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Artificial Intelligence 001

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Assignment 3

1) Give a complete problem formulation for each of the following problems. Choose a formulation that is precise enough to be implemented. HINT: A problem formulation consists of an initial state, goal test, successor function and cost function.

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.

For this case, the initial state would be six glass boxes with locks on them. The six boxes would be aligned adjacent to each other in such a way that the first five boxes would have keys to the next box and the sixth box would contain a banana. The key to the first box would be with us. The goat test would be finding a banana in a box. Successor function could be similar to RESULT(firstBox, toSecondBox) = Second Box and the other set of actions would then be {toThirdBox, toFourthbox, toFifthBox, toSixthbox}and opening the resultant box. Finally, the cost for each step could be the time taken to pick the key up and unlock the next lock.

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.

The initial state would be a random sequence made up by the letters ‘A’, ‘B’, ‘C’, and ‘E’. For examples: ABEBCCEC OR BEACEBCABE and so on. The goal state would be a sequence consisting just a single E. For the case to succeed, we must prioritize converting the parts of the sequence into either AC or BB so as to produce more E and hence shorten the length of the sequence. So the successor functions could be such that it converts the parts of sequence into E or into combinations that can make AC, AB, BB or Ex (where x could be A, B, C, E). The cost function can be applied one per action and the cost values can differ depending on whether the sequence has shortened or just changed.

c. There is an n x 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.

A square divided into n rows and n columns with unpainted tiles and bottomless pits. This is the initial state. The goal of this case is to paint the unpainted floors and avoid the bottomless pits. So, the goal state is all floor painted except the bottomless pits. The successor function for this case is a conditional function which first checks whether the part being inspected is a floor or a bottomless pit using a laser sensor. If it is floor it further checks whether it is painted or not. If the part is a bottomless pit or painted floor, it moves to the adjacent sides and if it is an unpainted floor, it paints the floor. The other thing to keep in mind is to make sure the AI machine moves to all the floors in order to make sure all the floors are visited. For this, conditions can be applied to rows or columns with which the machine move upwards on even columns and upwards on odd columns. The cost function for this case would include the time taken to paint a floor, amount of paint used, and time taken to sense whether the part is floor or pit.

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.

The container ship with an unknown number of containers within the range of 0 to 845 containers is the initial state for this case. Our aim is to remove each container simultaneously to empty the container ship. So, the goal state is an empty container ship. The successor function for this case is quite similar to the above case of floor painting. The machine is made sure to hover around the 13\*13 grid to ensure each block is empty and then lower a step down as the while the whole level empties. The time taken for the laser to return back after reflecting could be a major factor to determine the level (first to fifth). The cost function for this case would be time taken for the sensor to receive the light, time taken to reach a container from a fixed height and move it onto the dock. It would also include taking these readings per action.

boolean unsafe = (eastMissionary < eastCannibal) || (westMissionary < westCannibal) || (eastMissionary < 0)

|| (westMissionary < 0) || (eastCannibal <0) || (westCannibal < 0);

if(!unsafe) {

allMoves.add(this);