CS 461 NAME:_____
Midterm Exam
Spring 2018

THIS EXAM IS PRINTED FRONT AND BACK. Be sure to do all problems. The last page is blank if you need more room for any answer.

1. (4 pts ea = 12 pts) What are the worst-case bounds (in big-O form) of the following search methods with branching factor *b* and search depth *d*? Specify bounds for time and for space; if the bound for both has the same big-O form, you may give 1 answer and specify it applies to both.
    a. Unguided (brute-force) Breadth first search

    b. Bidirectional search

    c. Depth-first search

2. (5 pts) Explain what it means for a search method to be *complete*, and how this differs from being *optimal.*

(5 points). Explain why iteratively-deepening breadth-first search is one of the most commonly used implementations for unguided search.

(5 points) Explain how a *beam search of width k* differs from doing *k* hill-climbing searches in parallel.

(5 points) In a backtracking search, what is the advantage of the minimum-remaining-values (MRV) heuristic?

(5 points) Given the following KB, show 5 inferences that can be drawn via resolution. (Results of 1 resolution can be used in future resolutions. Specify by number which statements you are resolving.)

1. $P1 \vee P3 \vee \neg P4$
2. $P2 \vee P4 \vee P1$
3. $\neg P2 \vee \neg P5 \neg P4$
4. $P2 \vee P3$
5. $P3 \vee \neg P1$

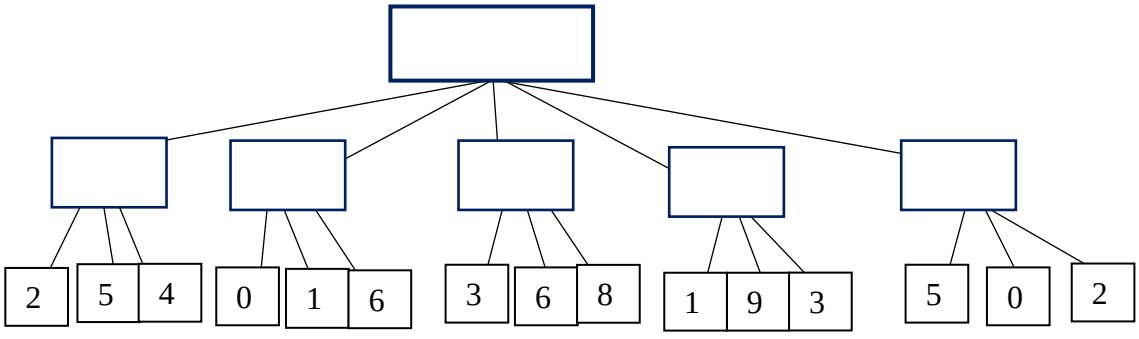
3. (5 pts) We are solving a problem via simulated annealing, and we note that only a small fraction of the possible successor states are being accepted. What does that tell us about how our algorithm is progressing?

4. (5 points) What quantity is minimized in A* search? (Give the formula and specify what each term means)

5. (5 points) In selecting a heuristic to guide a search strategy, what must be true of the heuristic to ensure good results?

6. (6 points) Describe 2 methods by which heuristics can be generated.

7 A game search is in progress. The player has the goal of maximizing the score, the opponent is trying to minimize. 5 possible moves are being considered, with 3 replies by the opponent for each. Here are the evaluations:



(5 points) For each move being considered and the root position, fill in the backed-up score.

(2 points) Draw a line from the root through the path indicating best play by both sides.

8. (10 points) Explain how Monte Carlo tree search can evaluate a move as relatively favorable or unfavorable even if nothing is known but the basic rules of the game.

SCRATCH/CONTINUATION