mini-x report

Course Code: BSDSESM1KU

Student	Email
David A. Feldner	dafe@itu.dk
Marius Thomsen	mariu@itu.dk
Marius W. S. Nielsen	mawn@itu.dk
Markus Grand Petersen	mgrp@itu.dk
Michael Daniel Fabricius	midf@itu.dk

1 Systems perspective

1.1 Description of the project

mini-x is a blazingly fast twitter/x clone written in Rust with the Actix framework.

1.2 Design and Architechture of the project

`Markus` Mini-x is designed with focus on performance, scalability and type safety. The application is structured into two main parts: the API server and the frontend client as seen in `main.rs`. The API Server and Frontend Client are two sides of the same coin. The frontend part lets users interact with mini-x through a user interface whereas the API Server lets programmers interface with the application through command-line execution for compatability with the course simulation.

1.2.1 API Server

The API server is built using Actix-Web, a blazingly fast web framework for Rust.

1.2.2 Frontend Client

`TODO: Create diagrams to show the architecture`

1.3 Dependencies of mini-x

- Rust and Actix-web:
  - The backend service is written in Rust, with Actix-web as the chosen framework due to its performance and ease of use in developing web apps. Actix-web handles the HTTP requests and routing
- PostgreSQL
  - Used for data storage in a robust and scalable way.
- Diesel.rs

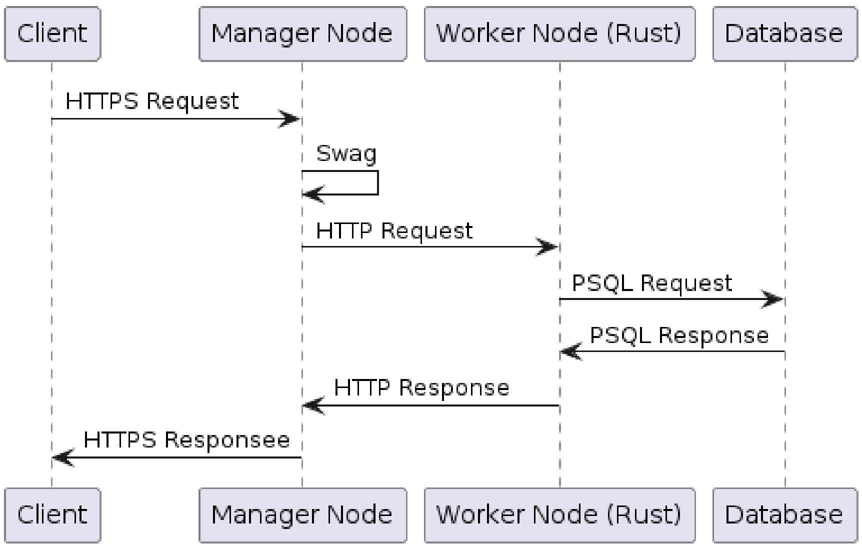
  - Diesel was used for ORM to ensure safe database interactions. Diesel provides type safety and convinient DSL for rust, such that complex SQL queries can be constructed safely.
- Docker and Docker Swarm:
  - Docker is used for containerization to ensure that the app runs identically across varying environments. Docker swarm manages a cluser of Docker Engines so we can spread workload horizontally.
- EFK stack:
  - ElasticSearch, Filebeat and Kibana was used for logging
- Prometheus and Grafana
  - Prometheus collects data from our api and frontend. The data is then shown in grafana for monitoring

1.4 Current state of mini-x

1.5 Important interactions of sub systems

```
Make UML Sequence diagram that shows the flow of information through your system from user requ
```

```
Make illustrative sequence diagram that shows how requests from the simulator traverse your sys
```



2 Process' persepctive

2.1 CI/CD Explanation

```
Mar
A complete description of stages and tools included in the CI/CD chains, including deployment a
```

To ensure that our system is always in a healthy condition and that as we have the highest quality as possible we have several workflows and tools to enable this. The first thing we should mention is the compiler in Rust has effectively a built-in static analysis tool.

Workflows/Tools and their purpose

- Workflow: Continuous Deployment - Run on push to main
  - Building and pushing the latest image to Docker Hub
  - Deploying to the docker swarm
- Workflow: Publish - Run on push to main with version tag
  - Whenever we reach a new milestone we push a new git tag. This workflow then builds our application and archives the current sourcecode in a zipped file and makes a release along with all build artifacts.
- Workflow: Rust Format Check - Run on PR or push to main.
  - Runs static code analysis tool (linting tools). For this we use the rust packages clippy and rustfmt, and run them against our code.
- Workflow: Test Mini-X - Run on PR
  - Runs the api and frontend Python tests we inherited against our service. This ensures we only merge when all tests pass.
- Workflow: Generate Report PDF - Run on push to any branch
  - Generates a pdf report from the markdown in our repository. This uses the `baileyjm02/markdown-to-pdf@v1` action to generate the report with a browser, and then `stefanzweifel/git-auto-commit-action@v5` to commit the result back to the same branch.
- Tool: Docker
  - Used as our containerizing software, used to ensure consistency in the environment, Load balancing and reliability

2.2 Monitoring

`Markus`

```
How do you monitor your systems and what precisely do you monitor?
```

2.3 Logging

`Daniel`

```
What do you log in your systems and how do you aggregate logs?
```

2.4 Security

```
Brief results of the security assessment and brief description of how did you harden the securi
```

2.4.1 Assets in our system.

In our system, there are six virtual machines hosted on Digital Ocean. Five of them hold an interest in a malicious party. Monitoring provides all endpoints

2.4.2 Assets and their value

- Application: The application has three replicas on three separate virtual machines.
- public information is found here, including usernames.
- 3 nodes worth of computing power
- Database: A single virtual machine with a backup
- All our data, hashed passwords, email, usernames, all messages
- Logging: A single VM with all our logs and errors.
- Users: The users on the application
- Provides value.

2.4.3 Threats and Risks to Assets

- Application:
- DDOS: our application can handle many requests per second depending on the endpoint.
- While our service can handle the simulator and then some. We could put all our VMs to full load with one machine running FFUF in Kali, targeting computationally heavy endpoints.
- Database:
- Injection: All fields are sanitized. The ORM we use is injection-safe. The one SQL query we have uses prepared states.
- Hashed passwords: Here we use bcrypt to encrypt them with salted hashing
- Man in the middle: We send our data from the application to the database using HTTP
- Logging:
- Verbose error messages: having better responses from your other attempt will enable better attacks.
- GDPR theft: Some user data can be acquired.
- Uptime:
- Our system is vulnerable to DDos attack affection up time. Decreased will affect the number of users.
- Users:
- Obscene content: There is no content filter, all content is allowed, which could result in inappropriate content, deterring users from the service
- no service: If our service is down, users leave
- no content: Without content, users don't stay

2.5 IaC Strategy

```
Applied strategy for scaling and upgrades
```

We use Vagrant as our tool for IaC, along with the vagrant-digitalocean and vagrant-docker plugins. In our vagrant file we have described all the virtual machines, called droplets in digital ocean, needed for our service, allowing us to bring our service up with a single command. Vagrant will automatically start new droplets, copy docker and environment variables, install docker

3 Lessons learned perspective

```
Describe the biggest issues,
how you solved them, and which are major lessons learned with regards to:
Evolution and refactoring, Operation and Maintenence
of your ITU-MiniTwit systems.
Link back to respective commit messages, issues, tickets, etc.
to illustrate these.

Also reflect and describe what was the "DevOps" style of your work.
For example, what did you do differently to previous development projects
and how did it work?
```

3.1 Evolution and refactoring

3.2 Operation

3.2.1 Data loss

During the project we had 2 incidents that caused data loss. The first incident happened right at the start of the simulator when we had deployed the database without a volume. We had also set up a deployment workflow for when code was pushed to main or merged with a PR. This meant that approving any PR or pushing to main would cause our database to be deleted. Since everyone on the team was not aware of this issue, we ended up deleting our database. Because of a recent backup and quick action we quickly got up and running again - now with a volume for the database.

When we switched to having our postgres instance on its own server, we had set the password to be 'postgres' on a postgres server running on port 5432 - the default postgres port. This caused our database to be deleted by adversaries before we changed the password. Quite a silly mistake, we thought having a insecure password for a day or two would be fine, but that was not the case. Again due to backups we were able to restore some of the data.

3.2.2 Adding indexes live in production

After looking at our response time from day to day we noticed that it was higher as time went. This was a big problem for us. After hooking up our postgres database to a locally running client of mini-x with timers in the code, we could see that the database was the culprit and our application was still blazingly fast. After seeing which queries were slow we put an index on the database while it was in production and immiedietly resolved our speed issues. Some queries were still slow, and we fixed those by rewriting our ORM code to another query.

3.3 Maintenence

4 Usage of LLM's in mini-x

```
Mention LLM tools how and where we used them and which ones did they help, speed up or slow us
```

With regards to the use of LLM's in mini-x, ChatGPT was used in the early stages of development as a means for fast researching. Since the group was unfamiliar with the programming language known as Rust, we used ChatGPT as an introductory tutor extracting the basics of the language far quicker than searching through docs. As we began the port to Rust, we used Copilot as another aid in the process of learning the API of new frameworks such as Actix-web, PostgreSQL and Docker.

Figure List

API Squence Diagram - mrmar

Architecture Diagram(Might be contained in 3+1) - Markus

3+1 Model viewpoint - Mar

3+1 Component viewpoint - David

3+1 Deployment viewpoint - Daniel

Dependencies Diagram (NOT REQUIRED but cool)