1. a) Give a PEAS description of the task environment for the following agents: (15 marks)
   - An intelligent agent that solves Rubik's Cube.
   - A drone to deliver commercial packages in a city.

   b) For each of the above scenarios, characterize and discuss the environment according to whether it is fully or partially observable, static or dynamic, deterministic or stochastic, episodic or sequential, discrete or continuous.

2. Consider the problem of moving a knight on a 4x3 chess board with start and goal states labeled as S and G in the figure below. The letter in each cell represents its name and the subscript digit is its heuristic value, h(). Assume all transitions have the cost value of 1.

   Note: A knight in the chess moves in an "L-shape". In fact, it can move two squares in any direction vertically followed by one square horizontally, or two squares in any direction horizontally followed by one square vertically. (25 marks)

S_4	A_1	B_2
C_1	D_2	E_3
F_2	H_3	**G_0**
I_1	J_2	K_3

   a) Create a search graph for the knight on this board.

   b) Write the sequence of nodes in the order visited by the specified algorithms below.

   Assumptions:

   - The algorithms do not generate paths with loops.
   - Nodes are selected in the alphabetical order when a tie occurs.
   - A node is visited when that it is at the front of the search queue.

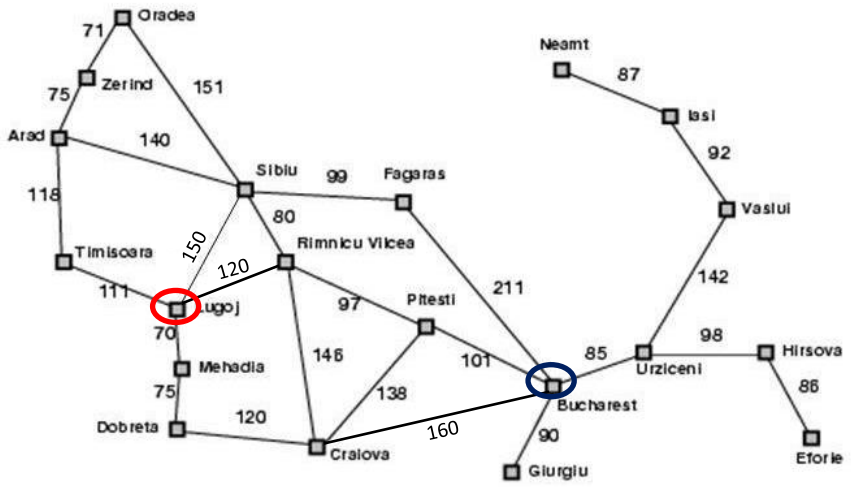
   I. Depth-first search algorithm.

   II. Breadth-first search algorithm.

   III. A* search algorithm. Please also show the total cost and details of the steps.

   IV. Please discuss which search algorithm do you prefer to use for this problem and why?

3. Given the figure below, suppose you want to go from start location "Lugoj" to destination location "Bucharest". The route distances are labeled on the edges between towns. The table on the right gives the straight-line distances from the cities to Bucharest. Write down the order in which the states are visited, and the path found by the following search algorithms. Show the steps that the algorithm takes to find the path. (15 marks)



Straight-line distances to Bucharest	
Arad	366
Bucharest	0
Craiova	160
Drobeta	242
Eforie	161
Fagaras	176
Giurgiu	77
Hirsova	151
Iasi	226
Lugoj	244
Mehadia	241
Neamt	234
Oradea	380
Pitesti	100
Rimnicu Vilcea	193
Sibiu	253
Timisoara	329
Urziceni	80
Vaslui	199
Zerind	374

Note: Assume that algorithms execute the goal check when nodes are visited.

I. Greedy Search

II. Uniform Cost search algorithm

III. A* search algorithm. Please also show the total cost and details of the steps.

4. The "missionaries and cannibals" problem is a classic AI problem. Three missionaries and three cannibals are on one side of the river and want to cross the river using a boat. The boat can hold one or two people and must have at least one person in it to cross the river. The issue is, at any time, on either side of the river, if there is a positive number of missionaries and the number of cannibals is greater than the number of missionaries, the missionaries will get eaten. Therefore, the problem is to find a way to get everyone to the other side of the river without ever leaving a group of missionaries outnumbered by the cannibals on either side of the river. (15 marks)
Note: Assume that in the initial state the same number of missionaries and cannibals are on one side of the river.

a) Propose three different admissible heuristics for this problem.

b) Explain your heuristics and discuss why they are admissible.

5. Someone asked the following question on Stackoverflow website at "https://stackoverflow.com/questions/33026560/what-is-the-point-of-ida-vs-a-algorithm", "What is the point of IDA* vs A* algorithm", "I don't understand how IDA* saves memory space. From how I understand IDA* is A* with iterative deepening. What's the difference between the amount of memory A* uses vs IDA*." (10 marks)

   What is your answer to this question?

6. Please describe and show how genetic algorithm works for the 5-queen problem. Assume the number of initial population is 5, and the number of iterations are 4. Please first describe the required steps, your individual representation method, and the fitness function. (20 marks)