Kubernetes Project Assignment: FlaskApp with Database

Objective:

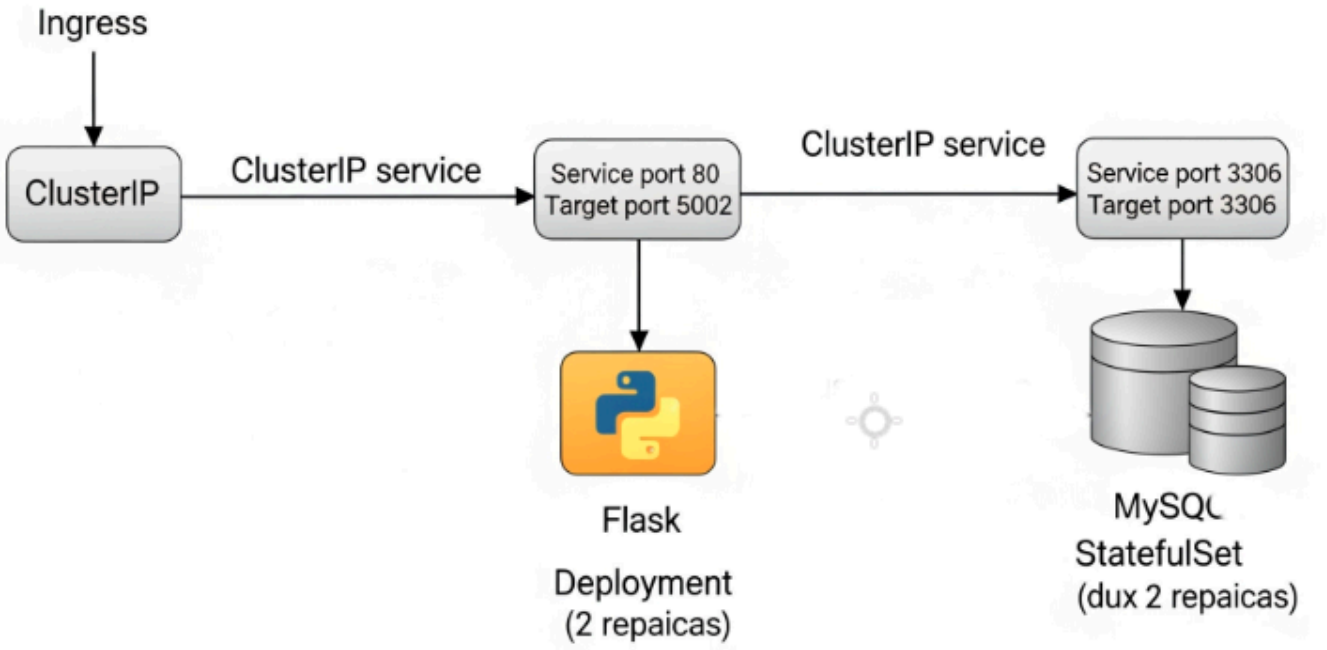
Deploy a web application (FlaskApp) with a database backend on a Kubernetes cluster using core Kubernetes resources.

Prerequisites:

You are provided with two project directories:

- `flaskapp/` – Python Flask application with Dockerfile
- `database/` – Database service (MySQL) with Dockerfile

Simple Architecture :-



Tasks:

1. Build & Push Docker Images

- Build Docker images for both `flaskapp` and `database` using the provided Dockerfiles.
- Push the images to your **DockerHub repository**. "use at least one private repositery to use secrets in kubernetes later "

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2. Kubernetes Cluster Setup

- Set up a Kubernetes cluster using **kubeadm**, **k3s , "minikube not allowed"**

- Minimum 2 nodes:
  - 1 Master Node
  - 1 Worker Node

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3. Application Deployment

Use the following Kubernetes resources to deploy your applications:

- **Deployment** for the Flask application.
- **StatefulSet** for the Database to ensure stable persistent identity and volume.
- **ConfigMap** to store environment configuration for the FlaskApp.
- **ConfigMap** to store environment configuration for the MySQL.
- **Secret** to store sensitive data like Docker Registry Credentials .
- **PersistentVolume** (hostPath for testing).
- **ClusterIP Service** to expose FlaskApp and database internally.
- **Ingress** to route HTTP traffic to FlaskApp (use ingress-nginx or similar controller).
- **Network policy**
- **Readiness , startup , liveness**
- **Limits** (you can use **Resource Limit Range** or **Resource Quota**)
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- **StorageClass** and **Dynamic Provisioning** (NFS). -- Bonus
- **PersistentVolumeClaim** -- Bouns
- **NodePort Service** to test external access to FlaskApp. -- Bonus

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Flask Application to MySQL Database Connection :-

The Flask application connects to a MySQL database using environment variables to configure credentials, database name, and connection host. This setup ensures modularity and ease of deployment in Kubernetes environments.

The following environment variables must be set in the Flask app **Deployment** to allow successful communication with the MySQL **StatefulSet**:

```
MYSQL_DATABASE_USER: "root"
MYSQL_DATABASE_PASSWORD: "root"
MYSQL_DATABASE_DB: "BucketList"
MYSQL_DATABASE_HOST: "db-service"
```

Explanation:

Variable	Description
`MYSQL_DATABASE_USER`	Username used by the Flask app to access MySQL
`MYSQL_DATABASE_PASSWORD`	Password for the MySQL user
`MYSQL_DATABASE_DB`	Name of the database to connect to
`MYSQL_DATABASE_HOST`	Hostname of the MySQL service (`db-service`)

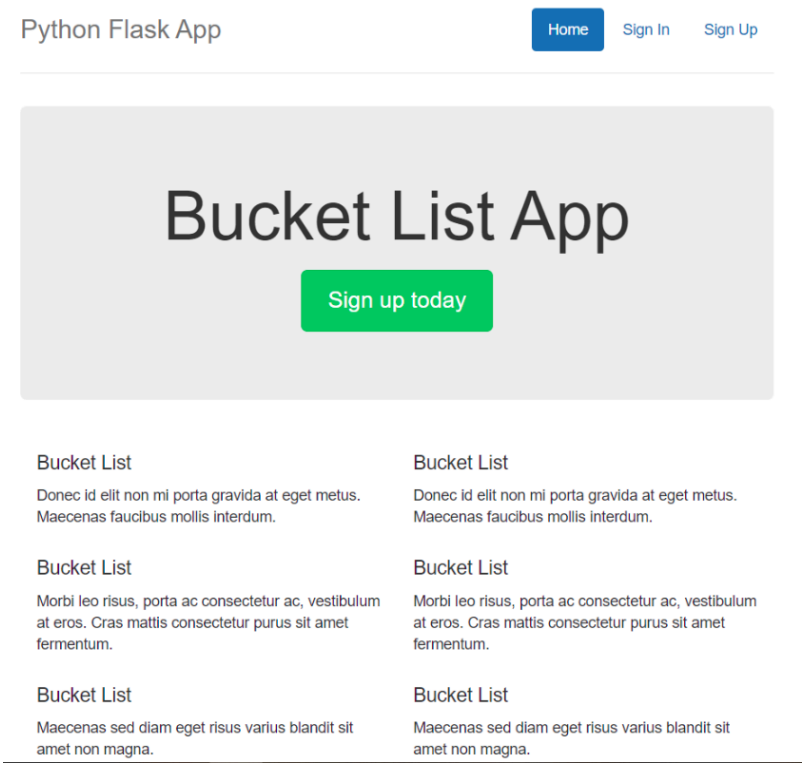
2- MySQL Root Password (Important for StatefulSet)

In your MySQL **StatefulSet**, you must configure the `MYSQL_ROOT_PASSWORD` to enable initialization and root-level access:

Bonus: Dynamic Provisioning with NFS :-

- Install and configure an **NFS server** on a node (master node or another new node dedicated for NFS).
- Create a **StorageClass** that points to the NFS server.
- Update PVCs to use the dynamic provisioning from the NFS-backed StorageClass.

Validation & Testing :-

- Confirm:
  - FlaskApp connects to DB and shows output.
  - NodePort works: access via `curl` or browser using `NodeIP:NodePort and  Cluster IP service`
  - 

  - Ingress works with domain mapping (e.g., `/flask` path).

- PVCs are bound and pods have persistent volumes.
- Secrets are mounted/used securely.

📤 Submission Requirements

- `README.md` documenting:
  - Steps to deploy
  - How to test each service (curl, browser, ingress)
  - Any issues faced and how you solved them
- Kubernetes YAML files (`deployments/`, `services/`, `configmap/`, `secrets/`, etc.)
- screen recording of:
  - Application running
  - `kubectl get all -A`
  - Browser or `curl` result
- GitHub repo
