

CSC110Y1-F Fall 2020 - Fundamentals of Computer
Science 1
Course Project Proposal

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1. **Part 1**

2. Part 2

Research Question: To what extent do the changes in the Amazon rainforest's area affect the local annual precipitation and air quality?

During our initial research of topics related to climate change, we found that the South American rainforest contributes 20% (Thomas, 2020) of the oxygen produced by photosynthesis on land, while the Amazon rainforest is responsible for 10% of the current greenhouse gas emissions (Melillo et al., y 20). This information was surprising to us since 20% of photosynthesis implies a lot of conversion from carbon dioxide, which is a greenhouse gas, to oxygen, whereas the 10% contribution to greenhouse gas seems to contradict that information. Due to this contradiction, we were curious about whether tree populations actually help control the climate. After some research, we learned that the effect of trees on climate change is more complex than we originally thought. There are many factors to consider, such as the carbon dioxide to oxygen conversion, tendency to trap heat due to their dark colour, reaction to form methane and ozone, and political movements revolving tree plantations (Marshall, y 26). This led us into choosing an empirical approach—we wanted to directly observe the relationship between the change of tree population and climate change. We chose to focus our data on the Amazon rainforest not only because it is the largest rainforest on Earth (World Wildlife Fund., 2013), but also because there have been several pieces of evidence that show that the Amazon rainforest has been suffering from deforestation recently. For example, over 700,000 km² (270,000 mi²) of Amazon rainforest had been lost since 1970, reducing its size to 80.7% of its original size, in 2018 (Butler, ry 4); There have been more than 40,000 fires in the rainforest in 2019 (Government of Brazil., er 4); and that forest exploitation in Amazon has risen for 14 consecutive months in June 2020 (Reuters, 2020). With these major evidences of deforestation correlating to the change in global and local climate, we believe that it is a relevant topic to contemporary society that should not be ignored.

3. **Part 3**

4. Part 4

We first create a function that parses the `html` element of the stats on the website as a string, and converts it to a `nested array` so that it's easier to work with. This will involve using a `for loop`, `if statements`, and an `accumulator` keeping track of the data parsed so far. Using this function, we will collect our data for deforestation in the Amazon rain-forest over the past few decades. With the data now converted into a form that we can easily manipulate, we shall focus on analysing the data using our own functions.

For this project, we use smooth polynomial fitting to relate two of the variables in our `nested list`. Now, although there exist readily available functions that would do the same in the module `scipy`, we try implementing our own functions for the same, to test our learning from the course.

We split the mathematical algorithm for this problem using top-down design. Firstly, the main function would have two lists, `l_x`, `l_y`, of same length as input (for the two variables), along with an integer n (where $n \leq \text{len}(l_x)$; representing degree of intended polynomial). The function body would have calls to helper functions. Note: this is only a rough outline and the exact technical details may be changed based on the results after testing the functions.

Firstly, we have a function to calculate the perpendicular distance of one point from a given polynomial. As opposed to the naive approach to the problem, we use Newton-Raphson method *repeatedly* to estimate a solution for the derivative of the expression for the difference between the point and the polynomial, hence finding the coordinates of the foot of perpendicular, and consequently, the length of perpendicular.

The first estimate for the polynomial will be trivial, and we will then run the simplex algorithm to minimize the sum of the squares of the perpendiculars using two more helper functions, yielding the polynomial regression model. We now move towards plotting the resulting graph using the `matplotlib` library.

We also plan to write a function to calculate the coefficient of determination to check whether the graph shows an appropriate relationship between the independent variable (forest cover) and the dependent variable.

In addition to the graph, we plan to create an interactive text-based report of our data, where the user inputs a value for the independent or dependent variable, and the program will provide the corresponding dependent or independent value, coefficient of determination, or the slope of the tangent at the point, depending on which one the user asks for. The output will be text-based, and will require string concatenation, and `if statements` to check whether to add trivial information to the report.

The input/output model will use `while loops` and input prompts to keep the program interactive. We also extrapolate the data to yield the predictions about future data using the interactive i/o model. Finally, we use the extrapolated data to summarize the upcoming significant years where the dependent variable will reach a certain milestone.

References

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