Artificial Intelligence

Exercises on Search and Planning

1 Types of questions

For each of the domains described in the next section answer the following questions

1.1 Search

- characterize the state space, the operators, initial and final state;
- apply all the uninformed search techniques to find a solution and draw the corresponding search tree (consider both the case including the visited node check and without);
- discuss, optimality and computational complexity of each of the uninformed methods on the chosen environment.
- define at least one admissible heuristic and find a solution using A* and draw the corresponding search tree;
- discuss, optimality and computational complexity of each of the informed methods with respect to the chosen environment;
- find a solution with Best First Search and compare to A*;
- find a formulation of the problem that allows to use local search methods and apply any of the local search methods to obtain a solution.

1.2 Planning

- Define the domain in STRIPS/PDDL
- Define the problem in STRIPS/PDDL
- Apply forward planning and backwards planning to find a plan to reach the goal (describe the search process highlighting the alternatives not further explored in each step)
- Find a POP plan that achieves the goal
- Discuss the possibility of modelling the problem through HTN (not well suited to every problem)

2 Domains

Basic grid-world

Consider an environment represented by a $n \times n$ *grid*. An agent can move in any of the 8 adjacent cells unless they are occupied by an obstacle. The cost of each move is one. The agent starts from the lower leftmost cell and should reach the upper rightmost cell.

Formalize the problem of finding a sequence of agent moves to reach the goal.

Variant of the basic grid-world

Consider the case where the agent moves only horizontally and vertically (NOT along the diagonal) and must rotate in the corresponding direction in order to move. Same questions as above.

Slot-Machine

Consider a deterministic slot-machine, with three buttons that allow to change the value shown in the corresponding display. The admissible values are the digits 0..4. Every button changes the value by adding 3 (modulo 5). The sum of the three numbers can not be greater than 10 and lower than 4, unless the three values are all equal.

The initial state should have different digits and the goal state with all the digits equal.

Device placement

Consider an environment characterized by a 2×2 grid to be covered by two kind of devices (`A`,`B`). The grid is initially empty and the devices can be placed in the grid one at a time if the following constraints are satisfied. Type A devices can be placed in the grid only if the chosen cell is not occupied by another type A device (if there is already a type B device the type A device can be placed on top of the type B device). A type B device can only be placed in a a free cell. It is forbidden to have two devices of the same type on a row and on a column. The goal is to cover all the cells of the grid with devices.