National University of Singapore
School of Computing
CS3243 Introduction to AI

Tutorial 2: Uninformed Search

Issue: January 22, 2015 Due: February 6, 2015

Important Instructions:

- *Your solutions for this tutorial must be TYPE-WRITTEN.*
- *Make TWO copies of your solutions: one for you and one to be SUBMITTED TO THE TUTOR IN CLASS. Your submission in your respective tutorial class will be used to indicate your CLASS ATTENDANCE. Late submission will NOT be entertained.*
- *YOUR SOLUTION TO QUESTION* 1 *will be GRADED for this tutorial.*
- *You may discuss the content of the questions with your classmates. But everyone should work out and write up ALL the solutions by yourself.*

1. The Missionaries and Cannibals problem is usually stated as follows (refer to page 115 of the textbook, i.e., AIMA 3rd edition). Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Find a way to get everyone to the other side, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place.

   Questions:

   - Give the representation of a state in this problem;
   - Using the state representation defined above, specify the initial state and goal state.
   - Define its actions (to simplify your problem, you can ignore the possibility of illegal states); and
   - Using the state representation and actions defined above, specify the transition model/function T (i.e., when each of the actions defined above is applied to a current state, what is the resulting next state?). To simplify the problem, you can ignore the possibility of illegal states.

2. Consider the vacuum world problem with the state space shown in Figure 1. With the state numbers assigned in Figure 4.9 (page 134) of AIMA 3rd edition, let the initial state be state 1 and the goal state be either state 7 or state 8. Assume that the order of expansion of actions is S, R, L.

   (a) Give a trace of the breadth-first search algorithm in the style of Figures 3.11 and 3.12 of AIMA 3rd edition. That is, show the search tree at each stage (all repeated states are eliminated).

   (b) Give a similar trace of the depth-first search algorithm.

   (c) Which of these two search algorithms is better for this problem? Why? Is one search strategy always better than the other in general?

   (d) Give similar traces of breadth-first search and depth-first search when the order of expansion of the actions is R, L, S.

3. Sorting as Searching. We can sort a list of objects using only the operation of swapping two objects in the list. With this in mind, can you cast the sorting problem as a searching problem?

   Draw the state space when sorting the list of numbers (2,3,1) in ascending order. What is the minimum number of swaps required?

   Is the state space fully observable? Deterministic? Episodic? Static? Discrete? Justify your answers when necessary.

4. Describe a state space in which iterative deepening search performs much worse than depth-first search.

5. Consider the graph shown in Figure 2. Let S be the initial state and G be the goal state. The cost of each action is as indicated.

   (a) Give a trace of uniform-cost search.

   (b) When A generates G which is the goal with a path cost of 11, why doesn't the algorithm halt and return the search result since the goal has been found? With your observation, discuss how uniform-cost search ensures that the shortest path solution is selected.

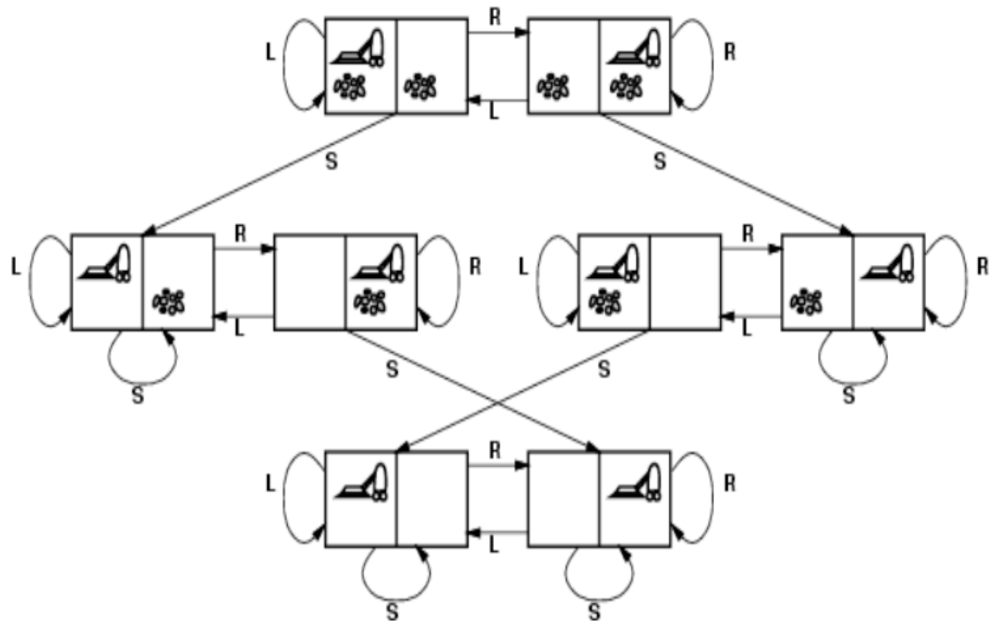

Figure 1: The state space for the vacuum world.

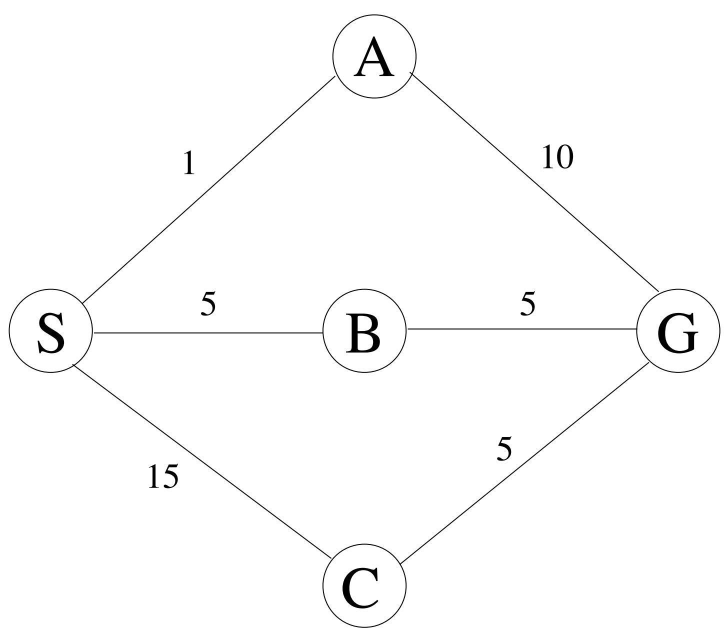

Figure 2: Graph of routes between S and G.