Ollscoil
Teicneolaíochta
an Atlantaigh

Atlantic
Technological
University

B.Sc. (Hons) in Software Development
Applied Project & Minor Dissertation

Project Proposal

Each student must complete the following form and submit it to their supervisor for consideration. Once your supervisor has signed-off on the proposal, you must submit the document for consideration using Moodle.

1. **Student Name:**

   Fionn McGoldrick

2. **Supervisor Name:**

   Douglas Mota Dias

3. **Project Name:**

   AI-Powered Programming Practice Tool (ByteLearn)

4. **Project Context**

   Describe the context of the problem domain here. Explain what you are proposing to do and your rationale for doing it. Explain why the problem domain is of interest.

   The project focuses on improving how people learn programming by creating a web-based platform inspired by Duolingo's engaging and fast-paced learning style. It aims to make programming education more accessible, personalised, and rewarding through short, targeted challenges powered by AI. As users select a programming language and topic, the system will generate interactive exercises that adapt to their level and provide immediate feedback.

   A key motivation behind the project is the increasing difficulty learners face in maintaining focus for long periods. With attention spans continuing to shorten, especially in digital environments, traditional tutorials and lectures are often ineffective. While platforms such as LeetCode excel at advanced problem-solving, they can be intimidating or inaccessible to beginners. Few platforms effectively combine theoretical understanding with practical, hands-on exercises in a structured and motivating format.

   To address this, the project integrates adaptive AI-generated challenges with a gamified learning approach designed to strengthen both theoretical and practical skills. Additionally, an optional sandbox environment (tested separately through tools such as StackBlitz and CodeSandbox.io) may be incorporated to allow learners to experiment with live coding examples directly within the platform, depending on available development time and feasibility.

   This problem domain interests me because I've seen these challenges affect my peers and have experienced many of them myself. As someone passionate about both programming and education, I'm particularly interested in how technology can make complex concepts more digestible and engaging. I've always been drawn to the intersection of learning and interactivity, finding ways to turn abstract theory into something hands-on and motivating. Through this project, I want to explore how AI can adapt to each learner's progress, providing personalized feedback that keeps users challenged but not overwhelmed. Ultimately, I hope to design a platform that not only teaches programming more effectively but also helps learners build confidence and curiosity as they improve.

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5. Project Objectives

Write out the key objectives of the project as bullet points. Each objective should be clear, realisable and measurable / testable, i.e. the success of your project is determined by the degree to which these are realised.

- Develop a fully functional web-based learning platform with user authentication, profiles, and progress tracking (videogame inspired 'level up' system).
- Implement AI-powered challenge generation via API calls to models like *Claude*, *ChatGPT*, and *Gemini*, enabling users to choose a language, optionally set a topic, and receive personalized exercises with automatic grading and secure code evaluation.
- Design and build a gamified progression system, including XP, levels and rewards to increase engagement and motivation.
- Ensure the platform provides accessible and beginner-friendly learning experiences, bridging the gap between introductory resources and advanced platforms like LeetCode.
- Evaluate the platforms effectiveness through user testing and feedback, focusing on usability, engagement and learning outcomes.
- Develop and integrate a custom AI classifier model to categorise quiz questions into difficulties.
- Optionally, a live coding sandbox feature may be integrated to enable in-browser practical exercises. This would involve using AI models to generate code and test cases, executed through a sandbox API such as StackBlitz or CodeSandbox.io. The inclusion of this feature will depend on project progress and feasibility assessments to ensure scope remains manageable.

6. Technologies & System Architecture

Explain the technologies you are going to use and why you selected them. These include the programming languages, operating systems, presentation and storage technologies and any cloud / 3rd party libraries / services that you intend to use.

- **Frontend**: *React* will be used with *Vite* and *TypeScript* to build a dynamic, component-based interface. *Vite* provides a fast development environment and optimized build process, while *React's* virtual DOM ensures efficient updates and smooth integration with backend APIs. The presentation layer will combine *React* components with *TypeScript*, *HTML*, *CSS*, and minimal *JavaScript* to deliver a responsive, browser-based interface.
- **Backend:** *Python* with *FastAPI* will be used to handle server-side logic, authentication, and API endpoints. Its asynchronous capabilities, automatic documentation, and modern design make it a fast and efficient choice for backend development. *Python* remains a key focus for this project, as I aim to strengthen my skills in both the language and its ecosystem while gaining experience with *FastAPI* for the first time.
- **Database**: *PostgreSQL* will serve as the main database for its reliability, security, and strong support for relational data. It will be managed through *TablePlus* to simplify development and visualization.
- **Deployment:** *Docker* will be used to containerize the backend, frontend, and database, ensuring consistent environments for both development and user testing. If the project progresses as planned, I aim to deploy the application to the cloud, such as *AWS*, for further feedback and live use.
- **Custom Classification Model**: *Python* with *PyTorch*, *scikit-learn*, *pandas*, and *NumPy* to build and train a classification model on a *CSV* dataset. Exporting to *ONNX* and embedding in backend. I want to gain hands-on experience with machine learning by developing a model and embedding it into the application's functionality.
- **Operating Systems**: With *Docker* containerization, the platform can be deployed on effectively any operating system. In terms of future deployment, the application could be hosted on *AWS* by deploying the *Docker* containers to a cloud service, allowing for scalable and reliable hosting.

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7. Schedule of Work

Using a Gantt chart or tabular format, outline your schedule of work for all the key project activities, deliverables and dates.

Gantt Chart — Project Timeline

Task List	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
Project Definition & Goal Setting	Sep – Oct											
Research & Requirements Gathering	Sep – Oct											
System & Architecture Planning		Oct – Nov										
Frontend Development (React)			Nov – Jan									
Backend Development (Django)			Nov – Feb									
Database Setup (PostgreSQL)				Dec – Jan								
AI Model Development & Embedding					Jan – Mar							
Integration (Frontend + Backend + Model)						Feb – Mar						
Dockerization & DevOps Setup							Mar					
Testing & Quality Assurance			Nov – Apr									
Project Documentation & Disseration					Jan – Apr							
Final Presentation & Submission								Apr				

Fionn McGoldrick

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