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Llamalyze – AI quiz platform

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*GitHub Repository:* [*https://github.com/Inviticux/COMP3000*](https://github.com/Inviticux/COMP3000) *| Word Count: 9157*

*Abstract*

This document is all about Llamalyze, the AI assisted quiz platform. This is an agile project that aims to not only aid the creation of quizzes by reading lecturers slide material but also to aid the feedback that students receive. The idea for this project came along in a discussion with a lecturer in which we discussed how he used quizzes to gauge the engagement of his lecturers and wondered if there was a way to integrate artificial intelligence into the quiz process.

As mentioned, this an Agile project. Agile has been chosen due to the structured nature of the overall methodology. Agile also has a clear structure in the phases and sprints that can be used to organise the workflow. On top of choosing agile for the development methodology, other project management tools will be used to ensure that the project remains on track. if disruption were to arise, risk management will allow the project to pivot at key pressure points.

The project is fairly technical, being designed to be a web-based platform it makes use of the popular website development stack MERN. This stack makes use of a range of technologies, they are MongoDB, Express, React and Node.js; this will form the backbone of the project. Sufficient research will be undertaken as I knew very little about how to build a platform especially one as technical as this.

Artificial intelligence will be a key part of this project and eventually prove to be one of the projects largest development challenges. It will be developed with security in mind as most AI requires a proprietary API in order to integrate with a product. For this reason, we will attempt to host the AI on docker, using its containerization for our benefit; this will also extend to other key services.

As for the model used, we discussed the use of Meta’s AI solution “Llama” as it has the unique quality of being locally hosted. The abundance of models would also prove to be a challenge as selecting the right model could hinder the generated aspects of the project.

Overall, this document will provide an insight into all of the aspects of this project, including in depth discussions into the Legal Social Ethical and Professional concerns of this project. It will also discuss how problems in development were handled and which processes allowed this project to remain an overall success.

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*Main Body*

*0.1 Introduction*

In the main body of this report, we will cover the aspects of the project, such as the management policies used and the relevant design processes.

The first chapter will focus on introducing and discussing the background of the project, and how that helped to shape the deliverables and objectives that would be adhered to during the rest of the phases of the project.

The second chapter discusses the methodology of the project and how we can use the included processes to out benefit. These techniques will allow the project to have a clear and defined structure.

After that, there is the Legal, social, ethical, and professional section which will discuss the LSEP concerns in this project. Specifically, this will delve into the individual concerns that AI and quizzes provide.

Chapter 4 is the project management section. This section outlines the methods used and how they evolved throughout the project by giving a view into each process at the start of the project and again at the end.

Next is the design section where we will discuss the technologies used and the overall architectural designs of the project. This includes UML diagrams and UI/UX designs. A justification section will also be included to provide insight into the decision-making process.

Chapter 6 is the end project report where we will cover the projects major points during key phases. We will also discuss the potential future steps in the project and how it can be transitioned to a production build.

After that is the reflections section where I will reflect on the project personally and assess various aspects such as the use of the management tools and how it could improve my skillset in the future.

Finally, we have the conclusion where the project will be critiqued to understand how each aspect lead to where the project is. We will also discuss how it could have been improved and mitigated throughout.

*Chapter 1: Background, Objectives and Deliverables*

*1.1 Background*

To begin with, we must introduce the project and its background. In recent years, the use of AI in various projects has increased (Djupe, P., 2024). It has been used in a wide range of applications such as chatbots, image upscales and automated customer assistance systems.

However, the use of AI when it comes to education is lacking, generative AI is often used to “plagiarise” works, as students can generate large batches of text using sophisticated prompts. This usually yields results that can easily appear more sophisticated than the student's regular prompt. In (Lo, Hew and Jong, 2024) they discuss students use of generative AI and its impact on their development.

Additionally, across the country, most lecturers make use of quizzes to gauge student engagement in their lectures, this is often scrapped due to how much effort it takes to setup a quiz for each individual session; this could be due to schedules having multiple sessions a week which increases the density of quizzing.

This is where the Llamalyze comes in. By bridging the gap between the two ideas, LLM AI models and Quiz creation, we can streamline the process of generating and assigning quizzes to students. Additionally, Llamalyze allows students to take the quizzes, therefore allowing us to generate personalised feedback on each quiz based on their responses. This feedback loop is crucial to the project and is also repeated for the lecturer; it highlights the most missed sections and collates data into helpful analytics, which allows them to see what they could improve upon for their lectures.

The idea of Llamalyze came about in a discussion with a lecturer who wanted to gauge his engagement in his lectures, we both mutually agreed that using LLMs could prove useful with their ability to rapidly generate text based on context; this make LLMs uniquely adapted for this task allowing them to reason based on the context provided and provide meaningful insight and responses.

However, most LLMS are usually only accessible through APIS from the provider, which means that the traffic could be picked up and used elsewhere, making lecturers' content public. Due to this, it would be important to protect the lecturer's data through the use of a locally hosted model, which would make use of the program Ollama, which allows for containerisation, which would be helpful for development.

*1.2 Objectives*

Moving onto the objectives of this project, it is important to identify these as this will allow the project to remain on course throughout the roughly 6 months that it is due to elapse. Projects that fail to identify their initial objectives often fail, in (Hussain, Mkpojiogu and Kamal, 2016) they discuss how poor requirements analysis can cause a project to ultimately fail. The main aspects of this project are the creation of the quiz system and the integration of the LLM technology.

The begin with we must first think back to the problem that the software is looking to solve to find the high-level objectives of the project. This project aims to provide a solution to the tediousness of quiz creation and assigning by using artificial intelligence to streamline the process. We could, however, break down this initial problem into a few main areas to point our focus for the project.

The first of which is the creation of the platform itself. I believe this is the most integral part of the project, as without it, there would be no platform for the Models to exist on. Due to this, this must be the first objective, and due to its importance sufficient metrics must be used to measure if the objective has been met at the end of the project; this will be discussed in the table at the end of the objectives section. Often the lack of metrics leads to the lack of definition and therefore difficulty in considering the task as complete.

The next part to focus on would the artificial intelligence which is mostly a part of the project that integrates with the system. This will allow the lecturers to more effectively create and streamline their content on the site. The AI is also required for the automatic student and lecturer feedback from the quizzes, this could be another objective as this does not directly link with the quiz generation.

In terms of the metrics of the objectives these could be as simple as a checkbox, but the project would benefit greatly from some more sophisticated management. A potential metric that has been used before is the process of reviews such as customer reviews and tests, these ensure by objectives have truly been completed by getting the opinion of other, sometimes an informed opinion is helpful for this.

Overall, the objectives of the project are rather easy to decipher, one of them is the creation of the system the others are related to the AI systems, the table of the objectives and their criteria is below.

|  |  |  |
| --- | --- | --- |
| *Objective* | *Description* | *Criteria* |
| Software Complete | The construction of a cohesive and well-suited software for the platform | * The software is built to the design * Sufficient Customer testing has been performed |
| AI – Generation | The AI can generate the quizzes for the students to take | * AI accuracy testing has been performed * User testing has been performed to ensure that the quizzes can be taken |
| AI – Feedback | The AI can generate the feedback once the quizzes have been completed | * AI accuracy testing has been completed * User testing to ensure feedback coherency |

*1.3 Deliverables*

When thinking about the deliverables of any project we must first look back to the objectives and figure out what must be done for each of the objectives to be fulfilled. After this we must look at the key dates in the projects lifespan, this allows us to get a bigger picture of the timescales between the key deliverables and might provide simple deliverable dates such as the project and report at the due date.

To begin with we can look at the dates for the project, these are below and show dates such as the due date the mid project review and key supervisory dates.

|  |  |
| --- | --- |
| *Date Title* | *Date* |
| Project deadline | 28/04/25 |
| Mid project review | 10/02/25 |
| Project showcase | 01/05/25 |
| Sprints | Every 2-3 Weeks |

This outlines two key dates that are important to the deliverables, the project deadline and the mid project review, these are dates where aspects of the project need to be showcased to others or handed over. Therefore, we must plan our deliverables around these dates, this will be explored more in the project management section of the report; specifically, how the project has been split up into sections of development.

The project can also be split into deliverables such as key development milestones these include but are not limited to backend endpoint creation, frontend page completion, LLM setup, Development environment setup and more. These can be added to the deliverables table as internal milestones/deliverables; they will not be formally handed over, but they mark key development points that can be marked.

Below is the main table of deliverables, the contents of the deliverable and the date in which it will be delivered.

|  |  |  |
| --- | --- | --- |
| *Deliverable* | *Contents* | *Date* |
| Final Project Handin | * Software in the form of GitHub repository * Final Report (This document) * Design Documentation located in the GitHub repository | 28.04.25 |
| Mid project review | * Design documentation * Proposed development schedule | 10.02.25 |
| Sprint Reviews | * Progress Reports * Software | Every 2-3 Weeks |

*Chapter 2: Method of approach*

*2.1 Methodology*

Methodology is one of the most important factors in a project and it relates directly to the success a project can find. Often mismanagement especially in relation to methodology can be the point of failure in a project, this is discussed in (Cerpa and Verner, 2009). This is why it is important to identify early on the methodology which the project will follow and the key points that will remain during the whole project.

For this project we will be following an Agile approach, this methodology is widely used in the computing industry and proves to be a massive success. Some projects discussed in (Serrador and Pinto, 2015) have used it to their benefit. The main reason for the methodology choice is that it is a standard when it comes to developing applications due to the ability to manage many sections. This is done using “sprints” which are often capped off with progress meetings.

A diagram of a scrum process

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These sprints will form much of the lifecycle of the project and allow key stakeholders to have a glimpse into the progress being made week by week using sprint review meetings (Alsulaimi and Abdullah, 2020); we will cover more of the sprints in the lifecycle section of this chapter.

The project will be undertaken by one member, myself and therefore will not be a fully comprehensive look into an agile project. Whilst the project can and will be using agile, agile is usually used as part of a large-scale project one with multiple teams working on different aspects of the project at the same time.

This is important to mention due to another crucial aspect for an agile project being that of the roles in a team. In agile there are a few vital roles that are played throughout the lifespan, these are but not limited to product owner, project manager, scrum master and other roles. As this is a solo project most if not all of the roles will fall under my domain; this will be furthered in the roles section of this chapter.

*2.2 Lifecycle*

Overall, the lifecycle of an Agile project revolves around sprints which form a baseline for the development of the project. Sprints can range in time anywhere from 1 week to 3 weeks per sprint and each sprint usually contains some form of progress meeting, sometimes referred to as the Sprint retrospective (Korimbocus, Towokul and Nagowah, 2019). This meeting either happens at the start of the sprint midway or at the end and sometimes there is more than one progress meeting.

Progress meetings serve as a way for the project manager to gain insight into how the project is doing and refer that information to the key stakeholders. Stakeholders often want to know how the project is progressing and if it is being managed appropriately. Often key stakeholders also include groups such as the users, as they have a vested interest in the project and its success, it can at times be more challenging to show progress to users as they are not directly involved with the project. Often social media is used to provide users with insight into a project.

The sprints will also encompass phases such as the design process and other key processes/phases. The activities of each sprint will be ruled by the product backlog which is a list of the requirements in their dumbed down state, they are usually in one of four categories, Epics which are the big features or goals of the project, User stories which are the smaller features of the project from the users point of view, subtask which are the steps to complete a user story and spikes which are research tasks which focus on researching a key technology. Product backlogs are useful for keeping the project on track and have been used in many public project such as (Sedano, Ralph and Péraire, 2019).

*2.3 Roles*

As far as the roles are concerned, this project is going to be taken on by one individual meaning that all the relevant internal roles will rest on a single individual. This does not mean that the roles are irrelevant for this project, as there are external roles such as project stakeholders and users which are just as vital as the internal roles.

In an agile project there are a few key and universal roles, these being stakeholders scrum master, product owner, development team (Hoda, Noble and Marshall, 2012). Other roles are often related to the development and contain roles such as UI/UX developer, QI tester and others; these are often team specific and have little requirements.

The first major role to discuss is the product owner, they oversee the product backlog, this means that any tasks and features that are required are organised by the PO. This has a direct impact on the developers as they arrange the order of the work and what features are the most important first.

The next most important role is the scrum master, they oversee organising each sprint and the scrum team themselves. They also oversee the daily standup and the review meetings and are important in the informing chain of developers to stakeholders.

Speaking of the stakeholders they are the next key group in our roles, they are key when it comes to requirements gathering and feedback on prereleases. They represent the interests of customers user or the business and help shape the product by expressing what’s needed and what sections are not working as expected.

A group of people with text

AI-generated content may be incorrect.

*Chapter 3: Legal, Social, Ethical and Professional Issues*

*3.1 Legal*

A close-up of a chart

AI-generated content may be incorrect.The legal side of a computing project often refers to the laws in which the product will have to abide by, the most common of which is the General Data protection Regulation (2018) (gdpr-info.eu, 2018). This regulation relates to the storage, transmission and usage of personal data in relation to computer software. Companies often must employ compliance officers for legal issues due to their complexity.

GDPR mainly discusses topics such as data security and how long companies will have to store data for, this is important for auditing in the event of problems such as lawsuits and breaches (Alhazmi and Arachchilage, 2021). For this project we will need to keep a keen eye on the security of the project and ensure that customer data is being handled correctly. Currently the project has no plans to be deployed or released so security is a factor for transitioning the main build to a production build after the initial handover.

*3.2 Social*

Socially a computing project must ensure that it is usable and caters to its wide range of users. Traditionally most applications in education have accessibility setting that would allow the product to have compatibility with screen readers and other existing compatibility features. Additionally, a colourblind mode could be added to the application with minimal development time, simply adjusting a few colours options

After this another social concern would be the generation of questions, ensuring that insensitive or biased questions are not generated via the AI, this could potentially show Llamalyze in a negative light and frame the application as ignorant culturally. This could be circumvented by adding some checks to the generation code to doctor the AI to not allow certain topics to be discussed. This is already being practised by OpenAI, the creator of ChatGPT, they ban certain topics from being discussed with their AI.

*3.3 Ethical*

In computing ethics often one of the biggest failing points is the transparency of a project, especially when Artificial intelligence is concerned, users will often ask about the extent to which AI has been used and how much the AI is being relied upon. This has been a major evolving story online and (Liehner et al., 2023) discusses how users feel about AI. To combat this, we could issue statements or sample prompts that the AI engine is using to show users our processes and align with them ethically.

On top of this cheating would be another major ethical concern especially given the nature of the app. Combatting this could prove to be challenging, and we could research how other quizzing software such as Hegarty maths and Kahoot avoid users cheating and implement a similar approach. One alteration that could be made would be encrypting the answers or having the software confirm that answer with the server once the attempt has been submitted.

*3.4 Professional*

How we conduct ourselves professionally is a huge part of day-to-day life and it is equally important to this project. To remain professional in this project as it is a platform it is crucial to create a terms and conditions for the platform. This terms and conditions will lay out to users how we expect them to use our site and how we will update and preserve the site on our end.

Another aspect that we can improve to maintain a professional image would be to ensure that the code that is written is to a good standard and is well maintainable, to do this we must ensure that code is sufficiently laid out and commented to allow for further development. Additionally, we should make documentation to ensure that each section of the project is well documented.

Finally, for the production build we can ensure that security updates are pushed on time as to ensure the security of our product. The security of an application is often the most important part of the process and especially so in the case of Llamalyze. If proper security is not added for a production build users would be able to bypass the authorisation methods and even edit answers.

*Chapter 4: Project Management*

*4.1 Methods*

How we manage a project is directly related to the success a project can find. Strong management is the key to ensuring that serious problems can be avoided or dealt with; accordingly, this can also ensure that the project follows a clearly constructed structure which can guarantee the developers in what they must do.

For this project a wide range of management tools and policies have been used both ensuring that we stay on track and the quality of the project is satisfactory at its conclusion. The first management tool we will be making use of is a Gantt chart, this time management tool allows us to track the time spent on each stage of the project; this means that phases, sprints and key dates are all logged in the Gantt chart allowing for any member of the project either myself or my supervisor to see which stage of the project we are on. This tool will also be updated to display changes in the lifecycle due to issues.

The next tool that will be used is the product backlog, this was discussed previously in the methodology section; like discussed it forms the backbone of the project ensuring that each task is organized and stays up to date. The backlog also serves as a point of reference for milestones, allowing us to assign task to a specific milestone.

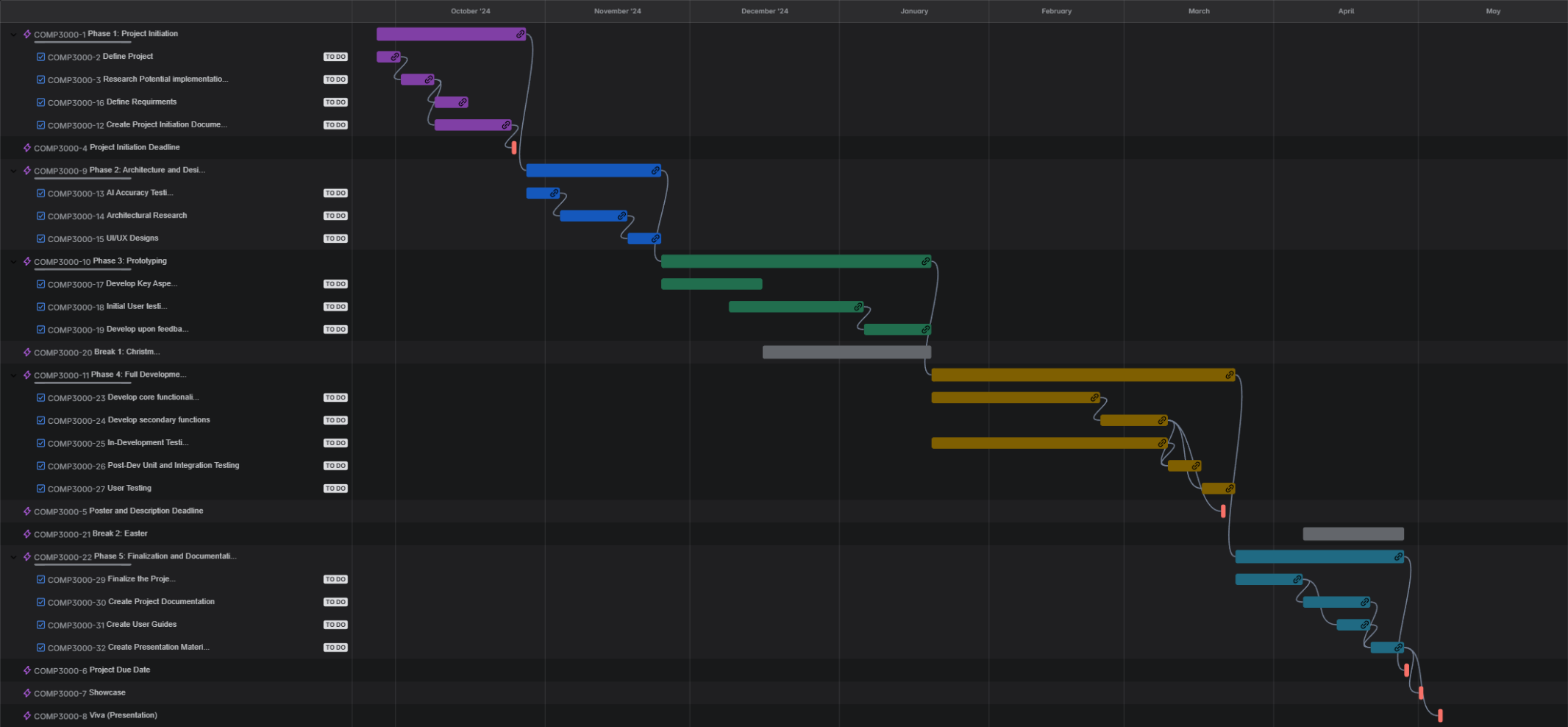
The final tool that is used is the Risk management plan, risk is often one of the main considerations in a project and often allows us to lower the chances of failure by putting mitigations in place (McManus, 2012).

*4.2 Processes & Procedures*

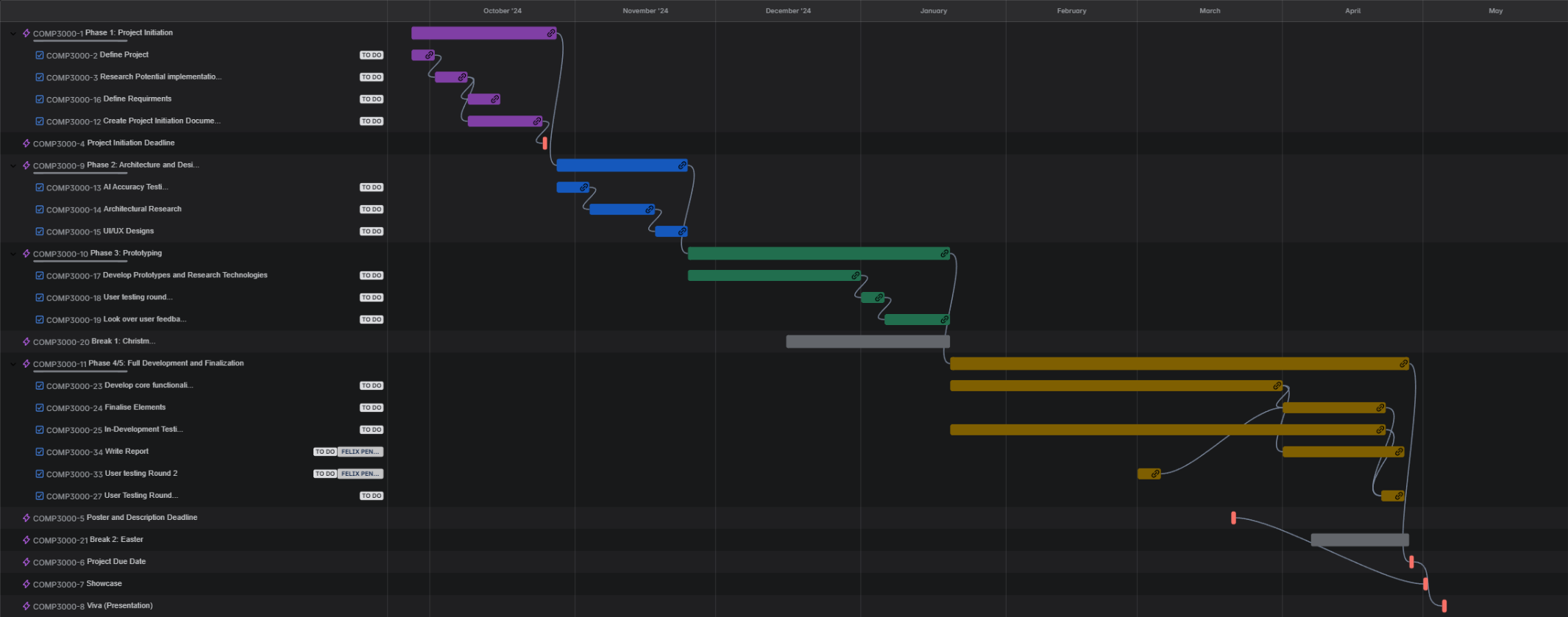
As previously mentioned, there are three main tools used to ensure this project stays on track. The first of which we discussed was the Gantt chart, this was used throughout the projects lifespan and was updated according to the challenges we faced throughout. The above chart is the estimated timeline of the project, each of the colours represents a phase.

There were 5 main phases, Project initiation which encompassed initial research into the idea and defining the requirements of the project. Architecture and design, which focussed on defining how the project would be created and the technologies that will be

used. After that we had prototyping which encompassed creating mock-ups and testing if certain implementation would be possible. Next was the full development section where the majority of the app was created. Finally, we had the finalization and documentation section which focused on creating documentation and finishing off the development. The primary Gantt chart is below



Throughout the project this undertook major changes. The development phase and the finalisation phase merged, with the tasks of each coinciding with each other. This was primarily due to problems faced with integrating the Artificial intelligence into the app, this is discussed further in the end-project report and reflections section. The updated Gantt chart is below



A screenshot of a computer

AI-generated content may be incorrect.The next management tool was the product backlog, this was done on Trello using a kanban board with it being updated as phases progressed, this remained the same throughout the project with only a single major change and a few minor changes being made such as the addition of missed features like the core profile options. The major change was the pivot on some of the AI features due to the complexity of the implementation and drawback with the model used. The board has been arranged to show epic use stories subtasks and spikes. Each item is in its respective section either to-do doing done or will do. This is below

The final tool was the risk management plan, this came in incredibly useful during the issues with the AI as it minimised the damage caused by the disruption; the risk plan allowed us to merge two of the phases and extend the development of the project without compromising the integrity of the written side of the project. A link to the risk plan is in the Appendix at the bottom of the document past the references.

*4.3 Handover*

Getting the handover correct is vital to a projects lasting success, for this reason its important to decide how and when the handover will be executed (Stettina and Kroon, 2013). In this section we will discuss how this project will be transitioned into its closure for the hand-in date mentioned in the deliverables section. Additionally, we will talk about how the project can be transitioned into a production build after the marking of this module.

To begin with it is important to define what will be handed over and in what state. This was talked about in the deliverables section and will be expanded to include the delivery method here. The table below shows this.

|  |  |  |
| --- | --- | --- |
| Handover Item | Data Included | Handover Method |
| Software | * Database * Server * Frontend * Ollama Instance * Docker-compose | Handed over using a GitHub repository, link is located above the abstract in this document. |
| Demo Video | * Shows working software * Shows some of the development environment | Handed over through this YouTube link:  <https://youtu.be/oA2s2bW62YI> |
| This Report | * In depth discussions on multiple aspects of the project * GitHub Repo Link * Video Link | Handed over through the DLE via Turn-it-in |

Additionally, the handover also includes a demonstration of the product working this will be in the form of an unlisted YouTube video which is accessible at the link in the table. This video will show some of the application flows in a 5-minute period. It will attempt to also show the Ollama local instance and MongoDB through Atlas which is a program from MongoDB to connect to DB instances. Both the Ollama and Mongo will be on the docker which shows the development environment used.

*Chapter 5: Application Design*

*5.1 System Architecture*

Design is often one of the largest sections of a project, it is crucial to ensure that the products design not only works logically but also is suitably laid out for users.

The first piece of design work for this project is the logical diagrams, these have been created using UML (Unified Modelling Language) there are a number of diagrams that have been made to describe how the application will function (Rumpe, 2016). The diagrams that have been made are Component diagram, Deployment Diagram, Activity Diagram and a Package diagram. These diagrams will help to provide information about how the program will run.

The first diagram is the Component diagram, this shows each individual part of the project. In the case of this project, it will show the individual files on the system and how they will connect to one another, this is especially important between the frontend and backend high level components. This is below

A diagram of a computer server

AI-generated content may be incorrect.

The second diagram is the deployment diagram. In our case this will be used to show how the project was deployed in a development environment; this will allow possible development to continue and use a similar approach. This will also outline a possible solution for the production environment. This is below.

A diagram of a computer

AI-generated content may be incorrect.

The third diagram is an activity diagram, this will show the flow of the application from a student point of view. It will show the individual flows and how the flows interact to form a part of the application, this has excluded the quiz creation as this would make for a very large diagram and therefore rather unhelpful.

A diagram of a company

AI-generated content may be incorrect.

The final diagram is the package diagram, this shows the dependencies of the project and what resources each aspect of the project would need. For instance, the login page will need to make use of the userroutes on the server side and therefore make use of the profile mongo model.

A diagram of a diagram

AI-generated content may be incorrect.

After this the next most important aspect to discuss would be the technologies used in the project. There are many types of technologies used in this project from version control to frameworks all of which we will discuss here; additionally, there will be justification for each of the choices in 5.3 of this document.

For the frontend I have made use of the framework react as it is a widely used and supported framework with a suite of features that will ease certain parts of the project. It allows for the frontend to have a pre-production test environment. Additionally, it allows developers to make use of either JavaScript or typescript, this has aided my development due to having all elements be contained in a single page.

As for the backend this is making use of node.js which is a popular and widely used backend runtime environment. It allows JavaScript use on the backend side which unifies the language of my product. It also is useful when paired with express which is another used framework on the backend. The two together have allowed the backend to be simple despite the overall complexity of the project.

The current database is made using MongoDB. This is a document-based database software that allows for particularly unstructured data and is incredibly forgiving when developing application. Due to its forgiving nature, it has allowed me to not spend as much time developing a solid database, which could prove a hinderance but only for a production environment which this project is not.

This document has also been talking in great detail about the project being containerised, this is possible through the use of docker. Docker is a container platform that allows for running services like servers, databases and apps in isolated environments (Miell and Sayers, 2019). These environments can also be used to aid development by removing the need for deploying these services in the development phase.

Docker itself has its own configurations; these are called images, and each container can be made using an image. The product makes use of a docker-compose file to define the services and images used, the compose file contains four main services, the frontend which runs on a Nginx image, the backend which runs on a node image, the database which runs on a MongoDB image and the local AI container which runs on an Ollama image.

Ollama is used to host the local AI instance, this software allows users to select models and install them locally allowing them to “talk to” the LLM through a command line interface. I found this software in the research phase and have been using it not only for the project but in additional testing alongside my project. The model that this project makes use of if Llama from meta, specifically the 3.2:1b instance.

*5.2 UI/UX Design*

UI and UX otherwise referred to by user interface and user experience, it is one of the most important aspects of design as if a product is not user-friendly users will simply opt for another option (Hamidli, 2023). Interfaces are made when the initial design of the product is done as you will need to know where certain aspects will go on each page. UI/UX design is often targeted to the frontend of an application, this is where most if not all of the users will interact with you application.

The design process was carried out on Figma, an application design software. Figma itself is very similar to image editors such as photoshop but has the unique ability to mock up interactions with your product. This is especially useful for conducting user testing during this phase as getting input from the user early enough can help to prevent design issues later on.

Overall, there were designs for all of the major pages on the platform this includes the Login page, dashboard, module page, quiz taking page and the profile page. These designs did not include the Editor or the review pages as the review page was a slight change on the quiz taking page, as for the editor, the functionality was not only not designed yet but as this page would be for administrative purposes it was deemed less important than the others. Below are some of the designs

A screenshot of a login screen

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

Screens screenshot of a computer

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

Moving on to the user experience of the app, it is designed to feel incredibly similar to that of many universities digital learning environments. This is to aid the educational feel of the app whilst also maintaining its own appearance. Additionally, a lot of focus was put onto the ease of use of the app, so therefore most pages are less than 3 clicks away from each other, most of the pages can be accessed through the dashboard or through the top navigation bar.

Colours have also been used a lot in this project, they outline to users negatives and positives especially when it comes to quizzes and questions. The colours of the modules are also randomised with most of them being pastel colours meaning that the app doesn’t feel too corporate and inviting enough for users to want to use the app.

*5.3 Design Justification*

A lot of the project has been made using popular web development technologies, the main of which is the MERN stack. This has been chosen for two reasons, the wide support for the Stack and ability to get help online, and that I have some prior experience with it. The wide compatibility also enables the project to include other dependencies, and features.

The next consideration is the Local AI model. The model chosen as discussed was Llama3.2:1b running locally on a dockerised Ollama instance. This has been chosen due to a number of reasons the first of which is the wide compatibility that Ollama offers; on their website they have a section with all of the models that work with it. This would allow us to pivot on the model if problems were to arise, the only downside to this is the large hardware requirements of some of the models with some need upwards of 16GB of ram. Additionally, it has been chosen due to security, as this will be handling lecturers handcrafted content, we will need to be extra careful as to not “leak” the information. This would have been a major concern if an API approach was taken.

*Chapter 6: End-Project Report*

*6.1 Summary of Achievements*

After wrapping up development we must look back to the objectives that were defined in the beginning of the project, in the case of this document in section 1.2. Overall, 66% or 2/3 of the objectives have been completed, with the other objective running into issues during development. As for the product it remains mostly complete with only one aspect of the project being missed. From the objectives we have completed objective 1 and 3. This is a considerable proportion of the project and allows the project to perform its primary function which is to act as a quiz platform for students and lecturers.

Aside from the objectives this project also managed to cover a lot of technologies and their use. Firstly, the whole application was built using a modern full stack development stack, MERN (MongoDB, Express, React, Node.js) is one of the main stacks used worldwide for development of modern websites.

Additionally, the app made use of docker compose to effectively manage the services, this allowed for a consistent development environment across multiple devices. This also allow for easier testing as when performing user testing, I could not be on a stationary device rather a laptop.

The app also managed to make use of AI, despite the fact that only 50% of the AI features were implemented. The feedback system works and provides users with customised feedback based on the questions that they got wrong.

*6.2 System Evaluation*

Overall, as discussed, the platform managed to achieve 2 out of the 3 objectives outlined at the start of the project. The two objectives achieved were some of the larger parts of the system which currently performs well and has had extensive user testing.

The backend logic and API structure was robust and endured strenuous tests to ensure that it could keep up with a fair amount of volume, however the scalability remains uncertain as it was only tested with a small user set; a larger user base could cripple the system so would probably be best to implement a load balancing solution for a production build.

The UI/UX was mostly positive in the user testing with only a few issues, the most prominent of which was issues with colour and knowing if buttons were pressed/could be pressed. On the final round of user testing some users noted that they were finding it hard to review their quiz as the side buttons which show the questions, and their numbers were not coloured; this made it difficult to identify where problems were with their attempt.

One of the major issues that occurred was problems understanding and managing the data for the project, with the volume of data that needed to be handled with the project and by making use of MongoDB the data quickly became difficult to manage. For a future build it would be wise to select a data storage solution that was more suited for vast stores of data, especially in different types; an example of this would be a MySQL server which would allow a relational database. This would allow questions to have the correct relation to their parent quiz.

*6.3 Testing Summary*

Testing is an important part of any software development process, in total there were 3 rounds of user testing, 2 of dedicated testing and one in dev testing which encompassed the whole development process.

To begin with the in-development testing was the main testing method, it focused on ensuring that specific pieces of software were fully functional before moving on to another part of the system. This worked well for sections such as the frontend but less so for others such as the backend which was tested with postman whilst it was being created. Additionally, there was no testing for the database which only had the backend tests to back it up, this would need to be improved for a further build.

Next is the dedicated testing which focussed on a specific flow in the application such as creating a quiz or finding a piece of past feedback. The dedicated testing went well, and each flow worked to a satisfactory level, all apart from the creation flow which suffered as a result of the difficult AI development.

The final set of testing was 3 rounds of user testing, one in the design phase to ensure that the design suited the project; this was the smallest round of the three. The next in the middle of development after most of the UI elements had been implemented and the final was at the end of development to see what had been missed and allow for some critical feedback on what could be improved for a future development. A few examples from the rounds are below

A screenshot of a survey

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

A screenshot of a test

AI-generated content may be incorrect.

A screen shot of a computer

AI-generated content may be incorrect.

*6.4 Future Development*

For the future of this project there are some key aspects that will need to either be fully developed or worked upon. The main thing to improve the experience of the product is a substantial change in the data storage. As previously mentioned, the MongoDB storage is not suitable for the vast amount of data that will be handled by the system, for this a much more sophisticated solution would need to be in place such as MySQL or another form of relational database.

Another aspect to improve would be to fully develop the Artificial intelligence in the product. This was halted in the current version due to limitations with both the model used and the method in which it was added to the project. The AI was chosen due to the increased security of a local model; however, it could prove useful to pivot using an API such as the one from OpenAI.

*Chapter 7: Project Reflections*

*7.1 Technical Challenges*

Overall, the project faced a few challenges over the few months it ran for. Most of the issues were related to the development of the product, in which technical aspects were not behaving or had not been correctly researched. Due to this the development phase ran over by a number of weeks causing it to join with the finalization phase. This did not harm the finalization phase but could have been avoided with proper research.

One of the biggest technical hurdles I encountered was the implementation of Artificial Intelligence. This was one of the most challenging aspects of the project, due to the choice of model and method. The model was not sophisticated enough to generate a sufficient prompt often opting to put a random amount of filler text at the start and end of a prompt which degraded the overall experience with the AI in this project.

A further point to discuss with the AI was how costly the models were computationally. The largest Llama model, which would have proved incredibly useful for this project as it can produce much more sophisticated generated text, has a RAM requirement of 16GB. This is far larger than any of the devices that I was developing on. It would have been beneficial to move development to a provided lab that could handle the demand, however this would sacrifice the ability to run the program on my laptop; this would prove difficult for both Viva and Showcase.

A recurring issue during development was the poor choice in data storage. MongoDB was initially selected due to is prominence in the web development stack MERN. However, this proved to be a mistake as the unstructured and unrelated nature of MongoDB made the data hard to manage as each document in the database was not related to the other. This was particularly challenging with the Quizzes and Questions as these are parent and child relationships and in MongoDB this is not particularly possible. We managed to implement array storage in the Mongo to have quizzes contain the IDs for their questions however this was not ideal and proved difficult and costly computationally to implement.

*7.2 Personal Reflections*

Looking back on the project personally, my time management was a little lacklustre at times as I had to prioritise other modules which really lowered the amount of effort I was putting into the current sprint. In turn this harmed the development phase causing it to take longer than expected, however the quality of the overall projects core features did not suffer as a result of this. In future I hope to be able to not only devote my entire working time to the project but also ensure that I correctly prioritize tasks as this will allow me to identify which tasks will require the most effort and put them higher up on the list.

Additionally, undertaking an agile project as a solo developer degraded the experience of Agile. Agile primarily is for larger development teams, teams that have multiple levels of management and responsibility. Last year I undertook a project with 3 other member in an agile style, even with the additional member the agile experience was far more structured than it was in this project. As a solo developer, I could not only chose what I needed by there was no need for communication channels between each of the team members as I was all of them; the only channels needed were to my supervisor.

One of the most valuable lessons I took away from this project was the importance of research in a project and how making a wrong technological selection could massively hinder the development of an application. In this instance it was the data storage type, this meant that figuring out how each piece of data would be stored took longer than anticipated and ended up being a real challenge to work with.

*7.3 Future Improvements*

All of this means that for the future ensuring that I do proper research into my technologies will be my focus either moving forward with this project or when starting a new one. Most of the issues faced in this project can be put down to poor research in the initial phases of the project. This could have been due to focus on other modules however that should have been accommodated for in my time management.

Speaking of management, this is also an area that could see a lot of improvement as this has been one of the first projects that I have undertaken as a single developer. As a solo developer I have had to think about each individual aspect of the project, this meant that I had to spread my focus very thin across the whole project. It would be beneficial to undertake projects of this scale with other members of a team, allowing for agile to properly work with its roles.

Speaking on the scale of this project, I believe that I aimed too high. Creating a whole platform from scratch by myself was most likely the first failing of this project as I greatly overestimated my own skills. In future, this could be improved by either understanding more about different technologies or by correctly assessing the effort levels required; this could be done through the use of story points to correctly estimate the required effort for certain tasks (Mallidi and Sharma, 2021).

*Chapter 8: Conclusions*

*8.1 Project Conclusion*

Llamalyze intended to aid lecturers when creating quizzes to gauge student engagement, it attempted to make use of AI to smooth the process of both creating quizzes and gaining formative feedback for both students and lecturers. Overall, the project fell short in many aspects, the main of which was the generation of content through the Artificial Intelligence. However, it was able to build a solid platform and allow students to take advantage of the feedback from individual quizzes.

It is important to discuss the achievements of the project as it was a large-scale project, partially why it in the end fell short. However, the project did complete 2 of the three objectives that it set out to achieve. It also managed to achieve other smaller objectives such as containerising the application; this includes the local AI and other related services. This also includes scripts that allow the containers to easily install the required technologies and build the services from scratch, all it takes to run the application is one command.

Most of the application was correctly implemented as per the design specifications, this allows for the failed aspects of the project to serve as a stable base to develop upon for a production build. The application managed to have a suitable login and signup page, a working dashboard, module and quiz taking page; it also allowed user to gain formative feedback and review their past attempts.

The project also faced it fair share of challenges some even causing major disruption to the timeline. These disruptions caused the established phases for the project to a merge in 2 phases. Due to proper mitigation of this the project did not suffer catastrophically but it did cause the product to have less features than intended.

The change in phases was cause by issues with the AI elements of the project and poor selection of approach during the researching/design sections. The AI tended to add additional information into the output of the prompt, this causes the project to have issues with formatting feedback and creating quizzes.

Another partial failing of the project was the selection of the data storage method. The project opted for MongoDB but subsequently this caused issues due to the unstructured nature of document-oriented databases. There was discussion about changing to a relation database in a production environment, making use of MySQL.

Personally, this project has allowed me to develop a wide range of skills due to the various issues faced. The main of which related to the management of the project specifically the design section. This was shorter than it needed to be and therefore cause the application to suffer development problems. In future I will ensure that effort calculations, and other management tools are used to correctly assess the impact of shorter cycles.

The project has also furthered my understanding of web development, specifically the use of different technologies to the usual MERN stack. They will prove useful in the future as I have a wide range of skills now ranging from backend development to AI development; AI will be particularly useful going forward due to it prominence in the modern technology landscape.

As mentioned in the future development section, many aspects can be improved for a future version the first of which being a pivot in the AI approach. Shifting from a local AI to an API approach could prove to be easier however this comes with inherent content security concerns. Lecturer content could easily be stolen though a man in the middle attack.

Another improvement that could be made would be a change in the database. MongoDB is not meant to store large amounts of relational data and therefore It would be wise to pivot to something like MySQL or a cloud hosted solution like Microsoft Azure.

To conclude, Llamalyze managed to achieve a large number of its initial goals but fell short in others due to issues encountered during development and research. Despite these issues, the project managed to successfully deliver a stable and usable platform that allows students and lecturers to create, take, and review quizzes effectively. While there is room for significant technical improvements, the foundation created by this project provides a strong starting point for future developments.

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*Appendix*

Risk assessment OneDrive Link - [COMP3000-RISKASSESS.docx](https://liveplymouthac-my.sharepoint.com/:w:/g/personal/felix_pendered_students_plymouth_ac_uk/EXQoVcwKMUdFuI5jcSdRjF4BSI_w4q7hNRrUMdNsM23HDg?e=7PCFcs)