

CS 540 HW 2 – Searching for Solutions

Assigned: 2/20/08

Due: 3/5/08 (cannot be turned in later than 4pm 3/7/08 so solution can be released before the midterm)

Points: 100

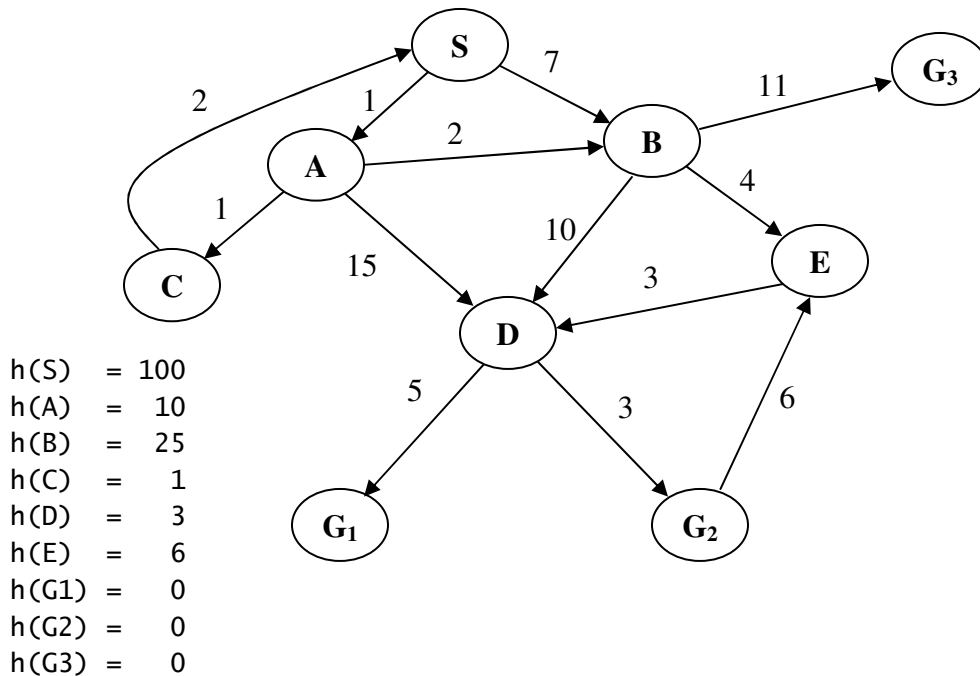
Note: all the questions on this homework are 'paper and pencil' ones.

Problem 1 (40 points)

Consider the search space below, where S is the start node and G_1 , G_2 , and G_3 satisfy the goal test. Arcs are labeled with the cost of traversing them and the h function's values are reported beside the graph.

For each of the following search strategies, indicate which goal state is reached (if any) and list, *in order*, all the states *popped off of the OPEN list*. When all else is equal, nodes should be removed from OPEN in alphabetical order.

- | | |
|------------------------|---|
| a. Breadth First | e. Best-first (using $f = h$) |
| b. Depth First | f. Best-first (using $f = g + h$) |
| c. Iterative Deepening | g. Beam Search (with beam width = 2 and $f = h$) |
| d. Uniform Cost | h. Hill Climbing (using the h function only) |



General Pseudocode for Searching

The following is the basic outline for the various search algorithms (some steps need to be modified depending on the specifics of the search being used).

```
OPEN = { startNode } // Nodes under consideration.
CLOSED = { } // Nodes that have been expanded.

While OPEN is not empty
{
    Remove the first item from OPEN. Call this item X.

    If goalState?(X) return the solution found.

    // Expand node X if it isn't a goal state.
    Add X to CLOSED.
    Generate the immediate neighbors (i.e., children) of X.
    Eliminate those children already in OPEN or CLOSED.
    Based on the search strategy, insert the remaining
        children into OPEN.
}
Return FAILURE // Failed if OPEN exhausted w/o a goal found.
```

Problem 2 (25 points)

- a. Name three (3) searches that may never find a solution, even when one exists. Briefly explain.
- b. When is breadth-first search an admissible search strategy? Briefly explain.
- c. Assume h_1 , h_2 , and h_3 are all admissible heuristic functions.
 - i. Is $h_4 = h_1 + h_2 + h_3$ admissible? Explain.
 - ii. Is $h_5 = (h_1 + h_2 + h_3) / 3$ admissible? Explain.
 - iii. Is $h_6 = \max(h_1, h_2, h_3)$ admissible? Explain.
 - iv. Would you prefer $h_7 = \min(h_1, h_2, h_3)$ or h_6 ? Why?

Problem 3 (35 points)

Read the problem description of Exercise 3.9 on page 90 of Russell and Norvig.

- a. How might you represent states for this problem?
- b. What would be the initial state in your representation?
- c. What would be the goal test for this task?
- d. Draw the state space explored by breadth-first search. Clearly label the arcs between nodes.
- e. Answer Part c of Exercise 3.9 in the text.