S6 Objectives

- Come up with a fitness function to represent a minimization or maximization problem
- Implement the Genetic Algorithm to solve optimization problems

No Way Home (3 pts)

You are a new Spider-man in the multiverse and trying to figure out a way to swing from your house to Oscorp. Assuming that you are in a 3 dimensional space, where your coordinate is given by 3 points (x, y, z), implement a fitness function that will model the score of a path to take in exactly 10 swings.

Upon mapping out the city for possible routes, you also find out that there are 3 possible obstacles that you might encounter that will slow down your path by increasing the total length of the path to take by a certain number of units. They are as follows:

a. Tree: Increased by a factor of 5 units
b. Building: Increased by a factor of 11 units
c. Sinister 6 villain: The length of your current segment in a path doubles (i.e. if you are in the 2nd and 3rd point of your path, the length will be multiplied by 2).

The distance formula for 3D points can be generalized using the euclidean distance as if it were in a cartesian plane.

Reference: https://www.varsitytutors.com/hotmath/hotmath_help/topics/distance-formula-in-3d)

Optimal Dog Breeds (3 pts)

You are in charge of simulating a dog breeding program that will find the best suitable match of a pair of dogs to create the ultimate dogo. To simplify the problem, the score of a pair of dogs is simply the sum of their attribute scores.

A dog can be represented by the following attributes:

- Breed (string)
- Weight (float)
- Body Fat (float from 0 - 1)
- Is Vaccinated (boolean)
- Has Won Award (boolean)
- Age (integer)
- Intelligence (float)

Create a fitness function that scores a pair of dogs with the following constraints:

a. If the pair of dogs' breed are not equal, then the value of the attribute is 0
b. The weight value should not be taken at face value and should be categorized according to the following range:
    i. Less than 40 = Poor and will have a negative effect on the score
    ii. 40 to 80 = Good
    iii. Greater than 80 = Average and will not have an effect on the score
c. The body fat should not be taken at face value and should be categorized according to the following range:
    i. 0 to 0.25 = Excellent
    ii. Greater than 0.25 to 0.75 = Average
    iii. Greater than 0.75 = Poor
d. If a dog has won an award, and the weight is not considered good, then it will be as good as not having won the award.
e. Assume that the age can only be from 1 - 5 where ages 1 and 2 will not be of any value, age 3 will add +1 to the score while ages 4 and 5 will add -1 to the score if the dog won an award and -2 if the dog is not an award winner.

What will the fitness function look like?

Black and White Mona Lisa (4 pts)

If Mona Lisa was painted in black and white as a 256 x 256 canvas, where each pixel in the canvas represented a value from 0 - 1 (percentage value from 0 - 255), write a genetic algorithm that will attempt to repaint mona lisa in a different resolution of 64x64 where each cell (pixel) of the 64x64 is a resolution is a representation of a 4x4 block in the 256x256 canvas. The average value of the 4x4 block from the original canvas will be the basis of truth or the representation of what is “ideal”.

Example:

Original block from Mona Lisa

0.90	0.98	0.95	0.95
0.98	0.98	0.98	0.95
0.98	0.95	0.90	0.90
0.90	0.98	0.90	0.98

A cell from the 64x64 repaint version related to block above has a value of: 0.94
Average Value of Original Block: 0.9475
Difference: (0.9475 - 0.94)^2 = 0.00225625