CS 2710/ISSP 2160 Fall 2015

Problem-Solving Search: Self Exercises

Solutions will be posted after you have had a chance to answer the questions yourselves. Note that these are more difficult questions than will be on the exam.

Q1 Suppose we were to change treesearch (or graphsearch) as follows: it applies the goal test to a node when the node is first generated, before the node is added to the fringe. Call this treesearchV2 (graphsearchV2).

- For breadth-first-search using treesearchV2, this change does not affect its completeness and optimality. And, this change can save time and space. In the worst case, when the goal is on the right frontier of the search tree, my version of breadth-first search generates, and adds to the fringe, an extra level of nodes than breadth-first-search using treesearchV2 does. In figure 3.21 (time and space), breadth-first search is $O(b^d)$, and uniform-cost search is $O(b^{(d+1)})$ if all edge-costs are equal. Figure 3.21 assumes that treesearchV2 is used for breadth-first-search.

  Note: the wrap-up in the chapter3part1 slides points out that the book writes separate code for breadth-first search that makes the above change (in addition, their separate version performs graphsearch rather than treesearch).

  Argue that breadth-first-search using treesearchV2 maintains the completeness and optimality properties of breadth-first search.

Q1.b However, for some of the other search algorithms we are covering, optimality is lost if treesearchV2 is used. Give an example. Specifically, first choose one of the search algorithms. Then, give the state space, and show a trace of the algorithm finding a suboptimal goal (specifically, show the fringe during each iteration). Your answer should clearly state why the goal is suboptimal. Give a **small** example.

Q2 In class, we said that breadth-first search is optimal if the edgecosts are all equal. On page 82 in R&N just below figure 3.11, we learn that this is too strict – it is optimal if the path cost is a nondecreasing function of the depth of the node. Explain why this is so.

Background notes: If g(n) is a nondecreasing function of the depth of the node, then, by the definition of nondecreasing functions, $g(b) \geq g(a)$ for all $b > a$. Breadth-first search applies the goal test to all nodes on level l before applying it to any node on level p, $p > l$.