

Report: Deployment and Monitoring of Calculator Microservice on GKE

1. Overview

This report outlines the process of deploying a Dockerized calculator microservice to Google Kubernetes Engine (GKE), and applying monitoring and visibility tools to collect and analyze deployment-related logs and metrics. Despite encountering deployment issues, observability features were successfully used to monitor the failure and diagnose the cause.

2. Deployment Steps

I. GCP Configuration & Artifact Registry

- `gcloud auth login`
- `gcloud config set project sit737-25t1-tariq-4b52e3f`
- `gcloud services enable container.googleapis.com`
- `gcloud services enable artifactregistry.googleapis.com`
- `gcloud artifacts repositories create calculator-repo --repository-format=docker --location=australia-southeast1 --description="Docker repo for calculator app"`
- `gcloud auth configure-docker australia-southeast1-docker.pkg.dev`

```
C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud auth login
Your browser has been opened to visit:

https://accounts.google.com/o/oauth2/auth?response_type=code&client_id=32555940559.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%2Fappengine.admin+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fsqlservice.login+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fcompute+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Faccounts.reauth&state=Fpbw7ZvTdV4q6WNpFjjgvwdqSYLDHX&access_type=offline&code_challenge=L83jnc50qXQnSYtdj3IbC4YFdNLCS0hAAs9T3uo6M1g&code_challenge_method=S256

You are now logged in as [s223124219@deakin.edu.au].
Your current project is [sit737-25t1-tariq-4b52e3f]. You can change this setting by running:
$ gcloud config set project PROJECT_ID

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud config set project sit737-25t1-tariq-4b52e3f
Updated property [core/project].

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud services enable container.googleapis.com
gcloud services enable artifactregistry.googleapis.com
C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>
C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud artifacts repositories create calculator-repo --repository-format=docker --location=australia-southeast1 --description="Docker repo for calculator app"
Create request issued for: [calculator-repo]
Waiting for operation [projects/sit737-25t1-tariq-4b52e3f/locations/australia-southeast1/operations/243799d4-6671-4fd4-bd32-7f9d1601c20b] to complete...done.
Created repository [calculator-repo].

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud auth configure-docker australia-southeast1-docker.pkg.dev
WARNING: Your config file at [C:\Users\musta\.docker\config.json] contains these credential helper entries:
{
  "credHelpers": {
    "australia-southeast1-docker.pkg.dev": "gcloud",
    "gcr.io": "gcloud",
    "us.gcr.io": "gcloud",
    "eu.gcr.io": "gcloud",
    "asia.gcr.io": "gcloud",
    "staging-k8s.gcr.io": "gcloud",
    "marketplace.gcr.io": "gcloud"
  }
}
Adding credentials for: australia-southeast1-docker.pkg.dev
gcloud credential helpers already registered correctly.
```

II. Docker Tagging and Pushing

- `docker tag calculator-microservice australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice`
- `docker push australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice`

```

• (base) PS C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p> docker build -t calculator-microservice .
[+] Building 3.7s (10/10) FINISHED
=> [internal] load build definition from Dockerfile
=> => transferring dockerfile: 642B
=> [internal] load metadata for docker.io/library/node:14
=> [internal] load .dockerignore
=> => transferring context: 2B
=> [1/5] FROM docker.io/library/node:14@sha256:a158d3b9b4e3fa813fa6c8c590b8f0a860e015ad4e59bbce5744d2f6fd8461aa
=> => resolve docker.io/library/node:14@sha256:a158d3b9b4e3fa813fa6c8c590b8f0a860e015ad4e59bbce5744d2f6fd8461aa
=> [internal] load build context
=> => transferring context: 73.56kB
=> CACHED [2/5] WORKDIR /usr/src/app
=> CACHED [3/5] COPY package*.json ./
=> CACHED [4/5] RUN npm install
=> [5/5] COPY . .
=> exporting to image
=> => exporting layers
=> => exporting manifest sha256:eaf1b8961de1a97edde34d43b5df5bf8f619a21f38cb8d4333caffa126be44fd
=> => exporting config sha256:e7b31b0012ab56092abbcd42734598ebe5777ac8724a26a11bdef527013bed9
=> => exporting attestation manifest sha256:e184c928def07ec29c21bd5e55ea2a98f4fcc8b823e7308c9df014a1f767d27b
=> => exporting manifest list sha256:68dc7d307414c850024f4f05003e8d0889036c9e01bde1b13c6ce32079489e18
=> => naming to docker.io/library/calculator-microservice:latest
=> => unpacking to docker.io/library/calculator-microservice:latest

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>docker tag calculator-microservice australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>docker push australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice
Using default tag: latest
The push refers to repository [australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice]
6f51ee0005dea: Pushed
0c8cc2f24add: Pushed
3d2201bd995c: Pushed
2ff1d7c41c74: Pushed
0d27fa8e9d122: Pushed
5f32ed3c3f27: Pushed
c27d1c09bb3a: Pushed
1769b4ecfecb: Pushed
763c5331443e: Pushed
da973eadb122: Pushed
1dc76e268b10: Pushed
b253aafae7a7: Pushed
f89ff5c5b4cb: Pushed
d9a8df589451: Pushed
latest: digest: sha256:68dc7d307414c850024f4f05003e8d0889036c9e01bde1b13c6ce32079489e18 size: 856

```

III. Cluster Creation and Deployment

- *gcloud container clusters create-auto calculator-cluster --region=australia-southeast1*
- *gcloud container clusters get-credentials calculator-cluster --region=australia-southeast1*
- *kubectl apply -f deployment.yaml*
- *kubectl apply -f service.yaml*

```

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud container clusters create-auto calculator-cluster --region=australia-southeast1
Note: The Kubernetes read-only port (10255) is now deprecated. Please update your workloads to use the recommended alternatives. See https://cloud.google.com/kubernetes-engine/docs/how-to/disable-kubenet-read-only-port for ways to check usage and for migration instructions.
Creating cluster calculator-cluster in australia-southeast1. Cluster is being health-checked (Kubernetes Control Plane is healthy)...done.
Created [https://container.googleapis.com/v1/projects/sit737-25t1-tariq-4b52e3f/zones/australia-southeast1/clusters/calculator-cluster].
To inspect the contents of your cluster, go to: https://console.cloud.google.com/kubernetes/workload/_gcloud/australia-southeast1/calculator-cluster?project=sit737-25t1-tariq-4b52e3f
kubeconfig entry generated for calculator-cluster.
NAME      LOCATION      MASTER_VERSION  MASTER_IP      MACHINE_TYPE    NODE_VERSION    NUM_NODES  STATUS
calculator-cluster  australia-southeast1  1.32.2-gke.1297002  34.87.226.112  e2-small        1.32.2-gke.1297002  3          RUNNING

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud container clusters get-credentials calculator-cluster --region=australia-southeast1
Fetching cluster endpoint and auth data.
kubeconfig entry generated for calculator-cluster.

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>kubectl apply -f deployment.yaml
deployment.apps/calculator-deployment configured

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>kubectl apply -f service.yaml
service/calculator-service unchanged

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
calculator-deployment-579d8df97-tl6n9  0/1     ImagePullBackOff  0          37h

```

3. Tools and Configuration

- **Google Cloud CLI:** For authentication, service enabling, registry configuration, and cluster management.
- **Docker:** For containerizing the microservice and pushing the image to Artifact Registry.
- **Kubernetes (kubectl):** For applying deployment and service configurations..
- **Logs Explorer (Google Cloud Logging):** For inspecting logs related to cluster operations and errors.
- **Cloud Monitoring (Stackdriver):** For viewing retry metrics and system health signals.

4. Issues Encountered

- 403 Forbidden – Artifact Registry Access

Upon applying the deployment:

```
kubectl apply -f deployment.yaml
```

The pods failed to start. Logs showed:

```
ErrImagePull
```

```
403 Forbidden: permission denied while trying to access artifact registry
```

The Kubernetes nodes could not access the Artifact Registry due to **missing permissions** or **incorrect IAM configuration** for the default GKE node service account.

Although the application failed to deploy due to an authentication error (403 Forbidden) when pulling the container image from Artifact Registry, the failure itself was successfully captured by GCP's monitoring and logging systems. I used **Logs Explorer** and **kubectl** tools to analyze logs associated with the failed deployment, including **ErrImagePull** events and repeated **back-off** retries.

Error Logs

```
C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>kubectl get pods
```

NAME	READY	STATUS	RESTARTS	AGE
calculator-deployment-579d8df97-tl6n9	0/1	ImagePullBackOff	0	37h

```
C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>kubectl describe pod calculator-deployment-579d8df97-tl6n9
```

Name: calculator-deployment-579d8df97-tl6n9

Namespace: default

Priority: 0

Service Account: default

Node: gk3-calculator-cluster-pool-2-c440af08-7x0f/10.152.0.12

Start Time: Sat, 17 May 2025 22:31:28 +1000

Labels: app=calculator

pod-template-hash=579d8df97

Annotations: <none>

Status: Pending

SeccompProfile: RuntimeDefault

IP: 10.48.0.67

IPs:

IP: 10.48.0.67

Controlled By: ReplicaSet/calculator-deployment-579d8df97

Containers:

calculator:

Container ID:

Image: australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice

Image ID:

Port: 3000/TCP

Host Port: 0/TCP

State: Waiting

Reason: ErrImagePull

Ready: False
Restart Count: 0
Limits:
cpu: 500m
ephemeral-storage: 1Gi
memory: 256Mi
Requests:
cpu: 250m
ephemeral-storage: 1Gi
memory: 256Mi
Liveness: http-get http://:3000/health delay=15s timeout=1s period=10s #success=1 #failure=3
Readiness: http-get http://:3000/health delay=5s timeout=1s period=10s #success=1 #failure=3
Environment: <none>
Mounts:
/var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-j69rt (ro)

Conditions:

Type	Status
PodReadyToStartContainers	True
Initialized	True
Ready	False
ContainersReady	False
PodScheduled	True

Volumes:

kube-api-access-j69rt:
Type: Projected (a volume that contains injected data from multiple sources)
TokenExpirationSeconds: 3607
ConfigMapName: kube-root-ca.crt
ConfigMapOptional: <nil>
DownwardAPI: true
QoS Class: Burstable
Node-Selectors: <none>
Tolerations: kubernetes.io/arch=amd64:NoSchedule
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
Warning	Failed	51m	(x437 over 37h)	kubelet Failed to pull image "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice": failed to pull and unpack image "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice:latest": failed to resolve reference "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice:latest": failed to authorize: failed to fetch oauth token: unexpected status from GET request to https://australia-southeast1-docker.pkg.dev/v2/token?scope=repository%3Asit737-25t1-tariq-4b52e3f%2Fcalculator-repo%2Fcalculator-microservice%3Apull&service=australia-southeast1-docker.pkg.dev: 403 Forbidden
Normal	BackOff	2m17s	(x9998 over 37h)	kubelet Back-off pulling image "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice"
Warning	Failed	110s	(x10000 over 37h)	kubelet Error: ImagePullBackOff

Error Screenshot

```
C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>kubectl describe pod calculator-deployment-579d8df97-tl6n9
Name:          calculator-deployment-579d8df97-tl6n9
Namespace:     default
Priority:       0
Service Account: default
Node:          gk3-calculator-cluster-pool-2-c440af08-7x0f/10.152.0.12
Start Time:    Sat, 17 May 2025 22:31:28 +1000
Labels:        app=calculator
               pod-template-hash=579d8df97
Annotations:   <none>
Status:        Pending
SeccompProfile: RuntimeDefault
IP:            10.48.0.67
IPs:
  IP:          10.48.0.67
Controlled By: ReplicaSet/calculator-deployment-579d8df97
Containers:
  calculator:
    Container ID:  australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice
    Image:         australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice
    Image ID:      <none>
    Port:          3000/TCP
    Host Port:     0/TCP
    State:         Waiting
      Reason:      ErrImagePull
    Ready:         False
    Restart Count: 0
    Limits:
      cpu:          500m
      ephemeral-storage: 1Gi
      memory:       256Mi
    Requests:
      cpu:          250m
      ephemeral-storage: 1Gi
      memory:       256Mi
    Liveness:       http-get http://:3000/health delay=15s timeout=1s period=10s #success=1 #failure=3
    Readiness:      http-get http://:3000/health delay=5s timeout=1s period=10s #success=1 #failure=3
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-j69rt (ro)
Conditions:
  Type                               Status
  PodReadyToStartContainers          True
  Initialized                         True
  Ready                              False
  ContainersReady                    False
  Volumes:
  kube-api-access-j69rt:
    Type:                Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds: 3607
    ConfigMapName:        kube-root-ca.crt
    ConfigMapOptional:    <nil>
    DownwardAPI:          true
  QoS Class:               Burstable
  Node-Selectors:          <none>
  Tolerations:             kubernetes.io/arch=amd64:NoSchedule
                           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
  ----      -
  Warning   Failed      51m (x437 over 37h)  kubelet   Failed to pull image "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice": failed to pull and unpack image "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice:latest": failed to resolve reference "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice:latest": failed to fetch oauth token: unexpected status from GET request to https://australia-southeast1-docker.pkg.dev/v2/token?scope=repository%3Asit737-25t1-tariq-4b52e3f%2Fcalculator-repo%2Fcalculator-microservice%3Apull&service=australia-southeast1-docker.pkg.dev: 403 Forbidden
  Normal    BackOff     2m17s (x9998 over 37h)  kubelet   Back-off pulling image "australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice"
  Warning   Failed      110s (x10000 over 37h)  kubelet   Error: ImagePullBackOff

C:\My Work\data\Deakin\Semester 4\Cloud Native Applications\Task 10.1P\sit737-2025-prac10p>gcloud artifacts docker images list australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo
Listing items under project sit737-25t1-tariq-4b52e3f, location australia-southeast1, repository calculator-repo.

IMAGE                                     DIGEST                                     CRE
AGE_TIME      UPDATE_TIME      SIZE
australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice sha256:68dc7d307414c850024f4f05003e8d0889036c9e01bde1b13c6ce32079489e18 202
5-05-15T16:23:48 2025-05-15T16:23:48 None
australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice sha256:e184c928def07ec29c21bd5e55ea2a98f4fcc8b823e7308c9df014a1f767d27b 202
5-05-15T16:23:46 2025-05-15T16:23:48 1347
australia-southeast1-docker.pkg.dev/sit737-25t1-tariq-4b52e3f/calculator-repo/calculator-microservice sha256:eaf1b8961de1a97edde34d43b5df5bf8f619a21f38cb8d4333caffa126be44fd 202
5-05-15T16:23:45 2025-05-15T16:23:46 356841605
```

I was **unable** collect logs from the **application itself**, because the container never started. Therefore, the **application metrics or health logs** are missing.

5. Conclusion

Although the calculator application failed to deploy successfully, I fulfilled the monitoring requirement by:

- Demonstrating use of **GCP observability tools** to identify deployment issues
- Collecting and analyzing **system logs and metrics**
- Gaining insights into **retry mechanisms and permission-related errors**

This experience underscores the importance of visibility tools in diagnosing deployment failures in cloud-native environments.