EXAM OF FUNDAMENTALS OF AI – FIRST MODULE

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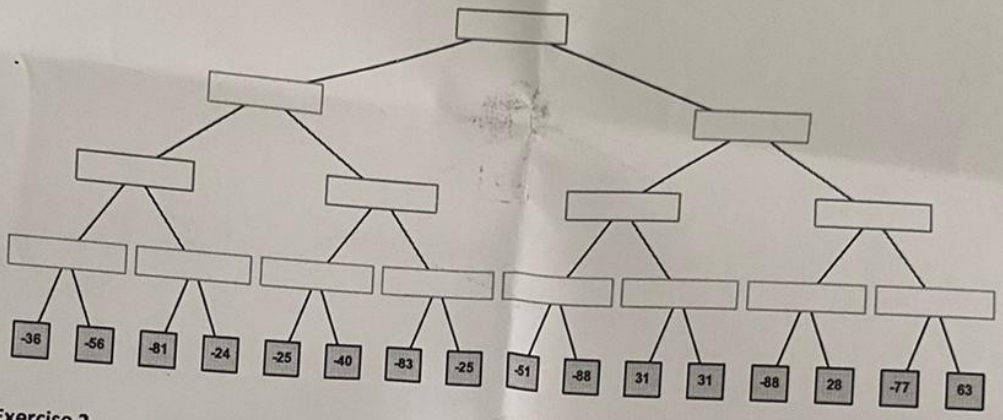
PROF. MICHELA MILANO

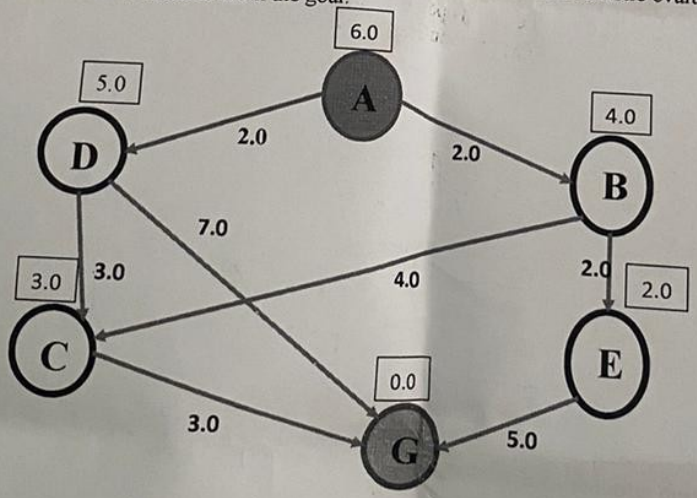
Exercise 1

Consider the following game tree where the first player is *MAX*. Show how the *min-max* algorithm works and show the *alfa-beta* cuts. Also, show which is the proposed move for the first player.



Exercise 2

Consider the following graph, where A is the starting node and G the goal node. The number on each arc is the cost of the operator for the move. Close to each node there is the heuristic evaluation of the node itself, namely its estimated distance from the goal:



a) Apply the depth-first search, and draw the developed search tree indicating for each node n the cost g(n) and the expansion order; in case of non-determinism, choose the nodes to be expanded according to the alphabetical order.

b) Apply the A* search, and draw the developed search tree indicating for each node n the function f(n) and the expansion order. In the case of non-determinism, choose the nodes to be expanded according to the alphabetical order. Consider as heuristic h(n) the one indicated in the square next to each node in the figure, that is: $h(A) = 6$, $h(B) = 4$, $h(C) = 3$, $h(D) = 5$, $h(E) = 2$, $h(G) = 0$. Is the heuristic h

defined in this way admissible?
What advantage is obtained by applying A*, compared to the outcome of the depth-first search?

Exercise 3

Given the following CSP:

A::[4, 5, 6, 7, 8, 9, 10]
B::[1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
C::[1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
D::[1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

A>B-5
C>B-7
A=D+3
B=D+2

Find the first solution through tree search, by applying forward checking, using alphabetical order of variables and lexicographic order of values.

Exercise 4

The Befana is in a house where two siblings live and, depending on whether a child behaved in a good or bad way during the past year, she has to deliver either candies or charcoal.

Given the following initial state:
handempty, good(sibling_1), bad(sibling_2), in_bag(candies), in_bag(charcoal)
you want to reach the goal:
has(sibling_1, candies), has(sibling_2, charcoal)

The actions are modeled as follows:
grab(Item)
PRECOND: handempty, in_bag(Item)
DELETE: handempty, in_bag(Item)
ADD: has(befana, Item)

give_candies(Person)
PRECOND: good(Person), has(befana, candies)
DELETE: has(befana, candies)
ADD: has(Person, candies), handempty

give_charcoal (Person)
PRECOND: bad(Person), has(befana, charcoal)
DELETE: has(befana, charcoal)
ADD: has(Person, charcoal), handempty

Solve the problem with the POP algorithm, identifying threats and their solution during the process.

Exercise 5

1) Model the action **grab** (preconditions, effects and frame axioms), and the **initial state** of the exercise 4 using the Kowalsky formulation.
2) Show two levels of graph plan when applied to exercise 4.
3) What are non-informed search strategies? Describe the strategies that have been presented during the course.
4) What is Particle Swarm Optimization and which are the main features?
5) What is conditional planning and what are its main limitations?