2)

INTRODUCTION

We wish to get our general GPA as a 3.0 and major GPA as a 3.5[1] while also minimizing our time. We also assume this is a fair and just universe where if we put in the time into our work, we will get a grade we want[2]. Therefore, time will be our objective function and we define the following constraints:

OBJECTIVE FUNCTION & CONSTRAINTS

Min t, where

$$t = c_{MATH3610} + x_{MATH3610} + c_{\text{BEE3310}} + x_{BEE3310} + c_{\text{CS4620}} + x_{CS4620} + c_{CS4775} + x_{CS4775} + c_{\text{CS4775}} + x_{MUSIC2101}$$

Subject to constraints

- $g > 3.0$ where
  - $g = \frac{MATH3610x_{MATH3610} + CS4620x_{CS4620} + \text{CS4775}x_{CS4775} + \text{MUSIC2101}x_{MUSIC2101}}{cred_{MATH3610} + cre_{\text{CS4620}} + cred_{CS4775} + cred_{\text{MUSIC2101}}}$
- $m > 3.5$ where $m = BEE3310x_{BEE3310}$
- $t < 77\ hours$

The 3.0 and 3.5 terms are self-explanatory as this is the goal of our problem, but the 126 comes from the expression of $24 * 7 - 6 * 7 - 7 * 7$, as there are 7 days in the week with 24 hours each day. We also assume the user will get an average of 6 hours of sleep a day and will spend 7 hours of each day up to personal use and being present in class. Therefore, we are now left with at max of 77 hours if we wish to keep this sleep schedule, want to maintain attending every class, and catch up with friends and the latest episode of *Stranger Things*.

We define the constants for classes as follows:

1. $c_{MATH3610} = a * cred_{MATH3610} * e_{MATH3610}$
2. $c_{\text{BEE3310}} = a * cred_{\text{BEE3310}} * e_{\text{BEE3310}}$
3. $c_{\text{CS4620}} = a * cred_{\text{CS4620}} * e_{\text{CS4620}}$
4. $c_{\text{CS4775}} = a * cred_{\text{CS4775}} * e_{\text{CS4775}}$
5. $c_{\text{MUSIC2101}} = a * cred_{\text{MUSIC2101}} * e_{\text{MUSIC2101}}$

Using the constants we defined on the next page, we see that c_{class} gives us the number of hours as $\frac{Hour}{credit} * credit$ and e_{class} is a scalar.

We define GPA of classes as follows

1. $MATH3610 = 1.0 + r_{MATH} * c_{MATH3610} * cred_{MATH3610}$
2. $BEE3310 = 1.0 + r_{\text{BEE3310}} * c_{\text{BEE3310}} * cred_{\text{BEE3310}}$
3. $CS4620 = 1.0 + r_{\text{CS}} * c_{\text{CS4620}} * cred_{\text{BEE3310}}$
4. $\text{CS4775} = 1.0 + r_{\text{CS}} * c_{\text{CS4775}} * cred_{\text{CS4620}}$
5. $\text{MUSIC2101} = 1.0 + r_{\text{MUSIC}} * c_{\text{MUSIC2101}} * cred_{\text{MUSIC2101}}$

[1] Even though this is not possible for me in any way, we make this assumption for the sake of the problem.
[2] If only…

Using the constants we defined on the next page, we see that $class$ gives us the grade in GPA terms of that class as $\frac{grade}{hou} * hour * credit$ is a scalar. We use this based on the typical GPA formula.[3] We also assume that we never actually fail the course, but we will at the very worse, the professor will give us a D, represented as a 1.0. Of course, we strive for better.

CONSTANTS

As an explanation for the constants, we define

- a: We use the famous adage of saying to spend three hours per one credit. a always equals 3.
- $cred_{class}$: This refer to the number of credits the given class is. This depends on the class.
- e_{class}: This number ranges from 0 to 1 depending on the experience the user (me) has with the course, with a 0 being this class is easy, and a 1 being the class needs my full attention. This is a unitless fudge factor only meant to scale the classes towards my favor. Using data from how I preformed in previous semesters, I was able to come up with these numbers[4].
- $r_{subject}$: This is used to in our g and m constraints to represent the grade per hour rate, so we can convert the grade we get given the amount of time we spent. This rate depends on the subject so classes in the same subject will have the same grade per time conversion. This rate can be calculated using numerical data, but again we make guesses at this number for the limited time we have for this assignment. Its unit is grade/hour.
- $x_{subject}$: This is the variable we are trying to solve to figure out how much time we spend as a ratio of the constant in our GPA classes variables (i.e $c_{MATH3610}$)

RESULTS

Running our solution with parameters and definitions of variables defined in the MATLAB code on the next page, we get the following answer as optimal:

```
Optimal solution found.
For MATH3610, spend 1.080000e+01 hours
For BEE3310, spend 6.275000e+00 hours
For CS4620, spend 12 hours
For CS4775, spend 12 hours
For MUSIC2101, spend 5.400000e+00 hours
```

Note that we represent x as a ratio of the time spent given the constants calculated. Therefore using our answer we obtain through linear programming in MATLAB, we multiply our answer vector by the class's associated given constant for time as defined in the objective function as seen below:

```
fprintf("For MATH3610, spend %d hours\n", ANSWER(1)+c_MATH);
fprintf("For BEE3310, spend %d hours\n", ANSWER(2)+c_BEE);
fprintf("For CS4620, spend %d hours\n", ANSWER(3)+c_CS4620);
fprintf("For CS4775, spend %d hours\n", ANSWER(4)+c_CS4775);
fprintf("For MUSIC2101, spend %d hours\n", ANSWER(5)+c_MUSIC2101);
```

[3] As a reference, please check out How to Calculate the Cumulative Grade Point Average (GPA): https://www.mtholyoke.edu/sites/default/files/registrar/docs/calculate_gpa.pdf

[4] I really didn't as I just took a guess, but I would if I truly wanted to be formal.

These answers seem extremely reasonable for our solution. The solution also seems to make sense as based on our efficiency terms, the time spent on each course matches it, so even though MUSIC2101 is a 4 credit course, its efficiency e = 0.2 for music means that it doesn't need that much time spent to do well. Indeed, CS4620, despite being 3 credits, requires the same amount of hours as CS4775, perhaps due to its high experience e = 1 for CS4775 as well. The fact both courses say 12 hours perhaps indicates there is a ceiling for the model that it cannot deal with spending more than 12 hours on a class.

In another situation where we define our e vector on the next page to all contain 1, we get the following now as optimal solution.

```
Optimal solution found.
For MATH3610, spend 12 hours
For BEE3310, spend 9.875000e+00 hours
For CS4620, spend 12 hours
For CS4775, spend 12 hours
For MUSIC2101, spend 15 hours
```

Here, we more clearly see that there is unlikely a 12 hour ceiling as speculated before, as our model indicates that we should spend 15 hours if we had no music experience at all.

Using our original inputs from which we guessed constants for rates depending on each class, we also observe that the general GPA g and major GPA m were equal to , respectfully. This seems to indicate that based on the rates I guesstimated, I am able to achieve a 4.0. For future research, we need more data and samples to determine how well I can study given an amount of time. These can be perhaps estimated using Bayesian Inferencing or some sort of estimation such as MLE in order to determine the parameters necessary for the model with a given training data.

Overall also, a major assumption made is that our function is linear, when in reality it is most likely far more complex. In addition, classes of similar subjects should be more related and intertwined with each other for similar results and rates, so this should be reflected more depending on the type of classes rather than just merely changing an efficiency constant e. More research and testing of parameters is needed overall to draw further conclusions, but our mathematical model seems to be on the right direction.