

1. Task Summary and Implementation

In this task, I extended the previously containerised and Kubernetes-deployed bilingual calculator application by integrating a MongoDB database for persistent storage of operation history. The goal was to allow the backend microservice to perform full CRUD operations against a dedicated MongoDB service running inside the same Kubernetes cluster.

To achieve this, I created several Kubernetes resource configurations:

- mongo-deployment.yaml: Deploys a single-replica MongoDB instance using the official image.
- mongo-service.yaml: Exposes MongoDB internally via a ClusterIP service.
- mongo-secret.yaml: Stores the root username and password for MongoDB.
- mongo-pv.yaml and mongo-pvc.yaml: Configure persistent volume storage using hostPath.

The calculator application's deployment.yaml was then modified to inject a MONGO_URL environment variable, pointing to the internal MongoDB service. The backend connects using the Mongoose ODM library. A new /history route was implemented to retrieve stored operations.

2. Kubernetes Commands and Interaction Process

Step 1: Apply Kubernetes Resources

```
kubectl apply -f mongo-secret.yaml
kubectl apply -f mongo-pv.yaml
kubectl apply -f mongo-pvc.yaml
kubectl apply -f mongo-deployment.yaml
kubectl apply -f mongo-service.yaml
kubectl apply -f deployment.yaml
kubectl apply -f service.yaml
```

Step 2: Confirm Pod Status

```
kubectl get pods
```

```
PS F:\海外留学相关\Deakin Year4 Tasks and Assignments\SIT323\9.1P\sit323-2025-prac9p> kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
calculator-deployment-698bd876b7-dxpdb 1/1     Running   0          39m
mongo-77f495c47d-99z2x                 1/1     Running   0          44m
```

Step 3: Access the Application

```
kubectl port-forward service/calculator-service 3000:80
```

Then visit <http://localhost:3000> in a browser.

3. MongoDB Functional Verification

After performing operations via the calculator UI, I visited the /history route to verify MongoDB recording. This endpoint returns recent arithmetic operation logs.

http://localhost:3000/history



The screenshot shows a web browser window with the address bar displaying 'localhost:3000/history'. The page content is a JSON array of five objects, each representing a history record. The records include fields for '_id', 'num1', 'num2', 'operation', 'result', 'timestamp', and '__v'.

```
[{"_id": "6822d2431a44c04feb10515c", "num1": 10, "num2": 2, "operation": "mod", "result": 0, "timestamp": "2025-05-13T05:02:05.678Z", "__v": 0}, {"_id": "6822d2431a44c04feb10515a", "num1": 10, "num2": 2, "operation": "power", "result": 100, "timestamp": "2025-05-13T05:02:02.674Z", "__v": 0}, {"_id": "6822d2431a44c04feb105158", "num1": 5, "num2": 3, "operation": "multiply", "result": 15, "timestamp": "2025-05-13T05:01:57.896Z", "__v": 0}, {"_id": "6822d2431a44c04feb105156", "num1": 5, "num2": 5, "operation": "add", "result": 10, "timestamp": "2025-05-13T05:01:55.529Z", "__v": 0}, {"_id": "6822c6b91a44c04feb105153", "num1": 8, "num2": 2, "operation": "power", "result": 64, "timestamp": "2025-05-13T04:12:41.856Z", "__v": 0}, {"_id": "6822c6b21a44c04feb105151", "num1": 2, "num2": 5, "operation": "multiply", "result": 10, "timestamp": "2025-05-13T04:12:41.856Z", "__v": 0}]
```

GitHub Link: <https://github.com/Lonely-DM/SIT323/tree/main/9.1P/sit323-2025-prac9p>