Rate My Tweet: Understanding Comparative Judgement in the Wild

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This work has not been previously accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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Abstract

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Todo list

Chapter 1

Introduction

1.1 Motivations

For the prior eight years, we have had involvement in some form of an educational environment. Seven of these years involve being a teacher within secondary and sixth form schools. While the focus of teaching is perceived to create lessons for students to learn and grow, we found more and more as the years went on that this wasn't the case. The focus was actually on providing reports about the students, which required data about the students from formal assessments. While having assessments to gauge the level that a student is at is an essential part of education. However, creating, marking, analysing and providing feedback for 30 students or more per class is a time-consuming task. Therefore, this assessment practice takes away the educators' time to do what is essential, creating meaningful lessons tailored for the students.

Therefore, our motivation is to create a tool for educators that will empower them to allow technology to do what it is good at and focus on what they are good at, creating and delivering lessons. To shape future generations views.

1.1.1 Objective

1.2 Overview

1.3 Contributions

The main contributions of this work can be seen as follows:

- **A LaTeX thesis template**

  Modify this document by adding additional TeX files for your top level content chapters.

- **A typesetting guide for useful primitive elements**

  Use the building blocks within this template to typeset each part of your document. Aim to use simple and reusable elements to keep your LaTeX code neat and to make your document consistently styled throughout.

- **A review of how to find and cite external resources**

  We review techniques and resources for finding and properly citing resources from the prior academic literature and from online resources.

Chapter 2

Lit Review

Education and the sharing of knowledge is a powerful tool. In fact, in our opinion the most important skill anyone can have. As a famous quote said, "give a man a fish, and he will starve, but teach him to fish, and he won't be hungry anymore". However, it wasn't until 1918 that education, as most people in England and Wales have experienced, started to come into effect [1].

Education over the years was very much about just giving the knowledge to the students from the teacher. It wasn't until 1988, under the Education Reforms Act 1988, that assessments got introduced. The introduction was through the introduction of the national curriculum in England and Wales [2].

As the curriculum got rolled out, statutory assessments got introduced to education between 1991 and 1995. Key Stage 1 first, followed by Key Stages 2 and 3, respectively.[1] Only for the core subjects of English, Mathematics and Science had the assessments first introduced. The first assessments in Key Stage 1 were a range of cross-curricular tasks to be delivered in the classroom, known as standardised assessment tasks - hence the common acronym 'SATs'. However, the complexity of the use of these meant more formal tasks quickly replaced them.[1] The assessments in Key Stages 2 and 3 were developed using more traditional tests.

In all 3 Key Stages, tests became the main form of statutory assessment, but a separate strand of Teacher Assessment was also used. This allowed teachers to make judgements about pupils they taught, based on their knowledge of the pupil's learning and attainment against the attainment targets contained within the national curriculum. The results of both tests and teacher assessments were reported using a common scale of attainment levels,

numbered 1 to 8 across the three key stages, with the national expectation that pupils would achieve Level 2 at the age of 7; Level 4 at the age of 11; and Level 5 or 6 by the age of 14.

This model continued, with minor adjustments to reflect the changing content of the National Curriculum, up to 2004. From 2005, the role of the tests was downplayed at Key Stage 1, with tests being used only internally to support teacher assessment judgements.[2] Further changes came in 2008 when the government announced that testing in Key Stage 3 was to be scrapped altogether.[3]

In 2013, then Education Minister, Michael Gove announced that when the new version of the National Curriculum was introduced to schools from 2014, the system of attainment levels would be removed.[4] As a result, since 2016, the old system has levels that are no longer used as part of statutory assessment. Instead, tests and teacher assessments now follow different models at each key stage.

2.1 The Purpose of Assessment, Marking and Feedback in Education

2.2 Traditional Methods of Marking and Providing Feedback

2.3 Why Traditional Traditional Marking and Feedback Methods are Effective

2.4 The Negative Aspects of Traditional Marking and Feedback Methods

2.5 What is Comparative Judgement

Comparative judgement is a mathematical way to determine which observation item is better than the other item also being observed compared to each other. This method was first proposed in 1927 by Louis Leon Thurstone, a psychologist, under the term "the law of comparative judgement" [3, 4]. In modern-day terminology, it gets more aptly described as a model used to obtain measurements from any pairwise comparison process. Examples of such methods are comparing the perceived intensity of physical stimuli, such as the weights of objects, and comparing the extremity of an attitude expressed within

statements, such as statements about capital punishment. The measurements represent how we perceive things rather than being measurements of actual physical properties. This kind of measurement is the focus of psychometrics and psychophysics. <wikipedia>

In more technical terms, the law of comparative judgment is a mathematical representation of a discriminal process. This process involves a comparison between pairs of a collection of entities concerning multiple magnitudes of attributes. The model's theoretical basis is closely related to item response theory and the theory underlying the Rasch model. These methods are used in psychology and education to analyse data from questionnaires and tests. <wikipedia>

While comparative judgement is a technique that has been around for almost 100 years, it wasn't until the early nineties that this technique got proposed for use within an educational setting. This first proposal was by Politt and Murry [5], who conducted a study where they tested candidates on their English proficiency within Cambridge's CPE speaking exam. The judges watched 2-minute videos and judged which one out of a pair of videos they deemed better at the requested task in the exam. However, before this, in the ninety seventies and eighties, comparative judgement was presented as a more theoretical basis for educational assessments [6].

With the momentum of his findings, Politt then presented comparative judgement as a tool for exam boards to use to be able to compare the standards of A-Levels from the different exam boards, replacing the direct judgement of a script that was at the time currently being used [7]. In his papers titled, "Let's Stop Marking Exams" [8], he presents a valid argument for using comparative judgement, with the advantages it brings over some traditional types of marking.

Politt, in 2010, also presented a paper at the Association for Educational Assessment – Europe. It was about How to Assess Writing Reliably and Validly. Politt presented evidence of the extraordinarily high reliability achieved with Comparative Judgement in assessing primary school pupils' skill in first-language English writing [9].

2.6 The Logic Behind Comparative Judgement and What it Aims to Do

How comparative judgement works is to present two options to a marker. The marker then gets asked to pick which one of the two options they think is the better one. The

marker will get presented with all possible combinations available, each time picking which one they think is the better one out of the two. An outputted score is then presented based on the method used. The original method, the Law of Comparative Judgement (LCJ), follows the formula:

$$S_i - S_j = x_{ij}\sqrt{\sigma_i^2 + \sigma_j^2 - 2r_{ij}\sigma_i\sigma_j},$$

Figure 2.1

S_i is the psychological scale value of stimuli i

However, an alternative version derived from Louis Leon Thurstone, referred to as the "Pairwise Comparison" [4], will provide an output based on the difference between the quality values is equal to the log of the odds in respect to object-A will be object-B. This formula gets represented as: $\log \text{odds}(A \text{ beats } B \mid v_a, v_b) = v_a - v_b$.

$\Pr\{X_{ji} = 1\} = \frac{e^{\delta_j - \delta_i}}{1+e^{\delta_j - \delta_i}} = \sigma(\delta_j - \delta_i)$

.

2.7 How effective is Comparative Judgement at Providing Feedback?

2.8 Related Work

2.8.1 Subsection all similar work

2.8.2 Comparison of similar work

Chapter 3

Methodology

3.1 Tools

To create the web application and insights from the tweets, we required to use several tools. It is a requirement that we develop a full-stack web application with a user UI, an area to input the user's judgements on the tweet, store the results using a database, and extract information from the tweets using NLP techniques. Several factors within the final application needed to be satisfied for the tools to be appropriate for use.

3.1.1 Programming Language

While many programming languages can handle creating a full-stack application and conducting ML, for example, Java, Php and JavaScript. We decided to use the Python language. We decided upon Python due to our familiarity with it over the other main languages and its versatility. We made this decision because Python can make full-stack applications with the use of additional libraries, as well as handle most NLP ML tasks using libraries like NLTK, SpaCy, Sci-Kit Learn and TensorFlow.

3.1.2 Libraries

3.1.2.1 Web Application

For creating the web application, there were two main libraries available. These were Django and Flask.

Django is a high-level Python Web framework that encourages rapid development and clean, pragmatic design. Built by experienced developers, it takes care of much of the hassle of Web development, so you can focus on writing your app without needing to reinvent the wheel. It's free and open source [10].

While Flask is a small framework by most standards—small enough to be called a "micro- framework," and small enough that once you become familiar with it, you will likely be able to read and understand all of its source code [11].

Flask has three main dependencies. The routing, debugging, and Web Server Gateway Interface (WSGI) subsystems come from Werkzeug; the template support is provided by Jinja2; and the command-line integration comes from Click. These dependencies are all authored by Armin Ronacher, the author of Flask [11].

Flask has no native support for accessing databases, validating web forms, authenticating users, or other high-level tasks. These and many other key services most web applications need are available through extensions that integrate with the core packages. As a developer, you have the power to cherry-pick the extensions that work best for your project, or even write your own if you feel inclined to. This is in contrast with a larger framework, where most choices have been made for you and are hard or sometimes impossible to change [11].

After experimenting with the two frameworks, we decided upon Flask. Flask got decided upon because of the short time frame to put the project together. Additionally, the lightweight nature of the framework also played a fact as we believe that as this will be just an initial prototype, all the other requirements that Django requires would be unessential additionals to the project. Therefore, taking focus away from what we believe is the main focus.

3.1.2.2 NLP Tasks

3.1.3 IDE

3.2 Software Development Life Cycle Methodology

3.3 Data Set

3.3.1 Data Capture Method

3.3.2 Pre-Processing

Chapter 4

Results and Discussion

In this document we have demonstrated the use of a LaTeX thesis template which can produce a professional looking academic document.

4.1 Contributions

The main contributions of this work can be summarised as follows:

- **A LaTeX thesis template**

  Modify this document by adding additional top level content chapters. These descriptions should take a more retrospective tone as you include summary of performance or viability.

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4.2 Future Work

Future editions of this template may include additional references to Futurama.

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Chapter 5

Conclusions and Future Work

In this document we have demonstrated the use of a LaTeX thesis template which can produce a professional looking academic document.

5.1 Contributions

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Bibliography

[1] UK Public General Acts, "Education act 1918," 1918.

[2] ——, "Education act 1988," 1988.

[3] L. L. Thurstone, "Psychophysical analysis," *The American journal of psychology*, vol. 38, no. 3, pp. 368–389, 1927.

[4] ——, "A law of comparative judgment." *Psychological review*, vol. 34, no. 4, p. 273, 1927.

[5] A. Pollitt and N. L. Murray, "What raters really pay attention to," *Studies in language testing*, vol. 3, pp. 74–91, 1996.

[6] D. Andrich, "A rating formulation for ordered response categories," *Psychometrika*, vol. 43, no. 4, pp. 561–573, 1978.

[7] P. Newton, J.-A. Baird, H. P. Harvey Goldstein, and P. Tymms, "Paired comparison methods," 2007.

[8] A. Pollitt, "Let's stop marking exams," 01 2004.

[9] ——, "Abolishing marksism and rescuing validity," *International Association for Educational Assessment, Brisbane, Australia. http://www. iaea. info/documents/paper_4d527d4e. pdf*, 2009.

[10] Django. (2021) Meet django. [Online]. Available: https://www.djangoproject.com/

[11] M. Grinberg, *Flask web development: developing web applications with python*. " O'Reilly Media, Inc.", 2018.

Appendix A

Implementation of a Relevant Algorithm

```
#include <stdio.h>

int main(int argc, char *argv[]) {
  printf("Hello world.\n");
  return 0;
}
```

Listing A.1: An implementation of an important algorithm from our work.

Appendix B

Supplementary Data

The results of large ablative studies can often take up a lot of space, even with neat visualisation and formatting. Consider putting full results in an appendix chapter and showing excerpts of interesting results in your chapters with detailed analysis. You can use labels and references to refer the reader here for the full data.