

Answer all questions on the exam. You may use the back for additional space. Total: 100 points. Good Luck.

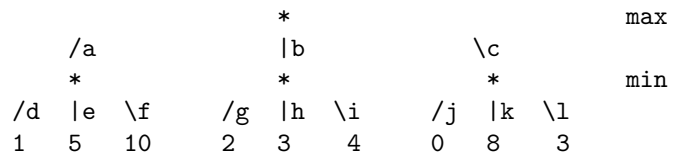
1. (25 pts) Consider a tree with branching factor  $b$  and the optimal goal state at depth  $d$  (root is at depth 0).
  - (a) Describe the four criteria used for evaluating the different search algorithms.
  - (b) Discuss breadth-first search and depth-first search for each of the four criteria.
  - (c) For each of the two algorithms, discuss in what situation you would choose one algorithm over the other.

2. (25 pts) On predicate logic:

- (a) Consider the sentence “All students study AI.” For each of the following logical sentences, state if it is a correct or incorrect translation **and** explain why it is correct/incorrect.
- $\forall x Student(x) \wedge Study(x, AI)$
  - $\forall x Student(x) \Rightarrow Study(x, AI)$
- (b) Consider the sentence “One student studies AI.” For each of the following logical sentences, state if it is a correct or incorrect translation **and** explain why it is correct/incorrect.
- $\exists x Student(x) \wedge Study(x, AI)$
  - $\exists x Student(x) \Rightarrow Study(x, AI)$
- (c) Explain if the following two logical sentences are the same or different in meaning (semantic):
- $\exists x \forall y Study(x, y)$
  - $\forall y \exists x Study(x, y)$
- (d) Explain if the following two logical sentences are the same or different in meaning (semantic):
- $\neg \forall x \neg Study(x, AI)$
  - $\exists x Study(x, AI)$

3. (25 pts) Consider a theorem prover application. The A\* algorithm can be used to search for the simplest (shortest) proof. Assume that the known axioms and theorems are represented as a knowledge base of Horn clauses in propositional logic, and that the prover uses Backward Chaining.
- (a) Propose an admissible heuristic.
  - (b) Prove that the proposed heuristic is admissible.

4. (25 pts) Given the following mini-max tree:



- (a) What is the next move?
- (b) Would alpha-beta pruning reduce the number of visited nodes? Explain.