King Fahd University of Petroleum & Minerals
Information and Computer Science Department

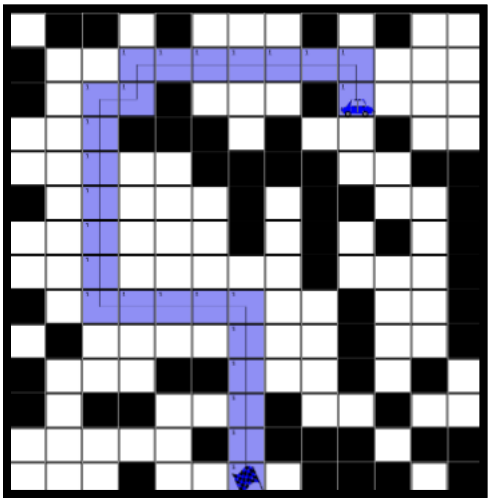
ICS 381: Principles of Artificial Intelligence (Term 211)

Programming Assignment #01 [Deadline: Oct. 17 before midnight]

Notes and Submission Guidelines:

1. This homework is to be done by individual students (**no group work**) and should abide by the university academic integrity policy; cheating will result in severe penalty and ZERO grade.
2. Submit a compressed file named HW1-ID.ZIP, where ID is your KFUPM ID; include the source code as a **Jupyter Notebook** and a PDF report briefly explaining the design and pseudocodes as well as results for various test cases under different conditions.
4. **Only submissions through Blackboard before the deadline will be accepted**. To avoid errors and follow a unified procedure, submissions are not accepted by emails or any other means for whatever reasons; so submit as early as possible to avoid technical problems at the last hour.
5. Failure to follow the above submission guidelines will be penalized.

To motivate your leaning experience of AI principle, in this programming assignment it is required to design and implement a simulator for a simple robot agent for path finding then compare and visualize the steps of different path finding algorithms. The environment consists of a grid that may have obstacles indicated by black cells. When the simulator program runs, it provides the user two options: (a) randomly generates a grid with obstacles, or (b) allows the user to specify the dimensions of the grid and the location of the obstacles (bonus score when using extra libraries and draw the grid using the mouse). The user also specifies the start and destination cells on the grid. An example of a grid and found path between start and end cells in shown below.



The user can select one of the following algorithms:

1) A* Algorithm
2) Theta* Algorithm (more information and pseudocode can be found at https://en.wikipedia.org/wiki/Theta*)
3) Genetic Algorithm (implementation in python at https://github.com/Yaaximus/genetic-algorithm-path-planning)

For A* algorithm, the user can choose to run the simulation and see the final path or to see the execution and movement step-by-step. For the genetic algorithm, allow the user to set and try various parameters and operations, such as population size, number of generations, crossover, mutation rate, recombination with/without elitism. You may external libraries or packages for the graphical user interface (GUI). However, since this assignment is for learning purpose, do not use exiting online solutions or packages for other AI algorithms.

The comparison should include the resulting paths, path lengths, and running times for various environments as well as start and end points (at least for the following scenarios).

Environment Specs	**A***	**Theta***	**GA**
Test case 1 (simple grid)	Visualize path Path length: Time:	Visualize path Path length: Time:	Visualize path Path length: Time:
Test case 2 same as test case 1 but different destination	Visualize path Path length: Time:	Visualize path Path length: Time:	Visualize path Path length: Time:
Test case 3 (medium complexity)	Visualize path Path length: Time:	Visualize path Path length: Time:	Visualize path Path length: Time:
Test case 4 same as test case 3 but different destination	Visualize path Path length: Time:	Visualize path Path length: Time:	Visualize path Path length: Time:
Test case 5 (complex grid)	Visualize path Path length: Time:	Path length: Time:	Path length:
Test case 6 same as test case 5 but different destination	Visualize path Path length: Time:	Visualize path Path length: Time:	Visualize path Path length: Time:

Assume any missing information and be creative. Follow good programming practices in writing clear and commented code in object-oriented paradigm.