Artificial Intelligence

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PART I – Search and Planning

October 30th, 2017

First Name and Last name

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The results of the exams of all the students will be posted in a single file in the Moodle web page. Each student will be identified only by his/her 'Matricola' code (Sapienza registration number). If you do not agree on having your grade listed in this file, please check this box:

NO-WEB [ ]

Maximum time is 75 minutes. You can use neither the text books nor your notes.

Students enrolled in the academic year 2016/17 in the Master Degree in Artificial Intelligence and Robotics, please check this box: [ ].

Students enrolled in the academic year 2017/18 in the Master Degree in Artificial Intelligence and Robotics, please check this box: [ ].

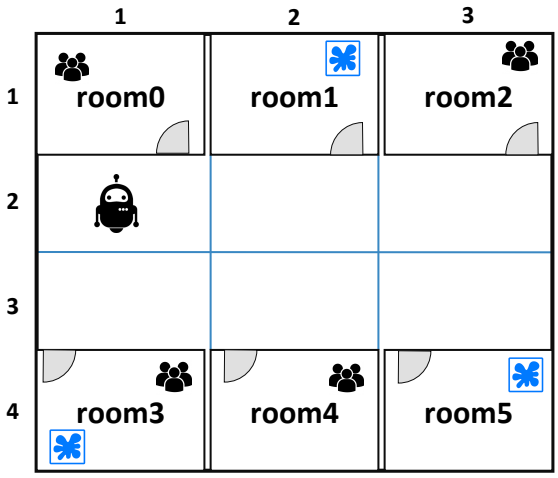
Students enrolled in academic year 2016/17 in the Master Degree Engineering in Computer Science and any other curricula that include a 6 ECTS course in Artificial Intelligence, please check this box: [ ]

Students enrolled in academic year 2017/18 in the Master Degree Engineering in Computer Science and any other curricula that include a 6 ECTS course in Artificial Intelligence, please check this box: [ ]

Exercise 1 (8 points)

MARRtino works in hotel

Our robot MARRtino works in a small hotel, whose map is represented as a grid world (see figure). MARRtino has the task of cleaning the rooms that are marked dirty in the map. MARRtino starts in the cell in front of room0 and can navigate the environment by moving inside the map in any of the 8 adjacent cells, that are traversable; it can also enter the hotel rooms by activating a specialized behavior, when is in the cell in front of the door. Once in a room MARRtino can clean it and then exit. MARRtino should not enter the rooms where it knows there are guests.



(a) Describe the domain in PDDL;

(b) Describe the problem in PDDL;

(c) Discuss the forward planning process to reach the goal, using a *perfect* heuristic that gives for each state the number of steps to reach the goal; for each step, show the current state, the applicable actions and the state resulting from the application of the chosen action.

Exercise 2 (4 points)

1. Describe the general principles underlying Hierarchical Task Networks.
2. Discuss whether the above problem can be suitably formalized using HTN.

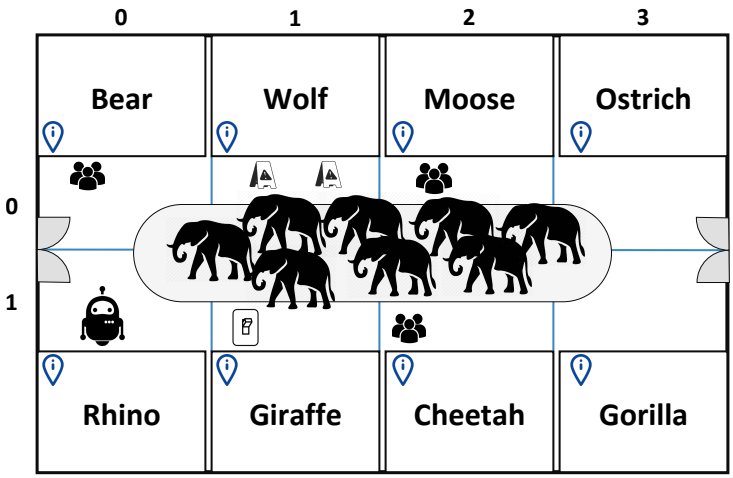
Exercise 3 (4 points)

Describe the local search techniques and in particular simulated annealing (not beam search and genetic algorithms).

Exercise 1 (8 points)

MARRtino at the natural history museum NYC

Our robot MARRtino works at the natural history museum in NYC and it knows the map of the museum, which is represented as a grid world (see figure). MARRtino starts from the cell in front of the *rhino* and it can navigate within the environment by moving in any of the adjacent cells, but it cannot enter the display areas with the animals nor the area with the wet floor signs. MARRtino is acting as the museum guide and its task is to turn the light on using the switch, and then reach each location where there are visitors and play the corresponding audio file. During the execution of the plan, people will patiently remain in the same location, waiting for MARRtino.



(a) Describe the domain in PDDL;

(b) Describe the problem in PDDL;

(c) Discuss the forward planning process to reach the goal, using a *perfect* heuristic that gives for each state the number of steps to reach the goal; for each step, show the current state, the applicable actions and the state resulting from the application of the chosen action.

Exercise 2 (4 points)

1. Describe the general principles underlying partial order planning.
2. Discuss whether the above problem can be suitably formalized using POP.

Exercise 3 (4 points)

Describe the heuristics that can be adopted in CSP (excluding forward reasoning).