Artificial Intelligence I

Lab 2 - Winter Semester 2023 / 2024
https://moodle.haw-landshut.de/course/view.php?id=10282

1. For each of the following activities, give a PEAS description of the task environment and characterize it in terms of the properties of task environments (observable? deterministic? episodic? static? discrete? agents?)

- Playing soccer.
- Shopping for used AI books on the Internet.
- Knitting a sweater.
- Bidding on an item at an auction.

2. Give a complete problem formulation for each of the following problems. Choose a formulation that is precise enough to be implemented.

(a) There are six glass boxes in a row, each with a lock. Each of the first five boxes holds a key unlocking the next box in line; the last box holds a banana. You have the key to the first box, and you want the banana.

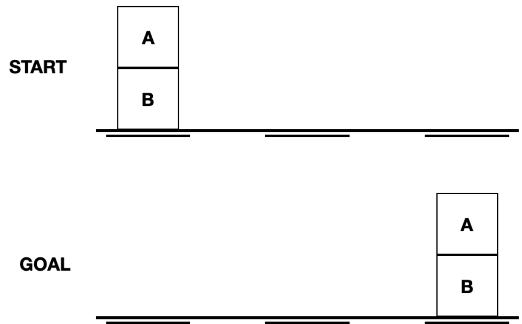
(b) You start with the sequence $ABABAECCEC$, or in general any sequence made from A, B, C, and E. You can transform this sequence using the following equalities: $AC = E$, $AB = BC$, $BB = E$, and $Ex = x$ for any x. For example, $ABBC$ can be transformed into AEC (using $BB = E$), and then AC (using $Ex = x$), and then E (using $AC = E$). Your goal is to produce the sequence E.

(c) There is an $n \times n$ grid of squares, each square initially being either unpainted floor or a bottomless pit. You start standing on an unpainted floor square, and can either paint the square under you or move onto an adjacent unpainted floor square. You want the whole floor painted.

(d) A container ship is in port, loaded high with containers. There 13 rows of containers, each 13 containers wide and 5 containers tall. You control a crane that can move to any location above the ship, pick up the container under it, and move it onto the dock. You want the ship unloaded.

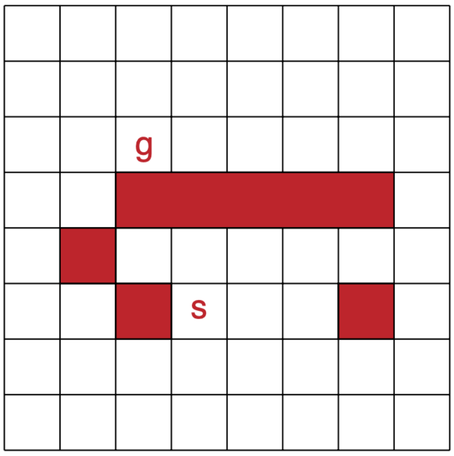
(e) Suppose two friends live in different cities on a map, such as the Romania map from the lecture. On every turn, we can simultaneously move each friend to a neighboring city on the map. The amount of time needed to move from city i to city j is equal to the road distance $d(i, j)$ between the cities, but on each turn the friend that arrives first must wait until the other one arrives (and calls the first on his/her cell phone) before the next turn can begin. We want the two friends to meet as quickly as possible.

3. Containers are restacked in a container warehouse. Three bays are available for this purpose. Containers A and B are to be transported from the left to the right bin, whereby the middle bin can be used. The containers can only be transported one at a time. With breadth-first search for the container problem, find a path from the starting node to the goal node.



Does it make sense to use depth-first search on the container-restacking-problem? How would you proceed if not only two containers are stacked on top of each other, but 10 or more?

4. Consider the problem of finding a path in the grid shown below from the position s to the position g. The robot can move on the grid horizontally and vertically, one square at a time (each step has a cost of one). No step may be made into a forbidden red area.



On the grid, number the nodes in the order in which they are removed from the frontier in a depth-first search from s to g, given that the order of the actions you will test is: **up, left, right**, then **down**. Assume there is a cycle check.

5. Consider the graph below where the problem is to find a path from start A to goal G. For each of the following algorithms, show the sequence of frontiers and give the path found.

(a) Depth-first search, where the neighbors are expanded in alphabetic ordering.

(b) Breadth-first search.