Artificial Intelligent (CDT 312) 2017 Exam 1

RULES: The exam starts on Tuesday 21th of March at 14:00 and it will end on Tuesday 21th 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. – The 8-puzzle is a square board with 9 positions, filled by 8 numbered tiles and one gap. At any point, a tile adjacent to the gap can be moved into the gap, creating a new gap position. In other words the gap can be swapped with an adjacent (horizontally and vertically) tile. The objective in the game is to begin with an arbitrary configuration of tiles, and move them so as to get the numbered tiles arranged in ascending order ordered from left to right, with 1 in the top left-hand position. Solve the following question: **(6 points)**

1.1. – What is the representation of a possible solution for the problem (not 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*.

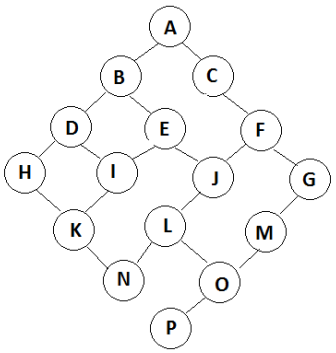
1.3. - Give to me f(n) equation used in A* and explain every parameter on it. *(1 point)*

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)*

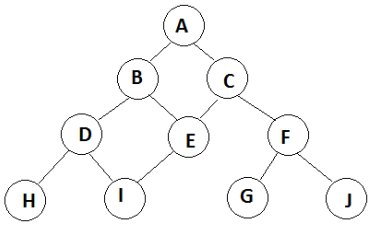
1.5. - Explain how A* works and give the main difference(s) with Greedy Best First Search. *(1.5 point)*

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)**

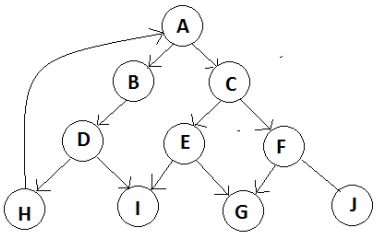
TREE 1



TREE 2



TREE 3



3. – Checkers 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 or/and genetic programing? Explain why you can choose that or those algorithm(s) and why you cannot choose the other(s) *(2 points)*

5.2. - Give the representation of a solution for this problem (The problem of training the weights of a neural net). *(2 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 genetic algorithms (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. *(2 point)*

6. – The 8-Queens problem is the problem of placing eight chess queens on an 8x8 chessboard so that no two queens threaten each other. Answer the following question: **(2 points)**

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

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