

Assignment II, Genetic Algorithms

Goal: To get acquainted with the idea and implementation of Genetic Algorithm (GA). To understand the effects of parameters in the GA on an optimization problem. To do necessary changes and modifications on the given implementation to resolve optimization problem.

Reading advice: Russell & Norvig: Artificial Intelligence - A Modern Approach, Section 4.3 in the 2nd edition.

Tasks

Tasks 1:

Problem Definition: You are going to solve a Travelling Salesman Problem (TSP). The TSP is defined as finding the shortest route between a set of locations or cities that must be visited by a salesman. The salesman's goal is to keep both the travel costs and the distance traveled as low as possible. Therefore, it is necessary to design and implement a computer-based algorithm to find these set of locations that must be visited by the salesman with a minimum cost. In this task, you will use a GA to resolve this optimization problem and the implementation of the GA is provided on the webpage link below:

You will test the performance of the GA using different combinations of population sizes and mutation probabilities to understand and analyze the effects of parameters on the GA and you are going to change the following parameter values to solve the corresponding problem:

- a) *Population size:* 10, 20, 50, 100
- b) *Mutation Rate:* 0.9, 0.6, 0.3, 0.1
- c) Do **not** change the other parameters in the GA.

Note that, you will run GA 10 different times for each parameter value and the average of the results will be shown on the graph. For instance, you will set the population size as 5 and run the algorithm 10 times and the average of the results in each iteration will be shown in the figure.

In the report, you must include the average results of figure. Summarize, analyze, and discuss the results.

Tasks 2:

Problem Definition: You are going to solve a maximization problem and describe the given mathematical equation. To do it, you must implement a fitness function the given equation below for the given GA implementation (you can download the code from the Canvas). The GA will be used for optimizing the equation which is as follows:

$$2*x*z*e^{-x}-2*y^3+y^2-3*z^3$$

In the report, you must include **only** fitness function implementation. Also, you must submit your whole python code with the report.

Tasks 3:

Problem Definition: You are going to solve a maze problem using Genetic Algorithm. The aim of this task is to find a path in a maze, shown in the figure below, for a mouse to reach the destination or food with a shortest and acceptable path. You are going to implement a Genetic Algorithm that will find the solution to find the path by optimizing the problem automatically.

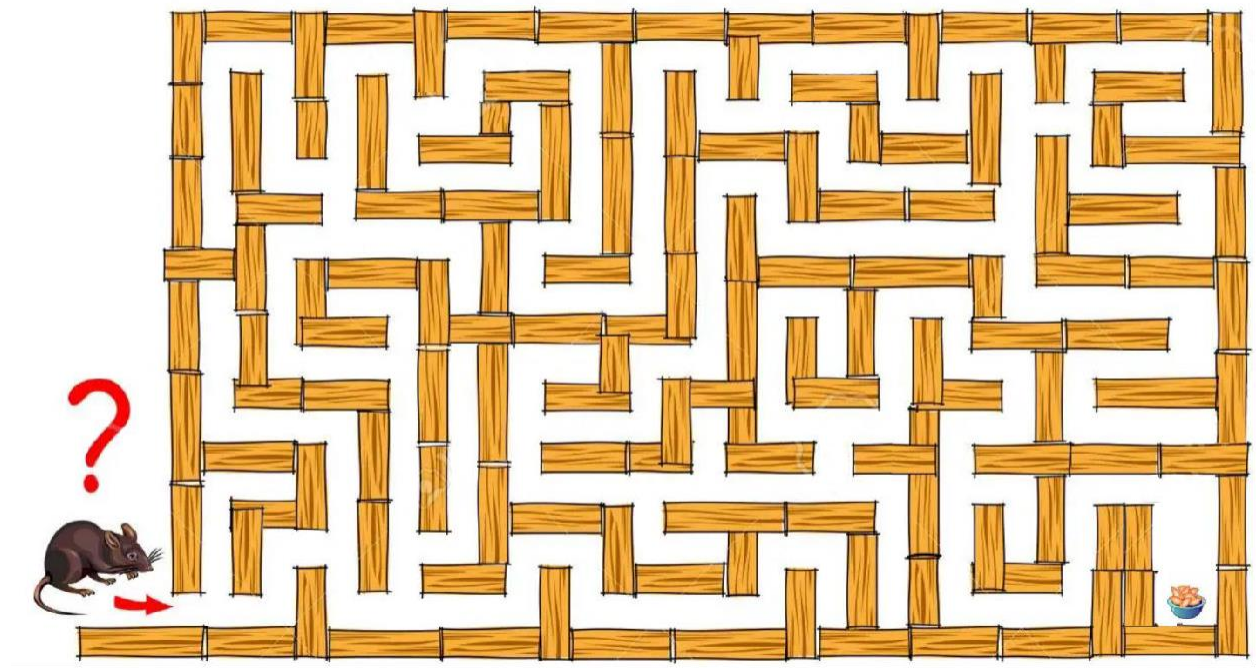
In this task, the implementation should be done in Python and submit the *implementation in .py or ipynb*.

Hint: To solve this problem, you need to create a 2D - matrix where the possible passes should be 1 and obstacles must be 1000. The matrix should be of the same size as the maze matrix (for this task, it is 20 x 33).

More information and details about the problem can be found on the following webpages:

<https://www.educative.io/answers/what-is-the-maze-problem>

<https://tonytruong.net/solving-a-2d-maze-game-using-a-genetic-algorithm-and-a-search-part-2/>



Grading and Evaluation

In order to pass this assignment, at least one task must be done well. For better grade, at least two tasks must be done well. The grading is mainly based on the quality of the report, how well you manage to make an intelligible analysis of the results and discuss, how well you understand the problem and do the necessary changes on the implementations to solve optimization problems.

The assignment is graded between F - A. It is important to note that this is an individual assignment. This means that everything that you submit for grading must be created by you. Plagiarism is not allowed in any form.