

Midterm Examination

Tuesday February 17, 2pm to 3:20pm

Your name:

Instructions: Look through the whole exam and answer the questions that you find easiest first. Answer each question in the space below the question, using the backs of the pages for extra space as necessary.

If necessary, you may make assumptions that are reasonable, and that do not make a question trivial. If you do make an assumption, state it clearly.

You may bring and use the following materials: Russell and Norvig, the published lecture and section notes, your own *personal* hand-written notes, and a calculator. You may not use any other materials.

(Question 1) [20 points] [Adapted from page 243 of *Introduction to Knowledge Systems* by Mark Stefik.] The heuristic function h used by the A* algorithm has *fixed absolute error* if for all nodes n , $h^*(n) - h(n) = c$ for some positive constant c . Here $h^*(n)$ is the cost of the lowest cost path from n to a goal node, so the cost of the lowest cost path from the start node through n to a goal node is $f^*(n) = g(n) + h^*(n)$.

(a) [6 points] Suppose that A* uses h with the property above. What can you say about which nodes this version of A* visits? Explain your answer.

(b) [4 points] What is the $O(\cdot)$ time complexity of this version of A*? Explain your answer.

(c) [4 points] What is the $O(\cdot)$ space complexity of this version of A*? Explain your answer.

(d) [6 points] [Adapted from page 259 of *Introduction to Knowledge Systems* by Mark Stefik.] Consider these two numeric weighting schemes for altering the contributions of g and h in the A* algorithm:

- $f_1(n) = (1 - w)g(n) + wh(n)$
- $f_2(n) = g(n) + vh(n)$ where $v > 0$

Prove that these two schemes lead to equivalent modified algorithms. That is, show that for each possible value of w (or v) there is an assignment to v (or w) that produces the same search behavior. Your argument should be independent of n .

6. Walksat uses a fixed amount of memory that is proportional to the size of the set of clauses to be satisfied.

7. DPLL uses a fixed amount of memory that is proportional to the size of the set of clauses to be satisfied.

8. Dynamic variable ordering is very helpful in making a CSP algorithm perform well.

9. The terms *expert system* and *knowledge-based system* are essentially synonyms.

10. Building a knowledge-based system is difficult, but keeping its knowledge updated is relatively easy.

