Artificial Intelligent (CDT 312) 2018 Exam 1

RULES: The exam starts on Tuesday 20th of March at 14:00 and it will end on Tuesday 20th of March at 21:00. Exams that are not handled in before 21:01 will not be corrected. In the subject of the email, write: "[CDT312 EXAM] studentName, StudentLastname", Emails without this subject will not be corrected.

The student is supposed to send a pdf with the following name:

- name_lastname_studentid.pdf

The exams with the incorrect format will not be corrected.

DO NOT COPY, if I find someone copying, He/She/both will be failed (also failed in the lab part) and this will be reported. I recommend you not to copy text from the book or from internet.

Use the given template (doc file) attached to the same email only for the first page of the pdf.

GRADE:

- score < 20: fail
- 20 <= score < 28: 3
- 28 <= score < 37: 4
- Score >= 37: 5

Good luck!!

1. – In the problem of finding the shortest path in a graph from one node to another is one of the most important problems in AI. Imaging a map (like the map from Rumania in the lectures or the map from Spain in the assignment 2) with some nodes and some connections between them. The problem is to find the path from one starting point to an end point. Solve the following question: **(6 points)**

1.1. – What is the representation of a possible solution for the problem (not necessary the best). (Write it in a mathematical way)*(1 point)*

1.2. - Give to me the fitness equation for this problem (what we want to minimize or maximize). (Write it in a mathematical way) *(1 point)*

Imagine that we want to solve this problem with A*.

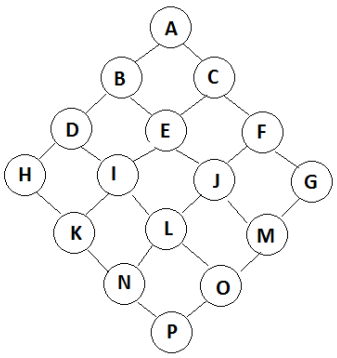
1.3. - Give to me f(n) equation used in A* and explain every parameter on it. *(1 point)*

1.4. - Give to me a possible heuristic function that will make A* optimal, and explain why, using this heuristic function, A* is optimal. *(1.5 points)*

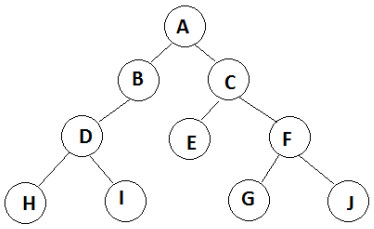
1.5. - Explain how A* works and give the main difference(s) with Greedy Best First Search. *(1.5 point)*

2. - Given the following trees. Tell me how many nodes will be explored, (counting the root (A) and the goal (G) and you can visit every node only once) with the following search strategies (if you can use them): Breadth-first Search, Uniform-Cost Search, depth-First Search, depth-limited search (with l = 1) and iterative deepening search. Additionally explain why you have that results and give the order that the nodes will be expanded. (Example: A->Y->…->G) (If two Childs have been created at the same time without a preference, the left child will have preference) **(6 points)**

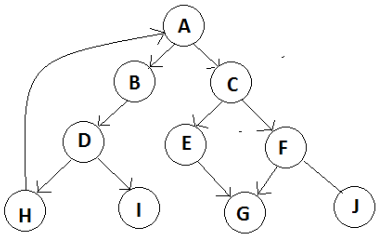
TREE 1



TREE 2



TREE 3



3. – Chess is a two-player strategy board game played on a chessboard. Applying tree search trying to find a final solution for this problem/game, answer the following questions: **(9 points)**

3.1. - What is consider as a state? *(1 point)*

3.2. - Which is the initial State? *(1 point)*

3.3. - Which is/are the possible action(s)? *(1 point)*

3.4. - Which is the goal state*? (1 point)*

3.5. - Give the following values:

3.5.1. - Which is the maximum branching factor of the tree (b)? *(1 point)*

3.5.2. - Which is the Depth of the shallowest solution (d)? *(1 point)*

3.5.3. - Which is the Maximum depth of the search tree (m)? *(1 point)*

3.6. - Is it suitable to use BFS or DFS to find a solution for this problem? Explain your answer. (2 points)

4. - Job shop scheduling problem. We have N jobs and every job has O operations. We have M identical machines. We want to run all the jobs in the given machines and we want to do it in the minimum possible time. Two operation from the same job need to be processed in order (in order to execute operation 2 from job 1, operation 1 from job 1 need to be finished). The operations do not required the same time to be solved. **(9 points).**In order to receive points from 4.2 you need to answer correctly 4.1, In order to receive the points from 4.3 you need to answer correctly 4.1 and 4.2 and so on.

4.1. – Give the representation of a solution of the problem. (Give it in a mathematical way) *(1.5 point)*

4.2. – Give the restriction(s) of the problem, using the previous representation. (Give it in a mathematical way)*(1.5 points)*

4.3. - What is the fitness function in this problem and how you can calculate it? (You can explain this question with text) *(1.5 points)*

4.4. - Which algorithm will you select to solve this problem, Particle Swarm Optimization, Genetic Algorithm or Differential Evolution? Explain why you selected that one and why you do not select the others. *(2.5 points)*

4.5. - From the selected algorithm, explain the main operators that the algorithm use. (Explain it with your own words) *(2 points)*

5. - In the lectures, we learn how to use backpropagation in order to train the weights of a neural net for a specific problem (titanic classification). Another way to train the weights is using Evolutionary algorithms. Answer the following questions **(8 points)**:

5.1. - Which evolutionary algorithm(s) is possible to use in order to train a neural net: Genetic Algorithm, Differential Evolution, Particle Swarm Optimization, ant colony optimization or/and genetic programing? Explain why you can choose that or those algorithm(s) and why you cannot choose the other(s) *(2.5 points)*

5.2. - Give the representation of a solution for this problem (The problem of training the weights of a neural net). (Give it in a mathematical way). *(2.5 point)*

5.3. - What will be the fitness function? (Explain this with text) *(2 point)*

5.4. - Imaging that you are solving this problem with Ant colony Optimization (it is possible that you cannot solve this problem with genetic algorithms), explain which crossover operator(s) is/are more suitable for this problem and explain it/them. *(1 point)*

6. – Sudoku. Check the rules on internet. Answer the following question: **(2 points)**

6.1. – What is the representation of a possible solution for the problem. (Write it in a mathematical way)*(1 point)*

6.2. - Give to me the constraints for this problem. (Write it in a mathematical way) *(1 point)*