**IT 340 Fall 2024**

**Programming Assignment 2 (80 points)**

1. (30 points) Modify the PathFindingAgent class so that the agent can return better results. Specifically, the modified code should meet the following two requirements:
   1. The agent should no longer return paths that have repeating cities.
   2. The agent should perform the search based on a budget constraint. This means the solve method will have one more parameter called budget. And the search result should include a cost that is lower or equal to a given budget. If the budget is too low, the method should stop after a few tries and display a message telling users to increase the budget.
2. (50 points) Implement the genetic algorithm for the 8-queen puzzle. The fitness function used to evaluate each state is provided in a separated Python file.

A screenshot of a computer program

Description automatically generated

A few suggestions regarding the implementations are given as follows:

1. The Random-Selection process may select parents based on their fitness. That is, it may only select parents that have a fitness score that is above some threshold.
2. The Mutate process may be applied to several locations on a chromosome, instead of one.

Sample output for the Visualization:

A group of graphs with numbers

Description automatically generated

Requirements:

1. Do not modify the fitness function provided.
2. You are required to include a separate function to produce the first generation (population).
3. You are required to set a random seed to make your results replicable.
4. You are required to include a visualization to demonstrate the trend of fitness scores for each generation. The sample output consists of the max (blue), min (yellow), and average (black) fitness scores in each generation under 4 different population sizes. Your implementation should do the same thing.
5. Use matplotlib for the visualization only.
6. Submit your Python source code file on Canvas.
7. Due September 24 at 11:59 PM.