

Software Tools and Techniques

Lab Assignment 8

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Team: 21

Repository link: https://github.com/Praanshu101/Application_Containerization

Docker Hub links: <https://hub.docker.com/repository/docker/rishanksoni/fastapi2/general>

Screenshots:

Screenshot when running building command and its output, running container and its output:

Building frontend:

```
root@frontend:/home/rishanksoni/CS203_Lab_8/frontend# docker build -t frontend .
[+] Building 2.1s (9/9) FINISHED
=> [internal] load build definition from Dockerfile
=> => transferring dockerfile: 223B
=> [internal] load metadata for docker.io/library/python:3.9-slim
=> [internal] load .dockerignore
=> => transferring context: 2B
=> [1/4] FROM docker.io/library/python:3.9-slim@sha256:e52ca5f579cc58fed41efcbb55a0ed5dccc6c7a156cba76acfb4ab42fcl9dd00
=> [internal] load build context
=> => transferring context: 128B
=> CACHED [2/4] WORKDIR /app
=> CACHED [3/4] COPY . .
=> CACHED [4/4] RUN pip install --no-cache-dir requests fastapi[standard] uvicorn gunicorn
=> exporting to image
=> => exporting layers
=> => writing image sha256:35ecb56c8956ad921a2838ef87ce3a84f307b3964607fcc4aaa9c405f7221a9e
=> => naming to docker.io/library/frontend
```

Running container on frontend:

```
root@frontend:/home/rishanksoni/CS203_Lab_8/frontend# docker run -d --name frontend -p 9567:9567 frontend
25b28d24aff4bf52cd7ad0cebffc9646cbceb22d668584ac27962f3f260e7dcf
root@frontend:/home/rishanksoni/CS203_Lab_8/frontend# docker logs frontend
INFO: Started server process [1]
INFO: Waiting for application startup.
INFO: Application startup complete.
INFO: Uvicorn running on http://0.0.0.0:9567 (Press CTRL+C to quit)
INFO: 14.139.98.80:10409 - "GET / HTTP/1.1" 200 OK
```

Building and running elasticsearch and backend container:

```
root@backend:/home/rishanksoni/sst-ai-app/Application_Containerization/backend# sudo docker compose up --build
WARNING: /home/rishanksoni/sst-ai-app/Application_Containerization/backend/docker-compose.yml: the attribute 'version' is obsolete, it will be ignored, please remove it to avoid potential confusion
Compose can now delegate builds to bake for better performance.
To do so, set COMPOSE_BAKE=true.
[+] Building 198.2s (10/10) FINISHED
=> [fastapi internal] load build definition from Dockerfile
=> => transferring dockerfile: 221B
=> [fastapi internal] load metadata for docker.io/library/python:3.9-slim
=> [fastapi internal] load .dockerignore
=> => transferring context: 2B
=> [fastapi 1/4] FROM docker.io/library/python:3.9-slim@sha256:e52ca5f579cc58fed41efcbb55a0ed5dccc6c7a156cba76acfb4ab42fcl9dd00
=> [fastapi internal] load build context
=> => transferring context: 2.39kB
=> CACHED [fastapi 2/4] WORKDIR /app
=> [fastapi 3/4] COPY . .
=> [fastapi 4/4] RUN pip install --no-cache-dir fastapi[standard] elasticsearch requests
=> [fastapi] exporting to image
=> => exporting layers
=> => writing image sha256:3158a727f3cac207d9e943c4912d3fdd6ae7e79440ed2ec91f2e991be39742296
=> => naming to docker.io/library/backend-fastapi
=> [fastapi] resolving provenance for metadata file
=> [fastapi 1/1]
[+] Building 3/1
✓ fastapi Built
[+] Building 3/4 orphan containers ([nginx]) for this project. If you removed or renamed this service in your compose file, you can run this command with the --remove-orphans flag to ci
✓ fastapi Built
✓ Container fastapi2 Started
✓ Container elasticsearch Healthy
root@backend:/home/rishanksoni/sst-ai-app/Application_Containerization/backend#
```

Screenshot of “netstat -antp | grep LISTEN” on Base Linux OS, where the container is running.

```
root@backend:/home/rishanksoni/sst-ai-app/Application_Containerization/backend# netstat -antp | grep LISTEN
tcp        0      0 0.0.0.0:9567          0.0.0.0:*             LISTEN      24477/docker-proxy
tcp        0      0 0.0.0.0:53:53        0.0.0.0:*             LISTEN      478/systemd-resolve
tcp        0      0 0.0.0.0:22           0.0.0.0:*             LISTEN      858/sshd: /usr/sbin
tcp        0      0 0.0.0.0:9200         0.0.0.0:*             LISTEN      22802/docker-proxy
tcp        0      0 0.0.0.0:20202        0.0.0.0:*             LISTEN      980/fluent-bit
tcp6       0      0 :::9567              :::*                   LISTEN      24484/docker-proxy
tcp6       0      0 :::22                :::*                   LISTEN      858/sshd: /usr/sbin
tcp6       0      0 :::9200              :::*                   LISTEN      22807/docker-proxy
tcp6       0      0 :::20201             :::*                   LISTEN      933/otelopscol
```

```
root@frontend:/home/rishanksoni/CS203_Lab_8/frontend# netstat -antp | grep LISTEN
tcp        0      0 0.0.0.0:22           0.0.0.0:*             LISTEN      986/sshd: /usr/sbin
tcp        0      0 0.0.0.0:9567         0.0.0.0:*             LISTEN      323678/docker-proxy
tcp        0      0 0.0.0.0:53:53        0.0.0.0:*             LISTEN      446/systemd-resolve
tcp        0      0 0.0.0.0:20202        0.0.0.0:*             LISTEN      1116/fluent-bit
tcp6       0      0 :::22                :::*                   LISTEN      986/sshd: /usr/sbin
tcp6       0      0 :::9567              :::*                   LISTEN      323684/docker-proxy
tcp6       0      0 :::20201             :::*                   LISTEN      1079/otelopscol
```

Screenshot of testing insert query:

FastAPI Message Interface

hello from the other side I r

Get Insert

Best Scoring Document:

All Documents (in order of ID):

Document #1:
ID: miJTuzUBppWyp0QabJ94
Content: hello

Insert Status:

```
{
  "status": "Inserted",
  "document": {
    "id": "M3zI2ZUBvb-fm95qmsEL",
    "text": "hello from the other side I must have called a thousand timeshello from the other side I must have called a thousand timeshello from the other side I mu"
  }
}
```

Screenshot of testing get query:

FastAPI Message Interface

india

Get Insert

Best Scoring Document:

All Documents (in order of ID):

Document #1:
ID: 3
Content: In the early mediaeval era, Christianity, Islam, Judaism, and Zoroastrianism became established on India's southern and western coasts.[44] Muslim armies f

Document #2:
ID: 4
Content: India has been a federal republic since 1950, governed through a democratic parliamentary system. It is a pluralistic, multilingual and multi-ethnic societ

Document #3:
ID: 1
Content: India, officially the Republic of India,[j][21] is a country in South Asia. It is the seventh-largest country by area; the most populous country from June

Document #4:
ID: 2
Content: Modern humans arrived on the Indian subcontinent from Africa no later than 55,000 years ago.[28][29][30] Their long occupation, predominantly in isolation

FastAPI Message Interface

timeshello

Get Insert

Best Scoring Document:

All Documents (in order of ID):

Document #1:
ID: M3Z122UBvb-fm95qmsEL
Content: hello from the other side I must have called a thousand timeshello from the other side I must have called a thousand timeshello from the other side I must h

- -

Methods for Optimization:

Made Docker Images Smaller:

- Used a python:3.9-slim to reduce image size (lightweight python image).
- Combined multiple commands in Dockerfile to reduce image size.
- Used --no-cache-dir when installing packages to avoid extra storage usage.

Made Containers Start Faster:

- Set up a direct start command (uvicorn main:app --host 0.0.0.0 --port 9567) so the container runs immediately.
- Ensured the backend waits for Elasticsearch before starting, so it doesn't keep restarting.
- Used health checks to make sure services are ready before they are used.

Architecture diagram:

Google Cloud Platform

- Frontend VM (FastAPI Frontend)
 - Runs FastAPI UI on port 9567
 - Exposed to public via HTTPS
 - Connects to Backend via External IP
 - Contains input box & buttons (GET/INSERT)
- Backend & Elasticsearch VM (Docker Containers)
 - FastAPI Backend (Runs on port 9567)
 - Queries Elasticsearch
 - Handles GET & INSERT requests
 - Communicates with Elasticsearch over Docker network
 - Elasticsearch (Runs on port 9567, internal)
 - Stores indexed data
 - Responds to queries from FastAPI Backend
 - Docker Network
 - Internal bridge network (No direct host access)
 - Docker Volume
 - Stores Indexed Data Persistently

- Google Cloud Firewall Rules
 - Allows Frontend VM to access Backend
 - Blocks direct access to Backend & Elasticsearch