Week 10: Homework: Chapter 7: Configmap: Signature Project: MongoDB + Python Flask Web Framework + REST API + GKE

We are going to deploy two application under one domain into GKE. One built with node.js and another using python. Both application used mongodb server for data source and data operation.

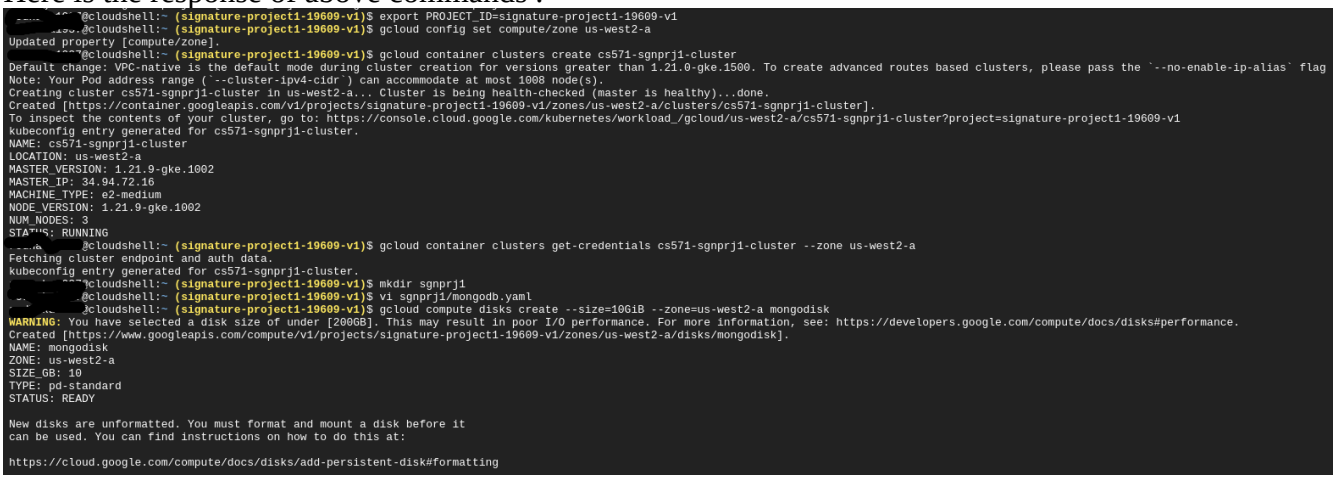
We need to create cluster -

```
$ export PROJECT_ID=signature-project1-19609-v1
$ gcloud config set compute/zone us-west2-a
$ gcloud container clusters create cs571-sgnprj1-cluster
$ gcloud container clusters get-credentials cs571-sgnprj1-cluster --zone us-west2-a
```

Now we need to create storage disk for mongodb.

```
$ gcloud compute disks create --size=10GiB --zone=us-west2-a mongodisk
```

Here is the response of above commands .



Now we will create a load balance service for mongodb deployment and we will deploy mongodb. Here is the YAML (mongodb-service.yaml) file for mongodb load-balancer-

```
apiVersion: v1
kind: Service
metadata:
  name: mongodb-service
spec:
  type: LoadBalancer
  ports:
    - port: 27017
      targetPort: 27017
  selector:
    app: mongodb
```

And here is the YAML (mongodb.yaml) file for mongodb deployment -

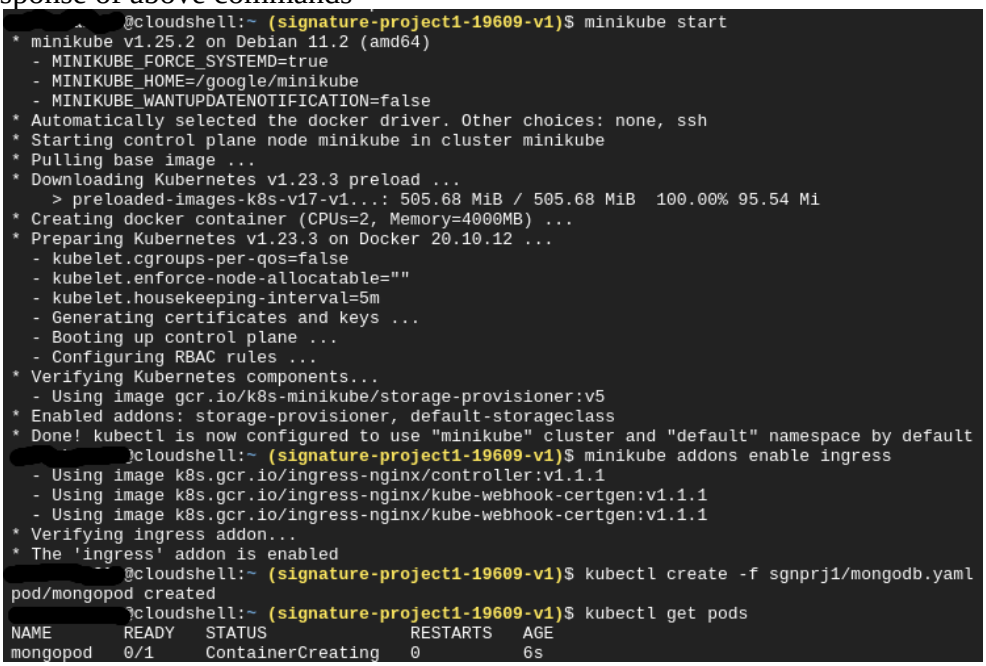
```
apiVersion: apps/v1
kind: Deployment
```

```
metadata:
  name: mongodb-deployment
spec:
  selector:
    matchLabels:
      app: mongodb
  strategy:
    type: Recreate
  template:
    metadata:
      labels:
        app: mongodb
    spec:
      volumes:
      - name: mongodb-data
        gcePersistentDisk:
          pdName: mongodisk
          fsType: ext4
      containers:
      - image: mongo
        name: mongodb
        volumeMounts:
        - name: mongodb-data
          mountPath: /data/db
        ports:
        - containerPort: 27017
          protocol: TCP
```

Start minikube and enable ingress, cause we need it later. Then we create mongo db pod

```
$ minikube start
$ minikube addons enable ingress
$ kubectl apply -f sgnprj1/mongodb-service.yaml
$ kubectl create -f sgnprj1/mongodb.yaml
```

Here is the response of above commands -



And here is the mongodb service with IP -

```
[redacted]@cloudshell:~ (signature-project1-19609-v1)$ kubectl get service
NAME              TYPE           CLUSTER-IP    EXTERNAL-IP   PORT(S)           AGE
kubernetes        ClusterIP      10.40.0.1     <none>        443/TCP           121m
mongodb-service   LoadBalancer   10.40.12.35   34.94.54.39   27017:32449/TCP   6m14s
[redacted]@cloudshell:~ (signature-project1-19609-v1)$
```

Now we need to check if mongodb can access by this service IP.

```
$ kubectl exec -it mongodb-deployment-68c6f84d89-hcsf4 -- bash
# mongo 34.94.54.39
```

Here is the response -

```
[redacted]@cloudshell:~ (signature-project1-19609-v1)$ kubectl exec -it mongodb-deployment-68c6f84d89-hcsf4 -- bash
root@mongodb-deployment-68c6f84d89-hcsf4:/# mongo 34.94.54.39
MongoDB shell version v5.0.6
connecting to: mongodb://34.94.54.39:27017/test?compressors=disabled&gssapiServiceName=mongodb
Implicit session: session { "id" : UUID("ca6d9678-e87b-4409-9bad-e4828bcafc8e") }
MongoDB server version: 5.0.6
================
Warning: the "mongo" shell has been superseded by "mongosh",
which delivers improved usability and compatibility.The "mongo" shell has been deprecated and will be removed in
an upcoming release.
For installation instructions, see
https://docs.mongodb.com/mongodb-shell/install/
================
---
The server generated these startup warnings when booting:
        2022-03-30T03:32:52.510+00:00: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine. See http://dochub.mongodb.org/core/prodnotes-filesystem
        2022-03-30T03:32:53.200+00:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
---
---
        Enable MongoDB's free cloud-based monitoring service, which will then receive and display
        metrics about your deployment (disk utilization, CPU, operation statistics, etc).

        The monitoring data will be available on a MongoDB website with a unique URL accessible to you
        and anyone you share the URL with. MongoDB may use this information to make product
        improvements and to suggest MongoDB products and deployment options to you.

        To enable free monitoring, run the following command: db.enableFreeMonitoring()
        To permanently disable this reminder, run the following command: db.disableFreeMonitoring()
---
> exit
bye
root@mongodb-deployment-68c6f84d89-hcsf4:/# exit
exit
[redacted]@cloudshell:~ (signature-project1-19609-v1)$
```

Now we need to create our application. We have two applications. They are -

1. Student server
2. Bookshelf

Here is the code for student server -

>> studentServer.js

```
var http = require('http');
var url = require('url');
var mongodb = require('mongodb');
const { MONGO_URL, MONGO_DATABASE } = process.env;
var MongoClient = mongodb.MongoClient;
var uri = 'mongodb://${MONGO_URL}/${MONGO_DATABASE}';
// Connect to the db
console.log(uri);
var server = http.createServer(function (req, res) {
  var result;
  // req.url = /api/score?student_id=11111
  var parsedUrl = url.parse(req.url, true);
  var student_id = parseInt(parsedUrl.query.student_id);
  // match req.url with the string /api/score
  if (/^\/api\/score/.test(req.url)) {
  // e.g., of student_id 1111
```

```
  MongoClient.connect(uri,{ useNewUrlParser: true, useUnifiedTopology:
true }, function(err, client){
    if (err) throw err;
    var db = client.db("studentdb");
    db.collection("students").findOne({"student_id":student_id}, (err,
student) => {
      if(err) throw new Error(err.message, null);
      if (student) {
        res.writeHead(200, { 'Content-Type': 'application/json' });
        res.end(JSON.stringify(student)+ '\n');
      }else {
        res.writeHead(404);
        res.end("Student Not Found \n");
      }
    });
    });
  } else {
    res.writeHead(404);
    res.end("Wrong url, please try again\n");
  }
});
server.listen(8080);
```

>> Dockerfile

```
FROM node:7
ADD studentServer.js /studentServer.js
RUN npm install mongodb
ENTRYPOINT ["node", "studentServer.js"]
```

>> studentserver-configmap.yaml

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: studentserver-config
data:
  MONGO_URL: 34.82.46.209
  MONGO_DATABASE: mydb
```

>> studentserver-service.yaml

```
apiVersion: v1
kind: Service
metadata:
  name: studentserver-service
  annotations:
    cloud.google.com/neg: '{"ingress": true}'
spec:
  type: LoadBalancer
  ports:
      # service port in cluster
    - port: 8080
      # port to contact inside container
      targetPort: 8080
  selector:
    app: studentserver-deployment
```

>> studentserver-deployment.yaml

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: studentserver-deployment
  labels:
    app: studentserver-deployment
spec:
  replicas: 1
  selector:
    matchLabels:
      app: studentserver-deployment
  template:
    metadata:
      labels:
        app: studentserver-deployment
    spec:
      containers:
        - image: us-west2-docker.pkg.dev/signature-project1-19609-v1/cs571-
sgnprj1-repo/shkr19609-sgnprj1-student-server
          imagePullPolicy: Always
          name: studentserver-deployment
          command: [ "/bin/bash", "-ce", "tail -f /dev/null" ]
          ports:
            - containerPort: 8080
          env:
            - name: MONGO_URL
              valueFrom:
                configMapKeyRef:
                  name: studentserver-config
                  key: MONGO_URL
            - name: MONGO_DATABASE
              valueFrom:
                configMapKeyRef:
                  name: studentserver-config
                  key: MONGO_DATABASE
```

Here is the code for bookshelf application -

>> bookshelf.py

```
from flask import Flask, request, jsonify
from flask_pymongo import PyMongo
from flask import request
from bson.objectid import ObjectId
import socket
import os
app = Flask(__name__)
app.config["MONGO_URI"] ="mongodb://"+os.getenv("MONGO_URL")
+"/"+os.getenv("MONGO_DATABASE")
app.config['JSONIFY_PRETTYPRINT_REGULAR'] = True
mongo = PyMongo(app)
db = mongo.db
@app.route("/")
def index():
    hostname = socket.gethostname()
```

```
    return jsonify(message="Welcome to bookshelf app! I am running inside {}
pod!".format(hostname))
@app.route("/books")
def get_all_tasks():
    books = db.bookshelf.find()
    data = []
    for book in books:
        data.append({
            "id": str(book["_id"]),
            "Book Name": book["book_name"],
            "Book Author": book["book_author"],
            "ISBN" : book["ISBN"]
        })
    return jsonify( data )
@app.route("/book", methods=["POST"])
def add_book():
    book = request.get_json(force=True)
    db.bookshelf.insert_one({
        "book_name": book["book_name"],
        "book_author": book["book_author"],
        "ISBN": book["isbn"]
    })
    return jsonify( message="Task saved successfully!" )
@app.route("/book/<id>", methods=["PUT"])
def update_book(id):
    data = request.get_json(force=True)
    print(data)
    response = db.bookshelf.update_many(
        {"_id": ObjectId(id)},
        {"$set": {
            "book_name": data['book_name'],
            "book_author": data["book_author"],
            "ISBN": data["isbn"]
        }})
    if response.matched_count:
        message = "Task updated successfully!"
    else:
        message = "No book found!"
    return jsonify( message=message )
@app.route("/book/<id>", methods=["DELETE"])
def delete_task(id):
    response = db.bookshelf.delete_one({"_id": ObjectId(id)})
    if response.deleted_count:
        message = "Task deleted successfully!"
    else:
        message = "No book found!"
    return jsonify( message=message )
@app.route("/tasks/delete", methods=["POST"])
def delete_all_tasks():
    db.bookshelf.remove()
    return jsonify( message="All Books deleted!" )
if __name__ == "__main__":
    app.run(host="0.0.0.0", port=5000)
```

>>> Dockerfile

```
FROM python:alpine3.7
COPY . /app
WORKDIR /app
COPY requirements.txt requirements.txt
RUN pip install -r requirements.txt
ENV PORT 5000
EXPOSE 5000
ENTRYPOINT [ "python3", "bookshelf.py" ]
```

>> requirements.txt

```
Flask==2.1.0
Flask-PyMongo==2.3.0
```

>> bookshelf-configmap.yaml

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: bookshelf-config
data:
  # SERVICE_NAME.NAMESPACE.svc.cluster.local:SERVICE_PORT
  MONGO_URL: 34.82.46.209
  MONGO_DATABASE: mydb
```

>> bookshelf-service.yaml

```
apiVersion: v1
kind: Service
metadata:
  name: bookshelf-service
spec:
  type: LoadBalancer
  ports:
      # service port in cluster
    - port: 5000
      # port to contact inside container
      targetPort: 5000
  selector:
    app: bookshelf-deployment
```

>> bookshelf-deployment.yaml

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: bookshelf-deployment
  labels:
    app: bookshelf-deployment
spec:
  replicas: 1
  selector:
    matchLabels:
      app: bookshelf-deployment
  template:
```

```
    metadata:
      labels:
        app: bookshelf-deployment
    spec:
      containers:
        - image: us-west2-docker.pkg.dev/signature-project1-19609-v1/cs571-
sgnprj1-repo/shkr19609-sgnprj1-bookshelf
          imagePullPolicy: Always
          name: bookshelf-deployment
          ports:
            - containerPort: 5000
          env:
            - name: MONGO_URL
              valueFrom:
                configMapKeyRef:
                  name: bookshelf-config
                  key: MONGO_URL
            - name: MONGO_DATABASE
              valueFrom:
                configMapKeyRef:
                  name: bookshelf-config
                  key: MONGO_DATABASE
```

GCP commands to get output -

Before proceed, we need to add some data into mongodb student db manually. Here is the code -

>> student-data-manual-input.js

```
var MongoClient = require('mongodb').MongoClient;
var url = "mongodb://34.94.54.39/mydb"
// Connect to the db
MongoClient.connect(url,{ useNewUrlParser: true, useUnifiedTopology: true },
function(err, client){
  if (err) throw err;
  // create a document to be inserted
  var db = client.db("studentdb");
  const docs = [
    { student_id: 11111, student_name: "Bruce Lee", grade: 84},
    { student_id: 22222, student_name: "Jackie Chen", grade: 93 },
    { student_id: 33333, student_name: "Jet Li", grade: 88}
  ]
  db.collection("students").insertMany(docs, function(err, res){
    if(err) throw err;
    console.log(res.insertedCount);
    client.close();
  });
  db.collection("students").findOne({"student_id": 11111},
  function(err, result){
    console.log(result);
  });
});
```

Now we need to execute with node. Before execute we need to install mongodb into GCP folder. Here is the commands -

```
$ cd sgnprj1
$ vi student-data-manual-input.js
$ npm install mongodb
$ node student-data-manual-input.js
```

Also we need our common ingress service. Here is the ingress YAML (sgnprg1-ingress.yaml) file -

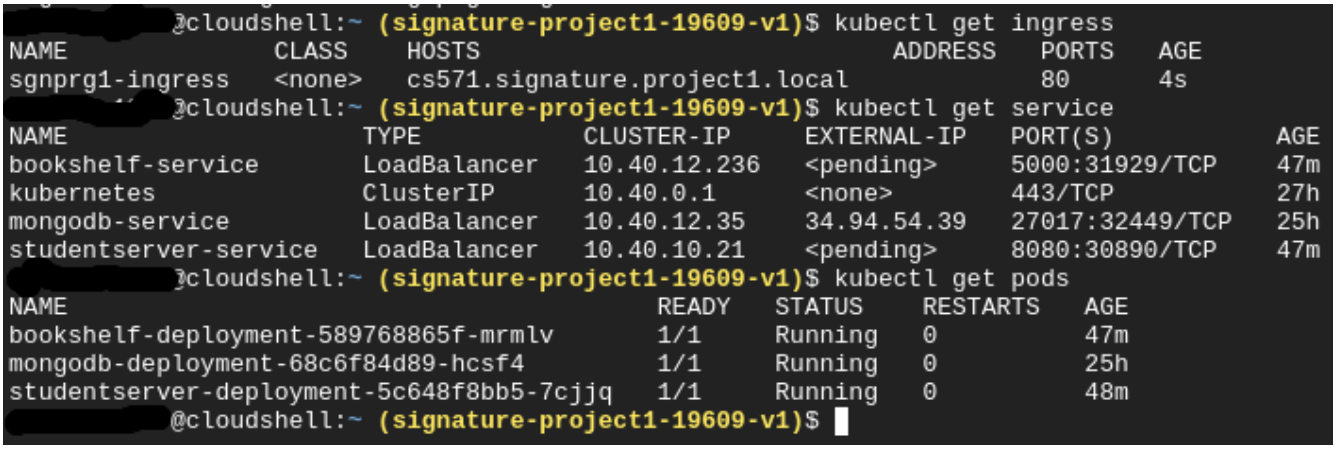
```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: sgnprg1-ingress
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /$2
spec:
  rules:
    - host: cs571.signature.project1.local
      http:
        paths:
          - path: /studentserver(/|$)(.*)
            pathType: Prefix
            backend:
              service:
                name: studentserver-service
                port:
                  number: 8080
          - path: /bookshelf(/|$)(.*)
            pathType: Prefix
            backend:
              service:
                name: bookshelf-service
                port:
                  number: 5000
```

Now we are ready to build and deploy our applications. Here is the commands -

```
$ export PRJ_IMG_ROOT=us-west2-docker.pkg.dev
$ gcloud artifacts repositories create cs571-sgnprj1-repo --repository-
format=docker --location=us-west2 --description="Cloud Computing Signature
Project Repository for SFBU, MSCS, Spring 2022, SHKR"
$ gcloud auth configure-docker ${PRJ_IMG_ROOT}
-- build student server and push to repository
$ docker build -t ${PRJ_IMG_ROOT}/${PROJECT_ID}/cs571-sgnprj1-repo/shkr19609-
sgnprj1-student-server ./sgnprj1/student-server/
$ docker push ${PRJ_IMG_ROOT}/${PROJECT_ID}/cs571-sgnprj1-repo/shkr19609-
sgnprj1-student-server
-- build bookshelf and push to repository
$ docker build -t ${PRJ_IMG_ROOT}/${PROJECT_ID}/cs571-sgnprj1-repo/shkr19609-
sgnprj1-bookshelf ./sgnprj1/bookshelf/
$ docker push ${PRJ_IMG_ROOT}/${PROJECT_ID}/cs571-sgnprj1-repo/shkr19609-
sgnprj1-bookshelf

$ kubectl apply -f sgnprj1/student-server/studentserver-configmap.yaml
$ kubectl apply -f sgnprj1/student-server/studentserver-deployment.yaml
$ kubectl apply -f sgnprj1/student-server/studentserver-service.yaml

$ kubectl apply -f sgnprj1/bookshelf/bookshelf-configmap.yaml
$ kubectl apply -f sgnprj1/bookshelf/bookshelf-deployment.yaml
```

```
$ kubectl apply -f sgnprj1/bookshelf/bookshelf-service.yaml

$ kubectl apply -f sgnprj1/sgnprj1-ingress.yaml
```

After executed all the command above following response we found -



Now we have to wait until our application propagate and GCP assign IP for our applications.

We will able to access this application using following endpoints by curl -

```
>> student server:
curl http://cs571.signature.project1.local/studentserver/api/score?
student_id=11111

>> bookshelf: this is a REST server, we need to post data here..
1. To get the list of books -
curl http://cs571.signature.project1.local/bookshelf/books

2. Add a book into server -
curl -X POST -d "{\"book_name\": \"cloud computing\",\"book_author\":
\"unkown\", \"isbn\": \"123456\" }"
http://cs571.signature.project1.local/bookshelf/book

3. Update a book -
curl -X PUT -d "{\"book_name\": \"123\",\"book_author\": \"test\", \"isbn\":
\"123updated\" }" http://cs571.signature.project1.local/bookshelf/book/id

4. Delete a book -
curl -X DELETE http://cs571.signature.project1.local/bookshelf/book/id
```

As the domain is local, we need to add and entry into “/etc/hosts” file for corresponding IP. As the propagation still in progress, I don’t have IP in my hand. So, I ignore this part.

Github Link: https://github.com/mkhan-sfbu/cs571-signature-project1