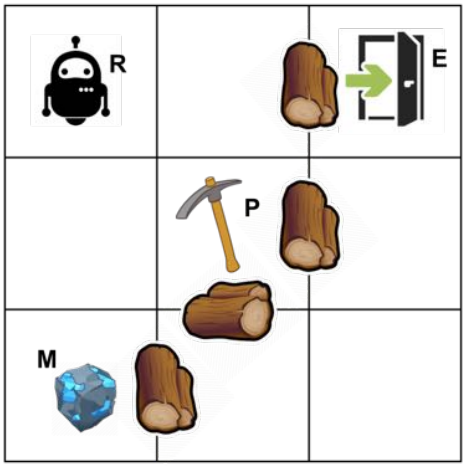
Search and Planning

Exercise 1 (8 points)

The figure shows the initial state of the world of a mining robot R that has the job to collect a rare mineral M and exit the mine at location E. The robot can move in the mine one cell at a time horizontally and vertically, but not along a diagonal. It can collect objects and strike (destroy) obstacles, if it is holding the pickaxe P. Wood obstacles can be strucken to clear the path (i.e. after a strike, the obstacle is removed and the path becomes traversable); however, after one strike the pickaxe becomes unusable. The goal of the robot is to exit the mine holding the mineral. While moving, the robot can hold only one object at time. Wooden obstacles exist in between two cells and they can be strucken only from one of these two cells. An obstacle does not prevent the robot from moving in the two cells that are partially occupied by the obstacle, but it does not allow the motion of the robot across the occupied border between the two cells.



(a) Model the mining robot problem in PDDL by defining the problem and domain file.

(b) Define a plan that achieves the goal.

(c) Show the forward planning process, by describing 4 steps in a state space exploration (for each step, you have to show the current state, the applicable actions and the state resulting from the application of each applicable action); at each step you have to choose only one successor state, according to the above presented plan.

(d) discuss the domain independent heuristics that can be applied by a forward planner.

Exercise 2 (4 points)

Define the notion of constraint satisfaction problem. Provide an example. Describe the main heuristics that can be applied to speed up the search for a solution using a backtracking algorithm.

Exercise 3 (4 points)

Define the notion of heuristics for heuristic search, providing examples. Sketch the main techniques to obtain heuristics for a given search problem.