud/us-central1/hello-cluster?project=assignment
2-438508
kubeconfig entry generated for hello-cluster.
NAME: hello-cluster
LOCATION: us-central1
MASTER_VERSION: 1.30.5-gke.1443001
MASTER_IP: 34.134.26.105
MACHINE_TYPE: e2-small
NODE_VERSION: 1.30.5-gke.1443001
NUM_NODES: 3
STATUS: RUNNING
```

Create a Kubernetes Deployment for your hello-app Docker image.



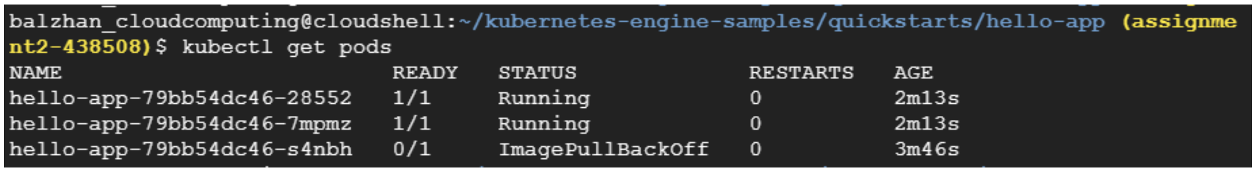
```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$ kubectl create deployment hello
-app --image=us-central1-docker.pkg.dev/${PROJECT_ID}/hello-repo/hello-app:v1
Warning: autopilot-default-resources-mutator:Autopilot updated Deployment default/hello-app: defaulted unspecified 'cpu' resource for containers [hello-app] (see http://g.co/gke/autopilot-def
aults).
```

Push the Docker image that you just built to the repository:



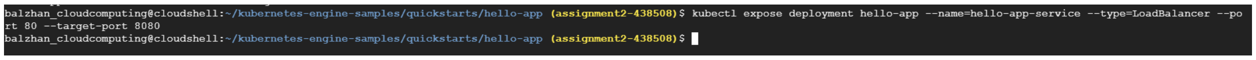
```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$ docker push us-central1-docker.pkg.dev/${PROJECT_ID}/hello-repo/hello-app:v1
The push refers to repository [us-central1-docker.pkg.dev/assignment2-438508/hello-repo/hello-app]
ffa23bb19b17: Pushed
6835249f577a: Pushed
24aacbf97031: Pushed
8451c71f8c1e: Pushed
2388d21e8e2b: Pushed
c048279a7d9f: Pushed
1a73b54f556b: Pushed
2a92d6ac9e4f: Pushed
bbb6cacb8c82: Pushed
ac805962e479: Pushed
af5aa97ebe6c: Pushed
4d049f83d9cf: Pushed
9ed498e122b2: Pushed
577c8ee06f39: Pushed
5342a2647e87: Pushed
```

To see the Pods created, run the following command:



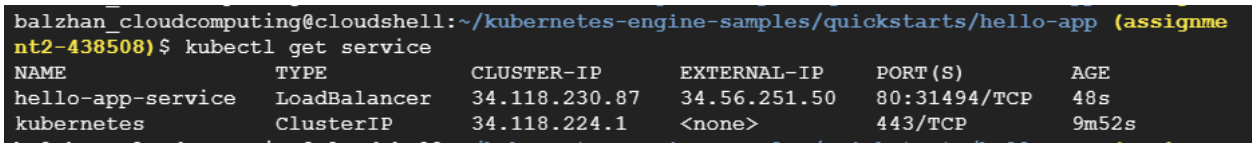
```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignme
nt2-438508)$ kubectl get pods
NAME                         READY   STATUS             RESTARTS   AGE
hello-app-79bb54dc46-28552   1/1     Running            0          2m13s
hello-app-79bb54dc46-7mpmz   1/1     Running            0          2m13s
hello-app-79bb54dc46-s4nbh   0/1     ImagePullBackOff   0          3m46s
```

Use the kubectl expose command to generate a Kubernetes Service for the hello-app deployment:



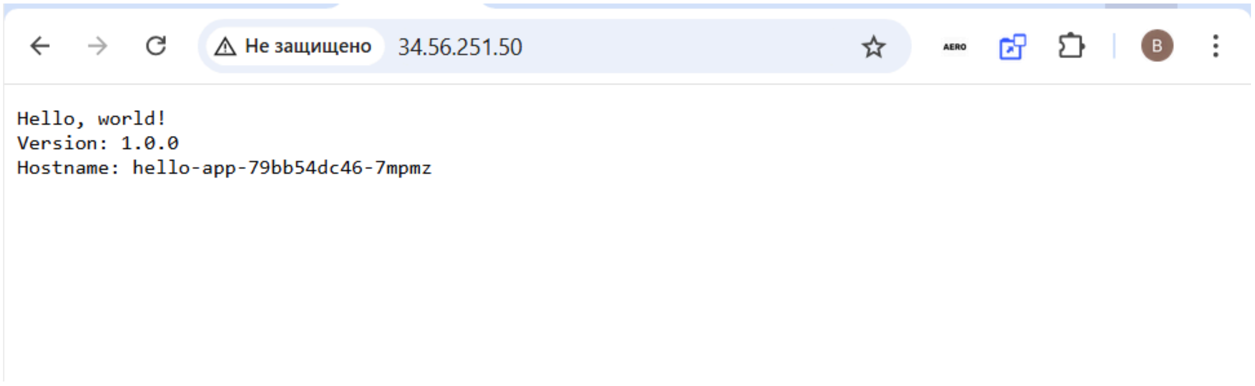
```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$ kubectl expose deployment hello-app --name=hello-app-service --type=LoadBalancer --po
rt 80 --target-port 8080
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$
```

Run the following command to get the Service details for hello-app-service:



```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignme
nt2-438508)$ kubectl get service
NAME                TYPE           CLUSTER-IP      EXTERNAL-IP    PORT(S)        AGE
hello-app-service   LoadBalancer   34.118.230.87   34.56.251.50   80:31494/TCP   48s
kubernetes          ClusterIP      34.118.224.1    <none>         443/TCP        9m52s
```

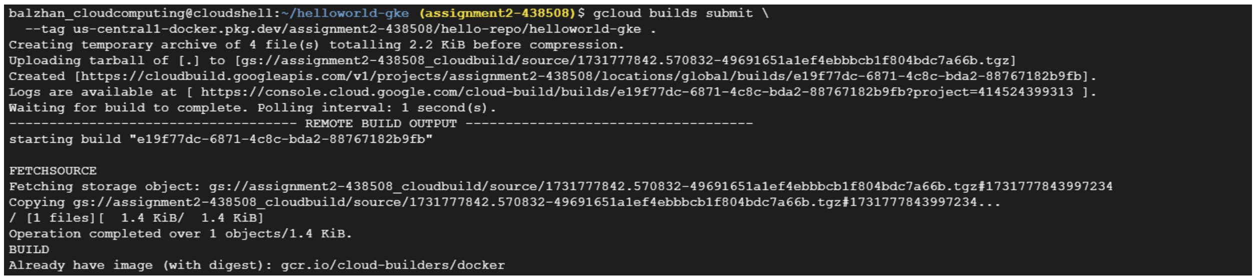
The app accessed through the internet



```
Hello, world!
Version: 1.0.0
Hostname: hello-app-79bb54dc46-7mpmz
```

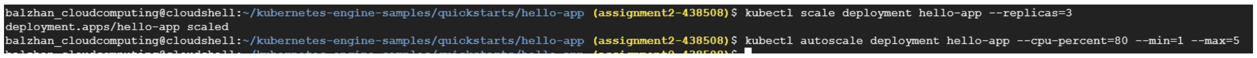
Exercise 5: Managing Pods and Deployments

Build your container image using Cloud Build, which is similar to running docker build and docker push, but the build happens on Google Cloud:



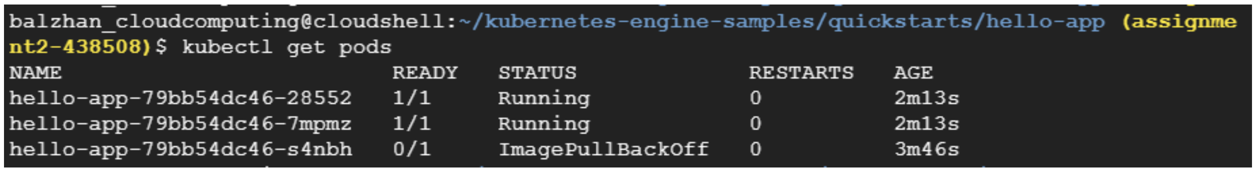
```
balzhan_cloudcomputing@cloudshell:~/helloworld-gke (assignment2-438508)$ gcloud builds submit \
  --tag us-central1-docker.pkg.dev/assignment2-438508/hello-repo/helloworld-gke .
Creating temporary archive of 4 file(s) totalling 2.2 KiB before compression.
Uploading tarball of [.] to [gs://assignment2-438508_cloudbuild/source/1731777842.570832-49691651a1ef4ebbbcb1f804bdc7a66b.tgz]
Created [https://cloudbuild.googleapis.com/v1/projects/assignment2-438508/locations/global/builds/e19f77dc-6871-4c8c-bda2-88767182b9fb].
Logs are available at [ https://console.cloud.google.com/cloud-build/builds/e19f77dc-6871-4c8c-bda2-88767182b9fb?project=414524399313 ].
Waiting for build to complete. Polling interval: 1 second(s).
------------------------------------ REMOTE BUILD OUTPUT ------------------------------------
starting build "e19f77dc-6871-4c8c-bda2-88767182b9fb"

FETCHSOURCE
Fetching storage object: gs://assignment2-438508_cloudbuild/source/1731777842.570832-49691651a1ef4ebbbcb1f804bdc7a66b.tgz#1731777843997234
Copying gs://assignment2-438508_cloudbuild/source/1731777842.570832-49691651a1ef4ebbbcb1f804bdc7a66b.tgz#1731777843997234...
/ [1 files][  1.4 KiB/  1.4 KiB]
Operation completed over 1 objects/1.4 KiB.
BUILD
Already have image (with digest): gcr.io/cloud-builders/docker
```

Create a HorizontalPodAutoscaler resource for your Deployment.

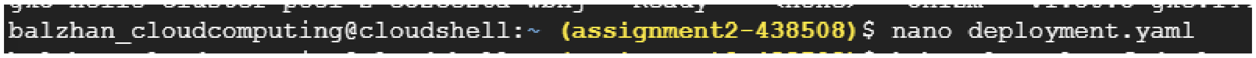


```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$ kubectl scale deployment hello-app --replicas=3
deployment.apps/hello-app scaled
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignment2-438508)$ kubectl autoscale deployment hello-app --cpu-percent=80 --min=1 --max=5
```

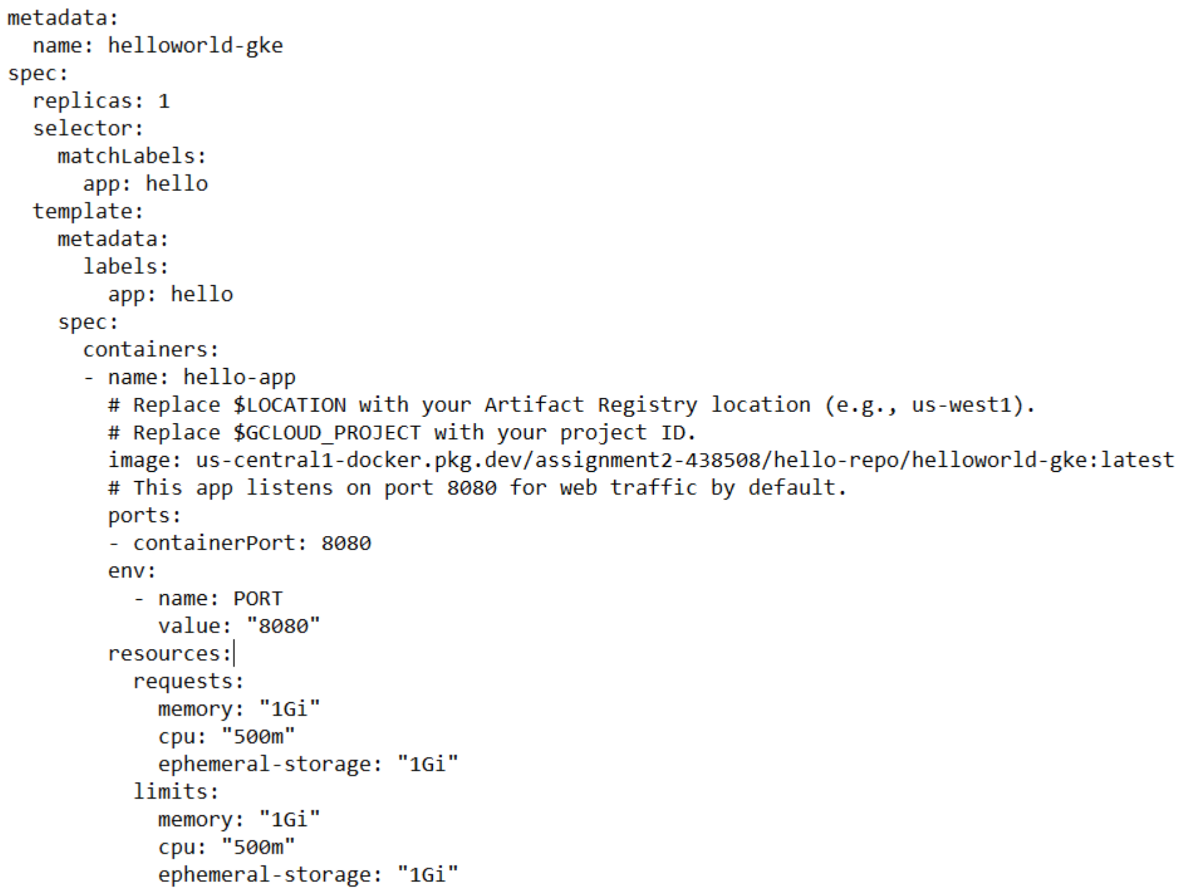
To see the Pods created, run the following command:



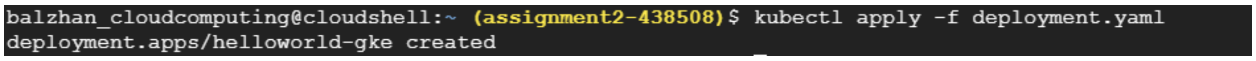
```
balzhan_cloudcomputing@cloudshell:~/kubernetes-engine-samples/quickstarts/hello-app (assignme
nt2-438508)$ kubectl get pods
NAME                         READY   STATUS             RESTARTS   AGE
hello-app-79bb54dc46-28552   1/1     Running            0          2m13s
hello-app-79bb54dc46-7mpmz   1/1     Running            0          2m13s
hello-app-79bb54dc46-s4nbh   0/1     ImagePullBackOff   0          3m46s
```



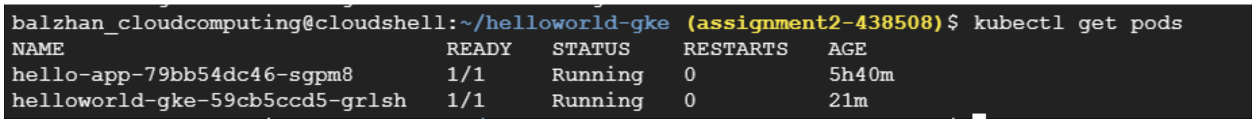
```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ nano deployment.yaml
```



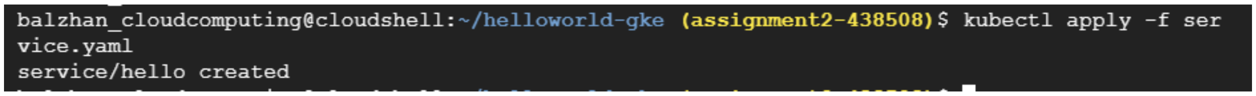
```yaml
metadata:
  name: helloworld-gke
spec:
  replicas: 1
  selector:
    matchLabels:
      app: hello
  template:
    metadata:
      labels:
        app: hello
    spec:
      containers:
      - name: hello-app
        # Replace $LOCATION with your Artifact Registry location (e.g., us-west1).
        # Replace $GCLOUD_PROJECT with your project ID.
        image: us-central1-docker.pkg.dev/assignment2-438508/hello-repo/helloworld-gke:latest
        # This app listens on port 8080 for web traffic by default.
        ports:
        - containerPort: 8080
        env:
          - name: PORT
            value: "8080"
        resources:
          requests:
            memory: "1Gi"
            cpu: "500m"
            ephemeral-storage: "1Gi"
          limits:
            memory: "1Gi"
            cpu: "500m"
            ephemeral-storage: "1Gi"
```



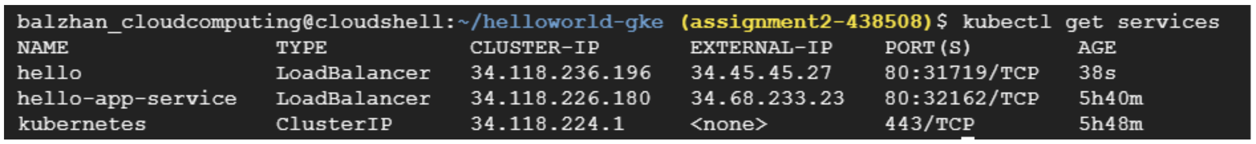
```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ kubectl apply -f deployment.yaml
deployment.apps/helloworld-gke created
```



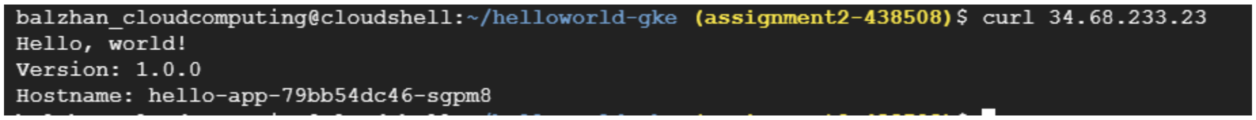
```
balzhan_cloudcomputing@cloudshell:~/helloworld-gke (assignment2-438508)$ kubectl get pods
NAME                             READY   STATUS    RESTARTS   AGE
hello-app-79bb54dc46-sgpm8       1/1     Running   0          5h40m
helloworld-gke-59cb5ccd5-grlsh   1/1     Running   0          21m
```



```
balzhan_cloudcomputing@cloudshell:~/helloworld-gke (assignment2-438508)$ kubectl apply -f ser
vice.yaml
service/hello created
```



```
balzhan_cloudcomputing@cloudshell:~/helloworld-gke (assignment2-438508)$ kubectl get services
NAME                TYPE           CLUSTER-IP       EXTERNAL-IP    PORT(S)        AGE
hello               LoadBalancer   34.118.236.196   34.45.45.27    80:31719/TCP   38s
hello-app-service   LoadBalancer   34.118.226.180   34.68.233.23   80:32162/TCP   5h40m
kubernetes          ClusterIP      34.118.224.1     <none>         443/TCP        5h48m
```

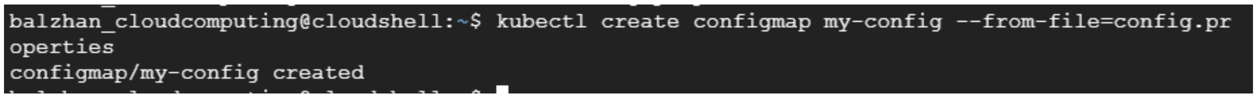


```
balzhan_cloudcomputing@cloudshell:~/helloworld-gke (assignment2-438508)$ curl 34.68.233.23
Hello, world!
Version: 1.0.0
Hostname: hello-app-79bb54dc46-sgpm8
```

Exercise 6: ConfigMaps and Secrets

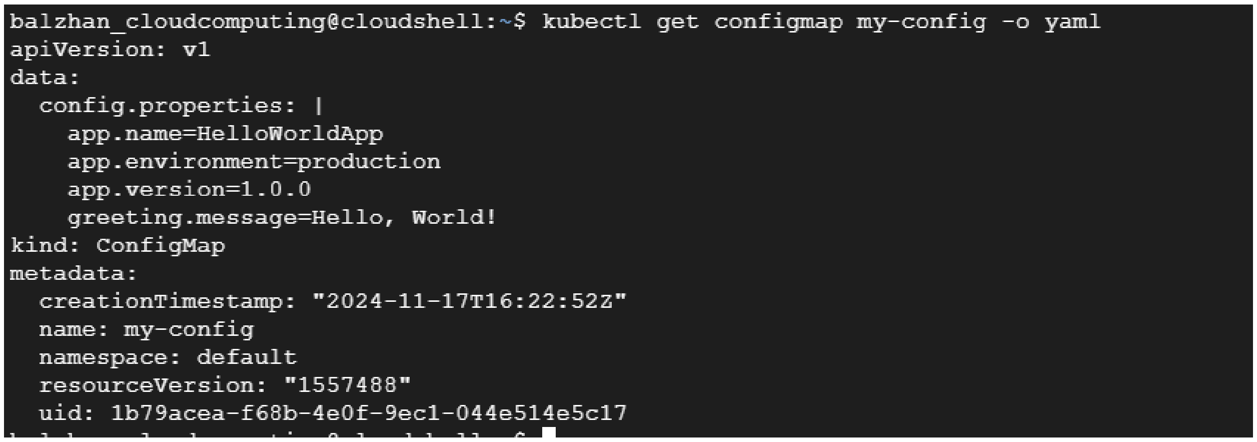
A ConfigMap is used to store non-sensitive configuration data in key-value pairs.

1. **Create ConfigMap from a file:**



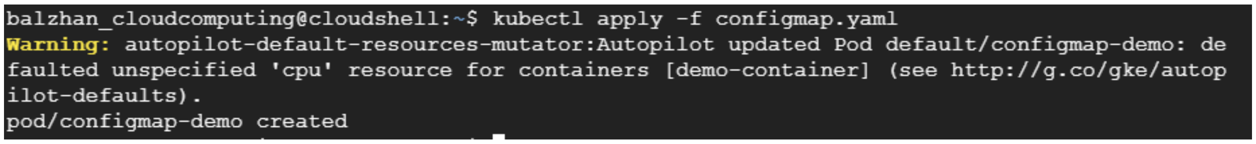
```
balzhan_cloudcomputing@cloudshell:~$ kubectl create configmap my-config --from-file=config.pr
operties
configmap/my-config created
```

Verify the ConfigMap:



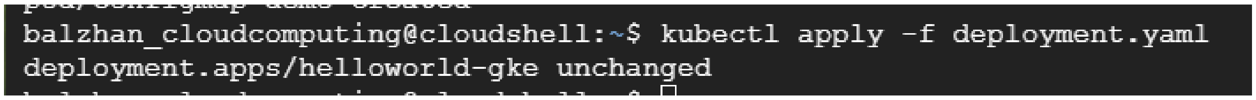
```
balzhan_cloudcomputing@cloudshell:~$ kubectl get configmap my-config -o yaml
apiVersion: v1
data:
  config.properties: |
    app.name=HelloWorldApp
    app.environment=production
    app.version=1.0.0
    greeting.message=Hello, World!
kind: ConfigMap
metadata:
  creationTimestamp: "2024-11-17T16:22:52Z"
  name: my-config
  namespace: default
  resourceVersion: "1557488"
  uid: 1b79acea-f68b-4e0f-9ec1-044e514e5c17
```

Applying the configmap file with stored keys



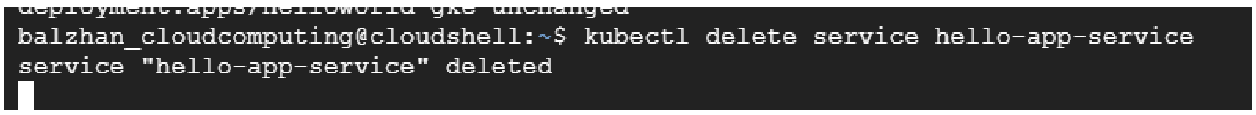
```
balzhan_cloudcomputing@cloudshell:~$ kubectl apply -f configmap.yaml
Warning: autopilot-default-resources-mutator:Autopilot updated Pod default/configmap-demo: de
faulted unspecified 'cpu' resource for containers [demo-container] (see http://g.co/gke/autop
ilot-defaults).
pod/configmap-demo created
```

Deploy app with new configured keys



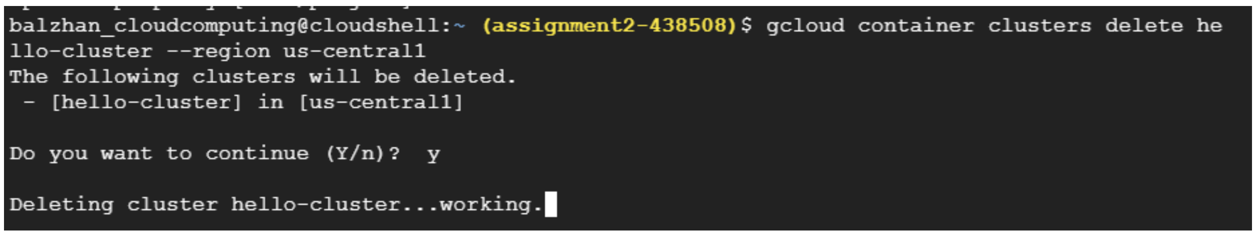
```
balzhan_cloudcomputing@cloudshell:~$ kubectl apply -f deployment.yaml
deployment.apps/helloworld-gke unchanged
```

Clean up



```
balzhan_cloudcomputing@cloudshell:~$ kubectl delete service hello-app-service
service "hello-app-service" deleted
```

Deleting the cluster

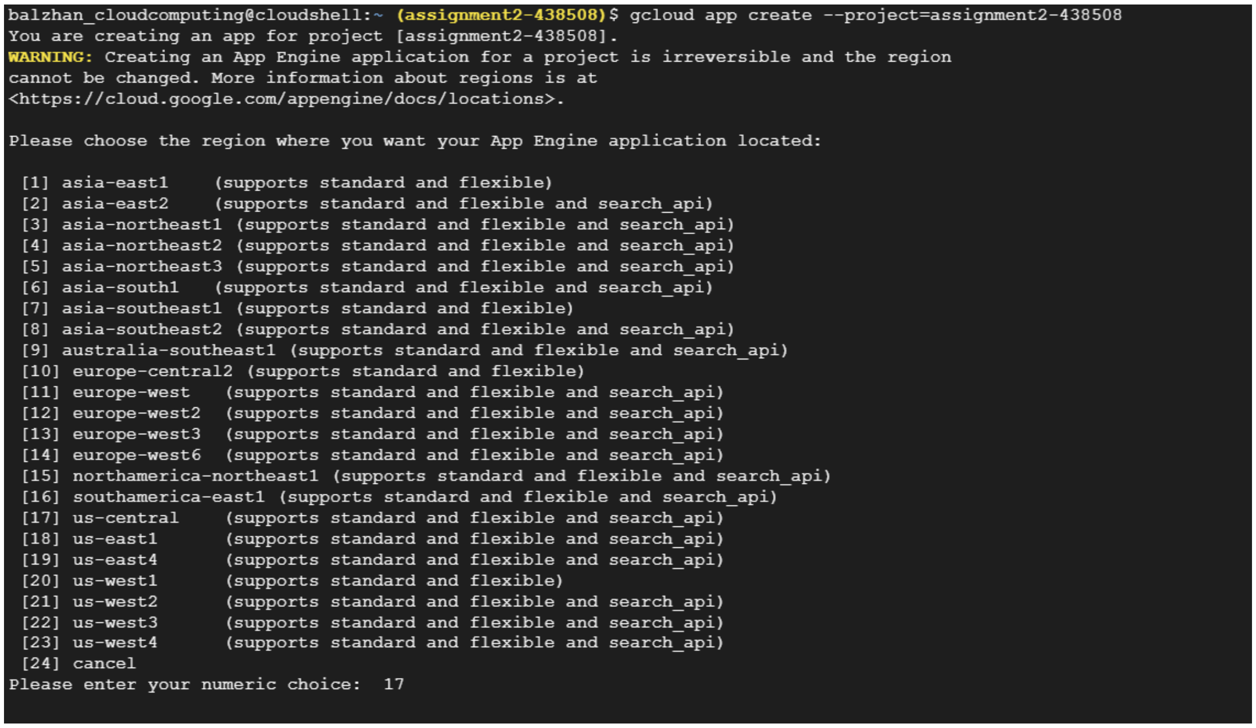


```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ gcloud container clusters delete he
llo-cluster --region us-central1
The following clusters will be deleted.
 - [hello-cluster] in [us-central1]

Do you want to continue (Y/n)?  y

Deleting cluster hello-cluster...working.
```

App Engine and Cloud Functions

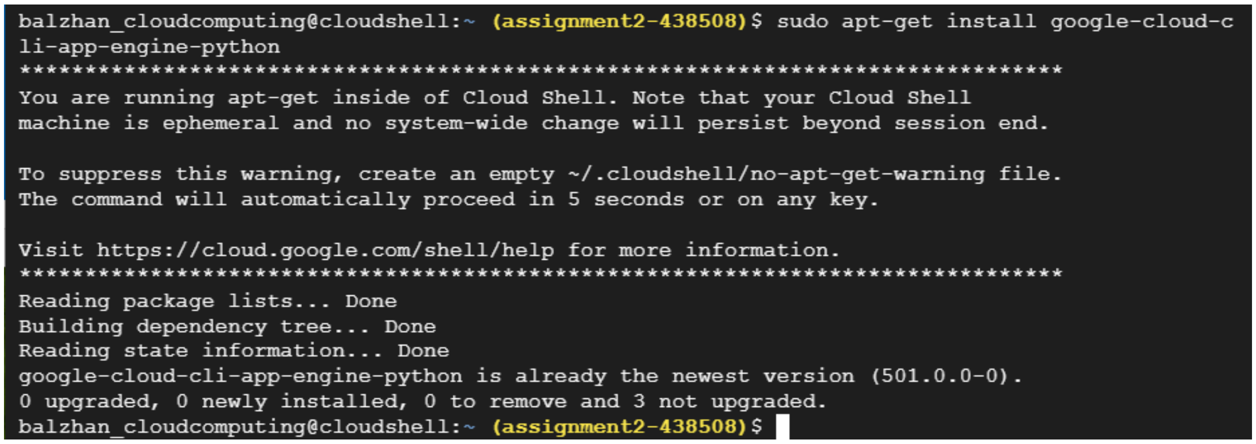
Exercise 7: Deploying an App on App Engine

Initialize your App Engine app with your project and choose its region:



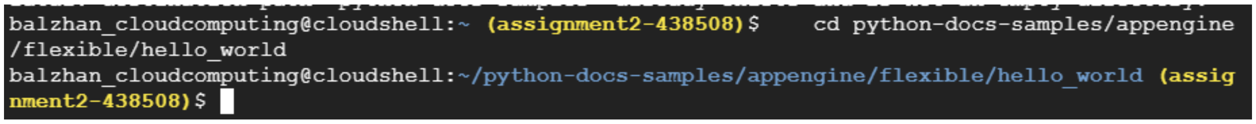
```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ gcloud app create --project=assignment2-438508
You are creating an app for project [assignment2-438508].
WARNING: Creating an App Engine application for a project is irreversible and the region
cannot be changed. More information about regions is at
<https://cloud.google.com/appengine/docs/locations>.

Please choose the region where you want your App Engine application located:

 [1] asia-east1    (supports standard and flexible)
 [2] asia-east2    (supports standard and flexible and search_api)
 [3] asia-northeast1 (supports standard and flexible and search_api)
 [4] asia-northeast2 (supports standard and flexible and search_api)
 [5] asia-northeast3 (supports standard and flexible and search_api)
 [6] asia-south1   (supports standard and flexible and search_api)
 [7] asia-southeast1 (supports standard and flexible)
 [8] asia-southeast2 (supports standard and flexible and search_api)
 [9] australia-southeast1 (supports standard and flexible and search_api)
 [10] europe-central2 (supports standard and flexible)
 [11] europe-west   (supports standard and flexible and search_api)
 [12] europe-west2  (supports standard and flexible and search_api)
 [13] europe-west3  (supports standard and flexible and search_api)
 [14] europe-west6  (supports standard and flexible and search_api)
 [15] northamerica-northeast1 (supports standard and flexible and search_api)
 [16] southamerica-east1 (supports standard and flexible and search_api)
 [17] us-central    (supports standard and flexible and search_api)
 [18] us-east1      (supports standard and flexible and search_api)
 [19] us-east4      (supports standard and flexible and search_api)
 [20] us-west1      (supports standard and flexible)
 [21] us-west2      (supports standard and flexible and search_api)
 [22] us-west3      (supports standard and flexible and search_api)
 [23] us-west4      (supports standard and flexible and search_api)
 [24] cancel
Please enter your numeric choice:  17
```

Run the following command to install the gcloud component that includes the App Engine extension for Python:



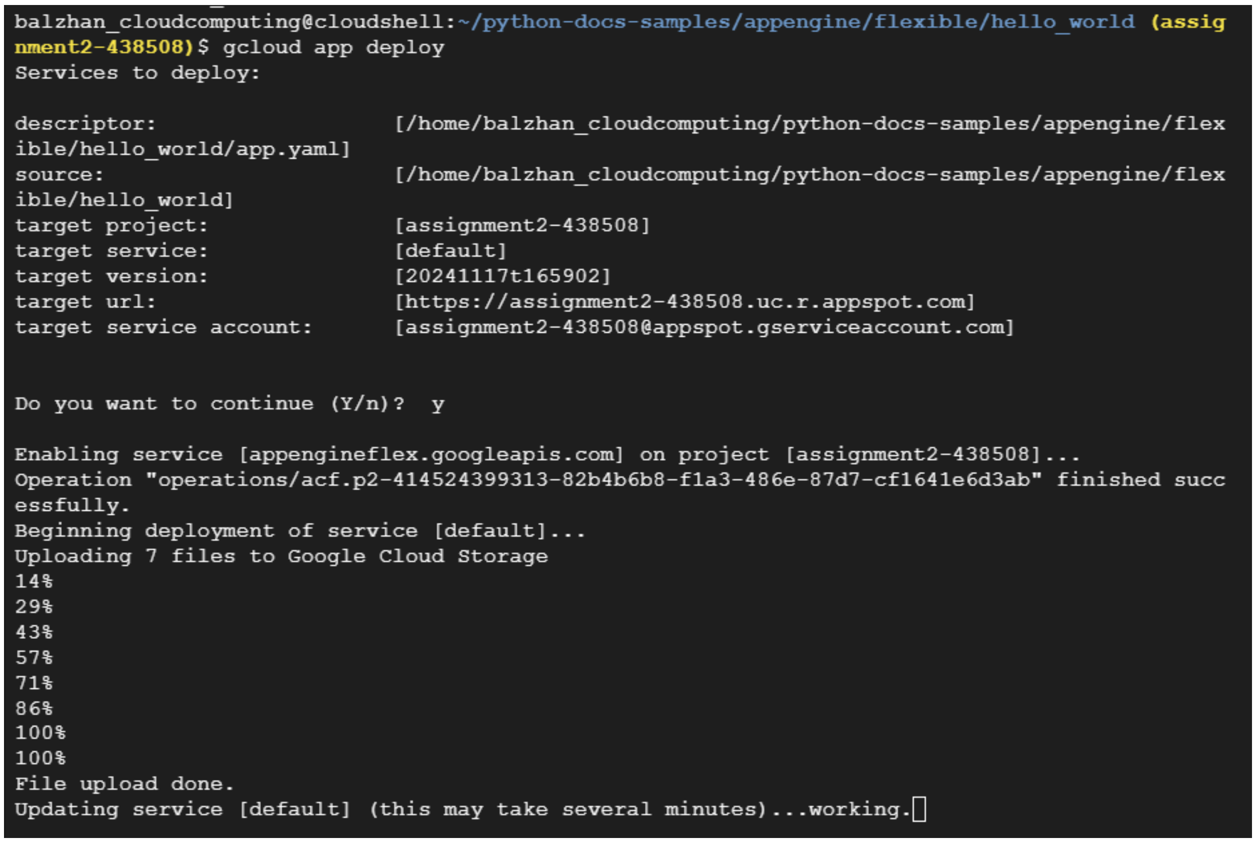
```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$ sudo apt-get install google-cloud-c
li-app-engine-python
********************************************************************************
You are running apt-get inside of Cloud Shell. Note that your Cloud Shell
machine is ephemeral and no system-wide change will persist beyond session end.

To suppress this warning, create an empty ~/.cloudshell/no-apt-get-warning file.
The command will automatically proceed in 5 seconds or on any key.

Visit https://cloud.google.com/shell/help for more information.
********************************************************************************
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
google-cloud-cli-app-engine-python is already the newest version (501.0.0-0).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$
```

Change to the directory that contains the sample code.



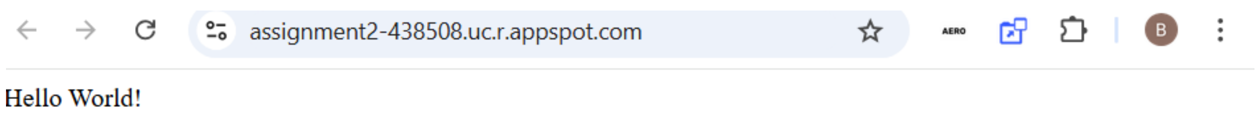
```
balzhan_cloudcomputing@cloudshell:~ (assignment2-438508)$    cd python-docs-samples/appengine
/flexible/hello_world
balzhan_cloudcomputing@cloudshell:~/python-docs-samples/appengine/flexible/hello_world (assig
nment2-438508)$
```

Deploy the Hello World app by running the following command from the hello_world directory:



```
balzhan_cloudcomputing@cloudshell:~/python-docs-samples/appengine/flexible/hello_world (assig
nment2-438508)$ gcloud app deploy
Services to deploy:

descriptor:                  [/home/balzhan_cloudcomputing/python-docs-samples/appengine/flex
ible/hello_world/app.yaml]
source:                      [/home/balzhan_cloudcomputing/python-docs-samples/appengine/flex
ible/hello_world]
target project:              [assignment2-438508]
target service:              [default]
target version:              [20241117t165902]
target url:                  [https://assignment2-438508.uc.r.appspot.com]
target service account:      [assignment2-438508@appspot.gserviceaccount.com]


Do you want to continue (Y/n)?  y

Enabling service [appengineflex.googleapis.com] on project [assignment2-438508]...
Operation "operations/acf.p2-414524399313-82b4b6b8-f1a3-486e-87d7-cf1641e6d3ab" finished succ
essfully.
Beginning deployment of service [default]...
Uploading 7 files to Google Cloud Storage
14%
29%
43%
57%
71%
86%
100%
100%
File upload done.
Updating service [default] (this may take several minutes)...working.
```

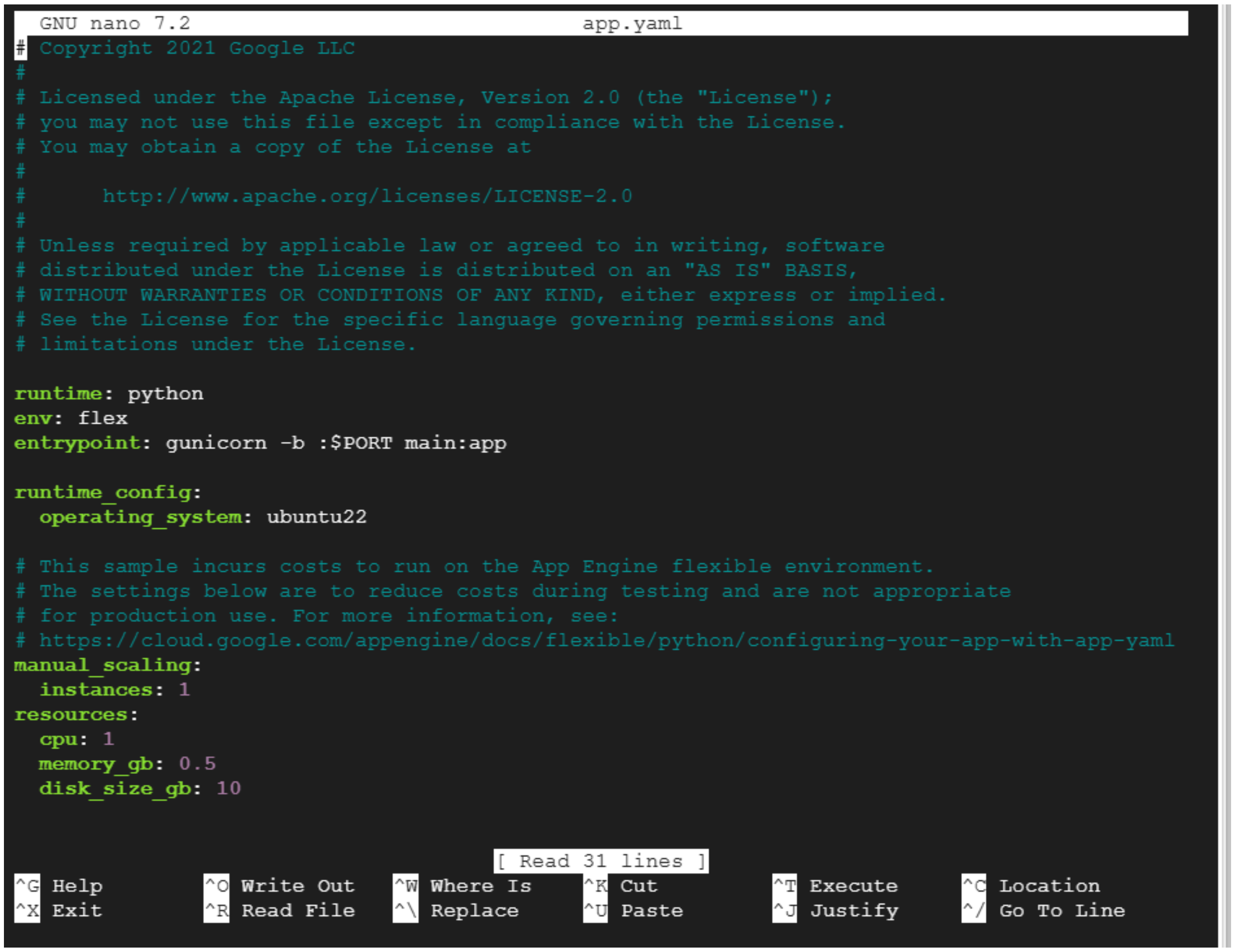
Launching an app



assignment2-438508.uc.r.appspot.com

Hello World!

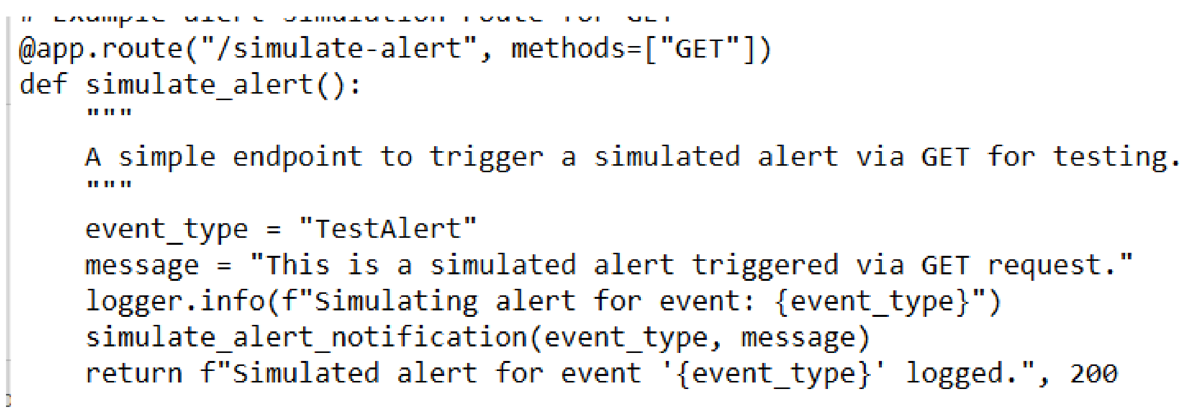
The app.yaml file describes the following configuration for your app:



```
  GNU nano 7.2                                  app.yaml
# Copyright 2021 Google LLC
#
# Licensed under the Apache License, Version 2.0 (the "License");
# you may not use this file except in compliance with the License.
# You may obtain a copy of the License at
#
#      http://www.apache.org/licenses/LICENSE-2.0
#
# Unless required by applicable law or agreed to in writing, software
# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.

runtime: python
env: flex
entrypoint: gunicorn -b :$PORT main:app

runtime_config:
  operating_system: ubuntu22

# This sample incurs costs to run on the App Engine flexible environment.
# The settings below are to reduce costs during testing and are not appropriate
# for production use. For more information, see:
# https://cloud.google.com/appengine/docs/flexible/python/configuring-your-app-with-app-yaml
manual_scaling:
  instances: 1
resources:
  cpu: 1
  memory_gb: 0.5
  disk_size_gb: 10

                                        [ Read 31 lines ]
^G Help        ^O Write Out   ^W Where Is    ^K Cut         ^T Execute     ^C Location
^X Exit        ^R Read File   ^\ Replace     ^U Paste       ^J Justify     ^/ Go To Line
```

Exercise 8: Using Cloud Functions

Adding triggering event on entering the application



```
# Example alert simulation route for GET
@app.route("/simulate-alert", methods=["GET"])
def simulate_alert():
    """
    A simple endpoint to trigger a simulated alert via GET for testing.
    """
    event_type = "TestAlert"
    message = "This is a simulated alert triggered via GET request."
    logger.info(f"Simulating alert for event: {event_type}")
    simulate_alert_notification(event_type, message)
    return f"Simulated alert for event '{event_type}' logged.", 200
```

Endpoint for triggering alert **/trigger-alert:**

- Accepts a **POST** request with a JSON payload to trigger an alert.

  Example payload:
  {

   "event_type": "ErrorEvent",

   "message": "Something went wrong."

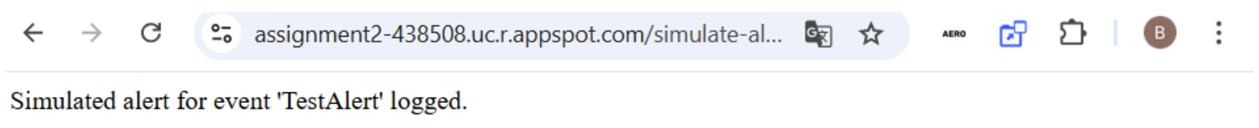
  }

- **/simulate-alert:**

A simple **GET** endpoint to simulate an alert with hardcoded values.

Simulated Alert Notification:

- Logs the simulated notification.
- Can be extended to send real notifications (e.g., email or SMS using APIs like SendGrid or Twilio).



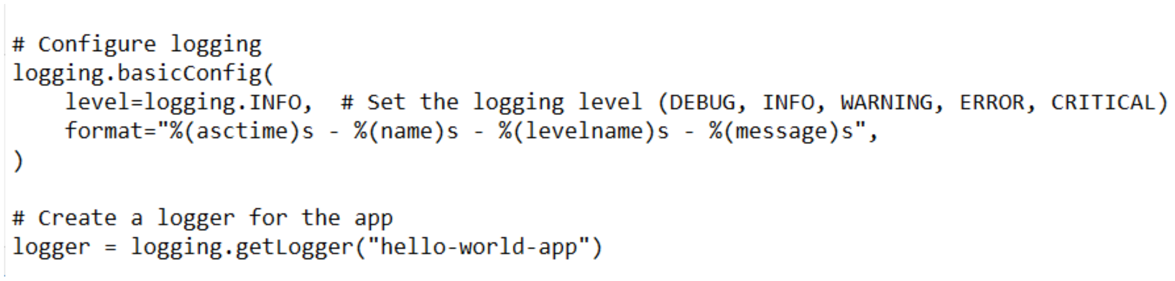
assignment2-438508.uc.r.appspot.com/simulate-al...

Simulated alert for event 'TestAlert' logged.

Simulated alert from the endpoint

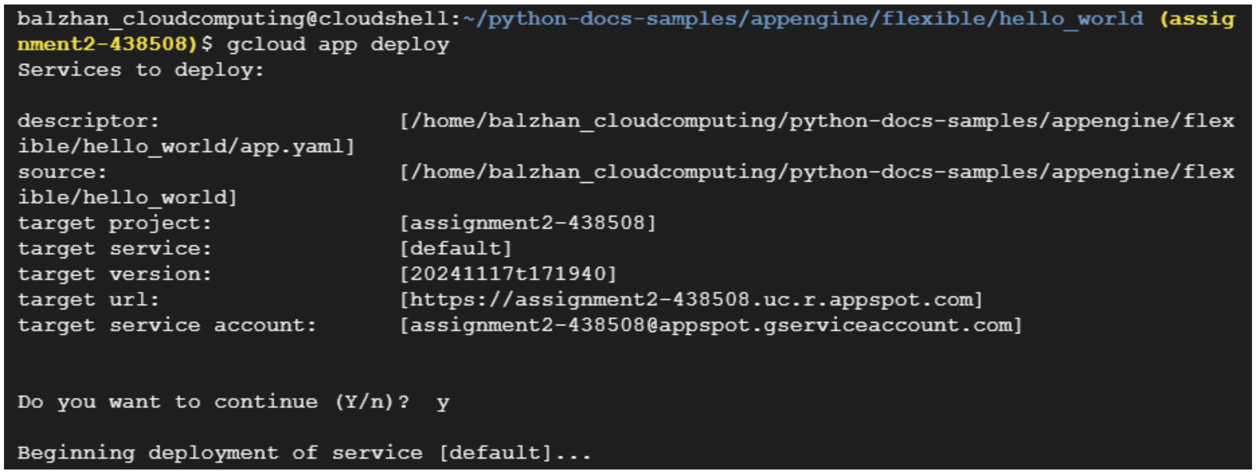
Exercise 9: Monitoring and Logging

Adding this logging to the main.py file



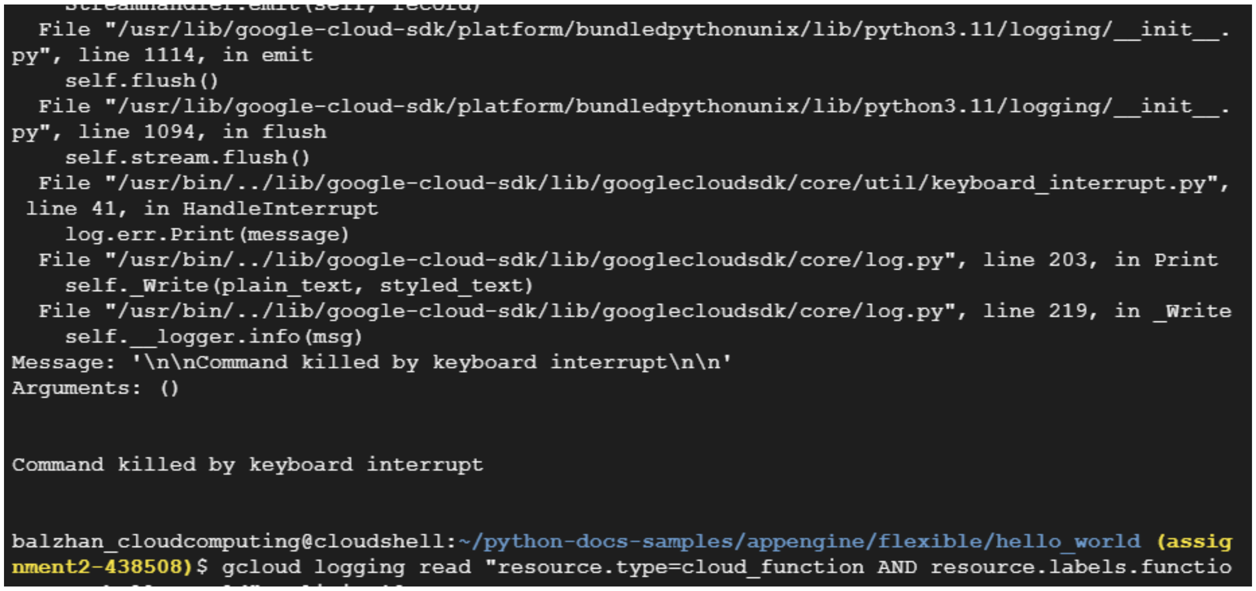
```
# Configure logging
logging.basicConfig(
    level=logging.INFO,  # Set the logging level (DEBUG, INFO, WARNING, ERROR, CRITICAL)
    format="%(asctime)s - %(name)s - %(levelname)s - %(message)s",
)

# Create a logger for the app
logger = logging.getLogger("hello-world-app")
```

Redeploying an app



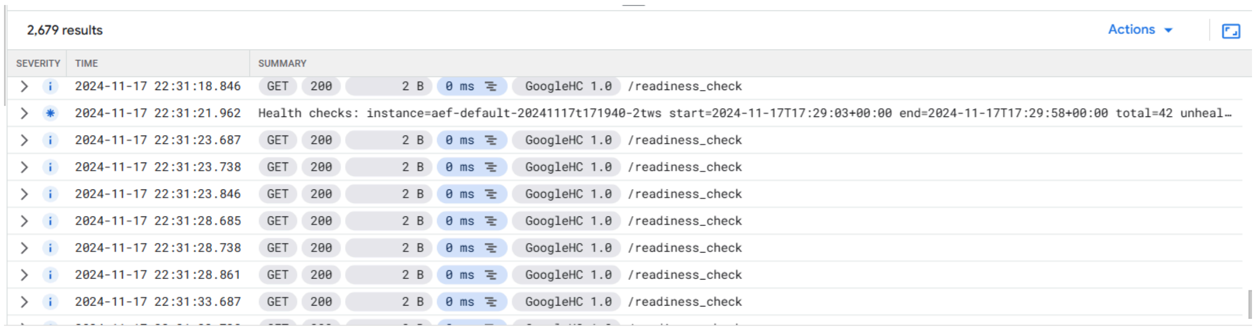
```
balzhan_cloudcomputing@cloudshell:~/python-docs-samples/appengine/flexible/hello_world (assig
nment2-438508)$ gcloud app deploy
Services to deploy:

descriptor:                  [/home/balzhan_cloudcomputing/python-docs-samples/appengine/flex
ible/hello_world/app.yaml]
source:                      [/home/balzhan_cloudcomputing/python-docs-samples/appengine/flex
ible/hello_world]
target project:              [assignment2-438508]
target service:              [default]
target version:              [20241117t171940]
target url:                  [https://assignment2-438508.uc.r.appspot.com]
target service account:      [assignment2-438508@appspot.gserviceaccount.com]


Do you want to continue (Y/n)?  y

Beginning deployment of service [default]...
```

Logging in the console



```
    StreamHandler.emit(self, record)
  File "/usr/lib/google-cloud-sdk/platform/bundledpythonunix/lib/python3.11/logging/__init__.
py", line 1114, in emit
    self.flush()
  File "/usr/lib/google-cloud-sdk/platform/bundledpythonunix/lib/python3.11/logging/__init__.
py", line 1094, in flush
    self.stream.flush()
  File "/usr/bin/../lib/google-cloud-sdk/lib/googlecloudsdk/core/util/keyboard_interrupt.py",
 line 41, in HandleInterrupt
    log.err.Print(message)
  File "/usr/bin/../lib/google-cloud-sdk/lib/googlecloudsdk/core/log.py", line 203, in Print
    self._Write(plain_text, styled_text)
  File "/usr/bin/../lib/google-cloud-sdk/lib/googlecloudsdk/core/log.py", line 219, in _Write
    self.__logger.info(msg)
Message: '\n\nCommand killed by keyboard interrupt\n\n'
Arguments: ()


Command killed by keyboard interrupt


balzhan_cloudcomputing@cloudshell:~/python-docs-samples/appengine/flexible/hello_world (assig
nment2-438508)$ gcloud logging read "resource.type=cloud_function AND resource.labels.functio
```

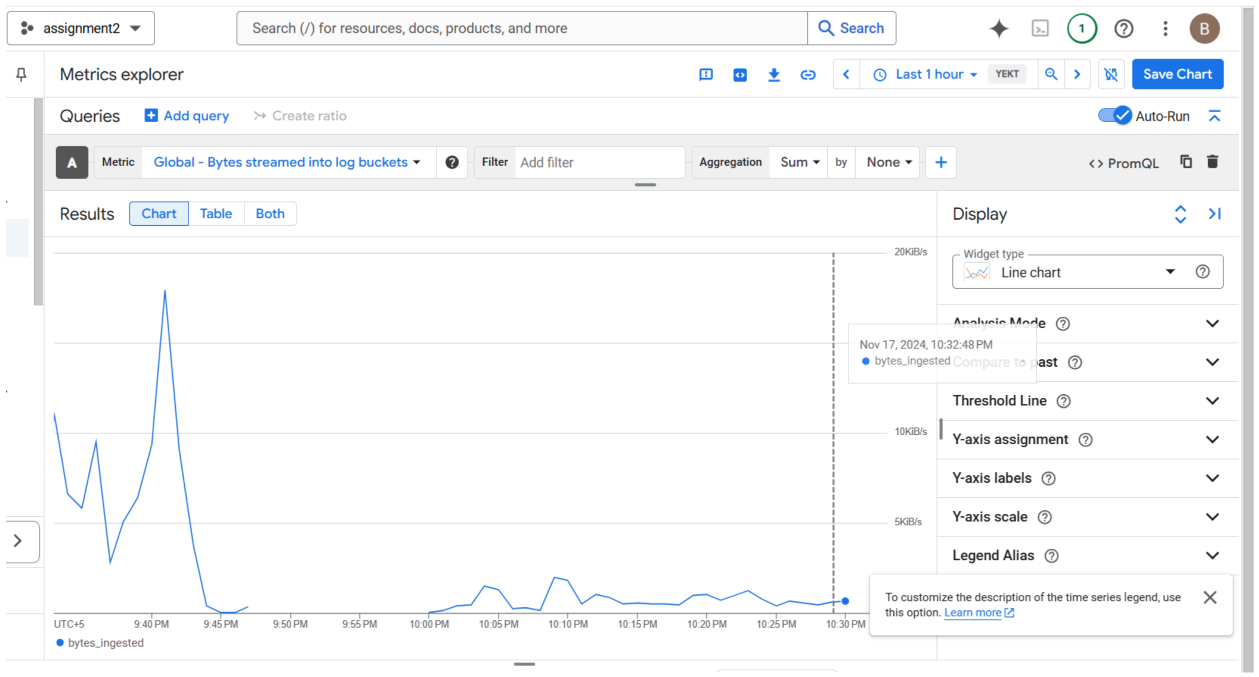
In the logs explorer we can see



```
2,679 results                                                                                          Actions

SEVERITY  TIME                      SUMMARY
>  i   2024-11-17 22:31:18.846   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
>  *   2024-11-17 22:31:21.962   Health checks: instance=aef-default-20241117t171940-2tws start=2024-11-17T17:29:03+00:00 end=2024-11-17T17:29:58+00:00 total=42 unheal…
>  i   2024-11-17 22:31:23.687   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
>  i   2024-11-17 22:31:23.738   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
>  i   2024-11-17 22:31:23.846   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
>  i   2024-11-17 22:31:28.685   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
>  i   2024-11-17 22:31:28.738   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
>  i   2024-11-17 22:31:28.861   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
>  i   2024-11-17 22:31:33.687   GET  200    2 B  0 ms   GoogleHC 1.0  /readiness_check
```

We can also set up dashboards for logging

- Navigate to **Monitoring > Dashboards** in the Cloud Console.
- Click **Create Dashboard** and add widgets to visualize metrics such as:
  - HTTP request count
  - Error rate
  - Latency



Metric: Global - Bytes streamed into log buckets

Filter: Add filter

Aggregation: Sum by None

Widget type: Line chart

Nov 17, 2024, 10:32:48 PM
● bytes_ingested

To customize the description of the time series legend, use this option. Learn more

2. **Add Metrics for App Engine:**
   - Metric Type: appengine.googleapis.com/http/server/response_count
   - Filter: resource.labels.module_id = "default"
3. **Add Metrics for Cloud Functions:**
   - Metric Type: cloudfunctions.googleapis.com/function/execution_count
   - Filter: resource.labels.function_name = "hello-world"

Conclusion

In conclusion, this set of exercises has helped us dive into essential Google Cloud Platform services like IAM, GKE, App Engine, and Cloud Functions. While some parts of the assignment were straightforward, such as setting up IAM roles and deploying applications to App Engine, other tasks proved to be more challenging. For instance, working with Google Kubernetes Engine required a deeper understanding of container orchestration, managing multi-container deployments, and scaling applications. Additionally, creating and managing service accounts for authenticating with Google Cloud Storage, as well as applying organization policies, required careful attention to permissions and restrictions. Despite these challenges, the exercises provided valuable hands-on experience that will be crucial for developing secure, scalable, and efficient cloud applications in the future.

References

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4. https://cloud.google.com/kubernetes-engine/docs/concepts/security-overview
5. GKE overview | Google Kubernetes Engine (GKE) | Google Cloud