Initial Plan

Automatic Code Analysis for real time feedback to support Student Development

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Credits: 40

Project Description

It has been long understood that feedback is important for student development, and it enhances the learning experience (Poulos and Mahony, 2008). Previous studies have evaluated the feedback process in a general manner. As far as I am aware, no studies have investigated specific feedback techniques for computer science students.
In this project I will investigate whether Automatic Code Analysis can be used to support student development by giving real time feedback on their programming. I will further develop a proof-of-concept program I have previously created for the university into a limited application to be used for experimentation.

Consider, for example, a Computer Science Student attempting their programming coursework assignment. They make a mistake, using a 'while' loop when a 'for' loop is more suitable. Under the current system the student receives feedback weeks later, at the same time as their mark. Not only is it likely that in the intervening time they have forgotten their original decision, but it has been found that 42% of students do not even access feedback when they receive their marks (Mensink and King, 2019).
It is not unreasonable to postulate that despite feedback being available, the error is not noticed by the student. The student will not use this opportunity to learn from their mistake and correct their learning. This mistake, and many others like it, will then be potentially replicated in their future work.
This would be especially troubling in the first year of university education, as the foundational year where accurate knowledge of subjects covered is presumed henceforth. In addition, students would be even less likely to review feedback when given the mark, as improvement has no direct immediate benefit as only a passing mark is required for that year. Of course, this presumes the evaluator gives feedback on the mistake. Evaluators typically ignore mistakes that do not directly impede marks, thus depriving students of the potential improvement.

Given that context, it is likely that improvement can be made on how feedback is delivered in university settings, as (Epstein et al., 2002) has shown immediate feedback "promotes retention and correction of inaccurate response strategies". Therefore, under ideal circumstances, to be better able to learn from mistakes feedback should be immediately accessible for students. This is evidently not practical for direct feedback from educators. They would need to be always available, for any number of students, and simultaneously give each student the same level of help to keep assessed works fair.

Hence, this project and its hypothesis. This project aims to produce a program capable of performing automatic code analysis on user generated code, which will be used to identify mistakes in real time.

These mistakes will be reported to the user with the hope the immediate feedback will allow them better opportunity to correct their understanding and guide subsequent learning (Brown, Peterson, and Yao, 2016).
The program will be tested on representative first year programming exercises, with a sample of current first year students, with the data evaluated and a conclusion to the hypothesis established.

Project Aims and Objectives

This project aims to test the hypothesis "Students using real time feedback from an Automatic Code Analysis tool during development will make less errors compared to a control group." A bespoke method of Automatic Code Analysis will be developed during this project. Primary research will be gathered on university students using and not using this tool to develop some software. The results will be compared and used to decide the truth of the hypothesis.
In addition, a usability study will be conducted on the software to judge if the tool is sufficiently usable for this task. This will inform future research and the trustworthiness of the results.

Objectives

- Conduct Primary research into the hypothesis "Students using real time feedback from an Automatic Code Analysis tool during development will make less errors compared to a control group."
    - Primary Research will be conducted using First year computer science students as participants
    - Statistical analysis will inform the conclusion of the report
    - **Requires Ethics Review and Approval**
- Produce minimal application capable of Automatic Code Analysis on given code
- Produce a Report detailing the process, and results of this project

Deliverables

- Program capable of Automatic Code Analysis
    - Example cases to be used for testing hypothesis
    - Should only work on request by the student, and only on the software specified
    - Should be minimally designed for the researching the hypothesis
    - Based on proof of concept[1] program I completed during my internship with Cardiff university.
    - [optionally] minimal GUI (Graphical User Interface) for usability
- Ethics Application for the experiment
    - Complete write up of the methods used to collect the data
    - Justifications for why the data is necessary
    - Explanations on how the data will be stored and accessed to comply with university regulations

[1] Proof of concept project is accessible here: https://git.cardiff.ac.uk/c1908527/cardiff_coursework_support. Working prototype for coursework support on first year module problem solving with python, with full documentation, and development process notes.

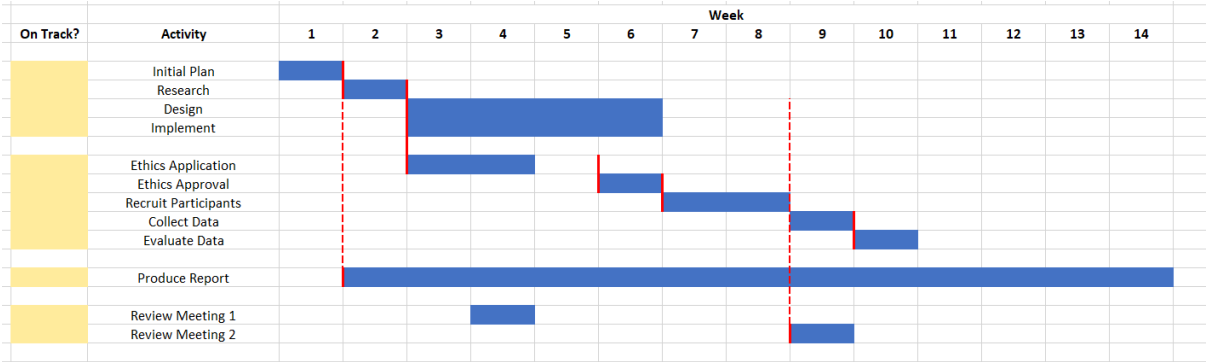
- Data collected from Students of Computer Science on using Automatic Code Analysis tools during development
    - Must be anonymised to comply with university regulations
    - Approval must be sought using Ethics Approval Document before **any** data is collected or participants contacted
    - Each student must be fully informed, and can leave at any time.
- Scientific Report
    - Full Report on the process of investigating this hypothesis
        - Abstract Conclusion
        - Write up of research into similar / existing solutions
        - Full and detailed explanation of the methods used during this project
            - In sufficient detail required for reproducing the project
        - Anonymised write up of the evidence collected
            - Evaluation of the evidence
        - Conclusion
            - Report of the findings of the evidence
            - Discussion of the limitations of the methodology used
            - Discussion of further research that can be undertaken on this topic

Work Plan

Milestones

- Completed Initial Plan [Inflexible]
  - Expected 07/02/2022
- First Major review Meeting
  - End of Week 4
  - Discuss progress of development and all stages up to this point.
- Initial Ethics Application submitted
  - Expected end of week 4
  - [Pending Approval after some revisions by end Week 6]
- Complete Implementation
  - Expected end of Week 6
  - Minimal software required for testing the theory completed
- Ethics Approval
  - Expected end of Week 6
- Major Review Meeting 2
  - When Participants have been recruited for the study
  - Expected end of Week 8
- Data Collected
  - Expected end of Week 9
  - Primary research completed with all participants
- Data Evaluated
  - Expected end of Week 10
  - Primary Research has been evaluated, with conclusions for the hypothesis drawn
- Final Report Finished and Submitted [Inflexible]
  - By 13/5/2022

I have also agreed with my supervisor to have regular weekly meetings to discuss progress.



References

Poulos, A. and Mahony, M., 2008. Effectiveness of feedback: the students' perspective. *Assessment & Evaluation in Higher Education*, 33(2), pp.143-154.

Epstein, M., Lazarus, A., Calvano, T., Matthews, K., Hendel, R., Epstein, B. and Brosvic, G., 2002. Immediate Feedback Assessment Technique Promotes Learning and Corrects Inaccurate first Responses. *The Psychological Record*, 52(2), pp.187-201.

Mensink, P. and King, K., 2019. Student access of online feedback is modified by the availability of assessment marks, gender and academic performance. *British Journal of Educational Technology*, 51(1), pp.10-22.

Brown, G., Peterson, E. and Yao, E., 2016. Student conceptions of feedback: Impact on self-regulation, self-efficacy, and academic achievement. *British Journal of Educational Psychology*, 86(4), pp.606-629.