Artificial Intelligence

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Homework 2

The homework must be delivered before *December, 19th 2016 23:55 UTC*. **The system will not accept neither new submissions nor modifications of already submitted material, when deadline is expired**.

In order to submit your solution, go to the course website `https://elearning2.uniroma1.it/course/view.php?id=4478` and search for the section **Homework-Planning**. In the same section, you also have to specify your preference for the discussion date in order to get a grade for the homework.

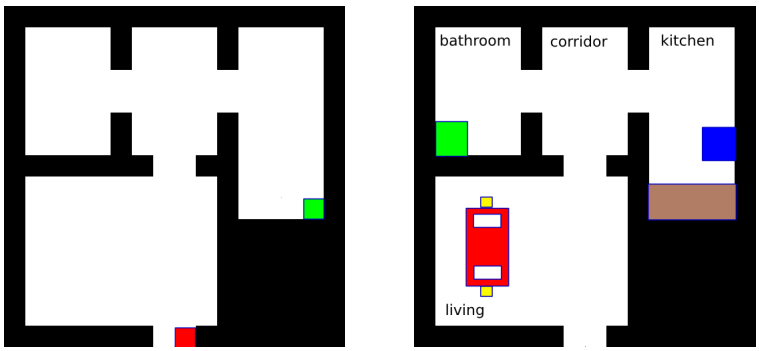
To deliver the homework you must provide an archive named *studentName_homework2*.zip, containing a folder for each exercise. Each folder must be filled by following the instructions specified in the "deliverable" section of the corresponding exercise.

Domestic Robot Problem

Vanilla

Consider the problem of a domestic robot that has to go from a *start* position to a *goal* position avoiding obstacles. The domestic environment is defined on an *Occupancy Grid* of $R \times C$ cells, as shown in Fig. 1(a), where the black cells represent walls and furniture, i.e. they cannot be traversed, while white cells are the admissible positions. The cell (r, c) is located in row r and column c, with $1 \leq r \leq R$ and $1 \leq c \leq C$. In order to navigate the environment

the robot can move to adjacent cells, as long as the resulting position is not outside the grid or on a black cell. A *solution* to the problem is a sequence of actions that bring the robot from *start* to *goal*.



(a) (b)

Figure 1: Domestic robot problem: (a) vanilla, (b) a possible extension with: table with cloth (red), trays (white), seats (yellow), closet (brown), dishwasher (blu), washing machine (green).

Extended

Consider the following extension to the previous problem description. The domestic environment is augmented by labeling each room of the house with its function (e.g. kitchen, bedroom, living, etc...) and adding typical domestic objects to provide it with furniture (e.g. tables, doors, closets, etc...), as shown in Fig. 1(b).

After you have dinner with your housemates (can be one or more, it doesn't matter), you want your personal robot to tidy up for you. Your habit is to eat in the living room, where you have the main table covered with a nice cloth and each seat is marked by a pre-defined cell. To make robot life easier, each place has a tray with plate and cutlery that the robot can grab. In particular, you want the robot to load and run the dishwasher and use the washing machine for the table cloth. Then, in order to complete the task, the robot has to put trays and dishes in the kitchen closet and the cloth on the table.

Homework

In the remainder you can find a description of the various exercises, with the specific requirements and instructions on how to deliver the corresponding solution.

EXERCISE 1

Requirement:

- Model the vanilla problem in `STRIPS`, translate it in `PDDL` and use `FF` to find a plan.

Deliverable: Write a brief report to explain your solution and the adopted design choices, present the problem formulation in `STRIPS` (predicates, actions, initial state and goal), provide (separately) the domain and problem files written in `PDDL` and show in the report the path computed by the planner by drawing it on a bitmap file (hint: you can use the code for Homework1).

EXERCISE 2

Requirement:

- Model the extended problem in `STRIPS`, translate it in `PDDL` and use `FF` to find a plan.

Deliverable: Write a brief report to explain your solution and the adopted design choices, present the problem formulation in `STRIPS` (predicates, actions, initial state and goal), provide (separately) the domain and problem files written in `PDDL` and show the plan computed by `FF`.

EXERCISE 3

Requirement:

- Model the extended problem in `POP`.

Deliverable: Write a brief report to explain your solution and the adopted design choices, present the problem formulation in `POP` by listing the relevant steps (hint: in doing so, choose an appropriate level of abstraction that makes the problem solvable in a reasonable number of steps) and draw the solution on a graph and highlight the ordering constraints that solve conflicts.

EXERCISE 4

Requirement:

- Model the extended problem in `HTN`.

Deliverable: Write a brief report to explain your solution and the adopted design choices, present the problem formulation in `HTN` by listing the primitive and high-level actions, show the process to generate a plan that implements the formulation.