CS261 Coursework Design Document

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1 Introduction

Deutsche Bank requires a system prototype to support the mentoring process for employees. The principal purpose of this document is to broadly record the process documentation and design choices for said system prototype. For process documentation, this document will detail development methodologies in addition to workflow and project organisation. Design choices include a prototype user interface design and technical diagrams demonstrating user interactions between multiple users and the system. Furthermore, our testing strategy and technical descriptions such as choice of technologies used and system architecture will be covered in depth to illustrate more full idea of the final product.

2 Process documentation and planning

2.1 Development methodology

We opted for an agile development methodology based on the Scrum model. The development timeline will be broken down into a large initial planning phase and a series of week-long sprints. We will have multiple meetings each sprint cycle to assess progress (sprint review) and adapt the plan if required.

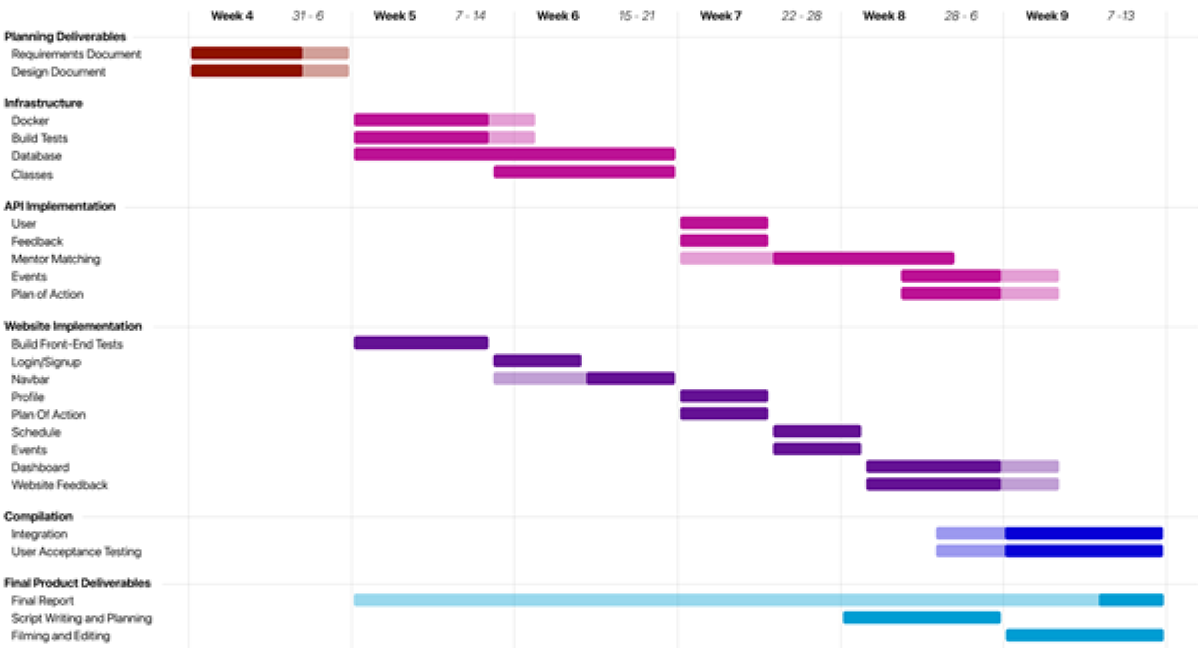
An agile methodology is optimal for a short timeframe as it allows rapid product development with concurrent implementation and testing so we can make effective use of the time available. It also allows for more flexibility if we face unexpected delays during development, which is likely with an inexperienced team. Producing a thorough plan before beginning the agile development process is suitable since deliverable deadlines are fixed, so ensuring work is completed on time is critical. Additionally, contact with the client is limited so requirements are unlikely to change and the project will not deviate much from the initial plan.

2.2 Project organisation and communication

We decided on a flat team hierarchy since we have similar levels of software development experience, self-managed but with well defined responsibilities. To communicate between meetings, we decided to use Discord, as it is already a popular choice within the team and is easy to learn for new users. It offers both text and voice chat as well as a number of features such as GitHub integration, so we are notified via Discord when on changes, for example when pull requests are made.

Discord can be used for online meetings however we aim to convene in-person at least twice a week, as this enables us to share ideas much more easily and maintain focus during meetings. At these meetings we can compare progress on the system with our plan, and assign tasks based on documentation or what tasks need doing in order to stay on schedule. We will use Trello to assist in the task management process, as it provides a visual representation of current project progress.

2.3 Project schedule



The timeline outlines which features of the system will be implemented each week, divided according to the team which is working on them, with final product documentation separated as this is a collaborative effort by the whole team. As we are following a Scrum methodology, task order may be adjusted weekly so that the project remains on track, so which features are completed in each week will most likely change. It also acts as a reminder that the final report should be completed, when time is available, concurrently with the project itself, so it doesn't need to be written in its entirety in the few days before submission.

2.4 Risk management

Risk	Impact	Likelihood	Severity	Mitigation	Contingency	Residual
Team members unable to work	Smaller team until the member can resume work	2	7	Team members take precautions	Reduce scope and reallocate work across team	2
Task longer than expected	Project delayed until task completed	5	4	Allocate buffer time to allow overrunning tasks	Re-assign team members to load balance	4
Poor code quality	System fails testing or linting procedures	5	4	Code review and automated testing through CI/CD	Re-assign team memebrs to fix pair program	3
Requirements change	Design and existing code must be changed	3	8	Use an agile methodology to facilitate requirements change	Update project plan and proceed with new one	3
Code lost	Code must be rewritten	1	7	Use 'git' as version control, and remote backup to GitHub	Restore code from local or remote backups	1
Problems with dependencies	Component of project fails external library or technology	2	4	Choose technologies and dependencies carefully	Find replacement library or technology	2
Scope creep	Addition of unnecessary features causing growth of project scale	7	4	Include extra features in project timeline, and stick to it	Drop lowest priority features	5

3 Technical description

3.1 Scope

Our system must satisfy a complex specification, so its development must be carefully planned and executed. However, the goal is to create a prototype, not a finished product. As such, various aspects which might be required for a system going into production are not needed within a prototype.

One example of this is limitations on the scalability, for example the number of concurrent users. It is much more important that key features are implemented than being able to support dynamically changing high numbers of concurrent users, as the prototype will likely only be tested by a few users at any time. However, this does not mean that the prototype should not be designed without a good basis for facilitating scalability later as the system moves through its lifecycle. Another example of this is the use of Deutsche Bank branding, which is explicitly not to be used, although it would be incorporated in the production system. Instead, a generic and simple theme should be used in the prototype, which could then be later replaced with the correct branding.

3.2 System attributes

This section will communicate the different qualities needed by software, what is within our scope, how we have addressed them, and what we are not doing for this prototype.

The end goal of the software engineering lifecycle is to end with satisfied customers. As such, it is crucial that usability of the software is given important consideration. Our goal is to ensure that the website is intuitive to use, has little ambiguity and can be learnt ideally without assistance even for non-technical users. There will be a wide coverage of acceptance testing carried out to ensure this is achieved. Along with this, our prototype aims, if possible, to make our system accessible to people with disabilities with features such as enlarging text and higher contrast colours.

Compatibility and portability are important points to consider since we want to make our system as portable as it needs to be, and compatible with systems used by most of our users. Being a web app, makes it portable since every user will have some access to a device able to run a browser. Extreme cases such as legacy browsers will not be prioritised since it

is unlikely to be used. The prototype will not include desktop and mobile applications since it is out of the scope and not needed with a web app, this early in the mentoring system.
Security is a relevant quality to consider, especially since we do not want to create issues for any relevant parties involved. Complete and effective considerations to security for most areas of vulnerability is out of scope for a prototype implementing its core functionalities. Important security details such as account access protection through salted/hashed stored passwords are to be implemented. Data will only be accessed through the REST API, allowing us to ensure only required data is sent, and adds a layer of security since our database is not directly interacted with. Allows us to also validate any user information before storing it in the database.

3.3 Technologies used

A fundamental decision in the project is deciding which technologies should be used to compose the so-called "tech stack". Since this is such an important set of decisions, we carefully considered a number of options with respect to a set of criteria which assess the quality of a component technology choice. These criteria include:

- Suitability, how well does the technology match the problem our system solves?
- Documentation and popularity, does the choice have strong documentation and an active community likely to have already answered problems we may encounter?
- Consistency, how well the choice meshes with the other component technologies?
- Performance, will the technology run sufficiently fast, and can it be scaled later needing to switch to something else more performant?
- Experience, how much prior knowledge does our team have of the technology?

We decided to implement the project as a web application, as opposed to a mobile or desktop only one. This is because it is generic and can be accessed by almost all users, as essentially every modern device has a web browser. However, this design choice must later be taken into consideration when ensuring the UI is suitable for mobile. This choice was made as the system must be widely accessible by users with many different types of devices, and a web application was the only suitable choice for this.

We chose Django for our backend framework, which runs on top of Python. This is suitable for our system as it facilitates fast development, which is required to finish our prototype in the very short turnaround of around five weeks, with very short code sprints, and it inherently supports our non-functional requirements of security and scalability. Furthermore, it has robust documentation and is widely used with an active community. Additionally, Python is so ubiquitous that it can interface consistently with almost any other technology choice, for example persistent data storage and sentiment analysis. Finally, our team has a lot of experience with Python development, and additionally testing techniques for Python, mitigating learning curves and ensuring bug-free code.

Since we are making a web application, we will use HTML/CSS/JS. We decided to use the Vue.JS framework for the frontend JS, as it facilitates writing responsive websites, but has a much less steep learning curve than other frameworks such as React, and is known to integrate well with Django, the backend framework we propose using. Furthermore, we are going to use bootstrap as the CSS framework as it allows us to quickly develop a professional looking website with little hassle by providing building block CSS classes.

We chose PostgreSQL to store our persistent data in the form of a relational database. This is because the type of data recorded by the system is well suited to storage in a relational schema. For example, storing a set of users, each of whom have various properties and relationships with other users is a very good match for this model. Furthermore, postgresql has very good documentation in comparison to other relational databases, and it meshes well into our tech stack as django and postgresql are commonly used in tandem. Finally, all of our team has experience with it due to the CS258 databases module.

We chose the python library NLTK (natural language toolkit) to implement our sentiment analysis. This is because it is compatible with the rest of the backend framework, which is already written in python, and it is the most popular and widely used library within its field.

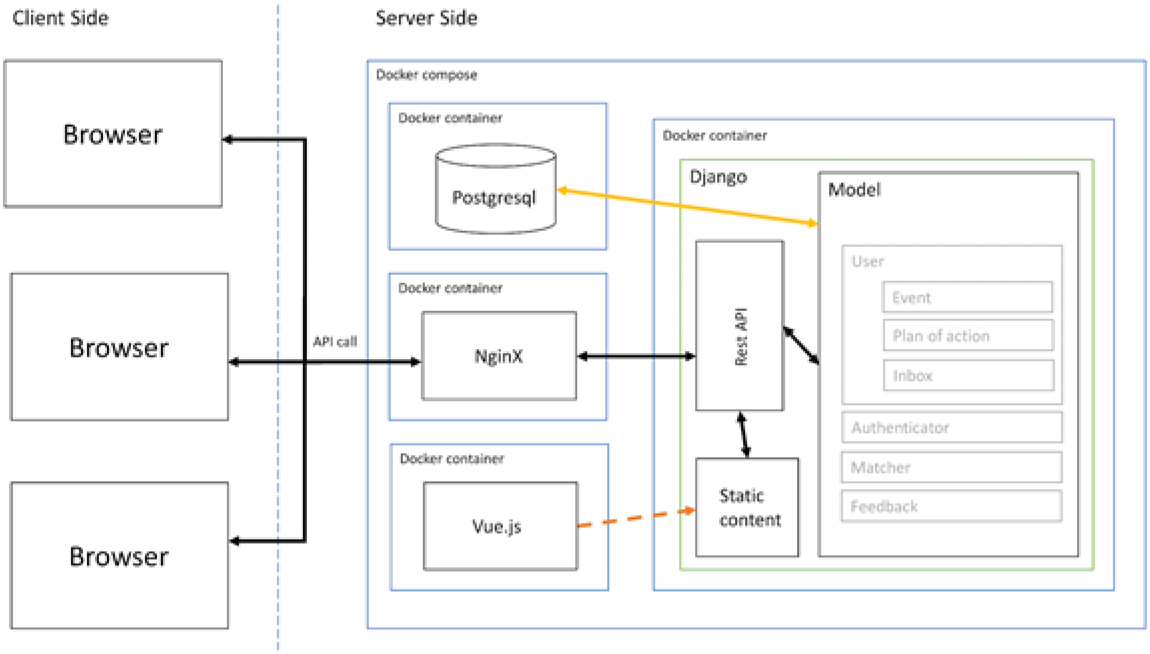
We will use JSON for the REST API, as it is incredibly ubiquitous, and links easily into most web frameworks, as it is a subset of javascript. Additionally, both our backend and frontend team members have experience with it, which is crucial as it will form the link between the two sides of the technology stack,

We chose docker for our containerisation. This supports all of the rest of the tech stack, and allows "lift-and-shift", which is a very useful property for prototype systems. Additionally, it is by far the most widely used choice for containerisation, and has good documentation. Finally, none of our team has experience with any form of containerisation, so choices cannot be compared by this metric.

We chose git with GitHub for our version control. This is because it is the industry standard for version control, every member of our team had at least rudimentary experience with it from CS133, and some members of our team had experience with advanced features for CI/CD such as GitHub Actions.

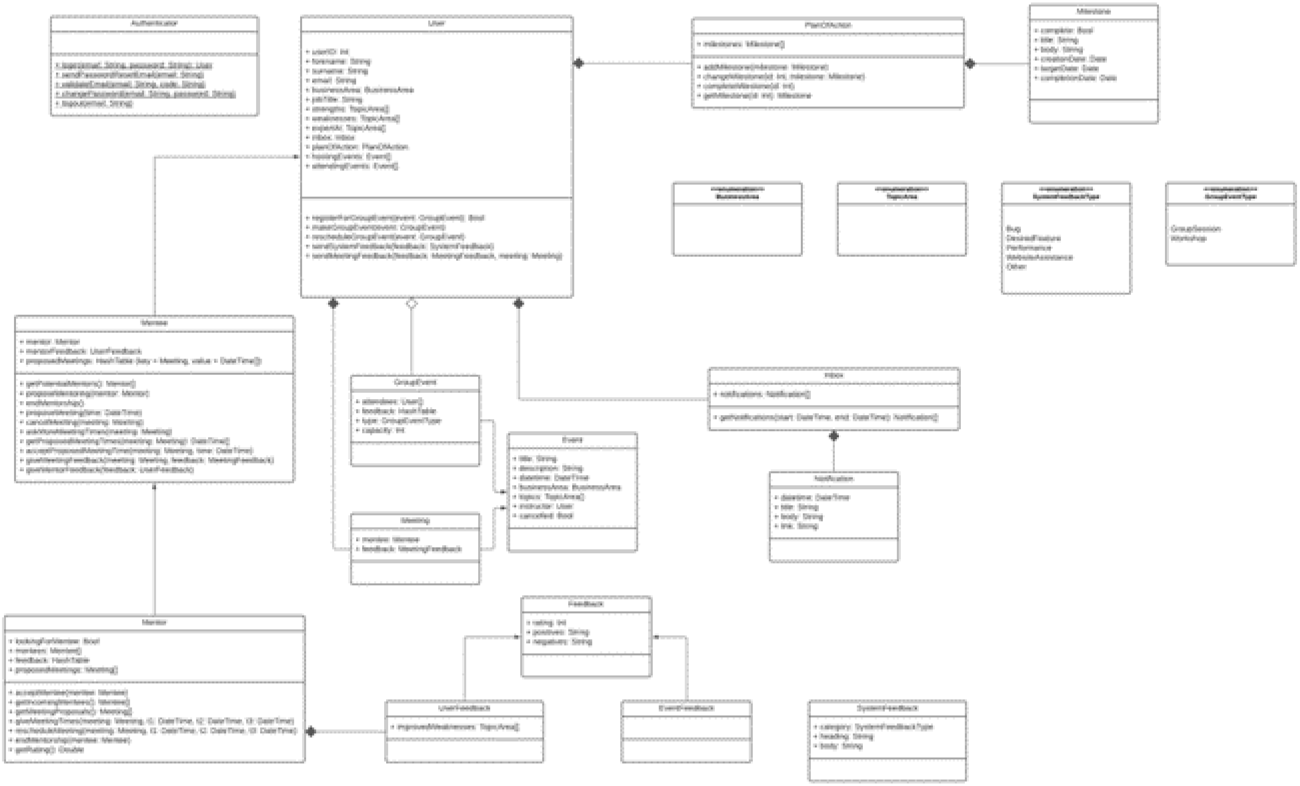
3.4 System architecture

Our system architecture follows the MVC (Model View Controller) architecture which is a well-known model to be successful in creating a system that presents data obtained through a controller that interacts with the database. This is reflected in the docker containerisation figure with our website being the view, the Django system being the controller, and Postgresql as the model. Being modularised to 3 separate components, allows easy distribution of development, with each focusing on a subset of skill sets. One downfall is that the system is tightly connected in that if one system fails, the rest falls... (include REST API also easy reference).



3.4.1 Database Design

3.4.2 Object Structure



3.4.3 API design

4 UI/UX design

4.1 Page Hierarchy

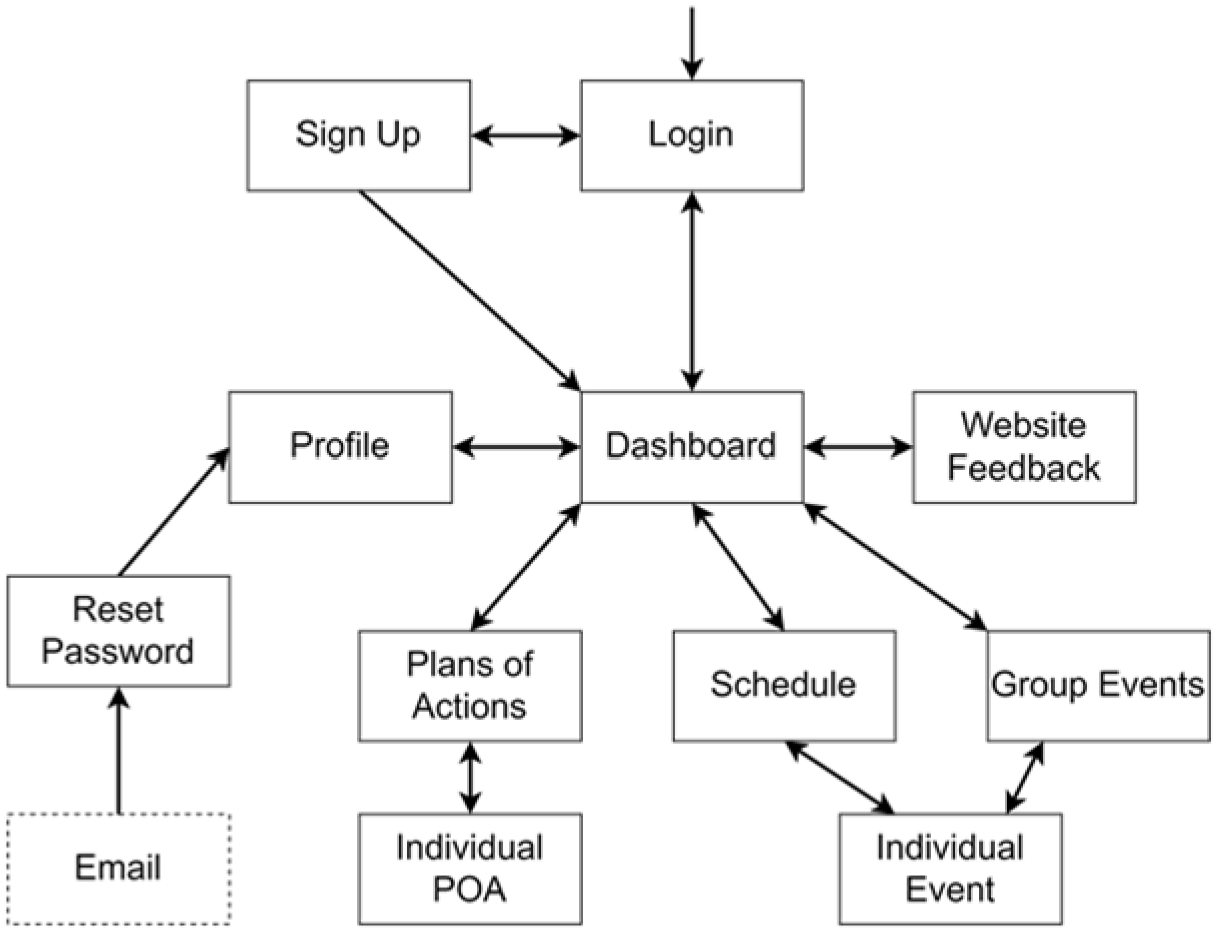
The landing page is the login screen which can lead to either the sign up or dashboard. The dashboard is the central hub for the user where all pages can be accessed from. The profile page will show all the users data and allow for the user to modify it. The user can also request reset password emails that will lead to a separate reset password page. Once the user has reset their password they are landed onto their profile page.

Another page that can be accessed from the dashboard is the plans of actions page. It will display the users plan of action and also if they have mentees then their plan of actions are shown to. Users can click on a plan of action to go to the individual plan of action page which allows the user to edit and change the plan of action there.

Another page is the schedule page which essentially shows the users meetings and group events coming up. It will also show requests from the system that the user should interact with such as feedback requests and meeting requests from the users mentees. If the user wants to inspect an individual event, then they will be directed to the individual events page that will show the user all the information about the event and allow the users with the correct permissions to modify the page.

Furthermore, the group events page advertises potential group events that the user could potentially go to. The user can filter and search for different group events that they may be interested in.

Finally, the user can go to the website feedback page to provide feedback about the website



4.2 Page Design

The dashboard is the central page for users that displays all the useful information for the user, such as their upcoming meetings, their current plan of action and allows them to get a new mentee or mentor. The navigation bar at the top of the page will be on most of the pages and will allow the user to access all the other pages of the website as well as their notifications. The notifications inform the user about any recent events that they may be interested in such as giving feedback about a recent event or a mentee/mentor meeting coming up. The drop down button next to the notification bell will link to the user's profile page, the website feedback form and a sign out button.

4.3 User-system interaction

4.3.1 Use case diagram

4.3.2 Sequence diagram

5 Testing

5.1 Test cases

5.2 Unit and integration testing

5.3 Acceptance testing

References