

Table of Contents

Team profile.....	3
Team Name: The Matchmakers	3
Personal Information and Career plans:	3
Career plans comparison:.....	6
Group processes:	7
Tools.....	7
Group website:	7
Group Git repository:.....	7
Comments on the audit trail:.....	7
Project Description	8
Overview	8
Topic	8
Motivation.....	8
Landscape	9
Aims	9
Aim.....	9
Goals:	9
Scope & Limits.....	11
Scope	11
Category.....	12
Sub Features.....	12
Details	12
Limits	18
Quizzes.....	18
Plans & Progress.....	19
Progress	19
Plans.....	20

Roles.....	26
Tools & Technology.....	28
Tools	28
Usage	28
Testing:	30
Risks:	31
Finance.....	31
Time	31
Difficulty.....	32
Popularity	32
Security Breach	32
A.I segregation.....	33
Latency.....	33
Communication.....	33
Skill & Jobs.....	34
Job.....	34
Description.....	34
Project outcomes	36
Outcomes.....	36
Prototype	37
Prototype illustrations	37
Prototype website:.....	39
Reflection.....	39
Thang's Reflection:.....	39
Chi's Reflection:.....	39
Tung's Reflection:.....	40
Son's reflection:.....	40
Group Reflection:	41
References.....	42

Team profile

Team Name: The Matchmakers

Personal Information and Career plans:

Name & Contact information	Personal information & Career plans
<p>Le Hoang Tung</p> <p>SID: s3979121</p> <p>Email: s3979121@rmit.edu.vn</p>	<p>Personal information: My name is Le Hoang Tung, and I am a freshman at RMIT. I describe myself as an introvert who usually spends time alone to figure things out, like how to play different types of musical instruments. Although my hobbies sound unrelated to my career, being curious about learning new skills and being patient is helpful in my studying journey. Being in the IT field for the last four months, I have been introduced to some programming languages and ways to interact with the computer using the terminal, and also I was required to build a microbit product. Since knowing more about the industry, I realized that IT was more than just coding to make things work. There are endless potential applications like building security systems, data science & analytics, AI, etc. That is why my journey in the IT field has many things to explore and will be interesting.</p> <p>Career plans: Honestly, I have not found the most suitable minor for myself, but I'm interested in being a front-end website developer after I graduate. This idea came from my experience while using LEGO's official website. Although LEGO is a famous company, the company website is not attractive to people except for the sales site. The page for the kids' playground is not user-</p>

	<p>friendly, resulting in the failure of LEGO video games. To be a front-end developer, I must first master the three languages: HTML, CSS, and JavaScript. Fortunately, in this project, I have an excellent opportunity to use all of them to design and build an essential website. Getting familiar with Git, Bootstrap library, and solid geometry is also important. If I want to become the leader of a UI design team, it will require me to lead many minor projects or to start with smaller companies like start-ups.</p>
<p>Bui Hoang Quynh Chi</p> <p>SID: s3978316</p> <p>Email: s3978316@rmit.edu.vn</p>	<p>Personal information: As a first-semester student studying for a Bachelor of Information Technology at RMIT, I mainly focus on projects when the end of the semester comes. However, photography is an enjoyable and rewarding hobby when I have free time. I love capturing special moments and telling stories through my images, which is a great way to explore and appreciate the beauty of the world around me. Even though I only had minimal prior knowledge of IT, specifically web development, in this project, I believe that RMIT will provide me with the necessary expertise and skillsets for my future job. To further strengthen my ability, particularly in front-end development, I took a great deal of effort into adhering to the proposal's learning plan. In the future, I plan to work on more realistic projects that will allow me to gain more hands-on experience and dig deeper into different fields in IT.</p> <p>Career plans: I am very excited to pursue a career as a web developer. I can create high-quality websites and web applications by leveraging my knowledge of programming languages, databases, and software development life cycles. I will have enough required skills and ambition to become a successful web developer when that time comes. I have already taken steps toward my education</p>

	<p>by completing introductory coding courses, and I am looking forward to continuing my learning by specializing in web development. I am also eager to stay updated with the most recent technology and trends in the web development industry.</p>
<p>Dang Quoc Thang</p> <p>SID: s3977877</p> <p>Email: s3977877@rmit.edu.vn</p>	<p>Personal information:</p> <p>As a new freshman in school, I have huge hopes and a love for humankind, so I always want to try my best to help others. So many little actions contribute to my hobby. I soon loved the IT world and have many things to do with it, such as when I have spare time, I will listen to technological speeches or read books about famous entrepreneurs. It helps me know how successful people reach that supremacy peak. To make this dream come true, I learned to program earlier in grade 12. Because I like Cloud Computing a lot, I also achieved a Google's Cloud certificate, and during this time, I also tried and received another certificate in AI, and I hope to do further than that. Soon realizing that I cannot complete my dream of helping humanity through small things, I want to be the best of myself in technology so that one day, I can be like my hero, Elon Musk - a real iron man in real life.</p> <p>Career plans:</p> <p>In the future, AI will contribute tremendously to humans to help them reduce the waste of time and be a friendly technology to us. So after researching many types of this technology, the more I learn, the more I love this thing. It's such a beautiful technology that will aid humans a lot. Due to this, I will try to become a developer at the early age of my career path; then, I will want to work further in the AI field and conduct more research about it. Finally, I may have a start-up or try to</p>

	apply this technology to different areas. And all of that is my path to being helpful to this community.
<p>Tang Trung Son</p> <p>SID: s3978330</p> <p>Email: s3978330@emitt.edu.vn</p>	<p>Personal information:</p> <p>My name is Tang Trung Son. I'm a first-year student studying IT at RMIT. I was born in Hanoi and lived in the city for most of my life. I consider myself someone who's in the middle of being extroverted and introverted, as I can be either one at any given time. I get bored quickly, so I keep myself entertained with many hobbies such as playing video games, hanging out with friends, playing the guitar, cooking, etc. That's why I think IT is the perfect major for me, as there are endless topics to learn and discover. The subject I'm interested in right now is Machine Learning and Artificial Intelligence, as I think they will spark the next technological revolution. Before studying this course, my only experience with the IT industry was a Data Science with Python course on edx. However, I aim to expand my horizons and study all there is to know in the IT industry.</p> <p>Career plans:</p> <p>In the future, I want to work in a more people-related position rather than as a developer. So, my dream job is to be an Engineering Manager at Google's Machine Learning department. Since middle school, I've looked up to Google as an IT company. I find how they invest millions to fund innovative technology research that can change the world inspiring. I want to join them in their cause of changing the world one innovative solution at a time.</p>

Career plans comparison:

Even though all members are interested in positions in the IT sector, the careers of each member differ heavily. Tung and Chi prefer to be in the front end of a

development team, while Thang and Son would like to be in the back end. Although Tung and Chi are considering careers in web development, Tung favors the job of a UI/UX designer, while Chi leans more toward being a web developer. Thang and Son are both interested in pursuing a career in the Machine Learning and Artificial Intelligence sector. However, Son prefers to work in a people-oriented position, while Thang wants to become a developer of A.I.s. Son and Tung prefer to be in a managerial position rather than being a developer of a team. Thang is the only person on the team with dreams of opening his own startup company and becoming its CEO. In the end, the diversity of these aspirations benefitted the team, as we ended up with a well-rounded team.

Group processes:

In overview, our team had no difficulties working together during this semester. We encountered zero conflicts between team members and meetings; even though they were only sometimes attended on time, they never missed a member or two. Our group communicated regularly through text messaging through our group chat and privately. Communications lowered during the Christmas break as some members went on holiday with their families. Meetings were held periodically to help the team report on the status of their work as well as to get to know each other. In the end, our team has become a group of well-acquainted friends.

Tools

Group website:

<https://quynhchi04.github.io/matchmaker.github.io/>

Group Git repository:

<https://github.com/RMIT-son/IIT-3>

Comments on the audit trail:

As you can see from our repository, all members completed their tasks and pushed their work onto the repository. Each member created their own separate branch to ensure the main branch was not affected. From the audit trail, you can see that each member contributed to this project. Even though Thang's commits number may seem low, it is because he preferred to do his work a docs page instead of files. Since Tung and Chi were mainly responsible for making the websites, they wrote the most lines out of everyone in the repository while Son made the most amount of commits as he needed to upload the most amount of files for members' use.

Project Description

Overview

Topic

During the project proposal, we collectively decided to work on a Dating service for RMIT students as our IT project for this semester. This service was actualized as a website where users can log in with their accounts and start their journey of finding their other half. However, later, we decided to expand beyond RMIT students and expand the reach of our product to not only students from other universities and colleges but also a broader age range. Nonetheless, this product's primary target audience is still focused on young adults.

To consolidate this shift, we decided to alter our existing product name from "Dating for RMIT" to "BEAT." The systems for this project are designed for the user's convenience. As such, this service is no longer only in website form but also a mobile app that users can access at any time and place. Our main objective is to get people out to the dating market and let them get to know new people as soon as possible without the hassle that more conventional dating services offer. Using our no-nonsense preference feature and a free monetary system, anyone can expect to get started just a few minutes after making an account. Combined with a user-friendly UI, a wide array of communication methods, and an intuitive matchmaking algorithm enhanced via Machine Learning, love has never been more effortless.

Motivation

The primary reason we, the Matchmakers, chose this as our project to work on for this semester is how this project has everything that piques the interest of each member. From Machine Learning to Web Development, these topics gave us the enthusiasm to research and delve deep into these sides of the IT industry without burning out. Furthermore, we were all interested in creating a product that would improve the lives of others, and as a result, choosing a project that could help people find their soulmates only seemed natural.

Through our personal experience and research on current trends in the IT industry, we concluded that dating services are on the rise in Vietnam and that many of Vietnam's young demographic find it challenging to meet people who share the same hobbies and interests and navigate the dating landscape, especially in this digital age. We were motivated to ease people through this rather tricky progress and guide them toward the path of finding their future loved ones. Working on this project will

allow us to demonstrate our programming abilities with various languages and frameworks and our entrepreneurship capabilities to prospective employers.

Landscape

Numerous companies present in Vietnam supply similar services to our product. Currently, our top 3 competitors in Vietnam include Tinder, EZmatch, and Bumble, with Tinder taking the top spot, controlling over 60% of the dating service market [1]. However, most of these services only provide a temporary pass for users to take advantage of their services, such as Tinder with its subscriptions and Bumble with their Bumble coins; they force users to pay money to use their services comfortably. Furthermore, these services have gamified their user experience, causing the loss of human connection between users. As mentioned before, our product is more focused on enhancing the user experience rather than the monetary gain of the service. Thus, we aim to provide this service to anyone with an Internet connection, regardless of their financial situation. Moreover, our streamlined preferences setup feature makes it so users can use our services with a couple of clicks and taps without all the hassle present in other dating services.

Aims

Aim

What our group looks to accomplish through this project is the establishment of a fully-fledged service that aids people on their journey of finding their other half. This service is designed with scalability in mind and can be endlessly improved over time. As mentioned before, the outcome of this project will be a website and mobile application where users will be matched and interact with each other virtually. This service will be comprised of multiple complex technology stacks and will require a vast amount of time and funding. As stated earlier, completing this project will not only aid members of our group in developing our skills and furthering our careers but also benefit the new generations of young adults in navigating the brutal modern dating scene.

Goals:

1. High Priority

1.1. Working website and mobile app

This website will be developed with various programming languages such as HTML, CSS and JavaScript, and frameworks such as React, Django, etc. The website will include a login page, the main UI, a navigation system, profile settings, user history, etc. These pages and features will be implemented similarly to a mobile app programmed in Kotlin for Android and Swift for IOS products. Since this is the primary

way for users to access our service, this project must feature a functional website and mobile app that is ready for commercial use for this project to achieve success.

1.2. Effective Matchmaking

Users would only use a matchmaking service that could create matches effectively, and the same applies to our service. The matchmaking algorithm must be highly optimized and thoroughly assessed before being put to live use for the service. This system will consist of multiple well-researched algorithms for matchmaking purposes, such as the Gale-Shapley algorithm [2] and our proprietary algorithm based on the 20 questions game. Without a genuinely effective matchmaking system, our service will not attain the trust of potential users and, in turn, will cause the failure of the entire service due to a lack of users.

1.3. Advanced Security and Privacy

With any popular service that manages user data, the protection and security of this data heavily lie on our shoulders, especially for a service such as ours, which works with extremely sensitive data from our users. The security for our service will consist of a host of layers of protection from cyber-attacks and data leaks, including encryption, Two-factor authentication (2FA), Integrated Malware Protection, and Blockchain Technology [3], to ensure that our users feel comfortable with our service handling their personal information. We believe that seriously developing these security measures is essential for our service, not only for morals and ethics but also for the susceptibility to lawsuits, fines, and distrust from the user base that will arise if these measures are not met.

2. Medium priority

2.1. Communications

It is vital for users to have the ability to contact their matches through our platform instead of getting them through other means. The communications systems we envision for this service are a chatting feature and a voice/video call feature similar to popular texting services (Messenger, WhatsApp, etc.), where users can send texts/pictures/videos to each other and stream their calls live on the Internet. This feature is prevalent in many dating services, and we agree that its inclusion will increase the convenience factor of our service.

2.2. Database & Accounts system

Like other dating services, the ability to store users' data for repeated use will prove helpful when users continue to use our service in the long run. This service will be

built from the ground up using PostgreSQL, MongoDB, and MySQL [4]. It will be utilized to store users' data and settings, preferences, the service's analytical data, etc. Expecting users to enter their preferences and data each time they want to access our service is nonsensical as it turns using the service from a pleasant experience into a chore.

2.3. Machine Learning

As Machine Learning and Artificial Intelligence become more prevalent in the IT industry, they become more critical in any IT-related service. We agree entirely that implementing this booming side of the industry is necessary for the success of our dating service. The usage for Machine Learning is almost limitless in services such as ours. We intend to use it to analyze the users' data and chat messages, enhance the matchmaking algorithm further, and create prompts for users to start chatting when they get stumped on how to start conversations. These features will improve our service and improve the user experience immensely.

3. Low priority

3.1. Monetary system

Even though BEAT may not be designed for monetary gain, money is still needed to fund the development and upkeep of the BEAT's services, servers, databases, etc. To refrain from interfering with the users when using our service, the primary means we will gain funds with the service is through visual advertisement banners that occasionally appear on our website and mobile app. We will additionally provide an optional membership that will remove those advertisements for users who find them too distracting or want to support our service.

3.2. Miscellaneous Features

Every IT service requires a collection of features that enhances the user experience and creates a satisfying experience to attract new users and attain existing ones. We are no outlier to this fact as our service will incorporate a host of features that will match our goals for the ideal user experience. These features include but are not limited to Geolocation, Reporting, Advanced search, etc. Features such as these will be the finishing touches to our service and contribute to the convenience we imagine users of BEAT will have the opportunity to experience.

Scope & Limits

Scope

Category	Sub Features	Details
UI	Website	BEAT will be hosted on a website platform catering to users that prefer to use our service through their Internet browsers.
	Mobile App	BEAT is also available as a mobile app, built on Kotlin and Swift to support IOS and Android compatibility.
	Graphics	Thanks to the graphics, users are kept engaged on the site [5]. The quantity will be restricted to guarantee that the website loads swiftly and effectively.
	Hyperlinks	You can discover what is available on our other web pages by clicking on the hyperlinks in the menu pane.
	Web Responsive Elements	The responsive web is designed for users of varying screen-size devices, flexible grids, breakpoints, and media queries with the aid of various frameworks, JavaScript, and CSS.
	Main UI	The UI consists of users' profile pictures, relevant information about the user, their biography, the matching score they received, and an Accept and Reject button.
	Like & Dislike	Utilizing the Like and Dislike buttons to proceed to the next candidate or confirm the match is the primary method by which users communicate with the platform.

Profile system	Account Creation	Users will enter some account information, including a username, a profile picture, some relevant information on themselves, and a personal biography.
	Social integration	SDKs from Facebook, Twitter, and Google will be used to provide quick account creation by logging in through pre-existing social media accounts.
	Preferences	Users will be asked a series of yes-or-no questions following the setup so that the matching algorithm can assess their responses.
	Profile management	By selecting profiles from the menu, users may modify their personal details at any time they desire. Users may view account statistics, including matching rates, history, etc.
Navigation system	Menu system	<p>The menu, which includes links to the home page, their profile, matches, chat rooms, and other pages, may be accessed by clicking on the hamburger icon in the top-right corner of the website/app.</p> <p>Users can locate menu items they cannot see by using the Search box at the top of the menu.</p>
	Discover Page	After pressing discover on the menu bar, users will be taken to a discover page, showcasing categories that can narrow down our recommendations.

Messaging system	Directory	Create a directory and establish the requisite dependencies, such as APIs and SDKs for Firebase, Websockets, and Socket.io [6]. The chat server and client will reside in this environment.
	Receiving & Sending	A chat server will manage other back-end tasks that won't be kept locally on the user's device, such as sending and receiving messages, listening for incoming message events, rendering existing messages, and broadcasting new messages to users [6].
	Conversation window	The discussion pane allows users to scroll up and down to read earlier messages easily.
	Contact list	When you click or tap on each contact's profile photo or name, a conversation window will appear for users' access.
	Voice Call/ Video chat	Users can call and talk to each other through our UI, and if users prefer the call to be more intimate, they can speak face to face through the Internet using their devices' cameras.
	20 Questions	Based on the 20 questions game, the algorithm will assign each user a value and pair them with other users who received a roughly comparable value. The list of questions will be cycled and updated constantly to maintain relevance.
Matching Algorithm	Scoring system	The algorithm will produce a value according to how similar the two users' are and display it to the users.

	Machine Learning Utilization	With the use of supervised and unsupervised machine learning, the machine will be given user data to improve user-matching accuracy.
	Gale-Shapley algorithm	The Gale-Shapley Algorithm will be used to establish stable and ideal matches, ensuring that no participant will end up with an undesirable match. [2].
	Geo-matching	Using users' locations and addresses, the algorithm can match users who live in close proximity to each other.
	NLP	We will collect and analyze user texts such as biographies and messages through Natural Language Processing to train our A.I.
Machine Learning	Icebreakers	Our A.I will generate phrases and sentences to help ease the conversation, such as providing opening lines to users or recommending icebreakers to break a silent conversation.
	Virtual Assistant	There will be an A.I assistant that can answer users' queries about how to use BEAT, how to successfully find a match, etc.
Notification system	Notification page	Notifications provide links to the related pages. The user will be sent to that page by tapping the icons on the menu.

	Push Notification	Users will receive push notifications on their mobile devices and emails informing them of matched results, messages, calls, and BEAT's updates and changes.
Database system	Profile information database	All of the user data and profiles will be saved in a MySQL and MongoDB-based database system, where they will be exported into our algorithms for analysis [4].
	Datastore	A data store will be created to track user data and messages and aid in the recovery of the messaging engines in the event of errors.
	Cloud Storage	Our database will be additionally uploaded to a separate cloud service to maintain backups and support remote cooperation and database scaling.
	Geo sharding	By scattering our database into multiple machines, we can allow the processing of smaller datasets in parallel across shards, reducing latency and workloads [7].
Security	PGP encryption	To preserve the privacy of our users, we employ PGP encryption to secure and encrypt communications transferred between users as well as information and files saved in the database. [4][8].
	TLS protocol	Used in conjunction with the Transport Layer Security (TLS) protocol to verify security certificates and safeguard server communication [4].

	Blockchain	Blockchain will be used to reduce fraud and unlawful behavior by generating a record that cannot be altered and encrypted end-to-end [9].
Monetary system	Google Adsense	Taking advantage of Google Adsense, by pasting the code provided by Google onto our website and choosing the location for them to appear, white space on the interface can be used for advertisements.
	Subscription Service	We will provide an optional subscription service that users pay annually to remove advertisements from our BEAT and support our service.
	Account Recovery	Users could recover their accounts if they forgot their login information. This will be through a link sent to the email users signed up with; if the link is pressed, we will send them an email containing the password.
Misc	Report System	If users find a profile with misleading, vulgar, or illegal content, they can flag it down, so our systems will recommend that profile less to other users.
	Geo-location	Using Google Maps and Google Location Services, BEAT will provide users with accurate location data and support our geo-match feature.

	Reviews	Users can leave reviews of our service on the review page accessible through the menu. Our team will manually read the reviews to assess our users' opinions.
--	---------	---

Limits

Feature	Details
Forums	A discussion page for users to post questions, news, or anything on their minds for others to comment on and discuss with each other.
Quizzes	Pop-up notifications that display fun questions about love and relationship that users can answer to gain access to our premium subscription for free temporarily.
Matching more than two people	A feature for matching multiple people to each other at the same time to cater to people who are interested in polyamorous relationships.
Group chat	Chatting feature for users to create a group chat where multiple users can exchange text messages, make voice calls, and stream videos to each other
Relationship Advice	Pieces of Advice made by our virtual assistant on maintaining a work-life balance, maintaining a healthy relationship, and avoiding conflicts.
Date spot recommendation	Recommendations made by our A.I that provide fun and romantic locations around the users' area so they can make plans to meet their match.

Plans & Progress

Progress

Foundation

Our project initially did not start out as a dating service but something completely different. Thang originally proposed we do the project about an AI powered virtual assistant capable of controlling appliances in the household. However, after some negotiations, members decided that the task was either too complex or too dull. That was when Son came up with the idea of a dating service catered to RMIT students. Doing this project would satisfy Thang's curiosity for Machine Learning, develop Chi's skill as a web developer, Tung's aptitude for UI design, and Son's interest in IT solutions for real-world applications.

After deciding on the topic for our project, we got to work. The first thing to do was divide responsibilities between team members. Son was chosen as the project manager as he had experience working in professional teams before and being the mastermind behind the project's topic. Thang volunteered to be our technical developer as he was interested in studying more about Machine Learning and Artificial Intelligence. Chi had some prior experience with HTML and CSS, so she was the perfect pick for our Lead Web Developer position. Tung was incredibly talented at designing with Canva, so he was given the role of Lead UI/UX designer.

Journey

During weeks 3 to 5, the plans we gave during the project proposal were carried out without any trouble. All members were able to follow the timetable precisely, and we finished our project proposal right on schedule. Moving on to week 6, when our team started working on the project, we immediately realized the great difficulty of the concepts we were researching. Since many of us did not have any prior experience in the IT sector, understanding these concepts and knowledge was a huge challenge to overcome. We realized we needed to account for the amount of time it would take to study for other courses and to join extra-curricular activities such as clubs and volunteering. Each member, except for Thang, had weekly club-related responsibilities that they had to attend to. The time that we could work on this project was limited, so we decided to rethink how we would go about doing this project.

We first decided to scale back on some of the features our prototype website would have, like notifications and message databases. Our prototype will be a bare-bones version of what we envision our project would look like and what users will experience while using it. Secondly, we decided that creating a functional

matchmaking algorithm was unrealistic as we needed more programming knowledge, so we only focused on the design of the algorithm instead. When we were discussing during a meeting about what is a good way of getting to know someone, Tung said that he used to play a game called 20 questions with his friends when he was little, which inspired us to design our matchmaking algorithm around 20 yes or no questions that users answer during the account setup process. During this time, we acknowledged that our product should not only be limited to RMIT students, so we decided to change our product name from Dating for RMIT to BEAT, a digital matchmaking service that is focused on young adults. While Chi and Tung were building the prototype website, our team realized that if we wanted to finish it before this assignment's due date, we would need more workforce, so Thang had to step up and aid in writing some of the HTML files. At the same time, Son supported them with materials on helpful libraries and tools to ease the process.

Result

Our team settled on creating our UI designs on Canva to showcase our ideas and coding web pages from scratch for our prototype product. The designs that will be shown later in the outcome section are our vision for what the website's UI will be like once it's completed, and the prototype is the product we created during this semester. Even though extensive changes were made to our initial plans, we would still consider these outcomes a success as we have learned much about group work, researching, programming, and how to adapt to shifting circumstances.

Plans

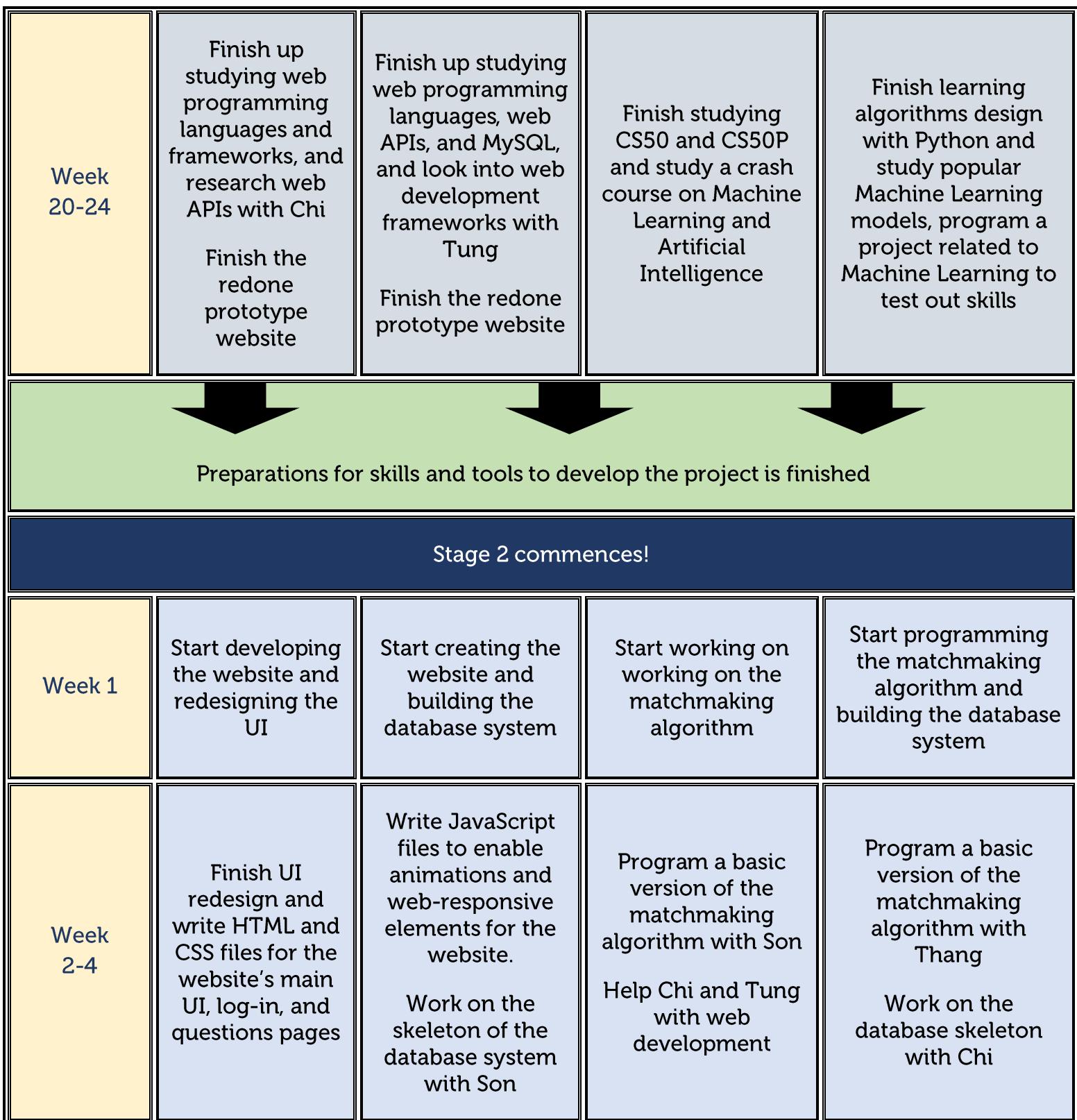
Our plans for developing this project will include three main stages

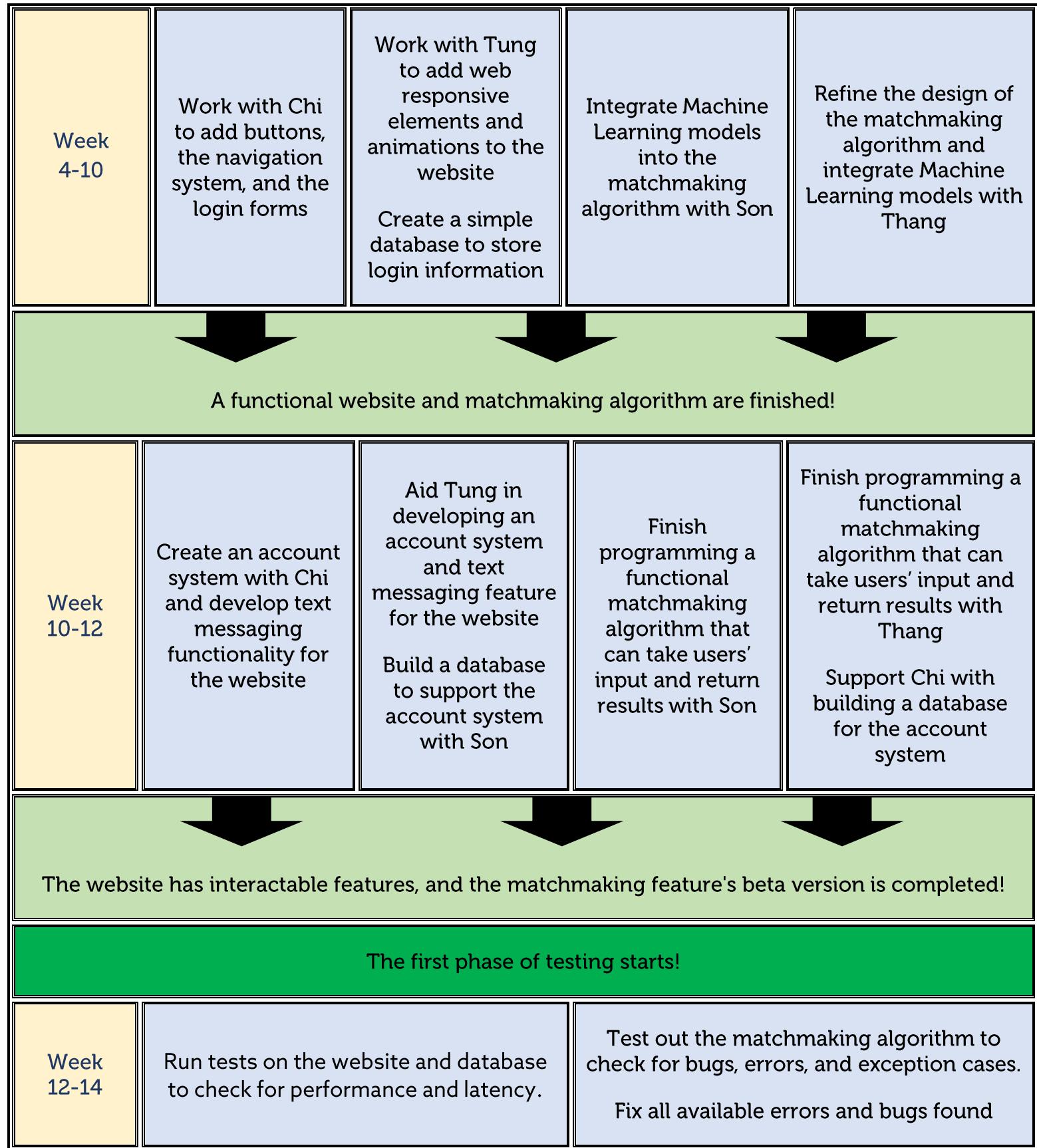
- Stage 1: Preparation
- Stage 2: Development
- Stage 3: Finishing Touches (the time for this stage will be more loosely defined)

People	Le Hoang Tung	Bui Hoang Quynh Chi	Dang Quoc Thang	Tang Trung Son
Time				

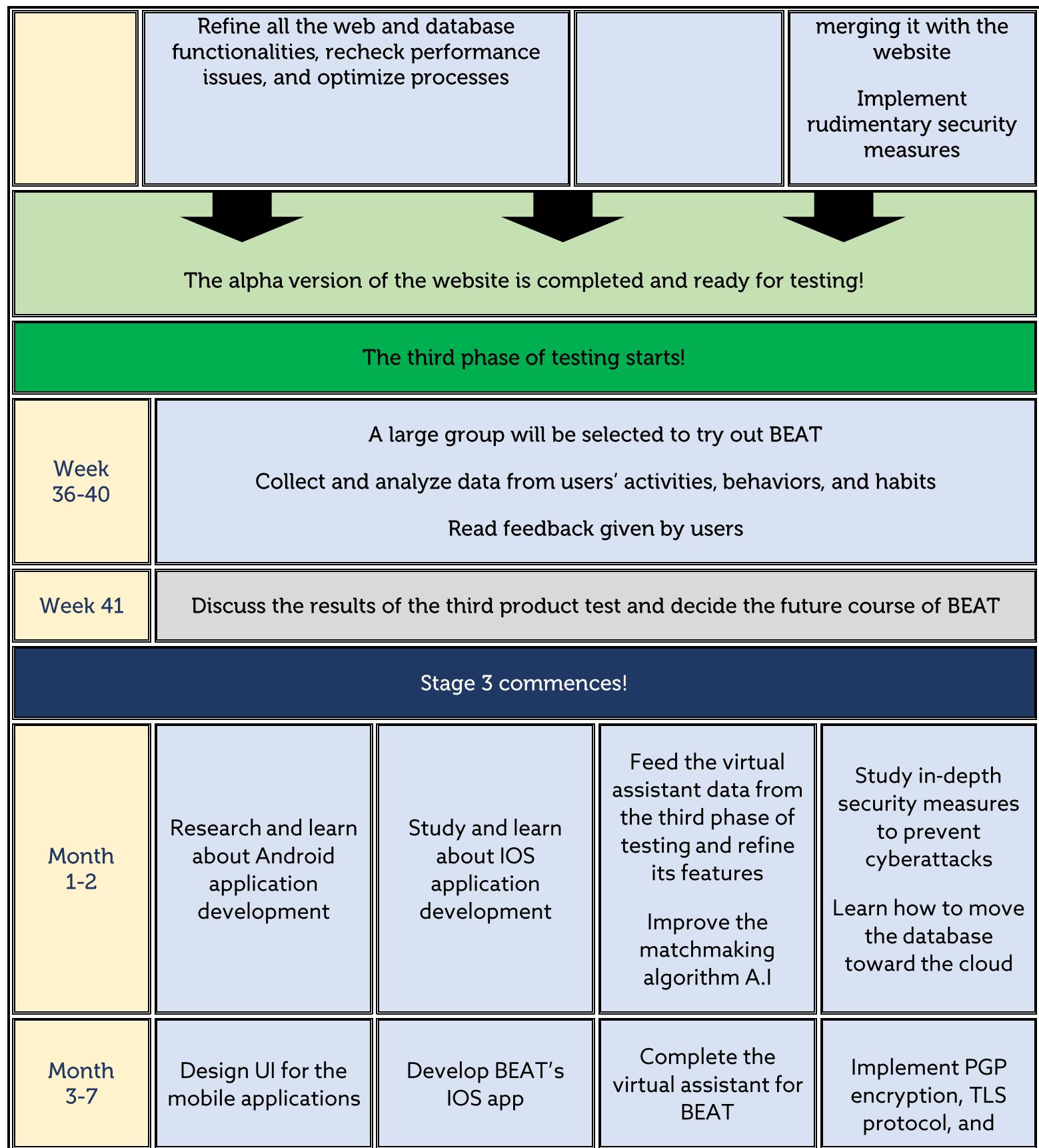
Stage 1 commences!

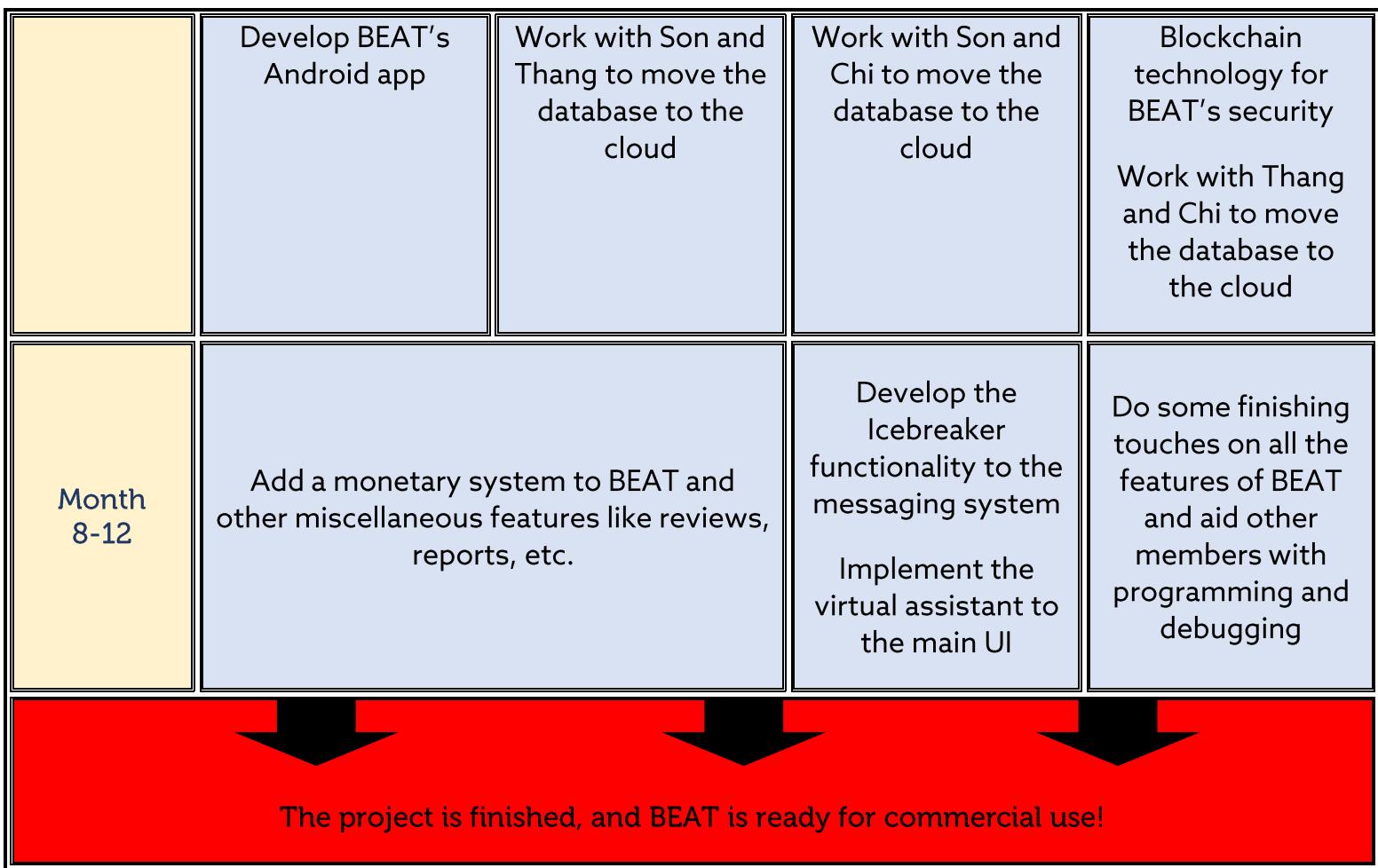
<p>Week 1</p>	<p>Layout project plans and assign tasks to each team member.</p> <p>Discuss options available for this project</p>			
<p>Week 2-4</p>	<p>Study HTML, CSS, JavaScript, and popular libraries used for making websites</p>	<p>Study HTML, CSS, JavaScript, PHP, and libraries to program web responsive elements and animations</p>	<p>Start enrolling in CS50 and CS50P (online computer science course) to learn in-depth programming</p>	<p>Research algorithms with Python and enroll in an online Machine Learning course</p>
<p>Week 4-12</p>	<p>Continuing to study web programming languages and learn how to use web development frameworks</p>	<p>Continue studying web programming languages, and start studying database schemas and web development APIs</p>	<p>Continue studying Python in CS50P and Computer Science with CS50 (50% done)</p>	<p>Program various projects to refine coding skills, continue to study the Machine Learning course</p> <p>Start looking into security measures with PGP and TLS protocol</p>
<p>Week 12-20</p>	<p>Continue studying web programming language and frameworks, and program personal project</p> <p>Redo prototype website with Chi to hone skills</p>	<p>Continue studying web programming languages and start learning MySQL</p> <p>Redo prototype website with Tung to hone skills</p>	<p>Continue studying CS50 and CS50P and start doing the final projects for both courses (75% done)</p>	<p>Continue studying Python algorithmic design and security measures, and program larger-scale products to train.</p> <p>Start studying database schemas and MongoDB</p>





	Debug and fix errors in website files			
The second phase of testing starts!				
Week 14-16	<p>Multiple tests involving volunteering participants will be conducted</p> <p>Varying sets of participants will be asked to test out the beta version of our matchmaking algorithm</p> <p>Record and analyze the data from these tests</p>			
Week 17	Reflect on the results of the tests and discuss future project direction			
Week 18-24	<p>Add file-sharing, picture-sharing, and video-sharing features to the website</p> <p>Work with Chi to implement voice calls and video streaming</p>	<p>Develop voice call and video streaming features for the website</p> <p>Work on the database system to store matchmaking data with Son</p>	<p>Work with Son to address all the issues with the matchmaking algorithm from the testing results</p> <p>Start developing the basics for a virtual assistant</p>	<p>Work with Thang to handle all the problems with the matchmaking algorithm from the testing results</p> <p>Develop the database system to store matchmaking data with Chi</p>
Week 24-30	<p>Add a notifications system to the website and social integration information for logging in</p>	<p>Add a Geolocation feature to the website</p> <p>Implement a feature that tracks user activities and stores data in the database</p>	<p>Continue working on the virtual assistant</p> <p>Develop an A.I with NLP to read text messages</p>	<p>Work with Chi to incorporate geo-matching into the matchmaking algorithm</p>
Week 30-36	<p>Merge the matchmaking algorithm to the website and create an alpha version of BEAT</p>		<p>Program beta version of the virtual assistant</p>	<p>Do final tests on the matchmaking algorithm before</p>





Roles

Regarding roles assigned to each team member, our team has four prominent positions designated to each group member: Project Manager, Lead Web Developer, Lead UI/UX Designer, and Technical Developer. However, these terms are very loosely defined in our group since the group is comprised of only first-semester students, and our knowledge of these subjects is limited. These roles can be easily shifted to meet current circumstances, such as having multiple Web Developers or UI/UX designers.

Name	Role	Description
Tang Trung Son	Project Manager,	During this project, Son oversaw the management of the tasks that needed to be

	UI/UX designer, Lead Technical Developer	accomplished, their assignment to suitable team members, and checking up on the team's progress. Son handled supporting teammates when they had difficulties in their duties and reallocating resources to help them further. Aside from that, Son had a hand in designing the Website UI and is the lead technical developer for the Matchmaking algorithm, Security, and Databases.
Bui Hoang Quynh Chi	Lead Web Developer, UI/UX Designer	Since Chi had prior experience with HTML and CSS, she was nominated as the Lead Web Developer for this project. In her position, Chi's primary responsibility is writing the code for our prototype and group websites, including their JavaScript elements. She also contributed many ideas during the design process of the website's UI.
Dang Quoc Thang	Technical Developer, Web Developer	Thang was chosen as the Technical Developer for this project thanks to his ambition to study Machine Learning and Artificial Intelligence. His role is developing and researching the Machine Learning sections of the project. Additionally, he aided in programming HTML for the prototype website.
Le Hoang Tung	Lead UI/UX Designer, Web Developer	For this project, Tung is the head of designing the UI/UX for our websites since he has considerable experience with Canva. He directed the designs, helped bring them to reality through Canva, and assisted in coding HTML and CSS for the prototype and group websites.

Tools & Technology

Tools	Usage
PyCharm	IDE to code Python.
Visual Studio Code	IDE to code HTML, CSS, and JavaScript.
HTML5	Constructing of the website layout.
CSS3	Control how web pages and user interfaces are laid out, colored, and with other visual components [10].
Python 3.9	Language for coding the matchmaking algorithm and Machine Learning algorithms.
R	Language for developing Artificial Intelligence.
Swift	Language for building IOS applications.
Kotlin	Language for building Android applications.
PHP	Enables cross-platform for adaptation.
MySQL	Building, controlling, and primary storage for the database [11].
MongoDB	Caching/intermediate storage for the database [11].
Bootstrap	Helps develop web-responsive elements [12].
PayPal REST API	API to process invoices from PayPal.

Ionic	Build and develop IOS and android applications.
React	Build an interactive User Interface.
Websocket	Allows two-way interactive communication between the user's browser and a server [13].
Apache	Accept directory requests and send information [14].
PGP encryption	Encrypt messages between users and data on the database.
TLS protocol	Validate security tickets and secure communications between servers.
Amazon SageMaker	Enables execution of Machine Learning models in Cloud-based systems.
TensorFlow	Manage Machine Learning systems [15].
FusionAuth	Authentication for users' accounts.
Firebase	Enables developing cross-platform applications.
Facebook SDK	Social Integration for Facebook
Cloud SDK	Social Integration for Google
Google Location Services	Locate and display locations of users

Google Cloud Platforms	Cloud solution for creating and managing database.
Graph API	Design data graphs and charts for analyzation.
Google Analytic	Analyze, follow, control data.
PageSpeed Insights	Test website performance.
Canva	Illustrate UI layout.
Github	Enables remote working collaboration.
Messenger	Text messaging.
Discord	Group meeting platform.
Google Meet	Alternative group meeting platform.

Testing:

For BEAT, we will have 3 phases of testing before determining whether the development was successful.

The first phase will be about BEAT's technical side. We will do a round of technical tests, which we will conduct with tools like Google Pagespeed Insights. This phase aims to find all the errors and bugs that are still present in our programs and code, as well as test the stability of our web platform and algorithms.

The second phase will require a small set of people currently studying at university to test our matchmaking algorithm's design. We will ask a handful of RMIT students (who are friends of the team), roughly 8 to 10 people, to help us conduct these tests. Half of the participants will have prior experience in relationships, while the other half does not. The participants will be asked to describe their ideal partner in life, including personality, likes, dislikes, etc. After which, we will give them a set list of yes or no

questions and log their answers before putting them into a beta version of our matchmaking algorithm. If the algorithm can match the participants with a pre-set profile that is similar to their aforementioned perfect partner, we will move on to the next phase. This phase will be repeated multiple times with different sets of participants to ensure the ideal design of our matchmaking algorithm.

The final phase will involve a more extensive group of participants. We will post about our product on social media groups such as RMIT Vietnam Society, asking people to test out our service. When they register through a google form, we will send out invitations through email to 500 randomly selected students. They will gain access to the beta version of BEAT, where they go through our user interface, get matched with other users, and text their preferred matches. Afterward, they will be asked to do a survey rating their experience while using BEAT's UI and how accurate our matchmaking algorithm was. When all these phases have been completed and yield successful results, we will consider the early development a success and start building other features of BEAT.

Risks:

Finance

Since BEAT is an immensely complex product designed with scalability in mind, most of the infrastructure and tools are locked away behind paywalls. As the entire team is composed entirely of first-year students, the chances of the team having access to some of these services are slim. Furthermore, the costs of some of the tools and services required to build the service, such as APIs, cloud servers, and frameworks, are too high for a team of college freshmen to fund. Aside from the software, there is the question of hardware. We do not own massive supercomputers that are present in the conglomerates that run other dating services. As a result, housing the databases and sophisticated algorithms for our service will take a lot of work. The team may have to spend a considerable amount of money to invest into this project. However, the money we make from the monetary systems and the traffic to the service may be much lower than we expected. These risks must be taken seriously as this will affect the financial situation of all parties involved in this project.

Time

This project will take not only a lot of effort to complete but also a substantial amount of time. Being versed in programming does not happen overnight. Building only 25 percent of the project would require mastery of programming languages such as Python, JavaScript, Swift, etc. To juggle learning the fundamentals of programming alongside APIs and frameworks is nearly impossible. Combined with the fact that the

first time most of our team members were exposed to this side of the IT industry was at the start of the semester. Learning the tools to build such a massive project will take years. Furthermore, since we are still starting in university, it is irresponsible to think everyone can spend most of their time on such a project. This fact can significantly delay BEAT's development.

Difficulty

Many of the systems that we envision for BEAT require an extensive amount of prior knowledge of multiple technology stacks to develop. These tools are complex to understand. Even though we may have plans to study them for use, that does not guarantee that the outcome will be precisely as we expect. In the future, chances are high that team members will find these too far too difficult and time-consuming to invest their time. Moreover, it is not likely that when members learn to utilize these tools, they will use them without running through some program-breaking bugs they cannot fix. The learning curve of learning and operating these tools must be seriously considered, as they are crucial to developing our dating service.

Popularity

Like any dating service, the effectiveness of its matchmaking heavily depends on the number of active users present in the system. A dating service can not be efficient without a sufficient number of users. That is why the popularity of BEAT is crucial for our service to operate. That said, accomplishing a notable reputation will be the most challenging feat of our project. We will need to create a marketing campaign for our service that effectively reaches as many people as possible. However, the outcome is primarily unpredictable. Some conditions, such as timing and user trends, can be accounted for, though volatile political and social disturbances may ruin our campaign completely.

Security Breach

It is imperative for a service that deals with the personal information of clients to have the most advanced security systems. Although we may implement security measures to prevent cyber-attacks from taking place, we can not account for every possible method an attacker might use to attack our system. Hackers and cybercriminals will constantly develop innovative solutions to steal our data and access our system illegally. The fallout from an event such as a data breach could be catastrophic as we will not only lose the faith of our user base, but we would also get in trouble with the authorities.

A.I segregation

Our matchmaking algorithm will include Machine Learning to enhance its capabilities by feeding the A.I with information from databases and our users' personal information, activities, and interactions. The problem lies with the underlying racism and sexism common in the general consensus. Even though we may not have designed our A.I to segregate one particular sex or racial group from another, there is a high chance it will adapt to the data that is fed to it and, in turn, pick up the unwanted characteristics of users [16]. This can lead to disastrous results as our matchmaking algorithm would be deemed inefficient, and its ability to give accurate matches would be hindered.

Latency

In the digital age, people's attention span is shortening with each coming year. From 12 seconds in 2000 to only 8.76 seconds just 15 years later [17]. The latency is a significant issue when discussing live services like ours. When users get a match, send a text, or simply move between pages, they expect it to occur immediately. This requires innovative solutions to be put out as communications between servers, the databases, and the app will need to be highly optimized to ensure the latency stays at a minimum. If these solutions are not completed, our service will become sluggish and lose users' interest, ultimately deterring users from using our service in the future.

Communication

During the project proposal, our group put out five main ground rules that would decide our operations for the entire semester. Those rules were:

- No physical or verbal abuse of teammates.
- Do your best to be present at all in-person and online meetings.
- If someone needs assistance with the assignment, they must ask for it immediately.
- Express your complaints to the team so that we may work together to find solutions.
- Frequently read team members' communications to stay informed on updates to the assignment.

These rules have been followed strictly throughout this semester, resulting in zero conflicts.

We initially proposed to have at least one meeting per week to increase productivity and report on the status of assignments. In reality, we were able to hold more than

two meetings each week, both online and offline. However, communications went down during the Christmas break as many team members went on holiday with their families and failed to announce that information to the team. We picked up the pace after the Christmas break ended and resumed our operations as usual. While we originally proposed to hold online meetings in Discord and Teams, one of our members: Thang, needed help gaining a smooth connection for our meetings. So, we decided to use Google Meet as our online meeting platform. The frequency of group meetings increased significantly to 5 per week during the last two weeks of the semester as we had to revise all our work and start piecing them together.

Messenger was primarily used to communicate with each other both in a group chat and privately to ask for support with assignments not only for this course but for other courses as well. We additionally incorporated using GitHub to work on developing the group website and the prototype website. Members had difficulty using GitHub in the first two weeks. However, after some group troubleshooting and time, all members became acquainted with GitHub.

Skill & Jobs

Job	Description
Full-Stack Developer	BEAT needs a full-stack developer who is an expert in both front-end and back-end systems to build our web app. They will handle the construction of our web application and the database operations to support our service. This will require extensive knowledge of programming languages such as HTML, CSS, JavaScript, PHP, Python, and many frameworks such as React, MongoDB, MySQL, and minor experience in Cloud Computing [4]. Because of our operation's small scale, this position also requires experience in UI/UX design to build the web app from scratch. Additionally, teamwork experience is needed as interactions are often expected with other members.
Mobile Developer	Building a mobile version of our service is essential for the convenience we envision for our product. As such, hiring a mobile developer is crucial for the success of this service. This job will involve the development of APIs (application

	programming interfaces) to support functionality on mobile devices as well as constructing and upkeeping applications for both IOS and Android. The technology stack needed for this position will be Kotlin, Swift, Java, JavaScript, Ionic, React Native, PhoneGap, etc. [4]. Prior experience with UI/UX design for mobile applications and teamwork is also necessary.
Lead Software Engineer / Machine Learning Engineer	The backbone of this service will be based on our matchmaking service, thus, having a reliable, robust, and responsive matchmaking algorithm is vital for BEAT. This position involves constructing our matchmaking algorithm from scratch and enhancing it using data analysis and machine learning tools. Having 5+ years of experience with Machine Learning and being well accustomed to Python, R, Splunk, SAS, Tensorflow, and Amazon SageMaker [18] is a must. Being lead software engineer, in addition to having innovative thinking, it is also highly crucial for them to have excellent leadership skills and past managerial experience.
Full - Stack QA engineer	To offload the number of tasks to other members and ensure the quality of the work output, BEAT will need a Full - Stack QA engineer in our team. The QA (Quality Assurance) Engineer will be responsible for performing assessments, testing the programs, finding errors and bugs in programs written by other team members, collaborating with them to fix those bugs, and improving the quality of the service in general. They must be well-versed in many programming languages like Java, JavaScript, Swift, Kotlin, Python, etc. It is imperative to have much experience working in teams and excellent communication skills, as this role will have to interact with other team members frequently.
Business Analyst	As investors will fund Beat, a business analyst is essential for the development process. They will oversee communicating with investors, improving the efficiency of business operations, and evaluating programs and technical processes [19]. This role requires past data analysis experience, research skills, excellent communication skills, and work experience in the IT industry.

	Consultations will frequently occur to assess the current market and BEAT's prospects.
--	--

Project outcomes

Outcomes

The product we designed is a primitive version of what we would like our product to look like in the future. BEAT can be used as a tool to help people find the love of their life or to find people who share the same interests. As of now, our website can display our UI and move you to the other pages. You can press the chat button on the main UI to type in texts and make them appear as text boxes. For the UI illustrations, we have five pages to showcase our vision for our website when we finish the product.

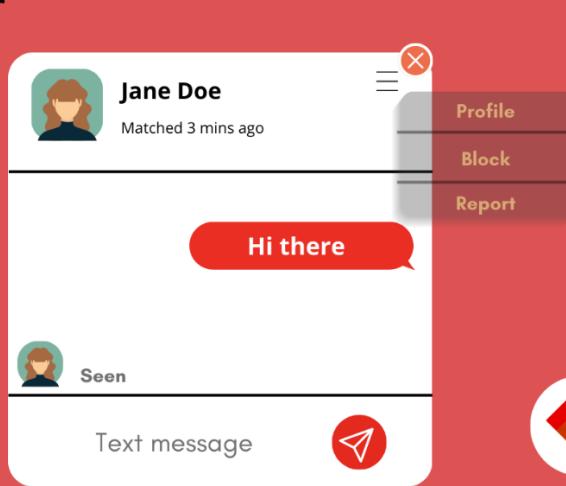
- The first is the login page, where users can fill in their login information and use BEAT.
- The second is our main UI, where you can see a user's profile picture, some relevant information, a personal biography, a similarity score, and a like or dislike button.
- The third is the questions page, which will show up during the account setup process, where users will answer 20 yes or no questions.
- The fourth is the matched page which will appear when two users like each other's profile
- The fifth is the messaging page, where users can send each other text messages or even call each other

Right now, the product is in very early development as we cannot develop all the features as they take a vast amount of time to learn. Most of the buttons on the prototype website are still unable to be used, and we still need to develop our matchmaking algorithm. In the future, we plan to refine our website with animations and web-responsive elements so that it will feel like an actual professional website. Additionally, we will develop a fully functioning matchmaking algorithm that can match users accurately.

Prototype

Prototype illustrations

Log in Page	
Main UI	

Questions Page	 <p>Question 1: <i>Is astrological sign at all important in a match?</i></p> <p style="text-align: center;"><input type="button" value="Yes"/> <input type="button" value="No"/></p>
Matched Page	
Messaging Page	

Prototype website:

https://tungxk.github.io/BEAT_login/?fbclid=IwAR0FaVkpNWU8hOU0_O5Ap9McQjWrjWn0To4KKiW_46nOxZ3K9VKVNHKJvA

Reflection

Thang's Reflection:

I'm in charge of the technical part of this project, especially the website and algorithms. At first, I thought it was nothing much to do. However, some first failures led me into big trouble. To be more specific, I researched many machine learning algorithms. It aims to find the same characteristics and features between users and their audiences; I thought it was some simple processes and math.

Nevertheless, I was shocked by the massive amount of math and ways to train a model into reality. Therefore, our prototype needs this function and is in development. And after that, I was in charge of the website interface, supporting my teammates, and tracking some processes to write my team's report. And that was doing quite well. I worked with my teammates and followed their approach; therefore, I knew their problems and how to suggest solutions. Finally, the project was done approximately as I expected. After doing this project, I learned more about making a product as realistic as possible, and I look forward to future projects and my career.

Chi's Reflection:

Through this long-term project, from the proposal to the assignment's final stage, I gained more knowledge of web programming languages and supportive frameworks such as Reactjs, Nodejs, and Tailwind CSS. The chosen topic was a dating service, which brought me many exciting insights. After focusing on the service's young users, UI/UX designer team initially identified the site's design as youthful, with bright colors of passionate love, and, most importantly, user-friendly. I am pleased with the outcome of both a simple yet appealing dating web prototype and the successfully launched report web.

If this project had no deadline, we would want to modify flaws to improve the user experience. For example, the dating web prototype should be responsive on different-sized devices, and the report web should contain multiple web pages linked to the homepage when clicking a button.

Tung's Reflection:

In this project, my role was Lead UI developer. It was a fortune for me to do the work I am interested in. Although we finished our task in time, we needed more communication. For the front-end development side, many improvements should be made in the future. First, the content display still needs to be well organized compared to other websites in the market. Secondly, our web did not include responsive elements for zooming interaction or display on various devices.

During the work progress, honestly, I was impressed by my teammates, especially my leader Son. He originally was more into the back end and made the idea of a dating service and designed a web structure. At first, I thought he could have been better at leading; but what has been happening was terrific. He helped others prepare the work and taught them how to talk and interact with listeners during the presentation.

This project taught me a lot about programming, designing, and presenting ideas. However, working as a team is what I have learned the most. Communication is essential to show other ideas and support each other when a problem arises. Despite being an introvert, it is still my responsibility to help others and show my work to keep track of the project.

Son's reflection:

Being the project manager, I learned many new lessons while doing this project. I was pleased with the outcomes of the assignments. Each member did their part well and on time. Members came to ask for help as soon as they encountered any issues, which made troubleshooting them quite a breeze. In retrospect, our team could have improved on the communications front, as during the Christmas break, some members needed to alert the group about their holiday plans.

Something I would change in the future is not getting to know my teammates well before working together. I had difficulty assigning tasks and roles to suitable people and had to take a few weeks to get acquainted with other members to reassign duties appropriately. What I found surprising about this project was the sheer complexity that other dating services had. I did not realize that behind even simple dating services was a collection of sophisticated systems working in unison to reach the result of matching two lovers. I gained a newfound respect for Dating services. One thing I learned about group work is the importance of good task management. Some members naturally perform better than others, and assigning

the correct number of tasks to those members is critical to achieving good results while doing projects like these.

Group Reflection:

As a whole, our group worked well together during this semester. We had a great time working with each other. The group was harmonious, and no members did any misconduct. The team was very supportive of each other throughout the semester, helping each other with assignments and questions regarding the lectures. At first, we decided not to allocate a leader and to share responsibilities equally; we realized that it was more beneficial to have a project manager to assign tasks, schedule meetings, and announce updates. After Son became the project manager, the group work dynamic changed immensely. We had structured meetings and a timeline to help guide us with work. The outcomes of this project far exceeded our expectations. We were able to produce both a prototype website and multiple designs for the UI while simultaneously having a group website with an attractive design. Members did their proficiently and due diligently, and no one complained about their workload.

Something that could need some improvements was the planning of the project and the communications between team members. Our original project proposal needed to be simpler for us to follow, which meant we had to cut many features we wanted our prototype to have. Additionally, we needed help planning out time to do our work as many members had other responsibilities, such as student societies, volunteering, and part-time jobs. Communication between members could have improved, as some members are very introverted and dislike communicating with others. For future projects, we will better communicate with members, especially for important information like going on holiday, etc.

We all agree that the one thing we were surprised about was how different working in a team can be compared to working individually. The amount of work we could accomplish in the little amount of time we had was astonishing. We did not account for the amount of communication needed to succeed in a project similar to this scope.

Our group learned many new skills and lessons this semester, but the most important lesson we learned was how to communicate effectively. Through multiple meetings, we learned how to communicate ideas and solutions effortlessly, grow out of our comfort zone, and do tasks that are important to the group. All members learned how to communicate their thoughts directly to each

other and to speak their minds when they sense something is not correct. Overall, this semester has been a genuinely profound learning experience.

References

- [1] Dating Services - Vietnam, , n.d.. [Online]. Available:
<https://www.statista.com/outlook/dmo/eservices/dating-services/vietnam>
- [2] K. Scanlon. "Dating Data: An Overview of the Algorithm." medium.com.
<https://medium.com/swlh/dating-data-an-overview-of-the-algorithm-afb9f0c08e2c> (accessed Nov. 11, 2022)
- [3] S. Mathis, "How do companies protect customer data? | TechTarget," *How do companies protect customer data?*
<https://www.techtarget.com/searchcustomerexperience/answer/How-do-companies-protect-customer-data> (accessed Jan. 15, 2023).
- [4] N. Keblawi. "An Engineer's Guide to Dating App Development". cometchat.com.
<https://www.cometchat.com/blog/building-your-own-dating-app> (accessed Nov. 11, 2022)
- [5] G. Geissler, G. Zinkhan, and R. T. Watson, "Web home page complexity and communication effectiveness," Journal of the Association for Information Systems, vol. 2, no. 1, p. 2, 2001.
- [6] Mike.R. "How to Build a Chat or Messaging App: The Ultimate Guide"
getstream.io. <https://getstream.io/blog/build-chat-messaging-app/> (accessed Nov. 11, 2022)
- [7] "What is Database Sharding? - Database Sharding Explained - AWS," Amazon Web Services, Inc. <https://aws.amazon.com/what-is/database-sharding/> (accessed Jan. 15, 2023).
- [8] M. Buckbee. "What is PGP Encryption and How Does It Work?". varonis.com.
<https://www.varonis.com/blog/pgp-encryption> (accessed Nov. 11, 2022)
- [9] "Benefits of blockchain - IBM Blockchain | IBM," Benefits of blockchain - IBM Blockchain | IBM. <https://www.ibm.com/topics/benefits-of-blockchain> (accessed Jan. 13, 2023).
- [10] "Create with CSS | Google Developer Student Clubs," *Google Developer Student Clubs*, Jan. 16, 2001.
<https://gdsc.community.dev/events/details/developer-student-clubs-sri-venkateshwara-college-of-engineering-bengaluru-presents-create-with-css/> (accessed Jan. 15, 2023).

[11] llanco, "Using MySQL and Mongodb together," *Stack Overflow*, May 20, 2012. <https://stackoverflow.com/questions/10676397/using-mysql-and-mongodb-together> (accessed Jan. 15, 2023).

[12] A. Zola, "What is a Bootstrap and how does it work?," *WhatIs.com*, Aug. 01, 2022. <https://www.techtarget.com/whatis/definition/bootstrap> (accessed Jan. 15, 2023).

[13] "The WebSocket API (WebSockets) - Web APIs | MDN," *The WebSocket API (WebSockets) - Web APIs | MDN*. https://developer.mozilla.org/en-US/docs/Web/API/WebSockets_API (accessed Jan. 15, 2023).

[14] "Apache | Definition & Facts," *Encyclopedia Britannica*, Jan. 10, 2023. <https://www.britannica.com/technology/Apache-Web-server> (accessed Jan. 15, 2023).

[15] "Introduction to TensorFlow | Machine Learning | Google Developers," *Google Developers*. <https://developers.google.com/machine-learning/crash-course/first-steps-with-tensorflow/toolkit> (accessed Jan. 15, 2023).

[16] T. McMullan, "Are the algorithms that power dating apps racially biased?," *WIRED UK*, Feb. 17, 2019. <https://www.wired.co.uk/article/racial-bias-dating-apps> (accessed Jan. 15, 2023).

[17] A. Hayes, "The Human Attention Span [INFOGRAPHIC] | Wyzowl," *Wyzowl*. <https://www.wyzowl.com/human-attention-span/> (accessed Jan. 15, 2023).

[18] J. A. Ribeiro Neto (Zezinho), "Tools for Data Analysis used in Data Science, ML and Big Data," *Medium*, Sep. 23, 2021. <https://medium.com/xnewdata/tools-for-data-analysis-used-in-data-science-ml-and-big-data-87e07e1ddb0> (accessed Jan. 15, 2023).

[19] A. Difranza, "What Does A Business Analyst Do?," *Northeastern University Graduate Programs*, Feb. 08, 2021. <https://www.northeastern.edu/graduate/blog/what-does-a-business-analyst-do/> (accessed Jan. 15, 2023).