



**Cloud Computing  
(SOFE 4630U)**

**Project Milestone 4: Microservices**

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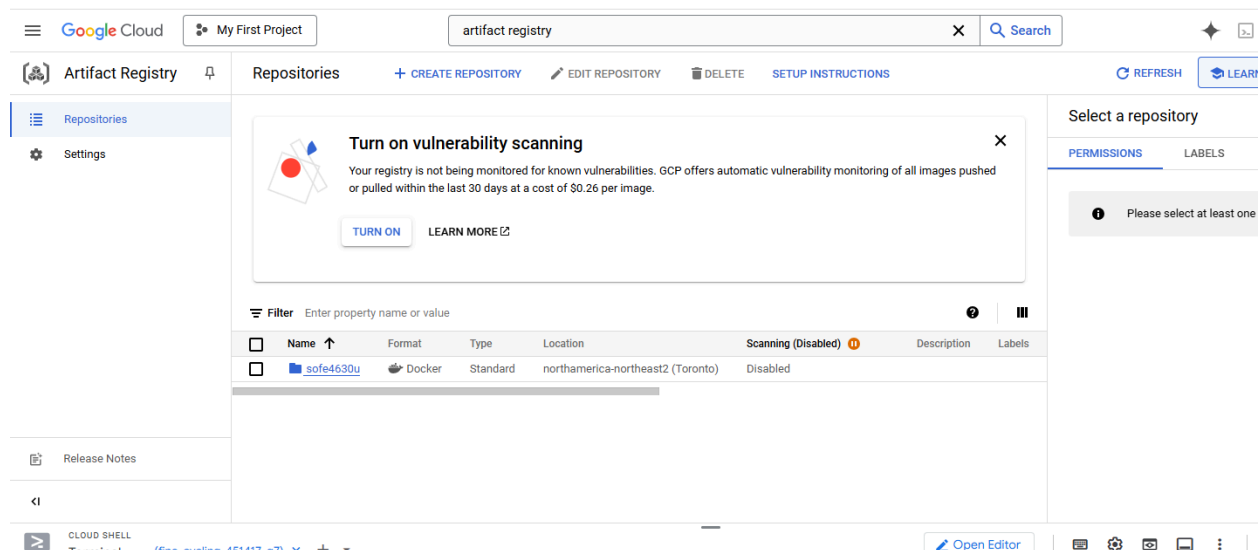
**Due Date:** March 14, 2025

**GitHub Link:**

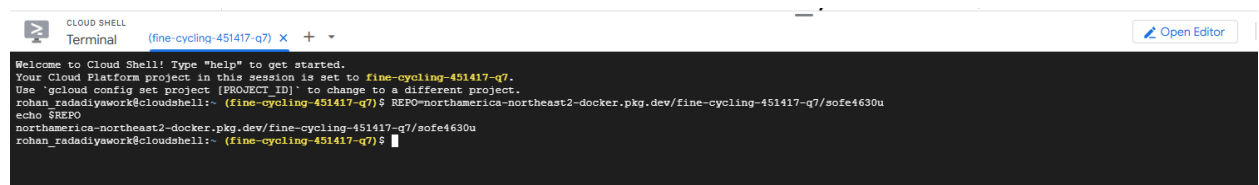
<https://github.com/rohanradadiya/Cloud-Computing-Project-MS-4>

**Google Drive for Videos:**

<https://drive.google.com/drive/folders/16M---vBvUWhzOViHeLaZrygLHYa5MgHI?usp=sharing>

**Screenshots:****Setting up the GCP Project:**

Created a repository within the Artifact Registry page, called “sofe4630u” (After creating a topic and service account key):



Copied the repo path and saved it in an environment variable:

**The Logger Service:**

Cloned the GitHub repository in the GCP console:

```

rohan_radadiyawork@cloudshell:~ (fine-cycling-451417-q7) $ mv ~/fine-cycling-451417-q7-b520b47cb17f.json ~/SOFE4630U-MS4/voting_logger/
rohan_radadiyawork@cloudshell:~ (fine-cycling-451417-q7) $ ls ~/SOFE4630U-MS4/voting_logger/
docker-compose.yaml  Dockerfile      fine-cycling-451417-q7-b520b47cb17f.json  logger.yaml  main.py
rohan_radadiyawork@cloudshell:~ (fine-cycling-451417-q7) $

```

Uploaded the previously created JSON file and moved it to the correct directory:

```

CLOUD SHELL
Terminal (fine-cycling-451417-q7) X + v

>> sha256:1d281e50d3e435595c266df06531a7e8c2eb0c185622c8ab2eed8d3760e6576b 64.39MB / 64.39MB
>> sha256:8bc03088662d3d9e09ab0c0be226220146fb470fd37aa0c2ae05ea52b0fa73d5c7 2.32kB / 2.32kB
>> sha256:155ad54a8b2812a0ec559ff820c0c4f0f0dddb337a226b11879f09e15f67b69fc 48.48MB / 48.48MB
>> sha256:9a663a1c0ba2e6f3dca05949d1c2ea364ca30e2a92a3af95b0c01427633ad9 10.35kB / 10.35kB
>> sha256:447713e77b4f6c3658cfba0c1e16b70ff6d9bf06563dc0cfc0b0454904aed33b4 211.34MB / 211.34MB
>> sha256:93bee368f9319cf7bd4fcc659256d85121430628478ba3d026b5a96967b35cbe 6.16MB / 6.16MB
>> extracting sha256:155ad54a8b2812a0ec559ff820c0c4f0f0dddb337a226b11879f09e15f67b69fc
>> sha256:95b7226c62e1a4719940920ae7fffdlea4915befd3139d7020b84da24152ffd9 19.85MB / 19.85MB
>> sha256:521cad6ddc5302ec0b1d426cdf6df64316fd18ddf3cb0924d24dae81b61501 250B / 250B
>> extracting sha256:8031108f3cda87bb32f090262d0109c8a0db99168050967becefad502e9a681b
>> extracting sha256:1d281e50d3e435595c266df06531a7e8c2eb0c185622c8ab2eed8d3760e6576b
>> extracting sha256:447713e77b4f6c3658cfba0c1e16b70ff6d9bf06563dc0cfc0b0454904aed33b4
>> extracting sha256:93bee368f9319cf7bd4fcc659256d85121430628478ba3d026b5a96967b35cbe
>> extracting sha256:95b7226c62e1a4719940920ae7fffdlea4915befd3139d7020b84da24152ffd9
>> extracting sha256:521cad6ddc5302ec0b1d426cdf6df64316fd18ddf3cb0924d24dae81b61501
>> [internal] load build context
>> transferring context: 7.16kB
>> [2/4] RUN pip install google-cloud-pubsub redis
>> [3/4] COPY *.json .
>> [4/4] ADD main.py .
>> exporting to image
>> exporting layers
>> writing image sha256:17d792bf4b55695a793da3d35f6ebe55f1683adc4603011480355b0c9dea73
>> naming to northamerica-northeast2-docker.pkg.dev/fine-cycling-451417-q7/sofe4630u/logger
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $

```

Executed the instruction in the Dockerfile and generated the image:

```

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $ docker push $LOGGER_IMAGE
Using default tag: latest
The push refers to repository [northamerica-northeast2-docker.pkg.dev/fine-cycling-451417-q7/sofe4630u/logger]
e0ed0d4be92d: Pushed
b83814db9497: Pushed
ff9c79e0a603: Pushed
01db3e67097a: Pushed
e49d0c09fa2a: Pushed
1c06760e5c93: Pushed
4b017a36f40c: Pushed
20a9b386a10e: Pushed
f8217d7865d2: Pushed
01c9a2a5f237: Pushed
latest: digest: sha256:d557f3a122409cc309468b9f068387370374689cee7fc9fe5783e6f83a98663 size: 2424
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $

```

Pushed the Docker image into the artifact repository for use in a Kubernetes deployment:

```

CLOUD SHELL
Terminal (fine-cycling-451417-q7) X + v

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $ gcloud container clusters create sofe4630-cluster --region=northamerica-northeast2 --num-nodes=1
Note: The kubelet readonly 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-kubelet-readonly-port for ways to check usage and for migration instructions.
Note: Your Pod address range (--cluster-ip-cidr) can accommodate at most 1008 node(s).
Creating cluster sofe4630-cluster in northamerica-northeast2... Cluster is being health-checked (Kubernetes Control Plane is healthy)...done.
Created https://console.cloud.google.com/api/projects/fine-cycling-451417-q7/zones/northamerica-northeast2/clusters/sofe4630-cluster.
To inspect the contents of your cluster, go to: https://console.cloud.google.com/kubernetes/workload/_gcloud/northamerica-northeast2/sofe4630-cluster?project=fine-cycling-451417-q7
kubeconfig entry generated for sofe4630-cluster.
NAME: sofe4630-cluster
LOCATION: northamerica-northeast2
MASTER VERSION: 1.31.5-gke.1233000
MASTER IP: 34.130.48.24
MACHINE TYPE: c2-medium
NODE VERSION: 1.31.5-gke.1233000
NUM NODES: 3
STATUS: RUNNING
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $ gcloud container clusters get-credentials sofe4630-cluster --region=northamerica-northeast2
Fetching cluster endpoint and auth data.
kubeconfig entry generated for sofe4630-cluster.
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $ kubectl get nodes
NAME                                STATUS    ROLES    AGE    VERSION
gke-sofe4630-cluster-default-pool-219d3c7-51dw Ready    <none>   93s    v1.31.5-gke.1233000
gke-sofe4630-cluster-default-pool-22ca0e13-ch5n Ready    <none>   93s    v1.31.5-gke.1233000
gke-sofe4630-cluster-default-pool-cac0a7c-kp92 Ready    <none>   93s    v1.31.5-gke.1233000
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $

```

Had to create a new cluster and connected kubectl to the newly created cluster:

```

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $ PROJECT=$PROJECT LOGGER_IMAGE=$LOGGER_IMAGE envsubst < logger.yaml | kubectl apply -f -
deployment.apps/logger-deployment created
service/redis created
deployment.apps/redis-deployment created
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7) $

```

Service and Redis server deployed:

```

rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$ kubectl get pods
kubectl logs <pod-name>
NAME                                READY    STATUS    RESTARTS   AGE
logger-deployment-5c697ccf6d-nv69p  1/1      Running   0           77s
logger-deployment-5c697ccf6d-q9bvv  1/1      Running   0           77s
logger-deployment-5c697ccf6d-trabc  1/1      Running   0           77s
redis-deployment-7b7f55cb55-2k94f   1/1      Running   0           77s
-bash: syntax error near unexpected token `newline'
rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$ kubectl logs logger-deployment-5c697ccf6d-q9bvv
Connected to Redis
Listening for messages on projects/fine-cycling-451417-q7/subscriptions/election-submit-sub..
rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$

```

Checking the deployment:

## The Voting Recorder Service:

```

rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$ cp ~/fine-cycling-451417-q7-b520b47cb17f.json ~/SOFE4630U-MS4/voting_record/
rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$ ls ~/SOFE4630U-MS4/voting_record/
docker-compose.yaml  Dockerfile  fine-cycling-451417-q7-b520b47cb17f.json  main.py  postgres  recorder.yaml
rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$

```

Copied JSON file to the path “~/SOFE4630U-MS4/voting\_record”:

```

rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$ REPO=northamerica-northeast2-docker.pkg.dev/fine-cycling-451417-q7/sofe4630u
RECORDER_IMAGE=$REPO/recorder
echo $RECORDER_IMAGE
northamerica-northeast2-docker.pkg.dev/fine-cycling-451417-q7/sofe4630u/recorder
rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$

```

Generated full name of the service image:

```

rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_logger (fine-cycling-451417-q7)$ cd ~/SOFE4630U-MS4/voting_record
ls
docker-compose.yaml  Dockerfile  fine-cycling-451417-q7-b520b47cb17f.json  main.py  postgres  recorder.yaml
rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$

```

Making sure that the path contains all of the necessary files:

```

CLOUD SHELL
Terminal (fine-cycling-451417-q7) x +
Open Editor

1c86740c5c93: Waiting
4b017a36fd9c: Waiting
20a9b386e10e: Waiting
f8217d7865d2: Waiting
01c9a2a5f237: Waiting
e4980c94a2a: Layer already exists
01db3e67097a: Layer already exists
1c86740c5c93: Layer already exists
4b017a36fd9c: Layer already exists
f8217d7865d2: Layer already exists
20a9b386e10e: Layer already exists
3d4a3fd9ce77: Pushed
78fbdde96cd3: Pushed
89ad3882feb3: Pushed
01c9a2a5f237: Pushed
latest: digest: sha256:d18d4728712479a3e8806361bd219a17c9fc9a2804fd7139ecbaa56f83b04397 size: 2424
DONE

ID: ef667b1d-45b7-471a-b280-11224d96a108
CREATE TIME: 2025-03-11T01:41:29+00:00
DURATION: 51s
SOURCE: gs://fine-cycling-451417-q7_cloudbuild/source/1741657289.337474-82299e450eb545d76b82bcc047c966c.tgz
IMAGES: northamerica-northeast2-docker.pkg.dev/fine-cycling-451417-q7/sofe4630u/recorder (+1 more)
STATUS: SUCCESS
rohan radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$

```

Executed the instruction in the Dockerfile to generate the image and push it to the artifact repository:

```

CLOUD SHELL
Terminal (fine-cycling-451417-q7) x + Open Editor

6cab14f8a434: Preparing
8d3ac3489996: Preparing
be6c168b4af5: Waiting
1737c2580132: Waiting
6cab14f8a434: Waiting
8d3ac3489996: Waiting
984018b572de: Pushed
4db156377c9: Pushed
6c651825e7c4: Pushed
5b87e9731513: Pushed
176b9203da6e: Pushed
6cab14f8a434: Pushed
1737c2580132: Pushed
8d3ac3489996: Pushed
be6c168b4af5: Pushed
election: digest: sha256:a5a3732542649f4c8ab524fa2223fa5146dbf3a639c75aee35c8d9c8f0d476c size: 2192
DONE

ID: 85fe5d98-0f50-4ab7-8800-cfaf5e5bf09b
CREATE TIME: 2025-03-11T01:44:19+00:00
DURATION: 300s
SOURCE: gcr://fine-cycling-451417-q7_cloudbuild/source/1741657458_82016-92ca71015798450ebf5e2ef4864aad81.tgz
IMAGES: northamerica-northeast2-docker.pkg.dev/fine-cycling-451417-q7/sofe4630u/postgres:election
STATUS: SUCCESS
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record/postgres (fine-cycling-451417-q7)$

```

Created and pushed the Docker image to the repository:

```

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record/postgres (fine-cycling-451417-q7)$ REPO=northamerica-northeast2-docker.pkg.dev/fine-cycling-451417-q7/sofe4630u
RECORDER_IMAGE=$REPO/recorder
POSTGRES_IMAGE=$REPO/postgres:election
PROJECT=$(gcloud config list project --format "value(core.project)")

cd ~/SOFE4630U-MS4/voting_record
POSTGRES_IMAGE=$POSTGRES_IMAGE PROJECT=$PROJECT RECORDER_IMAGE=$RECORDER_IMAGE envsubst < recorder.yaml | kubectl apply -f -
deployment.apps/recorder-deployment created
service/postgres created
deployment.apps/postgres-deployment created
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$

```

Deployed the service and the PostgreSQL server:

```

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
logger-deployment-5c697ccf6d-nv69p  1/1     Running   0           25m
logger-deployment-5c697ccf6d-q96bw  1/1     Running   0           25m
logger-deployment-5c697ccf6d-r8abc  1/1     Running   0           25m
postgres-deployment-6c4f6449c7-zgtg6 1/1     Running   0           79s
recorder-deployment-5d558d779c-tlqjw 1/1     Running   0           79s
recorder-deployment-5d558d779c-z6z2  1/1     Running   0           79s
recorder-deployment-5d558d779c-zd7c8 1/1     Running   0           79s
redis-deployment-7b7f55cb55-2k94f    1/1     Running   0           25m
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ kubectl logs recorder-deployment-5d558d779c-tlqjw
Waiting for POSTGRES server
Successfully connected to POSTGRES server
Listening for messages on projects/fine-cycling-451417-q7/subscriptions/election-record-sub..
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$

```

Ensured that pods are available and printed a pod's logs:

## The Voting Machine:

```

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ nano main.py
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ pwd
/home/rohan_radadiyawork/SOFE4630U-MS4/voting_record
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ find . -name "main.py"
./main.py
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ ls ~/.json
/home/rohan_radadiyawork/fine-cycling-451417-q7-b520b47cb17f.json
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ mv ~/fine-cycling-451417-q7-b520b47cb17f.json ~/SOFE4630U-MS4/voting_record/
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ ls ~/SOFE4630U-MS4/voting_record/*.json
/home/rohan_radadiyawork/SOFE4630U-MS4/voting_record/fine-cycling-451417-q7-b520b47cb17f.json
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$

```

Edited the main.py file and moved the JSON key into the same directory as the main.py file:

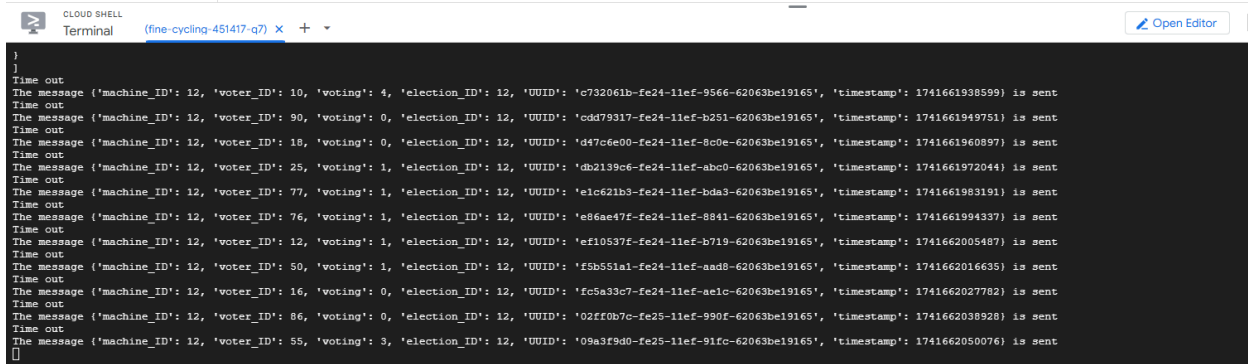
```

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ find -type d -name "voting_machine"
/home/rohan_radadiyawork/SOFE4630U-MS4/voting_machine
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_record (fine-cycling-451417-q7)$ cd /home/rohan_radadiyawork/SOFE4630U-MS4/voting_machine
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_machine (fine-cycling-451417-q7)$ nano main.py
rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_machine (fine-cycling-451417-q7)$ python main.py

rohan_radadiyawork@cloudshell:~/SOFE4630U-MS4/voting_machine (fine-cycling-451417-q7)$ python main.py
Please enter the election ID (integer): 12
Please enter the machine ID (integer): 12
Listening for messages on projects/fine-cycling-451417-q7/subscriptions/election-result-12-sub..

The message {'machine_ID': 12, 'voter_ID': 44, 'voting': 1, 'election_ID': 12, 'UUID': 'c0890d79-fe24-11ef-a805-62063be19165', 'timestamp': 1741661927448} is sent

```



```

}
Time out
The message {'machine_ID': 12, 'voter_ID': 10, 'voting': 4, 'election_ID': 12, 'UUID': 'c732061b-fe24-11ef-9566-62063be19165', 'timestamp': 1741661938599} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 90, 'voting': 0, 'election_ID': 12, 'UUID': 'cdd79317-fe24-11ef-b251-62063be19165', 'timestamp': 1741661949751} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 18, 'voting': 0, 'election_ID': 12, 'UUID': 'd47c6e00-fe24-11ef-8c0e-62063be19165', 'timestamp': 1741661960897} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 25, 'voting': 1, 'election_ID': 12, 'UUID': 'db2139c6-fe24-11ef-abc0-62063be19165', 'timestamp': 1741661972044} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 77, 'voting': 1, 'election_ID': 12, 'UUID': 'e1c621b3-fe24-11ef-bda3-62063be19165', 'timestamp': 1741661983191} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 76, 'voting': 1, 'election_ID': 12, 'UUID': 'e86ae47f-fe24-11ef-8841-62063be19165', 'timestamp': 1741661994337} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 12, 'voting': 1, 'election_ID': 12, 'UUID': 'ef10537f-fe24-11ef-b719-62063be19165', 'timestamp': 1741662005487} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 50, 'voting': 1, 'election_ID': 12, 'UUID': 'f5b551a1-fe24-11ef-aad8-62063be19165', 'timestamp': 1741662016635} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 16, 'voting': 0, 'election_ID': 12, 'UUID': 'fc5a33c7-fe24-11ef-a61c-62063be19165', 'timestamp': 1741662027782} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 86, 'voting': 0, 'election_ID': 12, 'UUID': '02ff0b7c-fe25-11ef-990f-62063be19165', 'timestamp': 1741662038928} is sent
Time out
The message {'machine_ID': 12, 'voter_ID': 55, 'voting': 3, 'election_ID': 12, 'UUID': '09a3f9d0-fe25-11ef-91fc-62063be19165', 'timestamp': 1741662050076} is sent

```

**Receiving all of the message notifications in the output now:**

## **Discussion:**

**Compare the advantages and disadvantages of using Dataflow vs microservices in preprocessing the smart reading.**

There are various aspects to consider when discussing Dataflow and microservices in preprocessing the smart reading. For example, dataflow offers the advantage of simplifying the processing of large-scale data in real time by leveraging fully managed services. It allows for easy handling of stream processing tasks like data ingestion, transformation, and analytics without the need for manual scaling or infrastructure management. Also, Dataflow integrates with other cloud services. However, some disadvantages are less flexibility in certain cases, potential latency, and even the complexity of managing costs depending on usage.

On the other hand, microservices provide a modular approach to application design because of breaking down complex systems into smaller and independently deployed components. This allows for better scalability, fault tolerance, and ease of updates since each microservice can evolve separately. Some disadvantages of this can be challenges in service communication, orchestration, and monitoring. There may also be challenges in deploying and maintaining each microservice, which can also increase the complexity of the overall architecture.