IT UNIVERSITY OF COPENHAGEN

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Design and architecture

Domain model

The domain model reflects the entities and their relationship of the Chirp application, as well as the interfaces of the repositories that allow for accessing and manipulating these different entities and their related data. These entities form the foundation of the business logic of the application. The diagram below shows the domain model of the Chirp application.

```
<img src="./images/uml/Domain-model-Chirp.Core.drawio.png" alt="Chirp Core" width="100%" />
```

Architecture — In the small

The application Chirp has been designed with Onion architecture in mind.

The diagram below shows the organization of the code of the Chirp application, showcasing the relationships and dependencies of different components of the program, highlighting how the code of the program is organised into different layers of the onion architecture design.

At the centre of the onion architecture are the domain entities in Chirp.Core, as seen in the domain model shown above.

Surrounding the Core is first the Chirp.Infrastructure layer. This layer contains the implementations of the repository interfaces, and is responsible for actually handing mechanisms of data storage, access and manipulation connected to the core entities.

The Web layer surrounds these layers. It is responsible for the presentation of the application, handling the user interface and user interactions. The layer interacts with the core and infrastructure layers, using the domain entities and data access mechanisms to allow the user the interact with the business logic and data of the application.

The diagram shows how the Chirp application has been designed with an inward flow of dependencies in accordance with Onion architecture, so that the inner layers remain independent of external dependencies.

Some relationships have been omitted to improve the readability of the diagram.

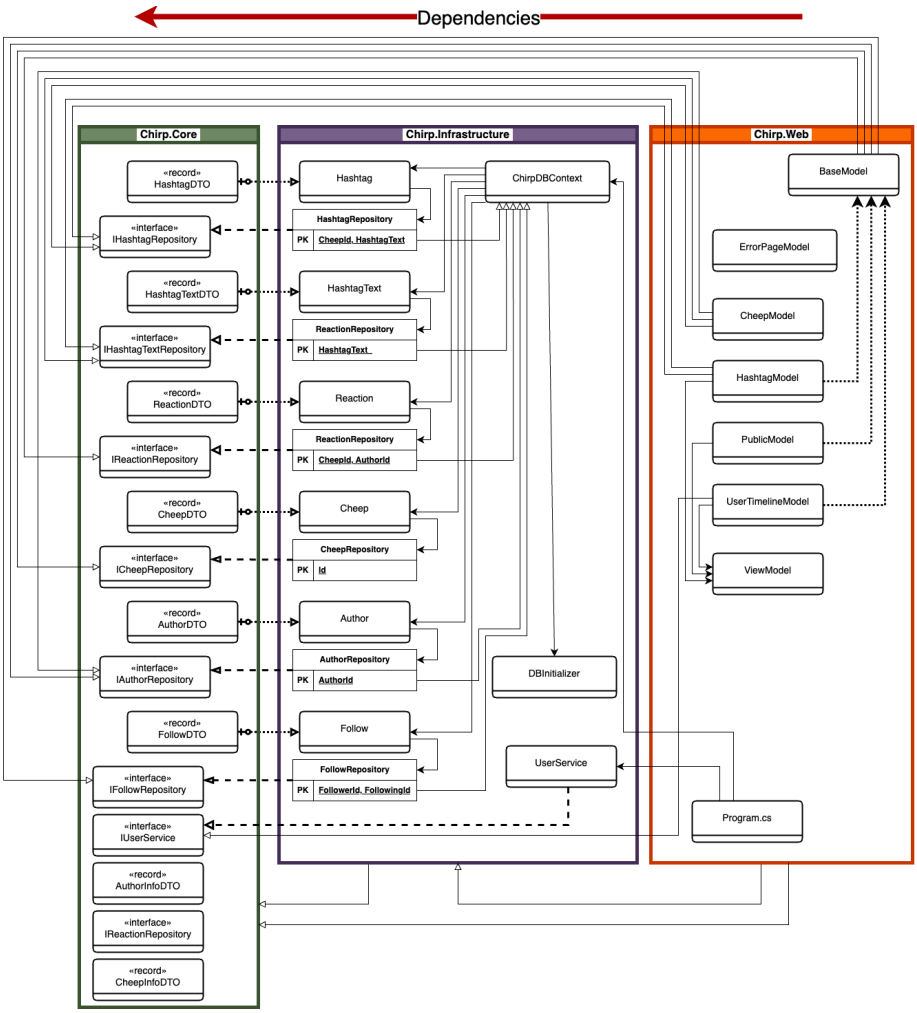


Figure 1: Architecture_in_the_small

The figure below shows a more simplistic view of the onion architecture structure of the components of the application.

Onion architecture, in the context of Chirp

Architecture of deployed application

The Chirp application is deployed on Microsoft Azure, utilizing Asure services with an Azure SQL database.

The diagram below shows the interaction between the client component with a user interface allowing the user to make requests and the application deployed on Microsoft Azure as the server component. The diagram also shows the interaction of this deployed application with the Azure SQL Database, as well as signing in through a social account (GitHub).

Architecture of deployed application

User activities

A user may follow various paths when using the Chirp application.

The diagram below shows a series of typical user activities through the Chirp application. The diagram shows what a user may do while remaining unauthorized, and after logging in and becoming authorized.

Additionally, the diagram below shows a slightly more detailed view of possible scenarios of a user journey through Chirp, in which a user enters the chirp website, logs in, or creates a profile if necessary, sends a cheep, and then logs out.

Sequence of functionality/calls trough *Chirp!*

There is a flow of messages and data through the chirp application, which allow the user to see and interact with a completely rendered web page.

The diagrams below illustrates this flow of messages and data, starting with the sending of an HTTP request by an authorized user to the root endpoint of the application and ending with the completely rendered web-page that is returned to the user. The diagram shows the different kinds of calls and the responses.

Process

Build, test, release, and deployment

The UML diagram below illustrates the flow of activities in the Github Actions workflows, showing how the Chirp application is built, tested, released and deployed.

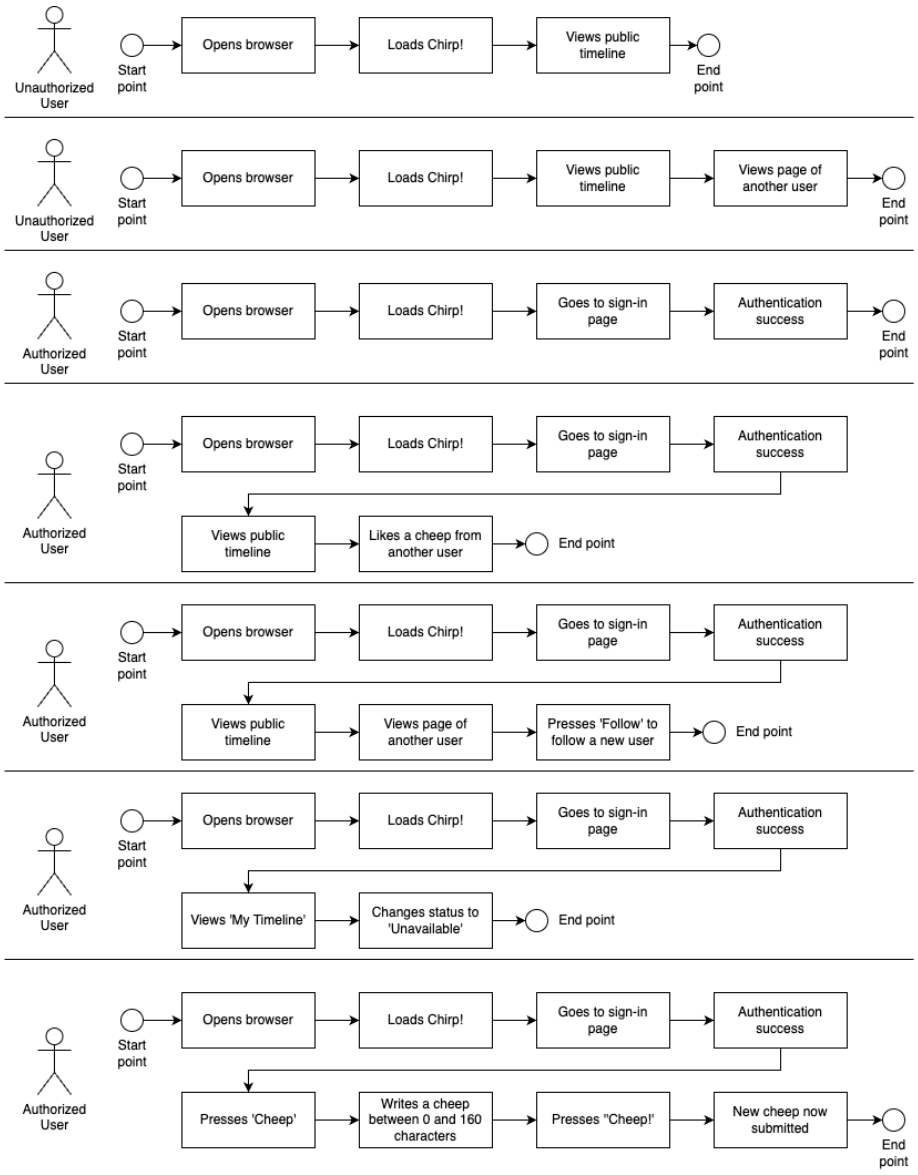


Figure 2: User_activities

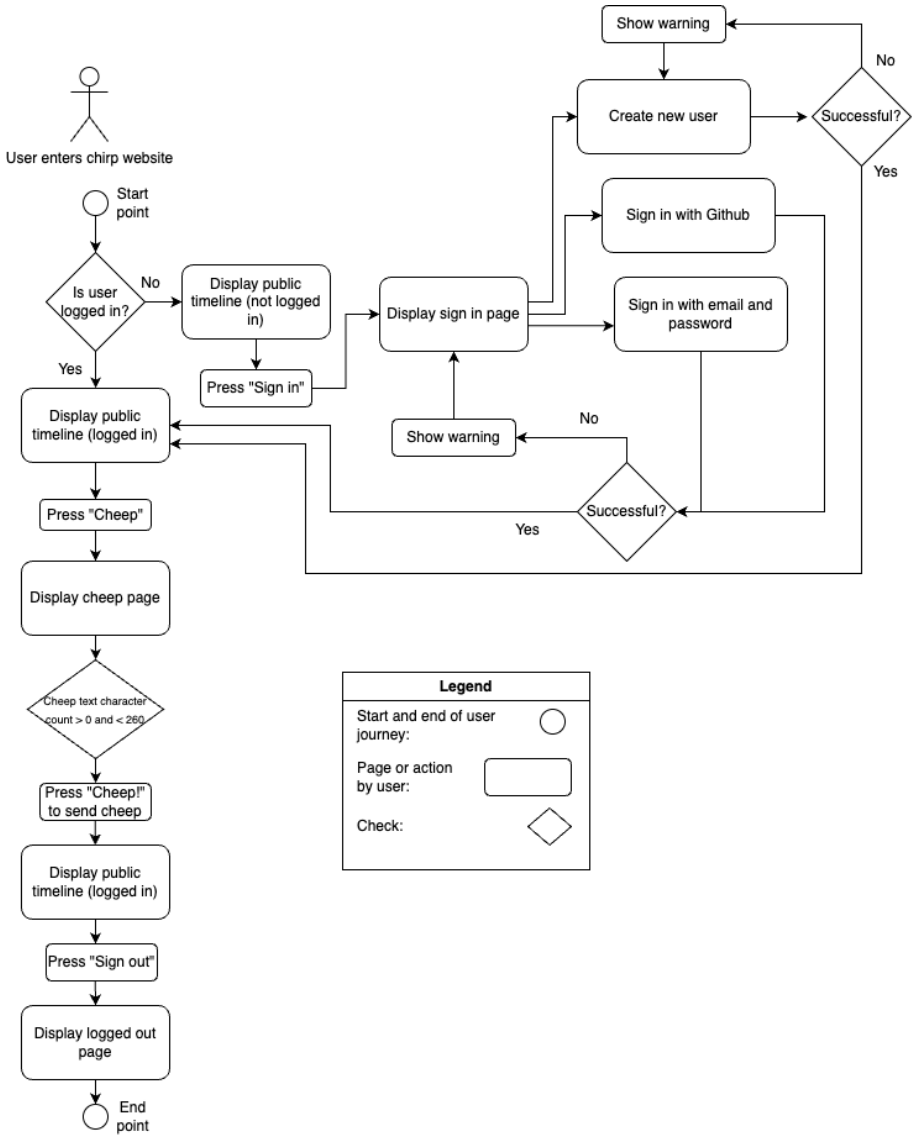


Figure 3: User_scenario

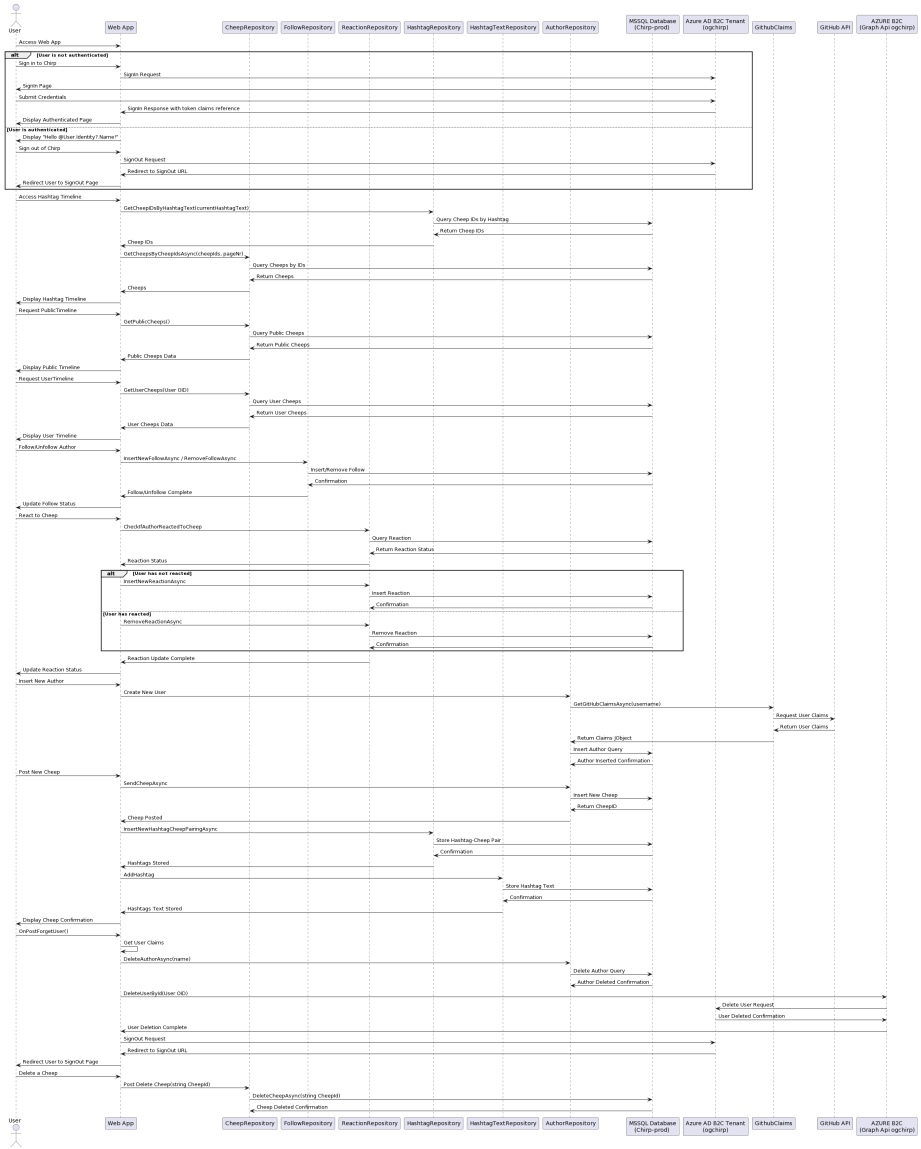


Figure 4: data_flow

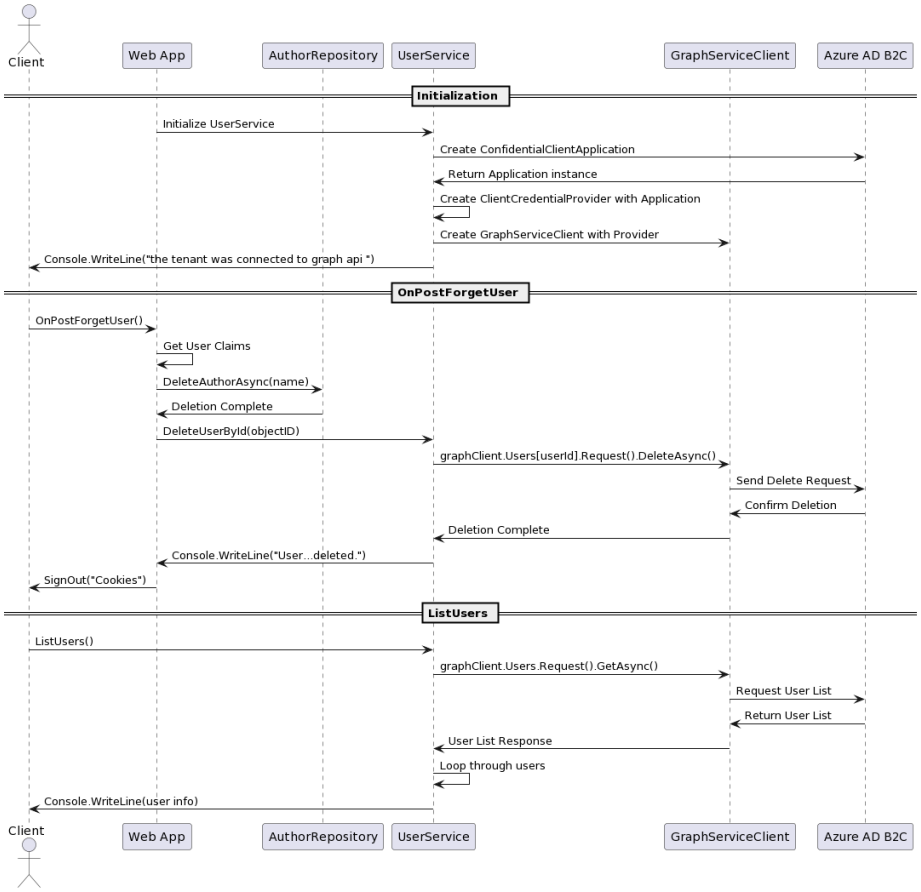


Figure 5: graph_api

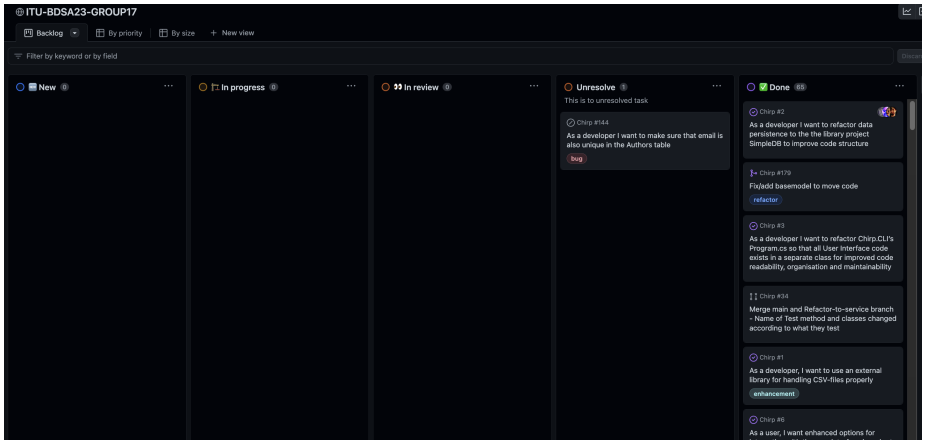
Team work

Throughout the project we have used GitHub issues to help structure the collaboration on the features of the Chirp application by multiple developers.

Overall we managed to complete all the features we wanted for the application. These include all the features specified by the requirements of the project and some extra features, such as some UI changes, hashtags, and ...

We have one unresolved task in our project board: To make the email unique in the the Authors table, since there was a possibility that an Author could appear twice or more in the table with same name and email but with different id. The reason we did not resolve it is the low priority.

The image below shows the project board just before hand-in, with the remaining unresolved issue.



There are of course many more features we could have implemented given time. Some ideas, which were discussed during development but not prioritized include the ability to comment on a cheep and sharing a cheep to name a few.

When deciding to prioritize a new feature or requirement, we create an issue featuring a description of the task with a list of acceptance criteria. This issue is then assigned to one or more developers, who work on it in a designated branch until the requirements are fulfilled, a merge request is created and the feature branch is merged into the main branch of the project repository.

The diagram below shows the lifecycle of a GitHub issue from it's creating until it is closed and resolved.

In practice, this process was not always strictly adhered to, but the diagram gives a general and idealized depiction of the process, which was mostly followed. Even though this process was not always strictly adhered to, the work with GitHub issues but still proved a very useful tool during development.

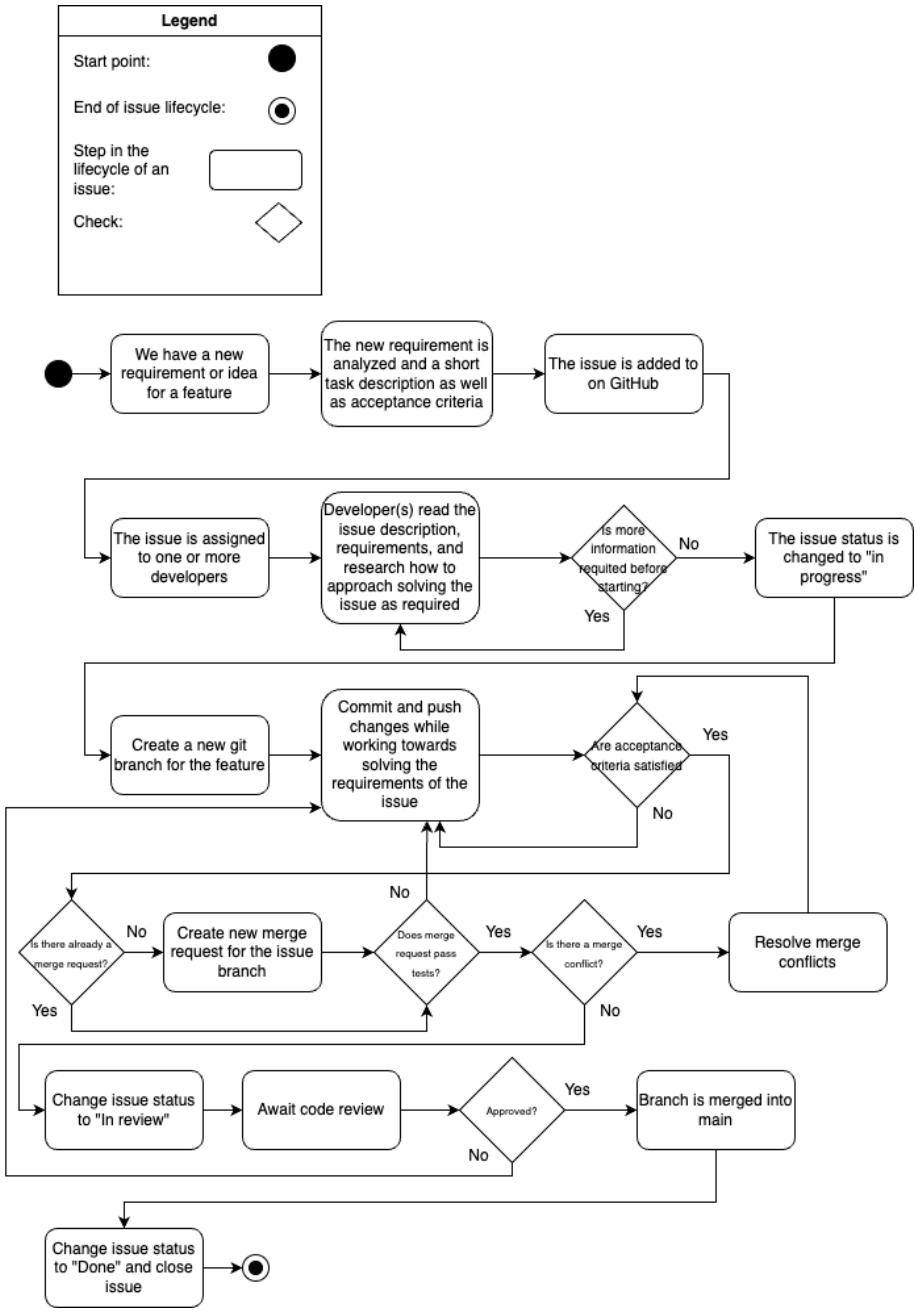


Figure 6: issue

How to make *Chirp!* work locally

Clone the repository using this git command

```
git clone https://github.com/ITU-BDSA23-GROUP17/Chirp/
```

Start the program using this command

```
cd src/Chirp.Web
dotnet run
```

After you run the command you can go to `https://localhost:7102` or `https://localhost:5273`

It will then open the browser and here you can interact with the application. You can sign in by clicking on the top right corner with either your email or sign up with Github.

After you successfully sign in into the *Chirp!* application you can now do one of the following feature we have implemented

- Sending a Cheep by clicking the blue box in the top right corner that says Cheep
- Delete your own Cheep
- Follow another user
- Unfollow a user you follow
- Go to another user and see their Cheeps only, by clicking on the name above their Cheep post
- Go to your timeline by clicking on the "My Timeline" in the navigation bar to see your information and your cheeps and in your profile you can
  - Set your status by choosing either online, offline or unavailable
  - Clicking on Forget, to remove yourself from the application
- Liking a Cheep by clicking on the thumbs up icon in a Cheep
- Removing a Cheep that you liked by clicking on the thumbs up icon
- When a Cheep has a # following a text, you can then click on the hashtag, it will then go to the hashtag page with all the Cheep that includes that hashtag, as well as displaying available hashtag that has been Cheeped. The order is descending by popularity.
- Sign out of the application

How to run test suite locally

In the root folder run this command to test all the test

```
dotnet test
```

Make sure you have docker running in your machine

The following test have been implemented

Unit test The unit tests are designed to test each individual component of our application by itself.

We have designed a series of unit tests to verify that our DTOs correctly encapsulate data. These tests confirm that each DTO retains and accurately represents the data passed to its constructor.

DTO Unit Tests

- `AuthorDTO_ShouldHoldProvidedValues`: Checks if the AuthorDTO object correctly assigns and retains the values provided.
- `CheepDTO_ShouldHoldProvidedValues`: Checks if the CheepDTO object correctly assigns and retains the values provided.
- `ReactionDTO_ShouldHoldProvidedValues`: Checks if the ReactionDTO object correctly assigns and retains the values provided.
- `HashtagDTO_ShouldHoldProvidedValues`: Checks if the HashtagDTO object correctly assigns and retains the values provided.

To run only the unit tests, use the following command in the root folder of the project:

```
dotnet test --filter Category=Unit
```

Integration test The integration tests are designed to test how different parts of the application interacts with eachother. These tests involves instances of the database containers and checks if the application does the CRUD operations as expected.

AuthorRepositoryTest

- `GetStatusNotNull`: Checks that the AuthorRepository is able to receive a non-null status (string).
- `GetStatusIsValid`: Checks that the AuthorRepository is able to receive a valid status, i.e., a status which equals ONLINE/OFFLINE/UNAVAILABLE
- `SetUserStatusOnline`: Checks that the AuthorRepository is able to change the status of a user to ONLINE.
- `SetUserStatusOffline`: Checks that the AuthorRepository is able to change the status of a user to OFFLINE.
- `SetUserStatusUnavailable`: Checks that the AuthorRepository is able to change the status of a user to UNAVAILABLE.

CheepRepositoryTest

- `InsertCheepAsyncAddsCheepToDatabase`: Checks that cheeps are properly inserted into the database and are retrievable.
- `CheepOverLimitNotInserted`: Checks that a cheep over limit (i.e., over 160 characters) is NOT inserted into the database.
- `CheepUnderLimitNotInserted`: Checks that empty cheeps (i.e., cheeps with 0 characters in length) is NOT inserted into the database.

FollowRepositoryTest

- `GetFollowerIDsByAuthorIDAsync_ReturnsCorrectFollowerIDs`: Checks if the correct follower IDs are returned for a given author ID.
- `GetFollowingIDsByAuthorIDAsync_ReturnsCorrectFollowingIDs`: Checks if the correct following IDs are returned for a given follower ID.
- `InsertNewFollowAsync_InsertsFollowSuccessfully`: Checks that a new follow relationship is successfully inserted into the database.
- `RemoveFollowAsync_RemovesFollowSuccessfully`: Checks that a follow relationship is removed as expected.
- `GetFollowerCountByAuthorIDAsync_ReturnsCorrectCount`: Checks if the correct follower count is returned for an author.
- `GetFollowingCountByAuthorIDAsync_ReturnsCorrectCount`: Checks if the correct count of followings is returned for an author.

HashtagRepositoryTest

- `GetCheepIDsByHashtagText_GetsCheepIDsTiedToHashtag`: Checks if cheep ID's tied to a hashtag gets retrieved
- `InsertNewCheepHashtagPairingAsync_InsertsANewHashtagWithCorrectCheepIdAndHashtagText`: Checks if a new hashtag-cheep pairing is correctly inserted.
- `GetPopulalarHashtags_Returns10PopularHashtags`: Checks if the method returns the top 10 popular hashtags based on frequency.

HashtagTextRepositoryTest

- `AddHashtag_AddsHashtagToDatabase`: Checks if a new hashtag is added to the database.
- `AddHashtag_WillNotAddTheSameHashtagMoreThanOnce`: Checks that duplicate hashtags are not added to the database.
- `RemoveHashtag_RemovedSpecifiedHashtagTextIfItExist`: Checks if the specified hashtag text is removed from the database.

Make sure Docker is running as the tests rely on `Testcontainers.MsSql` to create a containerized MS SQL Server instance.

To run only the integration tests, use the following command in the root folder of the project:

```
dotnet test --filter Category=Integration
```

Note: As you may notice in our test folder we have more integration tests than unit tests. The reason is that unit test which is testing in the `Chirp.Core` package have only a few methods compared to the integration test, which is testing in the `Chirp.Infrastructure` package. Normally you have more unit test than integration test.

End to end test

Ethics

License

We chose to use the MIT license for our Chirp application, since it allows other developers to distribute, use and copy our software without imposing significant restrictions.

LLMs, ChatGPT, CoPilot, and others

We have used LLMs in two ways: For aid in writing code and for aid in understanding the overall concepts of different frameworks, architectures and concepts. In both cases, this came with both advantages and disadvantages.

When using LLMs (Primarily ChatGPT) for gaining a basic understanding of for instance Entity Framework Core, Docker or Onion architecture, the ability to ask direct questions can be a powerful tool in gaining familiarity with these concepts. On the other hand, LLMs are not always a reliable source of information, meaning that the answers provided by ChatGPT and the knowledge gained had to be approached with a level of scepticism, which was at times more frustrating than helpful. Thus, using LLMs in this way did not mean, that we did not also need to seek out more reliable sources of information and documentation. It is also possible that using LLMs in this way at all leads to a more superficial understanding of the core concepts at play, as any question that arises may be quickly answered by the LLM, without the need to seriously engage with ones own confusions or lack of understanding of the area.

The use of LLMs in generating or helping with the writing of code has also been both helpful and brought certain disadvantages. Most of the time the code that was generated by ChatGPT did not work according to what we wanted, and sometimes the work with debugging code which relied on help from LLMs ended up being more work than it was to just research and properly understand the problem ourselves. ChatGPT was mostly for explaining errors or explaining the code, and did prove helpful in the debugging process in this regard. We have also used GitHub co-pilot for error handling for our code, but it was quite minimal use. It has the feature to autocomplete our code when we write, but frequently the code it suggest is in no use, the only time it was been effective is when we need to write something that was repeating or very predictable, e.g. when we write insert methods in to our database in `DbInitializer.cs`. co-pilot also was

helpful when writing tests, although we made a point out of not relying too much on it in order to make sure that we fully understood the tests and ensured that they properly tested what needed testing.

In conclusion the use of LLMs has been a useful tool to help with simple repetitive tasks or explaining, analyzing and understanding errors in the code and less helpful in understanding core concepts and ideas, and solving and aiding in complex complex tasks. Overall it is just another addition for a developers toolbox.