Assignment 3
CSC416
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CHAPTER 3: INFORMED SEARCH

Abstract

In this chapter, I learned about different ways of solving problems. The book introduced several algorithms and important metrics for assessing the effectiveness of heuristics. Also, the book focused on the notion of problem reduction by employing constraint satisfaction search. Basically a list of methods we can use for solving problems.

Questions:

1. **What distinguishes heuristic search methods from those discussed in Chapter 2?**

   a. **Give three definitions of heuristic search.**
      (1) It's a way of finding the optimal path to reach to a goal state.
      (2) It's a practical strategy for increasing the effectiveness of complex problems.
      (3) It can be used to enable people to avoid the examination of dead ends and to use only gathered data.
   b. **Give three ways heuristic information can be added to a search.**
      (1) To decide which note to expand next, instead of doing sessions strictly breadth first or depth first style.
      (2) To decide which successor or successors to generate when generating notes, rather than blindly generating all possible successors at once.
      (3) To decide that certain nose should be discarded (or pruned) from the search tree.

2. **Explain why hill climbing would be classified as a greedy algorithm?**

   Because a greedy algorithm is when you are in a situation with multiple choices, you pick the one that's the first best fit for the particular situation and not worrying about what will happen in the future. Hill climbing is the same. You can't see what the optimal path is from the bottom, so you try to pick the first best option from where you are standing not evaluating other options remained.

3. **Explain how steepest-ascent hill climbing can also provide an optimal solution.**

Different from regular hill climbing, steepest-ascent climbing method evaluates all of the possibilities pertained to the particular node you are at and select the best one out of all.

4. **Why is that the best-first search is more effective than hill climbing?**

   Because we are considering the possible remedies and formalized each situation. Best –first search maintains a list of open and closed nodes. Open nodes are queued up inside a priority queue. The least costly node will be evaluated first and open up the next few related nodes and queued up again in the priority queue, if it reaches to the goal, it will return with the shortest path. This way we can find the best optimal option by looking at the whole picture, not just evaluating paths that are only related to the current node.

5. **Explain how beam search works?**

   Beam search works almost like the breadth first search, but it maintains a beam width W. Every time it reaches to a level of nodes, it selects W numbers of less costly nodes to explore until it reaches to the goal. This way it saves memory storage but may not find the best path to the goal.

Exercises:

1. **Give three examples of heuristics and explain how they play a significant role in**
   a. **your day-to-day life, and**
   b. **The problem-solving process for some challenge that faces you.**

   1. Hill climbing, we encounter this heuristic all day. For example, when you are at a large sale store and trying to find a good suit for yourself, you are going to take the first good suit you see because you don't know whether it will be taken by someone else with people all around you.
   2. Steepest-ascent hill climbing, same scenario, with no people around you, you can evaluate what to buy by looking at everything they have.
   3. Best-first search, same scenario. When you have several good fitting suits you found and you need to make a decision based on the pricing, material of the suit etc. When you add these features up, you will get the one that's most suitable for you.

2. **Explain why hill climbing is called a "greedy algorithm."**

   Because a greedy algorithm is when you are in a situation with multiple choices, you pick the one that's the first best fit for the particular situation

and not worrying about what will happen in the future. Hill climbing is the same. You can't see what the optimal path is from the bottom, so you try to pick the first best option from where you are standing not evaluating other options remained.

a. **Describe some other algorithms that you know that are greedy.**

   The foothills problem or the plateau problem.

b. **How steepest-ascent hill climbing is an improvement over simple hill climbing.**

   It evaluates all of the successors but simple hill climbing only look for the first optimal choice and choose it.

c. **How is the best-first search improve over hill climbing?**

   It's putting every option inside a queue and decides the best way to reach the goal from a global viewing point.

3. **Suggest an admissible heuristic, not mentioned in the text, for solving the 3 – puzzle.**

   We can use the distance for the black box to solve the problem. Set h(n) to the estimated moves for the black box to move to the right spot. Simultaneously, we record the steps we have actually made as g(n). We branch it off from the start and find the optimal way.

4. **Suggest an admissible heuristic for the Missionaries and Cannibals problem that is robust enough to avoid unsafe states.**
   a. **Is your heuristic information enough to appreciably reduce the search backspace explored by and A* search?**

   We can use branch and bound. It's robust enough to avoid unsafe states because it contains all of the situations.
   It will not be enough to appreciably reduce the search because it lists every single possibility.

5. **Provide a heuristic that is appropriate for the graph coloring.**
   a. **Employ your heuristic to find the chromatic number of the graph in Figure 2.41 and chapter 2.**

   I would provide plain vanilla branch and bound to the graph. Starting from the first node, I can color anything so we'll start will red, then for V_2, we can pick anything other than red, say yellow. So then for V_3, V_6 and V_7,

we need to branch off to either repeat red or use a difference color. By analysis, the chromatic number is 3, V_1, V_3,V_7 are red, V_2,V_4,V_5 are yellow and V_6 is green.