Artificial & Computational Intelligence
Assignment 1 - Question 1

Problem statement

Minefield detection during the war is challenging with many uncertainties as detection is still an evolving field. During the war, the commander must undertake a challenge to reach a destination by avoiding detection and avoiding minefields using an optimal path. The challenge is probabilistic and non-deterministic; complete knowledge is unavailable for the minefield position. This changes drastically when technology is used to find mines. As part of Make in India, a company has designed a low-budget Drone that uses customized acoustic algorithms to detect mine cases and special chemical sensors to detect vapor leaks from mines. However, the accuracy of the system is always at most 80%. The terrain to be traversed can consist of open terrains, which the enemy can monitor, and large shrubs, which can reduce the chances of detection.

You are approached to build an AI-based decision support system that can take the inputs from the satellite (land terrain – the probability of detection (PoD), drone (probability of mine (PoM)), and from the commander to understand the level of risk he is willing to undertake to reach the destination at the earliest. However, avoiding the minefield has the highest priority, as the commander cannot risk his team by acting rashly.

Prove that your technique is correct for the case given as a maze problem when the fitness f(n) of a given coordinate cell is given by:

$$Minimize(f(n))=[(1+PoD)(1+PoM)]$$

Apply the Random Restart Hill Climbing algorithm & Suggest the best solution obtained and optimal cost so the commander can decide the best course of action. Interpret the observation eg., on how many no.of.random restarts were used in your algorithm to get the global optimum.

	0	1	2	3	4	5	6	7	8	9
9	0.2/0.9	0.8/1	0.05/0.05	0.8/0.9	0.8/0.9	[red]	Goal	0.05/0.05	0.2/0.1	[red]
8	[red]	0.05/0.05	0.05/0.05		0.8/0.9	0.8/0.9	0.05/0.05	0.05/0.05	0.2/0.1	0.2/0.1
7	0.2/0.9	[red]	0.2/0.1	[red]	0.2/0.1	[red]	[red]	[red]	0.2/0.1	0.2/0.1
6	0.2/0.9	[red]	0.2/0.1	[red]	0.2/0.1	0.3/0.9	0.2/0.1	0.2/0.1	0.2/0.1	0.2/0.1
5	0.2/0.9	[red]	0.2/0.1	[red]	0.3/0.9	0.2/0.1	0.2/0.1	0.2/0.9	0.2/0.9	0.2/0.1
4	0.2/0.9	0.2/1	0.2/0.1	0.3/0.9	0.3/0.9	0.2/0.1	[red]	[red]	[red]	0.05/0.05
3	0.2/0	0.2/0.1	0.2/0.1	0.05/0.05	0.05/0.05	0.05/0.05	[red]	0.05/0.05	0.05/0.05	0.05/0.05
2	0/0	0/0	0/0	0.05/0.05	0.05/0.05	0.05/0.05	[red]	0.05/0.05	0.05/0.05	0.05/0.05
1	0/0	0/0	0/0	0.05/0.05	0.05/0.05	[red]	0.05/0.05	0.05/0.05	[red]	0.05/0.05
0	0/0	0/0	0/0	[red]	[red]	[red]	0.05/0.05	0.05/0.05	[red]	[red]

represents starting points	represents Destination	represents no path

Inside Grid values

0.05/0.5   Probability of Detection / Probability of Mine

PoD/PoM

Evaluations will be based on the following:

1. Explain the PEAS (Performance measure, Environment, Actuator, Sensor.) for your agent. (20% marks)
2. Use the above mentioned algorithm and implement in PYTHON. (40% marks)
3. Print the optimal path sequence with costs. (20% marks)
4. Include code in your implementation to calculate the space complexity and time complexity for the informed search and print the same. For local search interpret the significance of the hyperparameters if any applicable . (20% marks)

Note 2:

- You are provided with the python notebook template which stipulates the structure of code and documentation. Use well intended python code.
- Use a separate MS word document for explaining the theory part. Do not include the theory part in the Python notebook except Python comments.
- The implementation code must be completely original and executable.
- Please keep your work (code, documentation) confidential. If your code is found to be plagiarized, you will be penalized severely. **Parties involved in the copy will be considered equal partners and will be penalized severely.**