# Criterion A:

## Scenario:

The client, Mr. Erin Baker, is a teacher of the Mathematics: Analysis and Applications International Baccalaureate (IB) course and IGCSE Extended and Additional Mathematics courses at an international school. His tasks involve teaching mathematics classes, writing and marking tests, handling Internal Assessments and producing effort grades. Effort grades are scores produced by the client’s school, which accompany scores achieved by students on tests, on every report card produced; they are an indication of the level of effort placed by the student in each subject. The effort grade may take one of “Excellent(E) … Good(G) … Satisfactory(S) [or] Unsatisfactory(U)” (Baker).

Graphical user interface

Description automatically generated

*Figure 1: Student report exemplar with an explanation of what each effort grade band correlates to*

Upon consultation, it was found that there were fundamental issues with generating the effort grades for his students in all his classes. He stated that the effort grade predictions were primarily made based on test scores and changes in them, “perceived” (Baker) effort placed in class and homework completion rates (Baker). Currently, Mr. Baker does not have a system to generate effort grades, he primarily “thinks what it might be, and enter it” (Baker). He feels that the current method of determining effort grades is “quite subjective” (Baker); teachers have different marking standards and expectations, especially given that effort is “difficult to put into numbers or categories” (Baker), and hence, difficult to standardise.

There are also elements of subjectivity present in how a teacher perceives a student to be working in class, introducing biases into how effort grades may be calculated.

Furthermore, calculating how much student scores have improved by is “time consuming” (Baker) as he performs calculations on changes in test scores on paper, with no “so called system” (Baker).

## Proposed product:

In order to resolve the identified issues, I intend on producing a user-friendly GUI that generates an effort grade based on the factors mentioned by the client to assist teachers in generating effort grades. As someone who is not particularly adept at using technology, the Windows, Menus, Icons and Pointers (WIMP) style of the system would suit him best, as opposed to a CLI.

The system will be programmed in Java JDK17 LTS using IntelliJ ultimate edition as the primary IDE for development. As it is more efficient to program the machine learning algorithm in python, I will be writing the algorithm using Microsoft’s Keras with Google’s TensorFlow as the backend.

## Success Criteria:

1. The client must be able to enter, edit and store test scores for each student
2. The client must be able to enter the number of total homework given to students and number of homework assignments completed by each student
3. The system should be able to generate the effort grade for a student based on test scores, homework completion rate and the client’s perceived effort grade, with a 50%, 25% and 25% weighting to each respective factor
4. The system should weight semester exam scores as 70% and average quarter test scores as 30% of the 50% weighting given to the final effort grade
5. The client should be able to override the generated effort grade and replace the score with the effort grade the client intends to award the student, and to be able to record why the client performed this action
6. The system should not allow for incorrect data types, incorrect data format or duplicate data to be entered, i.e. there should be error management in case invalid input is entered
7. The client should be able to enter the classes they teach and assign students to each class, with the data for each student being separate from other students, as no student can be in 2 classes for the same teacher
8. The system should be able to save entered data to secondary storage whenever the application is closed and should load said data when it is opened, provided the directory of stored data is not changed
9. The client should be able to search for a student and view all data corresponding to the student upon the input of a query for first name, last name or student ID
10. The client should be able to view all students in a class

each teacher has a different interpretation of what may count as a higher or lower effort score and that due to the difficulty in quantifying effort, there is no established marking standard amongst teachers. Furthermore,

Issues:

* Effort grades are subjective
* Calculating effort through how student scores have improved is time consuming
* Involves numerous factors and it is difficult to be fair with each student

# Appendix:

**First interview with client, 10/11/2021, Appendix 1**

**Legend:**

Underline – me speaking to Mr.Baker

No formatting – Mr.Baker responding to me

*Italics – Additional information for context and completeness’ sake added to the transcript*

Before we start this interview, could you please just clarify what your role is as a teacher of mathematics?

Yes, I am a mathematics teacher in the high school. I teach mathematics, write tests, mark tests, mark internal assessments and produce effort grades.

I became aware of the fact that there is an issue with quantifying the effort a student places in their work and the effort grade that is allocated to students. Could you please provide more information regarding this?

Yes, so for the actual grades, we have quite a straightforward way of calculating it. But for the effort grades, its not so straightforward and quite subjective. We base it on various things such as what grades they are achieving, but also how much effort they are putting in in class… For example, for a student who is good at math, but they are lazy, they should get a bad effort grade, but for someone who is not very good at math, but they try hard would get a good effort grade.

So, in other words, would you say that sometimes merely basing the effort of students based on a teacher’s perceived understanding of whether a student is working in class or not essentially introduces biases in the determination of effort grades?

Yeah, that can contribute to a bias. For example, a quite student who is not really working very hard but is not attracting attention to themselves, you might think as working harder than a noisy student who is maybe doing the exact same amount of work but is more noticeable… than not doing their work. Say for example if you were comparing with Mr.Hornell over in your class, and he obviously teaches in a very different way, what behaviour of a student might make me think “well this student is putting in a lot of work” is very different from what behaviour Mr.Hornell expects to see to think the same thing as me. As in his expectations may be different from mine.

As in, essentially, because effort is so difficult to put into numbers or categories, it’s obviously way more subjective than something like test scores, which, especially for math, is more of a “black and white” scenario.

I see. Would you say there are any cases where a student may not work a lot in class, but might work significantly more at home to make up for this?

There are some, students I can think of like that in my grade 10 class… one in particular who is not very hard working in class, but he has a tutor, and when he goes home, then he does the work. And you know, it really comes down to the student. Some students I know are not very comfortable in the school environment… maybe it’s too distracting for them, especially with the grade 9 and 10 classes. So, they might go home and work twice or even thrice as much and get the job done, because it’s more comfortable for them. So yeah, I’d say this does happen, but we can’t really measure that “work” until something like the semester exam, where we can go ahead and really see has this student been putting in the work or been slacking off.

And are there any other factors that you may consider when determining the effort grades of a student?

For the effort grade, it’s mainly through what grades they are achieving and if they’re making an improvement, through their homework, and how I perceive their effort in class, should contribute to effort grades. For example, in semester 1 if they got 3s and in semester 2 they got 5s, then that shows a big improvement-

So, in that case would you predict a higher effort grade?

Yes, then that should show as a higher effort grade.

So essentially would you say that because you can’t actually verify how much work a student is putting in, say at home, you need some way of indirectly measuring their effort, which is their performance on tests?

Yeah

And is there any difficulty in determining that improvement in their test scores, especially with the number of students that you may be dealing with?

Maybe not difficult, but time consuming, as I have to get each grade one by one off of the school website. It would be better to have some sort of a red or green traffic sign that says yes, it’s increased, or how much it’s increased by, ‘cause I usually end up having to calculate the change in test scores by hand on a piece of paper for each student.

Given that you are a math teacher yourself, how would you determine importance of each of those factors that you mentioned in determining the effort placed by a student? Perhaps on a scale out of 100?

Perhaps the most important factor is the actual grade, like during the semester exams. Then maybe… it’s more like a 50-60% to grades and 25% homework and 25% how I see them in class.

Within the exams themselves, are there any differences in the weightings you may give to semester exams vs quarter exams?

Because in the semester exam the students sit it all together, then we’d give a higher weighting to semester exams, for everything, from predicted grades to your effort grades.

*(Semester exams at Mr.Baker’s school are sat at once by all students in the grade, while quarter tests are sat at different time periods by each class taught by each mathematics teacher at Mr.Baker’s school)*

How would you weight these differences? If you had to weight this on a scale out of a 100?

Maybe 70% semester exams and 30% quarter tests… just because some students might not be as honest and might ask their friends what’s coming up on the test if their friends sat the test before them. Whereas with the semester exam that’s impossible, as anyone who doesn’t sit the semester exam on the day of the exam has their semester exam score discounted as we can’t be sure that they didn’t cheat, but still marked just so that the student can receive feedback and improve, assuming they were being honest.

And in terms of your current system, how do you assign effort grades to students? Are there any issues with this?

I mean, I don’t really have a “system” to calculate effort grades, I just think of what it might be and enter it, and that’s been a gaping problem for our department, but the Academic Advisors suggest that we should enter the effort grade that we think is best. But mathematically, I don’t think that you should just make a judgment like that without anything to back it up with other than “oh what we think is dot dot dot”. I can think of some cases where we only found out that the student works hard at their home through what their parents tell us at PTCs *(Parent Teacher Conferences)*, but we do not really see this in class, because of what I mentioned before.

So, that’s the main issue. Just that it’s a bit subjective. But system wise, entering the grades is not the difficult part. When we make the report, we have a drop-down list, where we can just select E for Excellent, G for… Good, S for Satisfactory and U *(for Unsatisfactory).*

But there is no so called “system” that I use to figure out the effort grades of a student, I just think about it, and enter the grade into the school website.

Are there any other bits of information that the new system will need to record and keep track of to generate the effort grade advisories for each student and how would you like it to track such information, like for example keeping track of a moving average for a student’s score on tests or the change in score relative to the previous two tests to indirectly measure effort?

It is important to keep track of the information. Like for example if a parent queries why was this grade awarded, then it’s good to have evidence for that.

Actually, the moving average idea sounds like a really good way of keeping track of that data. So, like a moving average is an average with more weighting to more recent scores, so not penalizing them for work that has been done in previous semesters and rewarding them more for their more recent work sounds like a great way to remove any subjectivity from how we calculate effort grades.

As a teacher, sometimes there may be cases which the system may simply not be able to account for, such as if a student had a traumatic incident happen to them, due to which their homework completion or their scores on tests may not be as high. In such cases, is there any override you would like for the system to have and how would you like such an override to be implemented? Would you prefer that you add a sort of “bias” to the system or would you prefer a complete manual override on the score?

Yeah, that would be good to have an override in those situations… there are always exceptions. Maybe just completely override the score and have somewhere to note down the reason why… but the system should still generate, based on what is put in, what it recommends… but the teacher can say the system recommended satisfactory, but the teacher could say the effort is excellent due to the student’s particular circumstances and what they’ve experienced.

I mean because it wouldn’t happen that often, I would just prefer to be able to completely override that score and just be able to note down why I chose to override it in case the Academic Advisors may ask. Like maybe if a student’s case was that because of what they’re facing at home, they couldn’t complete their homework, then they shouldn’t be penalized… even if their homework completion rate was lower.

In terms of the output of the system, what information would you like for the system to output and provide to you, when you have registered all the necessary information in the system?

Just the recommended effort grade, like an advisory. Also having the grade overall and homework completion percentage… so then if you see a student was awarded satisfactory and you ask why is that you would be able to see, “oh it’s because the student didn’t complete their homework”. So yeah, having a summary is useful to see why a student might have gotten a particular score.

Alright. Those were all of my questions to ask you, thank you so much Mr.Baker!

Yep, no problem!