

Individual Assignment 2

Docker and Containers

Total Weight: 5%

Due Date: Friday March 25

Objectives: You will be getting familiar with Docker by following Docker's documentation. After completing this assignment you should be more familiar with Docker, containers, and some of the functionality.

How to Sign up:

You will need to sign up during part 4 of the tutorial through the docker hub. It is the first step in part 4 and it provides links as to where to sign up. When you click the link it should open up straight to the sign up page where you create a docker id, email, password. If it helps, you can use your ISU email (although not required). This login will help you sign in onto the docker dashboard and play with docker (also in part 4).

Here's the link to sign up in case: <https://hub.docker.com/>

No Credit Card Needed:

To sign up you don't need any credit card info. You will just sign up using a free tier account. **If you get to point where credit card information is required, you must have not used the link through the docker documentation.** I do not need to enter any payment information.

Link to Docker's Documentation site:

Please refer to the side menu to the left and do parts 1 - 9 in "Get Started":

<https://docs.docker.com/get-started/>

What to Submit

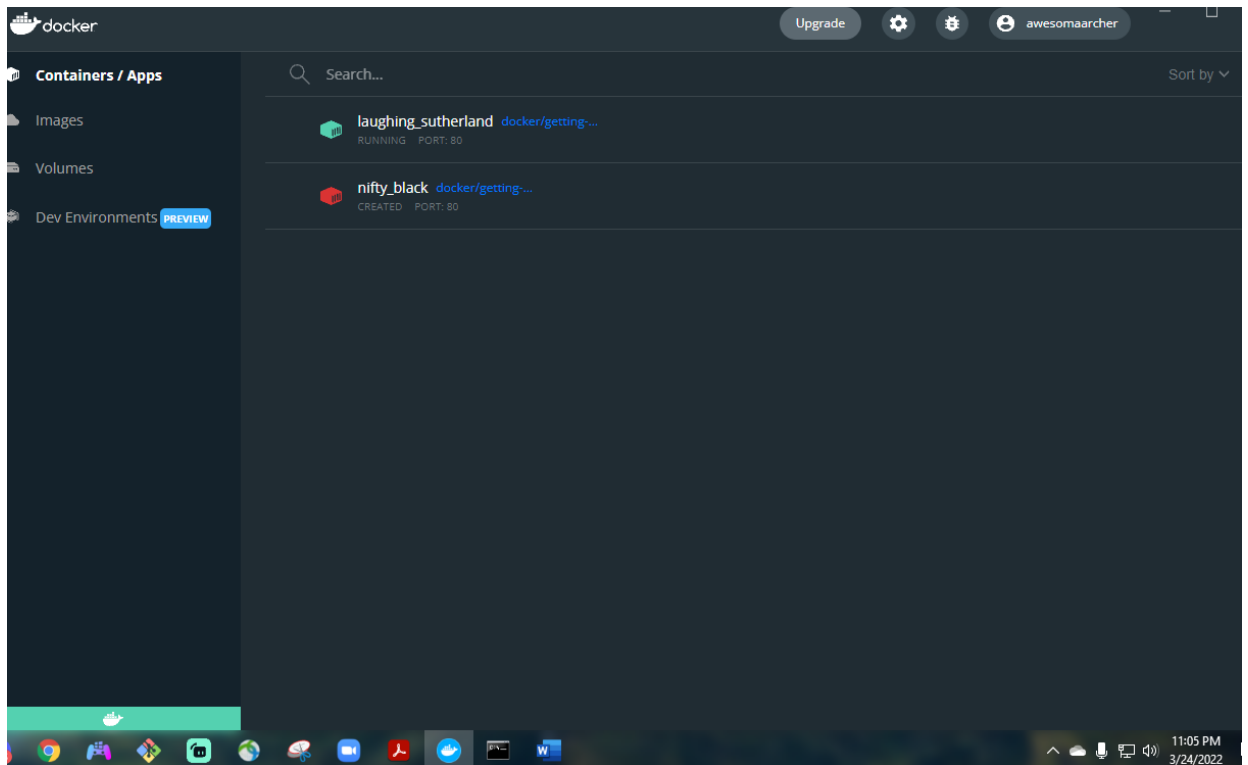
- A Single PDF Document with the necessary screenshots for each part
- A one-paragraph summary of what you learned

To complete this assignment follow the documentation and steps at the link above. Below you will find a list of the screenshots you need to provide at each of the 9 parts. Please make sure you provide all the listed screenshots below and provide captions for each.

List of Required Screenshots

Part 1: Getting Started

- Docker Dashboard with the docker/getting-started container running



- Application with instance running

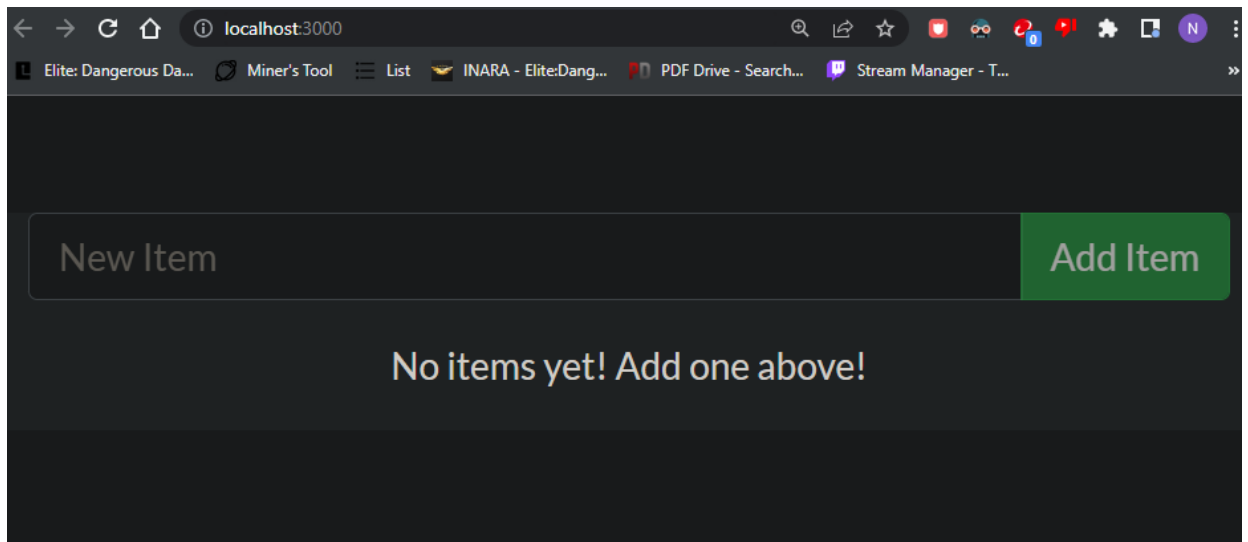
Part 2: Sample Application

- Dockerfile code

```
1 # syntax=docker/dockerfile:1
2 FROM node:12-alpine
3 RUN apk add --no-cache python2 g++ make
4 WORKDIR /app
5 COPY . .
6 RUN yarn install --production
7 CMD ["node", "src/index.js"]
8 EXPOSE 3000
```

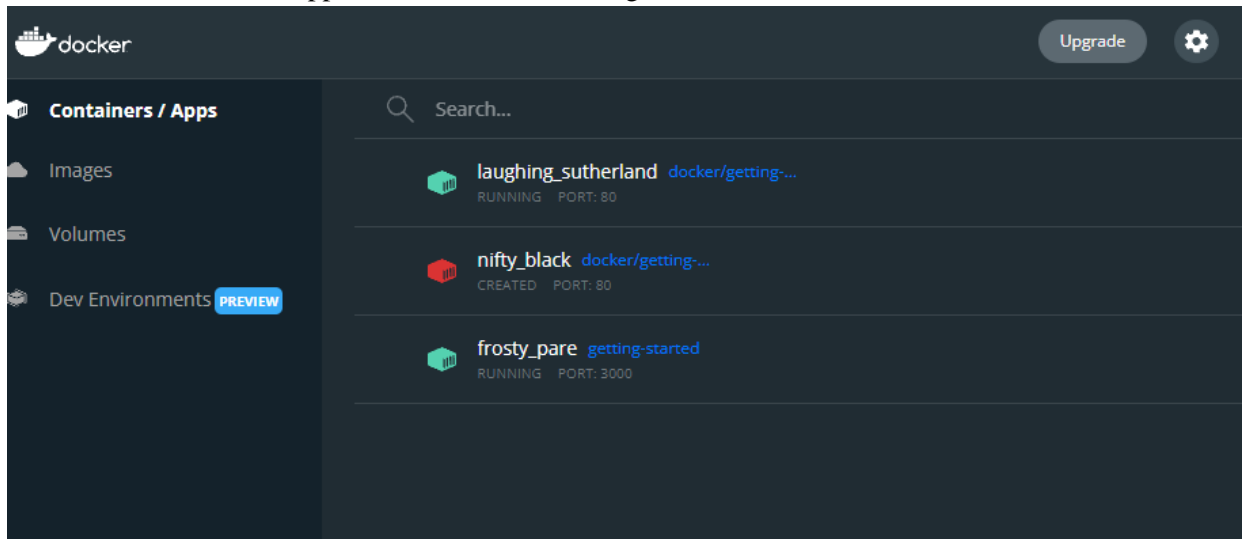
Dockerfile code with the configs

- The web browser of the running application



Sample items hosted on 3000 port

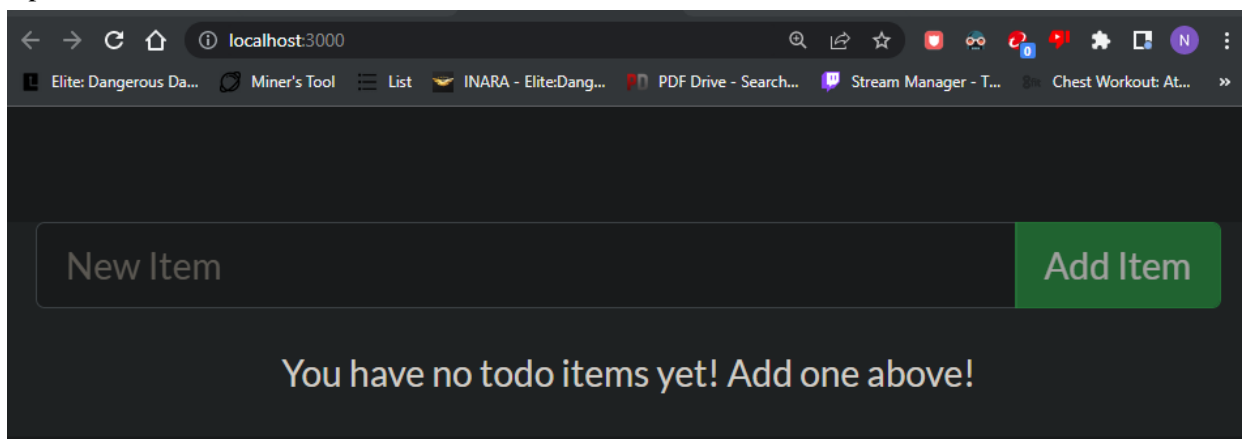
- Docker Dashboard with application container running



2 instances running as given

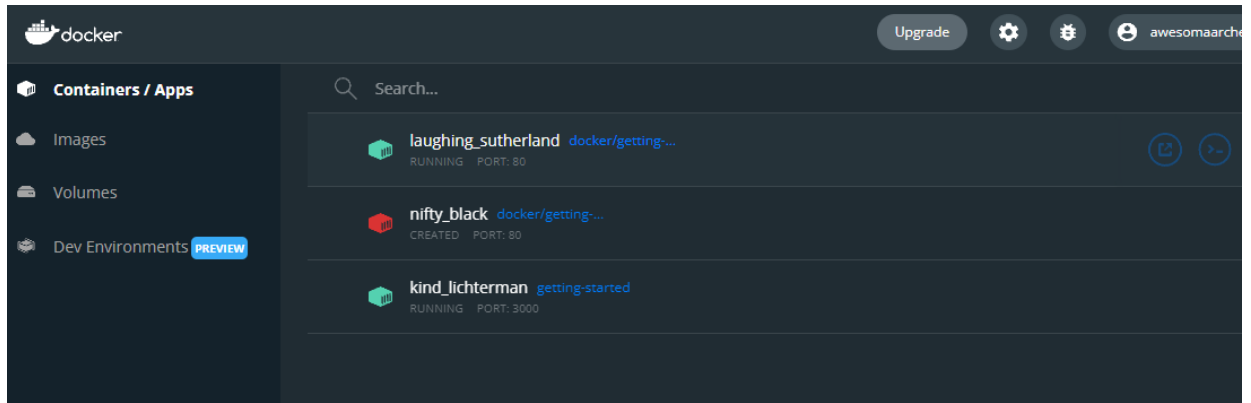
Part 3: Update the Application

- Updated web browser with modifications



“You have no todo items”

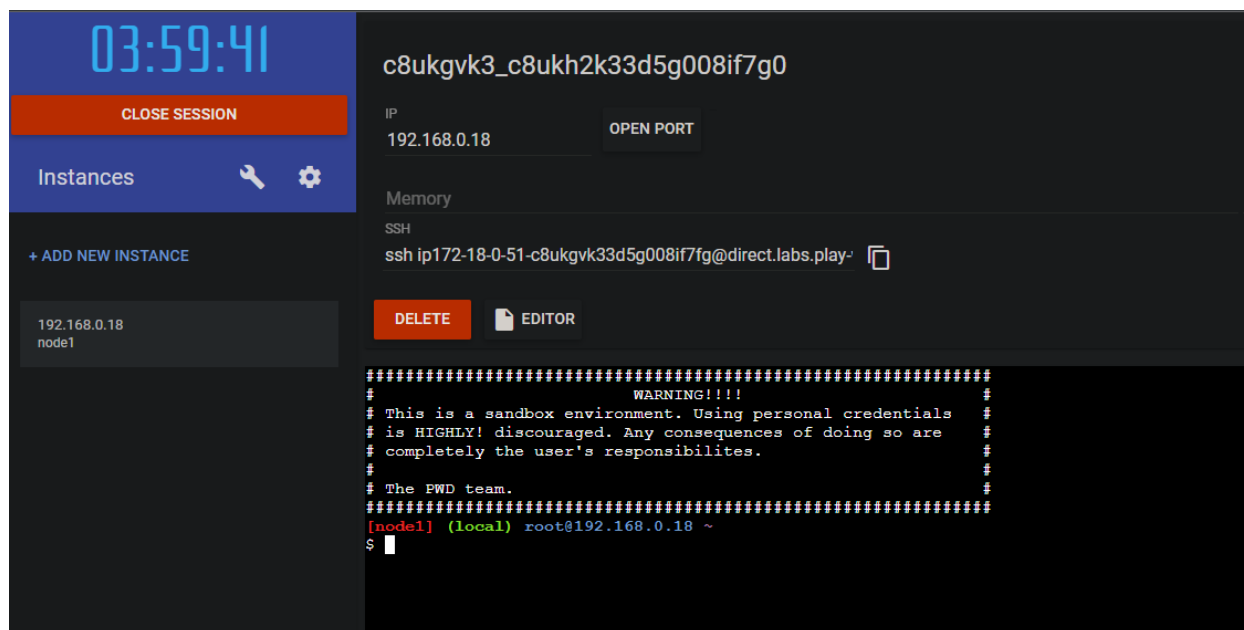
- Docker Dashboard with new application container running



New updated instances running in the Dashboard

Part 4: Share the application

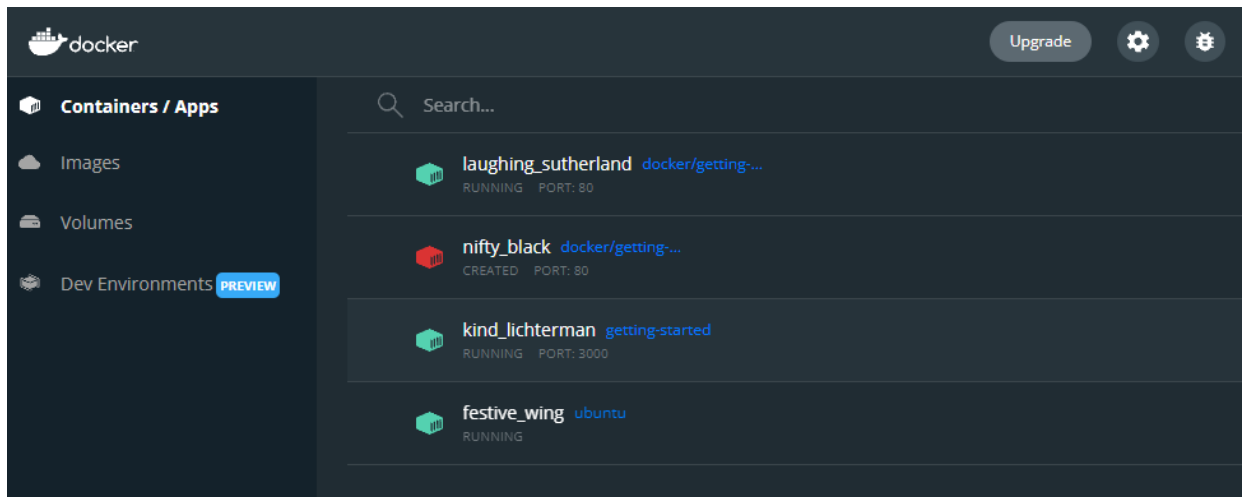
- Instance and terminal on Play with Docker site (similar to the documentation screenshot)



Terminal shows the session from the website

Part 5: Persist the DB

- Docker Dashboard with Ubuntu container



New Ubuntu Container shown in the screenshot!

- Output for command: `cat /data.txt`

```
# cat /data.txt
57
#
```

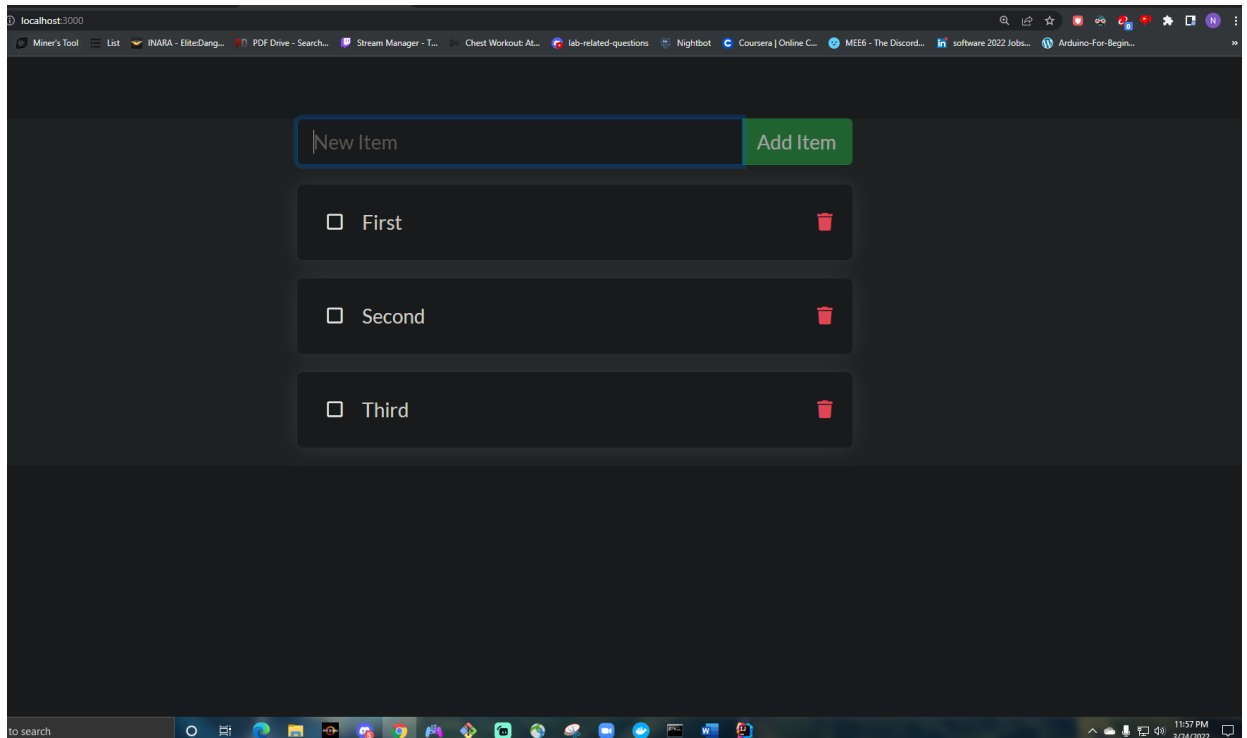
Running the terminal in the Ubuntu instance

- Output of random number for command: `docker exec <id> cat /data.txt`

```
F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app>docker exec 8facc2f6c1f3 cat /data.txt
57
F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app>
```

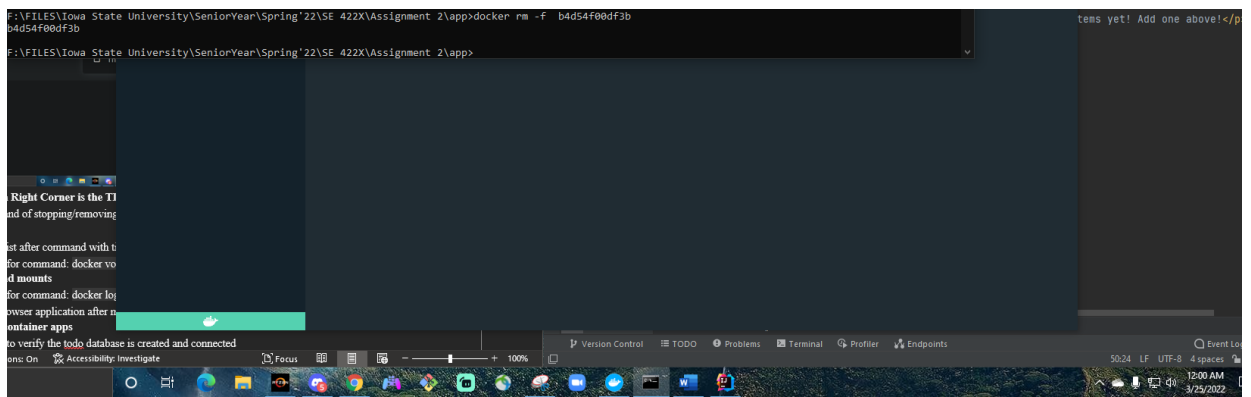
Running the terminal in the command prompt

- Added items on to-do list with timestamp



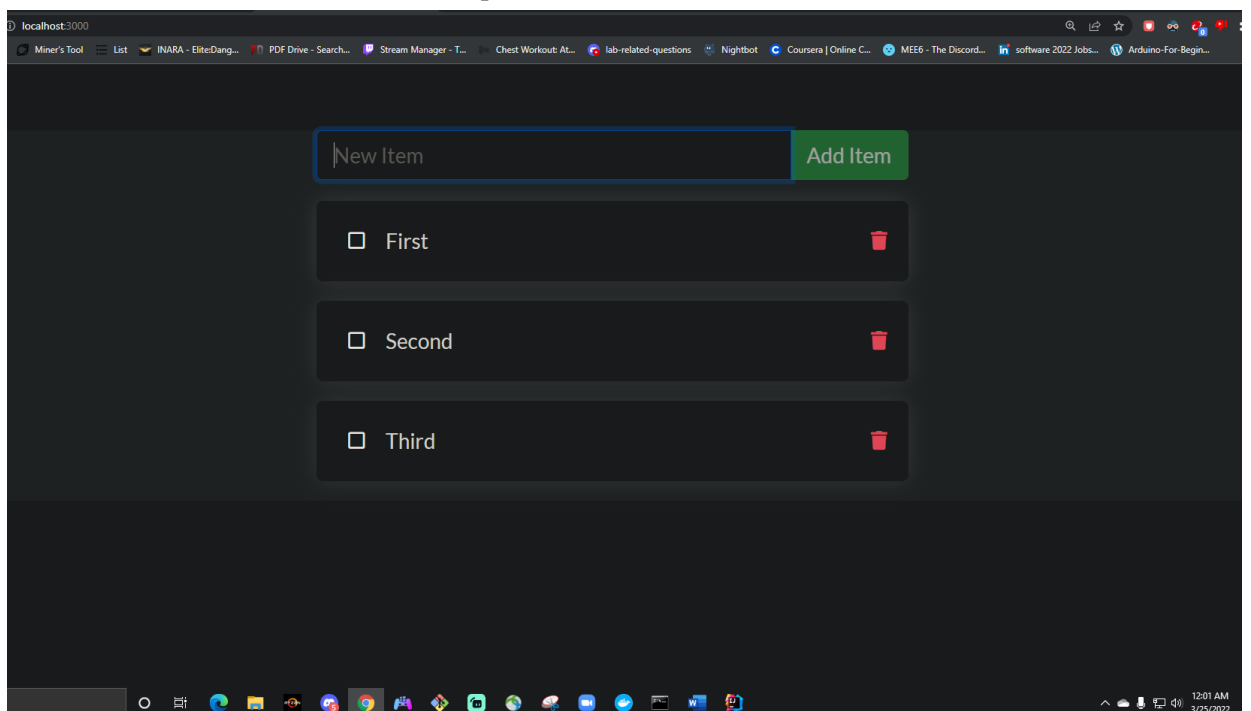
Timestamp with the todo list

- Command of stopping/removing container with timestamp



Stopped and Removed the timestamp

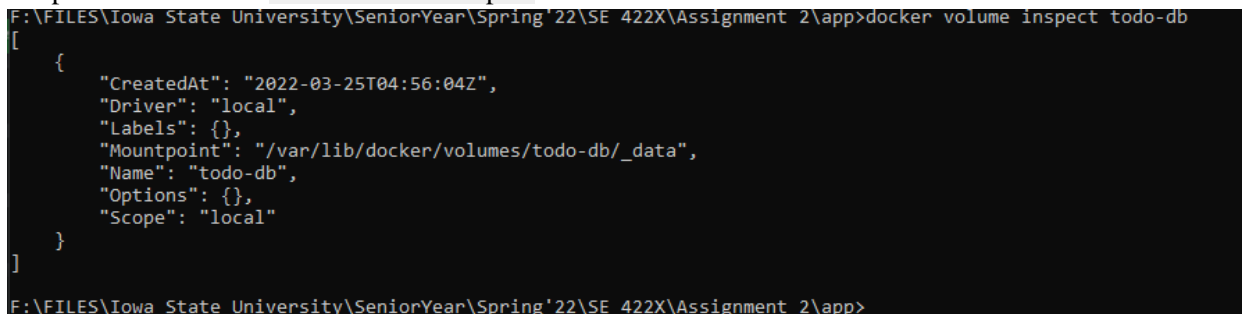
- To-do list after command with timestamp



Todo list still shows up after stopping the instance

Bottom Right Corner is the TIME!!

- Output for command: `docker volume inspect`



Docker volume shows up when inspecting the DB

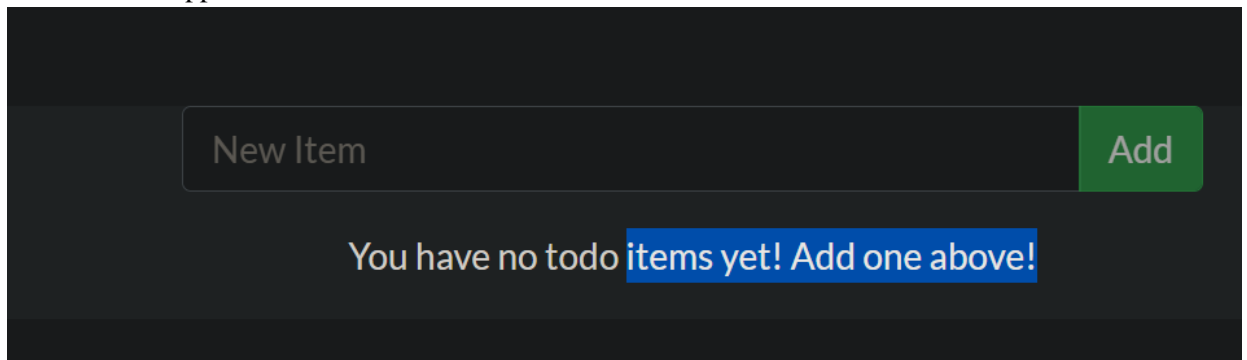
Part 6: Use bind mounts

- Output for command: `docker logs -f <id>`

```
S F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker log
arn install v1.22.17
1/4] Resolving packages...
arning Resolution field "ansi-regex@5.0.1" is incompatible with requested version "ansi-re
arning Resolution field "ansi-regex@5.0.1" is incompatible with requested version "ansi-re
arning sqlite3 > node-gyp > request@2.88.2: request has been deprecated, see https://githu
arning sqlite3 > node-gyp > tar@2.2.2: This version of tar is no longer supported, and wil
arning sqlite3 > node-gyp > request > har-validator@5.1.5: this library is no longer suppo
arning sqlite3 > node-gyp > request > uuid@3.4.0: Please upgrade to version 7 or higher.
h is known to be problematic. See https://v8.dev/blog/math-random for details.
2/4] Fetching packages...
3/4] Linking dependencies...
4/4] Building fresh packages...
uccess Saved lockfile.
one in 42.40s.
arn run v1.22.17
nodemon src/index.js
nodemon] 2.0.13
nodemon] to restart at any time, enter `rs`
nodemon] watching path(s): *.*
nodemon] watching extensions: js,mjs,json
nodemon] starting `node src/index.js`
sing sqlite database at /etc/todos/todo.db
listening on port 3000
```

Docker logs show sqlite database information

- Web browser application after modifications



New webpage!

Part 7: Multi-container apps

- Output to verify the todo database is created and connected

```

PS F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker run --name todo-app --network todo-app --network-alias mysql -v todo-mysql-data:/var/lib/mysql -e MYSQL_ROOT_PASSWORD=secret -e MYSQL_DATABASE=todos mysql:5.7
Unable to find image 'mysql:5.7' locally
5.7: Pulling from library/mysql
a4b007099961: Pull complete
e2b610d88fd9: Pull complete
38567843b438: Pull complete
5fc423bf9558: Pull complete
aa8241dfe828: Pull complete
cc662311610e: Pull complete
9832d1192cf2: Pull complete
3f242378e320: Pull complete
cc65503c0186: Pull complete
ce8944d50437: Pull complete
597d59a9a424: Pull complete
Digest: sha256:c8f68301981a7224cc9c063fc7a97b6ef13cfc4142b4871d1a35c95777ce96f4
Status: Downloaded newer image for mysql:5.7
b8efc468d7bd4f24c583c453cf993bb28ddd94feb052b6ad47bccab47349eaab

```

```

PS F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker exec
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 2
Server version: 5.7.37 MySQL Community Server (GPL)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> SHOW DATABASES
-> SHOW DATABASES;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to
W DATABASES' at line 2
mysql> SHOW DATABASES;
+-----+
| Database |
+-----+
| information_schema |
| mysql |
| performance_schema |

```

Both Screenshots show the mysql authentication

- Output for command: dig mysql


```

; <<>> DiG 9.16.22 <<>> mysql
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 29438
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;mysql.                IN      A

;; ANSWER SECTION:
mysql.                  600     IN      A      172.18.0.2

;; Query time: 0 msec
;; SERVER: 127.0.0.11#53(127.0.0.11)
;; WHEN: Fri Mar 25 05:32:30 UTC 2022
;; MSG SIZE rcvd: 44

```

Dig mysql shows info regarding the server info

- Select statement output from the todo items

```

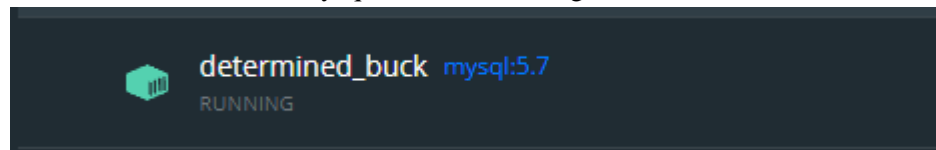
mysql> select * from todo_items;
+-----+-----+-----+
| id | name | completed |
+-----+-----+-----+
| bbfef54d-5ecc-4518-b403-5bf2b5c4aaf2 | First | 0 |
| ec22418d-cc50-4adb-81d1-23d883a857e2 | Second | 0 |
| bb2de566-8e31-4d45-bf0b-e7a3b207e1f0 | Third | 0 |
+-----+-----+-----+
3 rows in set (0.00 sec)

mysql>

```

The 3 instances from the website in the mysql database

- Docker Dashboard with mysql container running



Mysql database container running

Part 8: Use Docker Compose

- Entire docker-compose.yml file

```

version: "3.7"

services:
  app:
    image: node:12-alpine
    command: sh -c "yarn install && yarn run dev"
    ports:
      - 3000:3000
    working_dir: /app
    volumes:
      - ./:/app
    environment:
      MYSQL_HOST: mysql
      MYSQL_USER: root
      MYSQL_PASSWORD: secret
      MYSQL_DB: todos

  mysql:
    image: mysql:5.7
    volumes:
      - todo-mysql-data:/var/lib/mysql
    environment:
      MYSQL_ROOT_PASSWORD: secret
      MYSQL_DATABASE: todos

volumes:
  todo-mysql-data:

```

Config file showing the Docker Compose

- Output for command: docker-compose up

```

F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker-compose up -d
[+] Running 3/4
 - Network app_default          Created
 - Volume "app_todo-mysql-data" Created
 - Container app-app-1         Starting
 - Container app-mysql-1       Started

```

Creates the docker compose

- Docker-compose logs

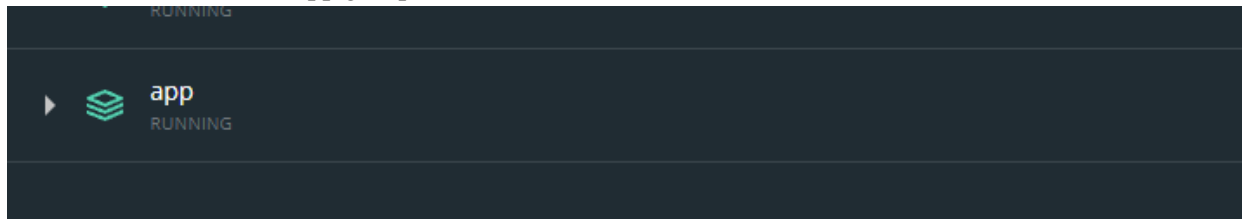
```

S F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker-compose logs -f
pp-mysql-1 | 2022-03-25 06:04:44+00:00 [Note] [Entrypoint]: Entrypoint script for MySQL Server 5.7.37-1debian10 started.
pp-mysql-1 | 2022-03-25 06:04:44+00:00 [Note] [Entrypoint]: Switching to dedicated user 'mysql'
pp-mysql-1 | 2022-03-25 06:04:44+00:00 [Note] [Entrypoint]: Entrypoint script for MySQL Server 5.7.37-1debian10 started.
pp-mysql-1 | 2022-03-25 06:04:44+00:00 [Note] [Entrypoint]: Initializing database files
pp-mysql-1 | 2022-03-25T06:04:44.765574Z 0 [Warning] TIMESTAMP with implicit DEFAULT value is deprecated. Please use --explicit_defaults_for_timestamp server option
ntation for more details).
pp-mysql-1 | 2022-03-25T06:04:44.878744Z 0 [Warning] InnoDB: New log files created, LSN=45790
pp-mysql-1 | 2022-03-25T06:04:44.903568Z 0 [Warning] InnoDB: Creating foreign key constraint system tables.
pp-mysql-1 | 2022-03-25T06:04:44.913760Z 0 [Warning] No existing UUID has been found, so we assume that this is the first time that this server has been started. G
ew UUID: 77f51372-ac01-11ec-9d01-0242ac130002.
pp-mysql-1 | 2022-03-25T06:04:44.915743Z 0 [Warning] Gtid table is not ready to be used. Table 'mysql.gtid_executed' cannot be opened.
pp-mysql-1 | 2022-03-25T06:04:45.392430Z 0 [Warning] A deprecated TLS version TLSv1 is enabled. Please use TLSv1.2 or higher.
pp-mysql-1 | 2022-03-25T06:04:45.392461Z 0 [Warning] A deprecated TLS version TLSv1.1 is enabled. Please use TLSv1.2 or higher.
pp-mysql-1 | 2022-03-25T06:04:45.392740Z 0 [Warning] CA certificate ca.pem is self signed.
pp-mysql-1 | 2022-03-25T06:04:45.700854Z 1 [Warning] root@localhost is created with an empty password ! Please consider switching off the --initialize-insecure opti
pp-mysql-1 | 2022-03-25 06:04:47+00:00 [Note] [Entrypoint]: Database files initialized
pp-mysql-1 | 2022-03-25 06:04:47+00:00 [Note] [Entrypoint]: Starting temporary server
pp-mysql-1 | 2022-03-25 06:04:47+00:00 [Note] [Entrypoint]: Waiting for server startup
pp-mysql-1 | 2022-03-25T06:04:48.011034Z 0 [Warning] TIMESTAMP with implicit DEFAULT value is deprecated. Please use --explicit_defaults_for_timestamp server option
ntation for more details).
pp-mysql-1 | 2022-03-25T06:04:48.012202Z 0 [Note] mysqld (mysqld 5.7.37) starting as process 77 ...
pp-mysql-1 | 2022-03-25T06:04:48.014395Z 0 [Note] InnoDB: PUNCH HOLE support available
pp-mysql-1 | 2022-03-25T06:04:48.014430Z 0 [Note] InnoDB: Mutexes and rw_locks use GCC atomic builtins
pp-mysql-1 | 2022-03-25T06:04:48.014434Z 0 [Note] InnoDB: Uses event mutexes
pp-mysql-1 | 2022-03-25T06:04:48.014436Z 0 [Note] InnoDB: GCC builtin __atomic_thread_fence() is used for memory barrier
pp-mysql-1 | 2022-03-25T06:04:48.014437Z 0 [Note] InnoDB: Compressed tables use zlib 1.2.11
pp-mysql-1 | 2022-03-25T06:04:48.014439Z 0 [Note] InnoDB: Using Linux native AIO
pp-mysql-1 | 2022-03-25T06:04:48.014593Z 0 [Note] InnoDB: Number of pools: 1
pp-mysql-1 | 2022-03-25T06:04:48.014671Z 0 [Note] InnoDB: Using CPU crc32 instructions
pp-mysql-1 | 2022-03-25T06:04:48.016185Z 0 [Note] InnoDB: Initializing buffer pool, total size = 128M, instances = 1, chunk size = 128M
pp-app-1 | yarn install v1.22.17
pp-app-1 | [1/4] Resolving packages...
pp-app-1 | warning Resolution field "ansi-regex@5.0.1" is incompatible with requested version "ansi-regex@^2.0.0"
pp-app-1 | warning Resolution field "ansi-regex@5.0.1" is incompatible with requested version "ansi-regex@^3.0.0"
pp-app-1 | success Already up-to-date.
pp-app-1 | Done in 0.38s.
pp-mysql-1 | 2022-03-25T06:04:48.023499Z 0 [Note] InnoDB: Completed initialization of buffer pool
pp-app-1 | yarn run v1.22.17
pp-app-1 | $ nodemon src/index.js
pp-app-1 | [nodemon] 2.0.13
pp-app-1 | [nodemon] to restart at any time, enter `rs`

```

Logs show various information for MySQL spanning thousands of lines

- Docker Dashboard with app group



App running in the background

Part 9: Image-building best practices

- Docker scan output

```
docker scan getting-started
```

```
Testing getting-started...
```

```
Package manager:    apk
Project name:       docker-image|getting-started
Docker image:       getting-started
Platform:           linux/amd64
Base image:         node:12.22.11-alpine3.15
```

```
🔍 Tested 16 dependencies for known vulnerabilities, no vulnerable paths found.
```

```
According to our scan, you are currently using the most secure version of the selected base image
```

```
For more free scans that keep your images secure, sign up to Snyk at https://dockr.ly/3ePqVcp
```

Scan is running showing the scan being performed

- Docker image history output

```
PS F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker image history getting-started
IMAGE          CREATED          CREATED BY                                      SIZE      COMMENT
66493d20fbc2   21 minutes ago  EXPOSE map[3000/tcp:{}]                       0B        buildkit.dockerfile.v0
<missing>      21 minutes ago  CMD ["node" "src/index.js"]                   0B        buildkit.dockerfile.v0
<missing>      21 minutes ago  RUN /bin/sh -c yarn install --production # b... 84MB      buildkit.dockerfile.v0
<missing>      21 minutes ago  COPY . . # buildkit                            58.2MB    buildkit.dockerfile.v0
<missing>      2 hours ago     WORKDIR /app                                    0B        buildkit.dockerfile.v0
<missing>      2 hours ago     RUN /bin/sh -c apk add --no-cache python2 g+... 223MB     buildkit.dockerfile.v0
```

Image history showing the various dockerfiles being created

- After modifying the package.json file, provide output for the new build

```
PS F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker build -t getting-started .
[+] Building 2.8s (14/14) FINISHED
=> [internal] load build definition from Dockerfile
=> => transferring dockerfile: 32B
=> [internal] load .dockerignore
=> => transferring context: 3B
=> resolve image config for docker.io/docker/dockerfile:1
=> CACHED docker image://docker.io/docker/dockerfile:1gona256:178c4e4a531795b9365dbf6c718da07c-f517fcb4a17f1543a775c0f548a9fc2ff
=> [internal] load .dockerignore
=> [internal] load build definition from Dockerfile
=> [internal] load metadata for docker.io/library/node:12-alpine
=> [1/5] FROM docker.io/library/node:12-alpine
=> [internal] load build context
=> => transferring context: 504.81kB
=> CACHED [2/5] WORKDIR /app
=> CACHED [3/5] COPY package.json yarn.lock ./
=> CACHED [4/5] RUN yarn install --production
=> [5/5] COPY
=> exporting to image
=> => exporting layers
=> => writing image sha256:d77fe9569352f1611f76ad1ea79f393ba061a614cc362343489a02ac20c-f528
=> => naming to docker.io/library/getting-started
PS F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app>
```

Output showing the new build after updating the file

```

<!DOCTYPE html>
<html>
<head>
  <meta charset="utf-8" />
  <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no, maximum-scale=1.0, user-
  <link rel="stylesheet" href="css/bootstrap.min.css" crossorigin="anonymous" />
  <link rel="stylesheet" href="css/font-awesome/all.min.css" crossorigin="anonymous" />
  <link href="https://fonts.googleapis.com/css?family=Lato&display=swap" rel="stylesheet" />
  <link rel="stylesheet" href="css/styles.css" />
  <title>The Jodo App</title>
</head>
<body>
  <div id="root"></div>
  <script src="js/react.production.min.js"></script>
  <script src="js/react-dom.production.min.js"></script>
  <script src="js/react-bootstrap.js"></script>
  <script src="js/babel.min.js"></script>
  <script type="text/babel" src="js/app.js"></script>
</body>
</html>

```

The updated title

- After modifying the title, provide output for the new build

```

PS F:\FILES\Iowa State University\SeniorYear\Spring'22\SE 422X\Assignment 2\app> docker build -t getting-started .
[+] Building 2.8s (14/14) FINISHED
=> [internal] load build definition from Dockerfile
=> => transferring dockerfile: 32B
=> [internal] load .dockerignore
=> => transferring context: 2B
=> resolve image config for docker.io/docker/dockerfile:1
=> CACHED docker-image://docker.io/docker/dockerfile:1@sha256:17b44eda93799b9365dbf6cf18da0fcf517fcb4a17f1943a775c0f548e0fc1
=> [internal] load .dockerignore
=> [internal] load build definition from Dockerfile
=> [internal] load metadata for docker.io/library/node:12-alpine
=> [1/5] FROM docker.io/library/node:12-alpine
=> [internal] load build context
=> => transferring context: 604.82kB
=> CACHED [2/5] WORKDIR /app
=> CACHED [3/5] COPY package.json yarn.lock ./
=> CACHED [4/5] RUN yarn install --production
=> [5/5] COPY . .
=> exporting to image
=> => exporting layers
=> => writing image sha256:315a28f8f6c053f53a1780b04e9a176ca963ab1eeac806dca0f6fb7159acd10
=> => naming to docker.io/library/getting-started

```

Output showing the new build after changing the index file

```

DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no,
    <link rel="stylesheet" href="css/bootstrap.min.css" crossorigin="anonymous" />
    <link rel="stylesheet" href="css/font-awesome/all.min.css" crossorigin="anonymous" />
    <link href="https://fonts.googleapis.com/css?family=Lato&display=swap" rel="stylesheet" />
    <link rel="stylesheet" href="css/styles.css" />
    <title>My Awesome Todo App!</title>
  </head>
  <body>
    <div id="root"></div>
    <script src="js/react.production.min.js"></script>
    <script src="js/react-dom.production.min.js"></script>
    <script src="js/react-bootstrap.js"></script>
    <script src="js/babel.min.js"></script>
    <script type="text/babel" src="js/app.js"></script>
  </body>
</html>

```

Updated Index file.

Good Luck.

Paragraph:

Throughout this assignment, I learned the importance of Docker when it comes to Cloud Computing. First, Container images are being created through its own custom filesystem. Next, I learned to start a container and setup a running react app using the Dockerfile. Next, I was able to add items through a todo list and I would have to rebuild and start a new container every time a change is made. Then, I was able to push the image to a registry and run the freshly pushed image. Then I realized that we can create an application and survive the restarts of the instances through DBs. I learned later that the SQLite migration was key for entering production. And Finally, I was able to learn how the use Docker Compose through multi container applications. I hope to use my knowledge in my future job and create Docker and run instances!