

ELEC60004/70068 Machine Reasoning

Tutorial 2 – Search

Before Getting Started

1. No comment.
 2. Like the FWGC problem, this is an example of a river-crossing problem.
 3. Think of this as a “planning simulator”. To test the program, you need to provide the answer being searched for. So rather, think of answering questions like “if the heaviest is this ball, what is the plan”, or “whichever ball is heaviest, there is a plan which produces the right answer”.
 4. Remember what was said about search spaces: sometimes there might not be a solution path from the initial state to the goal state.
 5. Remember what was said about search spaces: sometimes there might not be a solution path from the initial state to the goal state, and the search space is infinite.
1. You are given two empty drinking glasses. You are told that one holds exactly 7 pints and the other holds exactly 5 pints, but there are no measuring markers on either of them. There is a water pump that can be used to fill the glasses, and plants that need watering if you want to empty the glasses without wasting water. You are asked to get exactly 4 pints of beer into the 7-pint glass.

Formulate the search space in Prolog or other declarative notation, so that it could be used with the Prolog General Graph Search Engine (GGSE) discussed in the lectures and lecture notes. Indicate for each state-change rule, what action it represents in the ‘real’ world.

2. Escape from Castle Vanya. Four people come to a river in the night. There is a narrow bridge, but it can only hold two people at a time. They have one torch and, because it is night, the torch has to be used when crossing the bridge. Person A can cross the bridge in 1 minute, B in 2 minutes, C in 5 minutes, and D in 8 minutes. When two people cross the bridge together, they must move at the slower person’s pace.

The question is, can they all get across the bridge if the torch lasts only 15 minutes?

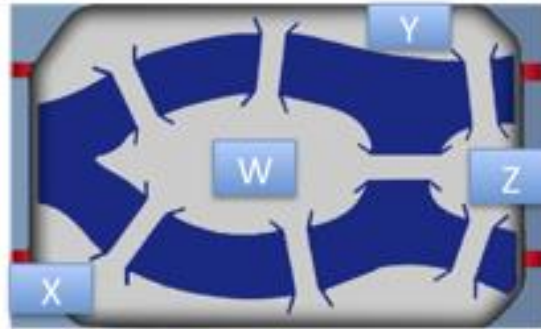
3. You are given 7 balls. They are identical in size, shape, colour and texture, but you are told that one is slightly heavier than the others.

You are also given a weighing machine with two pans. There is a button and a display on the machine. When the button is pressed, the display will indicate which of the pans is heavier, or if they are of the same weight. However, you are told that you can only press the button twice before the weighing machine self-destructs.

Formulate the search space for this problem in Prolog or other declarative notation, so that it could be used with the GGSE.

4. The river Pregel divides the town of Königsberg into four separate land masses, W, X, Y, and Z. Seven bridges connect the various parts of town, and some of the town's curious citizens wondered if it were possible to take a journey across all seven bridges without having to cross any bridge more than once.

Formulate the state space in Prolog or other declarative notation so that it can be used with the GGSE. How would you show that it is not possible to solve this problem (before Euler managed it).



5. The *ISN System* utilises three letters of the alphabet, I, S and N. Sequences of the ISN System are composed of just these three characters. There are four rules for generating a new sequence from an old one. Letting x and y stand for arbitrary sequences of I, S and N, these four rules are:

- (1) From xS, generate xSN
- (2) From Ix, generate Ixx
- (3) From xSSSy, generate xNy
- (4) From xNNy, generate xy

The problem is to show that from the sequence IS, the ISN-System can generate, by one or more application of the rules, the sequence IN.

Formulate the search space of the ISN System in Prolog or other declarative notation, so that it could be used with the GGSE.