

# Distributed Systems Project

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For this project we decided to deploy the application in a local Kubernetes cluster instead of using GKE.

We will be using minikube for the k8s cluster and kubectl.

```
jean@jean:~/Desktop/vs24-project-jean_ivan/DEPLOYMENT/app$ minikube start
minikube v1.33.1 on Linuxmint 21.3
Automatically selected the docker driver
Using Docker driver with root privileges
Starting "minikube" primary control-plane node in "minikube" cluster
Pulling base image v0.0.44 ...
Creating docker container (CPUs=2, Memory=2200MB) ...
Preparing Kubernetes v1.30.0 on Docker 26.1.1 ...
  Generating certificates and keys ...
  Booting up control plane ...
  Configuring RBAC rules ...
Configuring bridge CNI (Container Networking Interface) ...
Verifying Kubernetes components...
  Using image gcr.io/k8s-minikube/storage-provisioner:v5
Enabled addons: storage-provisioner, default-storageclass
kubectl not found. If you need it, try: 'minikube kubectl -- get pods -A'
Done! kubectl is now configured to use "minikube" cluster and "default" namespace by default
```

We will also be using helm for pulling down postgresql and other images.

## 1. Deploying the database

For this project we are using postgresql. The helm chart for it is found in the bitnami repository.

We can deploy postgresql using the install script found in the repo.

```
helm repo add bitnami https://charts.bitnami.com/bitnami
helm repo update

helm install postgresql -f values.yaml bitnami/postgresql
```

This adds the bitnami repo and then deploys postgresql using the values file, which just contains the username and password of an account and an initialization script for creating tables.

```

auth:
  username: admin
  password: password
  database: ds_proj_db

primary:
  initdb:
    scripts:
      init.sql: |
        CREATE TABLE IF NOT EXISTS accounts (
          acc_id UUID PRIMARY KEY,
          first_name VARCHAR(50),
          last_name VARCHAR(50),
          balance DECIMAL(15, 2)
        );
        CREATE TABLE IF NOT EXISTS logs (
          log_id UUID PRIMARY KEY,
          date TIMESTAMP WITH TIME ZONE DEFAULT CURRENT_TIMESTAMP,
          account_id UUID REFERENCES accounts(acc_id),
          operation VARCHAR(1),
          amount DECIMAL(15, 2),
          info JSONB
        );

```

Running the install script:

```

jean@jean:~/Desktop/vs24-project-jean_ivan/DEPLOYMENT/postgresql$ bash install.sh
"bitnami" has been added to your repositories
Hang tight while we grab the latest from your chart repositories...
...Successfully got an update from the "bitnami" chart repository
Update Complete. *Happy Helming!*
NAME: postgresql
LAST DEPLOYED: Tue Jun 11 21:19:48 2024
NAMESPACE: default
STATUS: deployed
REVISION: 1
TEST SUITE: None
NOTES:
CHART NAME: postgresql
CHART VERSION: 15.5.5
APP VERSION: 16.3.0

** Please be patient while the chart is being deployed **

PostgreSQL can be accessed via port 5432 on the following DNS names from within your cluster:

    postgresql.default.svc.cluster.local - Read/Write connection

```

After this, our other pods can access the database locally.

## 2. Building all of the images

In order for the apps to be deployed with kubernetes, we need to upload the images to an image registry, however if we don't want to do that we can point the terminal's docker cli to the docker engine running inside minikube and build the images locally.

This is done by the build script:

```
eval $(minikube docker-env)

docker build client -t dsp-client:latest
docker build manager -t dsp-manager:latest
docker build monitor -t dsp-monitor:latest
```

First of all, we modify our environment variables to make the docker-cli use the minikube docker, then we build the three images.

These images are now available to be used in pods.

## 3. Deploying the application

Now that the images are built, we can deploy the application in kubernetes. Let's start with the account manager.

### 3.1. Deploying the monitor

In order to deploy the monitor, we can run the following command:

```
jean@jean:~/Desktop/vs24-project-jean_ivan/DEPLOYMENT/app$ k apply -f monitor.yaml
deployment.apps/monitor-deployment created
service/monitor-service created
```

This creates the deployment and service in kubernetes as described by the monitor.yaml file:

```

apiVersion: apps/v1
kind: Deployment
metadata:
  name: monitor-deployment
  labels:
    app: monitor
spec:
  replicas: 1
  selector:
    matchLabels:
      app: monitor
  template:
    metadata:
      labels:
        app: monitor
    spec:
      containers:
        - name: monitor
          image: dsp-monitor:latest
          imagePullPolicy: IfNotPresent
          ports:
            - containerPort: 5000
---
apiVersion: v1
kind: Service
metadata:
  name: monitor-service
spec:
  type: NodePort
  selector:
    app: monitor
  ports:
    - protocol: TCP
      port: 5000
      targetPort: 5000
      nodePort: 30081

```

Now the account monitor is running on port 30081 in kubernetes. In order to access it, we can get the minikube ip using the following command:

```

jean@jean:~/Desktop/vs24-project-jean_ivan/DEPLOYMENT/app$ minikube ip
192.168.49.2

```

Now, if we go to 192.168.49.2:30081 in our browser, we can see the account monitor application:

← → ↻

192.168.49.2:30081

# Account info

[All logs](#)

First Name:  Last Name:

First name	Last name	Balance	ID	Logs
------------	-----------	---------	----	------

### 3.2. Deploying the accounts (account manager and clients)

In order to create an account, there is a script in the repository that looks like this:

```
UUID=$(uuidgen)
sed "s/{ACCOUNT_ID}/{UUID}/g" account.yaml > account-{$UUID}.yaml
minikube kubectl -- apply -f account-{$UUID}.yaml
rm account-{$UUID}.yaml
```

This script generates a UUID (which is going to be used as the account ID, replaces it using sed in the account.yaml template file and then applies it on minikube.

The account.yaml template looks like this:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: account-deployment-{ACCOUNT_ID}
  labels:
    app: account-{ACCOUNT_ID}
spec:
  replicas: 1
  selector:
    matchLabels:
      app: account-{ACCOUNT_ID}
  template:
    metadata:
      labels:
        app: account-{ACCOUNT_ID}
    spec:
      containers:
        - name: manager
          image: dsp-manager:latest
          imagePullPolicy: IfNotPresent
          ports:
            - containerPort: 3000
          env:
            - name: ACCOUNT_ID
              value: {ACCOUNT_ID}
        - name: client-1
          image: dsp-client:latest
          imagePullPolicy: IfNotPresent
        - name: client-2
          image: dsp-client:latest
          imagePullPolicy: IfNotPresent
```

The {ACCOUNT\_ID} placeholder is used for identifying the account in the deployment name and the labels, but it is also passed down to the manager as an environment variable, so the manager knows which account to talk to.

Let's create 3 accounts by running the script 3 times.

```
jean@jean:~/Desktop/vs24-project-jean_ivan/DEPLOYMENT/app$ ./create_account.sh && ./create_account.sh && ./create_account.sh
deployment.apps/account-deployment-cee0cd1b-bc66-4008-b292-481b017a26f2 created
deployment.apps/account-deployment-e97e6172-9b93-43a4-a1ae-76fb1b7e5e39 created
deployment.apps/account-deployment-0a1a2686-1e4d-4e50-a342-c870081dc60f created
```

Now, if we reopen the page, we can see the 3 accounts which were added

# Account info

All logs

First Name:  Last Name:

First name	Last name	Balance	ID	Logs
Bob	Williams	6815.88	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	<a href="#">View Logs</a>
Jane	Jones	3034.22	cee0cd1b-bc66-4008-b292-481b017a26f2	<a href="#">View Logs</a>
Alice	Smith	6956.33	0a1a2686-1e4d-4e50-a342-c870081dc60f	<a href="#">View Logs</a>

We can also open the logs for a specific account and see the history

Transaction info

[Go to Home](#)  
Start Date:  End Date:

Log id	Account id	Amount	Date	Operation	Info
e97e6172-9b93-43a4-097d-e59c555a42dd	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-582.05	2024-06-16 04:26:19.649832+00:00	W	{'info': {'description': "Withdrawal of \$-582.05"}, 'amount': -582.05, 'operation': 'W'}
e97e6172-9b93-43a4-25f6-493d2d28744d2	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	387.19	2024-06-16 04:26:19.495256+00:00	D	{'info': {'description': "Deposit of \$387.19"}, 'amount': 387.19, 'operation': 'D'}
e97e6172-9b93-43a4-5079-493d1f114842	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	263.95	2024-06-16 04:26:18.789417+00:00	D	{'info': {'description': "Deposit of \$263.95"}, 'amount': 263.95, 'operation': 'D'}
e97e6172-9b93-43a4-1861-c9ff52974d9a	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-190.18	2024-06-16 04:26:18.784693+00:00	W	{'info': {'description': "Withdrawal of \$-190.18"}, 'amount': -190.18, 'operation': 'W'}
e97e6172-9b93-43a4-1d58-91cde9ad407e	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	269.04	2024-06-16 04:26:18.688892+00:00	D	{'info': {'description': "Deposit of \$269.04"}, 'amount': 269.04, 'operation': 'D'}
e97e6172-9b93-43a4-33ee-a5d5574c47f6	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-915.90	2024-06-16 04:26:18.385903+00:00	W	{'info': {'description': "Withdrawal of \$-915.9"}, 'amount': -915.9, 'operation': 'W'}
e97e6172-9b93-43a4-bb38-31a9850a460b	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	104.14	2024-06-16 04:26:17.768239+00:00	D	{'info': {'description': "Deposit of \$104.14"}, 'amount': 104.14, 'operation': 'D'}
e97e6172-9b93-43a4-f317-9c4064f442bc	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-273.09	2024-06-16 04:26:17.584606+00:00	W	{'info': {'description': "Withdrawal of \$-273.09"}, 'amount': -273.09, 'operation': 'W'}
e97e6172-9b93-43a4-bb38-31a9850a460b	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-635.92	2024-06-16 04:26:17.493914+00:00	W	{'info': {'description': "Withdrawal of \$-635.92"}, 'amount': -635.92, 'operation': 'W'}
e97e6172-9b93-43a4-d954-848a668545be	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	974.28	2024-06-16 04:26:17.457534+00:00	D	{'info': {'description': "Deposit of \$974.28"}, 'amount': 974.28, 'operation': 'D'}
e97e6172-9b93-43a4-b4bf-6a92005a4256	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	697.37	2024-06-16 04:26:16.784109+00:00	D	{'info': {'description': "Deposit of \$697.37"}, 'amount': 697.37, 'operation': 'D'}
e97e6172-9b93-43a4-22b6-1ebaa304e0e	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	431.99	2024-06-16 04:26:15.348575+00:00	W	{'info': {'description': "Withdrawal of \$-431.99"}, 'amount': -431.99, 'operation': 'W'}
e97e6172-9b93-43a4-302c-2c14641f46ee	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	463.86	2024-06-16 04:26:15.100379+00:00	W	{'info': {'description': "Withdrawal of \$-463.86"}, 'amount': -463.86, 'operation': 'W'}
e97e6172-9b93-43a4-e1b9-c921dccc64216	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	450.30	2024-06-16 04:26:14.553045+00:00	D	{'info': {'description': "Deposit of \$450.3"}, 'amount': 450.3, 'operation': 'D'}
e97e6172-9b93-43a4-cac7-9ff1f39034fef	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-848.27	2024-06-16 04:26:14.241950+00:00	W	{'info': {'description': "Withdrawal of \$-848.27"}, 'amount': -848.27, 'operation': 'W'}
e97e6172-9b93-43a4-0054-e997851e485c	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-6.93	2024-06-16 04:26:13.753656+00:00	W	{'info': {'description': "Withdrawal of \$-6.93"}, 'amount': -6.93, 'operation': 'W'}
e97e6172-9b93-43a4-71bf-fbcca1ca43dc	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-668.84	2024-06-16 04:26:13.522506+00:00	W	{'info': {'description': "Withdrawal of \$-668.84"}, 'amount': -668.84, 'operation': 'W'}
e97e6172-9b93-43a4-15d4-de6905ef4083	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	699.10	2024-06-16 04:26:13.332628+00:00	D	{'info': {'description': "Deposit of \$699.1"}, 'amount': 699.1, 'operation': 'D'}
e97e6172-9b93-43a4-39c8-c404f9ec4b7a	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	494.10	2024-06-16 04:26:13.243259+00:00	D	{'info': {'description': "Deposit of \$494.1"}, 'amount': 494.1, 'operation': 'D'}
e97e6172-9b93-43a4-5cef-c6e64b8540f8	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-357.28	2024-06-16 04:26:13.019417+00:00	W	{'info': {'description': "Withdrawal of \$-357.28"}, 'amount': -357.28, 'operation': 'W'}
e97e6172-9b93-43a4-a6c1-38cd05b44348	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	896.45	2024-06-16 04:26:12.266755+00:00	D	{'info': {'description': "Deposit of \$896.45"}, 'amount': 896.45, 'operation': 'D'}
e97e6172-9b93-43a4-672c-3a0742764d95	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	517.12	2024-06-16 04:26:11.968534+00:00	D	{'info': {'description': "Deposit of \$517.12"}, 'amount': 517.12, 'operation': 'D'}
e97e6172-9b93-43a4-8acd-6c21494a43e4	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-70.42	2024-06-16 04:26:10.555102+00:00	W	{'info': {'description': "Withdrawal of \$-70.42"}, 'amount': -70.42, 'operation': 'W'}
e97e6172-9b93-43a4-974b-60c29f534661	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	101.56	2024-06-16 04:26:10.209972+00:00	D	{'info': {'description': "Deposit of \$101.56"}, 'amount': 101.56, 'operation': 'D'}
e97e6172-9b93-43a4-c1b9-b37b02841fa	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-103.44	2024-06-16 04:26:10.096114+00:00	W	{'info': {'description': "Withdrawal of \$-103.44"}, 'amount': -103.44, 'operation': 'W'}
e97e6172-9b93-43a4-0e0b-07416e6746a8	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	71.74	2024-06-16 04:26:09.763176+00:00	D	{'info': {'description': "Deposit of \$71.74"}, 'amount': 71.74, 'operation': 'D'}
e97e6172-9b93-43a4-5f19-80559fd149b4	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	276.45	2024-06-16 04:26:09.536640+00:00	D	{'info': {'description': "Deposit of \$276.45"}, 'amount': 276.45, 'operation': 'D'}

If we refresh the page, new logs will be added at the top

Transaction info

[Go to Home](#)

Start Date:  mm / dd / yyyy  End Date:  mm / dd / yyyy

Log id	Account id	Amount	Date	Operation	Info
e97e6172-9b93-43a4-c1af-808b45bd4be2	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-904.73	2024-06-16 04:26:26.484413+00:00	W	{'info': {'description': 'Withdrawal of \$-904.73'}, 'amount': -904.73, 'operation': 'W'}
e97e6172-9b93-43a4-568d-27954f2c448e	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	437.31	2024-06-16 04:26:26.120441+00:00	D	{'info': {'description': 'Deposit of \$437.31'}, 'amount': 437.31, 'operation': 'D'}
e97e6172-9b93-43a4-32c5-48acfb8e54902	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	316.90	2024-06-16 04:26:25.995323+00:00	D	{'info': {'description': 'Deposit of \$316.9'}, 'amount': 316.9, 'operation': 'D'}
e97e6172-9b93-43a4-7033-77e818824037	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	901.10	2024-06-16 04:26:25.636897+00:00	D	{'info': {'description': 'Deposit of \$901.1'}, 'amount': 901.1, 'operation': 'D'}
e97e6172-9b93-43a4-5d01-10c25d704be9	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	533.58	2024-06-16 04:26:24.926733+00:00	D	{'info': {'description': 'Deposit of \$533.58'}, 'amount': 533.58, 'operation': 'D'}
e97e6172-9b93-43a4-1112-2f5527d04746	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-200.15	2024-06-16 04:26:24.471780+00:00	W	{'info': {'description': 'Withdrawal of \$-200.15'}, 'amount': -200.15, 'operation': 'W'}
e97e6172-9b93-43a4-a9db-456aa7f54467	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	853.06	2024-06-16 04:26:24.305283+00:00	D	{'info': {'description': 'Deposit of \$853.06'}, 'amount': 853.06, 'operation': 'D'}
e97e6172-9b93-43a4-43a6-714083154c19	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	314.63	2024-06-16 04:26:24.219318+00:00	D	{'info': {'description': 'Deposit of \$314.63'}, 'amount': 314.63, 'operation': 'D'}
e97e6172-9b93-43a4-d44f-c26d51da454a	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-173.17	2024-06-16 04:26:23.908422+00:00	W	{'info': {'description': 'Withdrawal of \$-173.17'}, 'amount': -173.17, 'operation': 'W'}
e97e6172-9b93-43a4-97bb-d38183f34ea1	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	918.12	2024-06-16 04:26:23.320513+00:00	D	{'info': {'description': 'Deposit of \$918.12'}, 'amount': 918.12, 'operation': 'D'}
e97e6172-9b93-43a4-efaf-abeee44d4edf	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-488.27	2024-06-16 04:26:23.313921+00:00	W	{'info': {'description': 'Withdrawal of \$-488.27'}, 'amount': -488.27, 'operation': 'W'}
e97e6172-9b93-43a4-1a30-4f6860e942ce	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	826.90	2024-06-16 04:26:22.400421+00:00	D	{'info': {'description': 'Deposit of \$826.9'}, 'amount': 826.9, 'operation': 'D'}
e97e6172-9b93-43a4-e272-51b6ee254c93	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	617.77	2024-06-16 04:26:22.236967+00:00	D	{'info': {'description': 'Deposit of \$617.77'}, 'amount': 617.77, 'operation': 'D'}
e97e6172-9b93-43a4-9833-c1807aa47e5	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	72.51	2024-06-16 04:26:21.583453+00:00	D	{'info': {'description': 'Deposit of \$72.51'}, 'amount': 72.51, 'operation': 'D'}
e97e6172-9b93-43a4-5233-8da787e64895	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	471.41	2024-06-16 04:26:21.345089+00:00	D	{'info': {'description': 'Deposit of \$471.41'}, 'amount': 471.41, 'operation': 'D'}
e97e6172-9b93-43a4-1a19-b375361a4c08	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-669.93	2024-06-16 04:26:20.487703+00:00	W	{'info': {'description': 'Withdrawal of \$-669.93'}, 'amount': -669.93, 'operation': 'W'}
e97e6172-9b93-43a4-097d-e59c555a42dd	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-582.05	2024-06-16 04:26:19.649832+00:00	W	{'info': {'description': 'Withdrawal of \$-582.05'}, 'amount': -582.05, 'operation': 'W'}
e97e6172-9b93-43a4-25f6-d932d28744d2	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	387.19	2024-06-16 04:26:19.495256+00:00	D	{'info': {'description': 'Deposit of \$387.19'}, 'amount': 387.19, 'operation': 'D'}
e97e6172-9b93-43a4-5079-493d1f114842	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	263.95	2024-06-16 04:26:18.789417+00:00	D	{'info': {'description': 'Deposit of \$263.95'}, 'amount': 263.95, 'operation': 'D'}
e97e6172-9b93-43a4-1861-c9ff52974d9a	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-190.18	2024-06-16 04:26:18.784693+00:00	W	{'info': {'description': 'Withdrawal of \$-190.18'}, 'amount': -190.18, 'operation': 'W'}
e97e6172-9b93-43a4-1d58-91cde9ad407e	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	269.04	2024-06-16 04:26:18.688892+00:00	D	{'info': {'description': 'Deposit of \$269.04'}, 'amount': 269.04, 'operation': 'D'}
e97e6172-9b93-43a4-33ee-a5d5574c47f6	e97e6172-9b93-43a4-a1ae-76fb1b7e5e39	-915.90	2024-06-16 04:26:18.385903+00:00	D	{'info': {'description': 'Withdrawal of \$-915.9'}, 'amount': -915.9, 'operation': 'W'}
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