INITIAL PLAN

Project Title

Can machines learn to mark technical student reports?

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1. Project Description

Every year, university or high school students are working on projects, either group or individual. Many times, the correct answers to these projects are limited and each answer (together with justification) corresponds to one specific grade or grade class (First, 2:1, 2:2, 3, F). Without a doubt, this is an ideal situation and many times two answers can be marked differently, although they are the identical. Also, all reports are not marked by the same person.

Although there is a pattern and specific answers correspond to specific grade/grade class, these projects are still marked by a staff member on the role of group project client, individual project moderator or module leader/lecturer.

This project aim is to use machine learning approaches to mark (unmarked) student reports based on other marked student reports and maybe also give a justification of the mark. I am going to design a machine learning implementation and then train it using already marked student reports so that the program can capture and later use the pattern between student reports and their grade class.

A precise and accurate, but also efficient, machine learning approach could automate the entire marking process and minimize the time needed for lecturers to mark student reports. Other than this, a precise and accurate approach can minimize or eliminate the aforementioned abnormalities which take place when two identical student reports are marked differently.

2. Project Aims and Objectives

<u>Primary Aims and Objectives</u>

1. **Design** an (untrained) **implementation** of a machine learning approach (such as a classifier or a neural network) that can map student reports to a corresponding grade class.

2. **Train** the **implementation** using marked student reports. Input marked student reports with their grade class in order to train the implementation and capture and use the pattern between the report (answer is sections/subsections)

3. **Evaluate** on the **performance** of the **implementation** using evaluation measures and compare it to other possible approaches. (more details on Deliverables)

<u>Secondary/Optional Aims and Objectives</u>

1. **Design**, **Train** and **Evaluate more than one** approaches/implementations.
2. Other than a grade class, also provide an **explanation/justification** of the grade class and/or **other suggested answers**.

3. Work Plan

3.1. Weekly Work Plan from Week 2 (starting 05/02) to Week 12 (ending 11/05)

<u>Week 2,3 (05/02-18/02)</u>

- Complete the Ethical Approval Request Form in order to get approval to use and perhaps also publicize student reports on the final report in a form allowed by the Ethics committee (with or without grade, or with or without student name etc.) (since the data required are "Interviews, Observations, Questionnaires, Personal Data").

- Research **machine learning approaches and their algorithms** (such as Classification, Clustering and Association Rules etc.) and decide which is appropriate for our task.

- After deciding on the approach taken, research the various possible **methods of implementation** (such as Classification using Weka, or Classification using Neural Networks and Deep Learning etc.)

- After deciding on the method of implementation, **get familiar** with the machine learning approach and the method of the implementation, as well as similar approaches that can be later used for comparison and evaluation.

- Make a **hypothesis** of the expected result using this machine learning approach and this method of the implementation.

<u>Week 4 (19/02-25/02)</u>

- **Collect data** that will be used as training set for the implementation.

- Convert the dataset to **appropriate format for pre-processing**.

- **Pre-processing** of the dataset such as:
    - Cleaning it from spelling mistakes or missing values (that do not affect the grade)
    - Dividing to the reports' sections and subsections
    - Getting rid of unnecessary or irrelevant information (if they do not affect the grade)

- Convert the pre-processed dataset to **appropriate format for input** in the implementation.

- Decide **how the dataset should be divided in training and testing set**. There are various methods such as simply dividing the dataset to training set (e.g. 70% of dataset) and testing set (30% of the dataset) or rotating the training and testing sets (such as k-fold[1] cross-validation and Leave-one-out[2] cross-validation)

Week 5,6 (26/02-11/03) (could vary depending on implementation method)

- **Implement the approach's algorithm** (from Week 2,3) so that it can map unmarked student reports to grade classes based on the grade class of other marked reports that will be used for its training.

- MILESTONE 1: *Untrained Implementation*

Week 7,8 (12/03-23/03)

- **Train the implementation** (from Week 5,6) using the pre-processed training set (from Week 4)

- MILESTONE 2: *Trained Implementation*

Week 9 (16/04-22/04)

- **Test the implementation** using new marked student reports as test set. Input these student reports (input of the implementation) into the implementation and record the predicted grade class (output of the implementation).

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[1] https://en.wikipedia.org/wiki/Cross-validation_(statistics)#k-fold_cross-validation
[2] https://en.wikipedia.org/wiki/Cross-validation_(statistics)#Leave-one-out_cross-validation

- **Evaluate the performance of the algorithm/implementation** using quantitative evaluation methods such as recall, precision, the F1 measure and others

- MILESTONE 3: *Evaluation on the performance of the trained implementation*

Week 11,12 (30/04-11/05)

- **Compile final report** (contents of the final report can be found in Deliverables)

- MILESTONE 4: *Final Report*

Note on Weekly Plan:
The Easter Recess from 24/03/2018 to 15/04/2018 will also be used to complete any unfinished tasks from Weeks 1-8, or start the tasks from Weeks 9-12.

3.2. Deliverables

Deliverables:
- **Final Report** (deadline on 11/05/2018, 23:00)

The final report will contain:

- **Source Code** of the implementation.

- **Data Collected** (if approved to be publicized by Ethics Committee).

- A **description of** the **approach** and **methodology** (machine learning approach taken, implementation method taken).

- **Testing results** and a short explanation. The testing results will be a set of student reports each with a predicted and an actual grade class. The predicted grade class will be the output of the implementation (where the input is the student reports) and the actual grade class will be the grade class given by the professor who marked the student report.

- An **evaluation** of the performance of the algorithm/implementation:
  - using evaluation measures such as recall, precision, the F1 measure.
  - stating and explaining whether the testing results are satisfactory and why they are (or aren't) satisfactory,
  - comparing and contrasting to other possible algorithm/implementations,
  - stating and explaining whether the approaches taken could give better results and how)
  - stating and explaining whether the implementation would perform better under other circumstances, which are these and why.
  - stating and explaining whether the implementation could be used in practice.
  - stating and explaining the strengths and limitations of the implementation.
  - stating whether there could be future modifications/addition/reductions on the implementation, why they were not made now, how would the testing results and the overall performance change and why

3.3. Milestones

- MILESTONE 1: Untrained Implementation (informal deadline 11/03/2018, 23:59)

- MILESTONE 2: Trained Implementation (informal deadline 23/03/2018, 23:59)

- MILESTONE 3: Evaluation on the performance of the trained implementation (informal deadline 29/04/2018, 23:59)

- MILESTONE 4: Final Report (deadline 11/05/2018, 23:00)

3.4. Meetings with Supervisor

- Weekly Meetings every Wednesday (time to be determined) (07/02/2018, 14/02/2018, 21/02/2018, 28/02/2018, 07/03/2018, 14/03/2018, 21/03/2018, 18/04/2018, 25/04/2018, 02/05/2018, 09/05/2018)

- Special Review Meetings on:
1. 14/03/2018 (after completing MILESTONE 1 out of 4)
2. 18/04/2018 (after completing MILESTONE 2 out of 4 and Easter Recess)
3. 02/05/2018 (after completing MILESTONE 3 out of 4)
4. 09/05/2018 (Last Meeting, before completing MILESTONE 4 out of 4)