Report LINFO1361: Assignment 3

Group N°...

Student1: ....

Student2: ....

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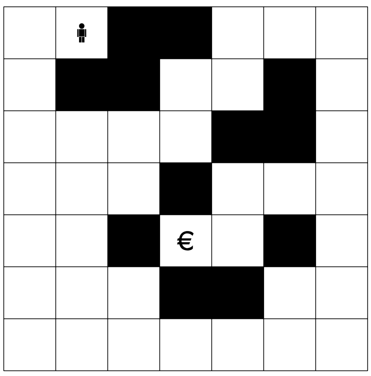
1 Search Algorithms and their relations (3 pts)

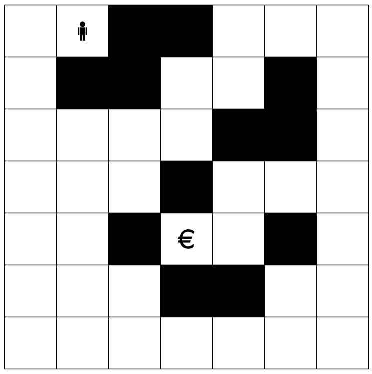
Consider the maze problems given on Figure 1. The goal is to find a path from 🚹 to € moving up, down, left or right. The black cells represent walls. This question must be answered by hand and doesn't require any programming.

1. Give a consistent heuristic for this problem. Prove that it is consistent. Also prove that it is admissible. **(1 pt)**

2. Show on the left maze the states (board positions) that are visited when performing a uniform-cost graph search, by writing the order numbers in the relevant cells. We assume that when different states in the fringe have the smallest value, the algorithm chooses the state with the smallest coordinate (i, j) ($(0, 0)$ being the bottom left position, i being the horizontal index and j the vertical one) using a lexicographical order. **(1 pt)**



3. Show on the right maze the board positions visited by $A^{\star}$ graph search with a manhattan distance heuristic (ignoring walls), by writing the order numbers in the relevant cells. A state is visited when it is selected in the fringe and expanded. When several states have the smallest path cost, they are visited in the same lexicographical order as the one used for uniform-cost graph search. **(1 pt)**



2 N-Amazons problem (8 pts)

1. Model the N problem as a search problem; describe: **(2 pts)**
   - States
   - Initial state
   - Actions / Transition model
   - Goal test
   - Path cost function

2. Give an upper bound on the number of different states for an N-Amazons problem with N=n. Justify your answer precisely. **(0.5 pt)**

3. Give an admissible heuristic for a N=n. Prove that it is admissible. What is its complexity ? **(1 pts)**

5. **Implement** your solver. Extend the *Problem* class and implement the necessary methods and other class(es) if necessary. **(0.5 pt)**

6. **Experiment**, compare and analyze informed (*astar_graph_search*), uninformed (*breadth_first_graph_search* and *depth_first_graph_search*) graph search of aima-python3 on N = [10, 11, 12, 13, 20, 25, 30]. **(3 pts for the whole question)**

   Report in a table the time and the number of explored nodes and the number of steps to reach the solution.

   Are the number of explored nodes always smaller with *astar_graph_search*? What about the computation time? Why?

   When no solution can be found by a strategy in a reasonable time (say **3 min**), indicate the reason (time-out and/or exceeded the memory).

	A^* Graph			BFS Graph			DFS Graph		
Inst.	NS	T(s)	EN	NS	T(s)	EN	NS	T(s)	EN
i01									
i02									
i03									
i04									
i05									
i06									
i07									
i08									
i09									
i10									

NS: Number of steps — **T**: Time — **EN**: Explored nodes

6. **Submit** your program on INGInious, using the A^* algorithm with your best heuristic(s). Your file must be named *namazon.py*. Your program should be able to, given an integer as argument, return the correct output. Your program must print to the standard output a solution to the N's given in argument for the N-Amazons problem, satisfying the described output format. **(2 pts)**

3 Local Search: Sudoku Problem (8 pts)

1. Formulate the Sudoku problem as a Local Search problem (problem, cost function, feasible solutions, optimal solutions). **(2 pts)**

1. You are given a template on Moodle: `sudoku.py`. Implement your own simulated annealing algorithm and your own `objective_score` function. Your program will be evaluated in on 15 instances (during 3 minutes each) of which 5 are hidden. We expect you to solve (get the optimal solution) at least 12 out of the 15. **(6 pt)**