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COS 470: Introduction to AI

Prelim I

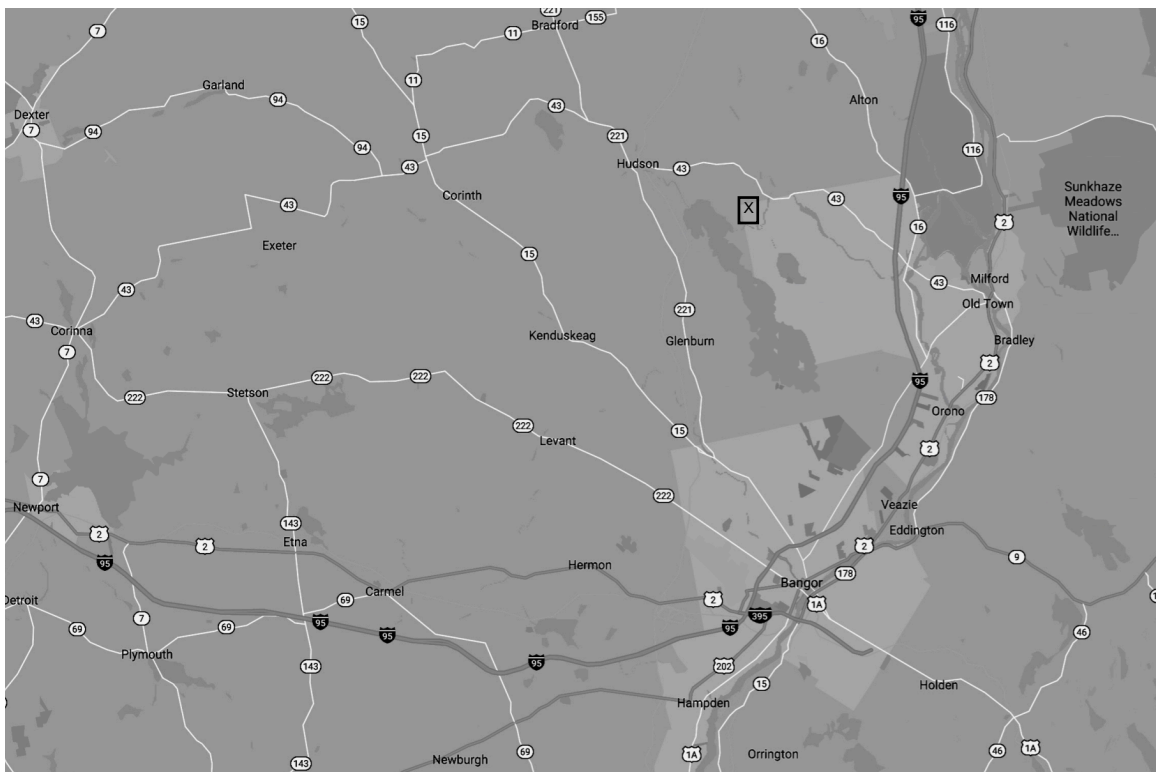
21 February 2019

Instructions: Answer all questions on these pages. Be fbrief! Partial/full credit will depend on the quality of your answer. There are 10 questions, 6 pages, and 80 points.

1. (5pts) What is *artificial intelligence*?

2. (5pts) Define “search” in the context of AI.

3. (5pts) Compare and contrast a reflex agent, a goal agent, and a utility-based agent.



4. (10pts) Suppose you are working for a company that makes GPS systems and your boss tasks you with the job of writing route planning program. Using the map above as a source of examples, and assuming routes are restricted to roads:

(a) What would correspond to the nodes in the search graphs we have been discussing? Be specific, and give an example of two different kinds.

(b) What search technique(s) would you use and why?

(c) What heuristic(s) would you use and why?

(d) Suppose your program also has to plan routes to get as close to a landmark specified by the user as possible while still staying on roads. For example, the user might want to hike to the spot on Pushaw Stream shown by the X in the box. Outline how you might change your program to allow this, still in the context of the search techniques you chose for part 4b.

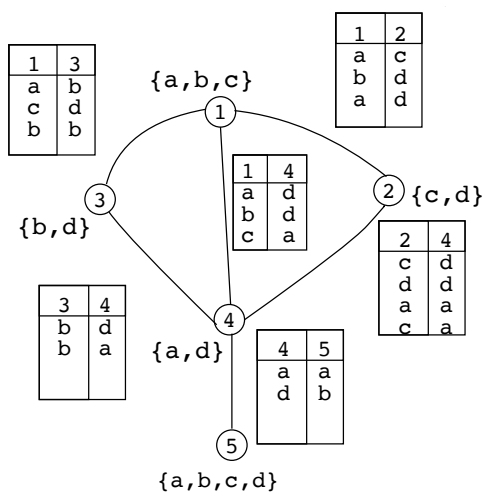
5. (10pts) Suppose we have this problem to solve: I am in my office in Orono and I want to be in a hotel room on Kaua'i, Hawaii.

(a) What kinds of things would a state contain, if this were to be solved as a search problem? (Hint: it's not sufficient to *just* consider location!)

(b) Describe the start state.

(c) What would be the operators for this problem (i.e., the things that move us from state to state)?

(d) Give a heuristic for this search problem.

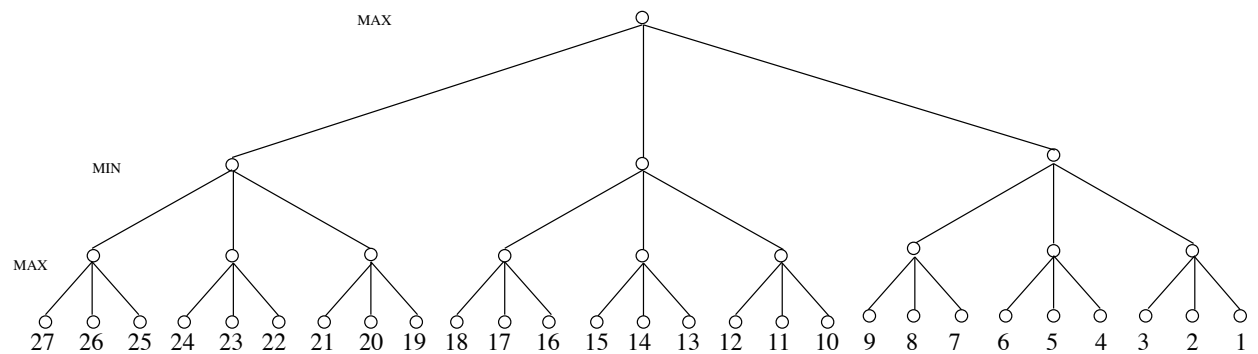
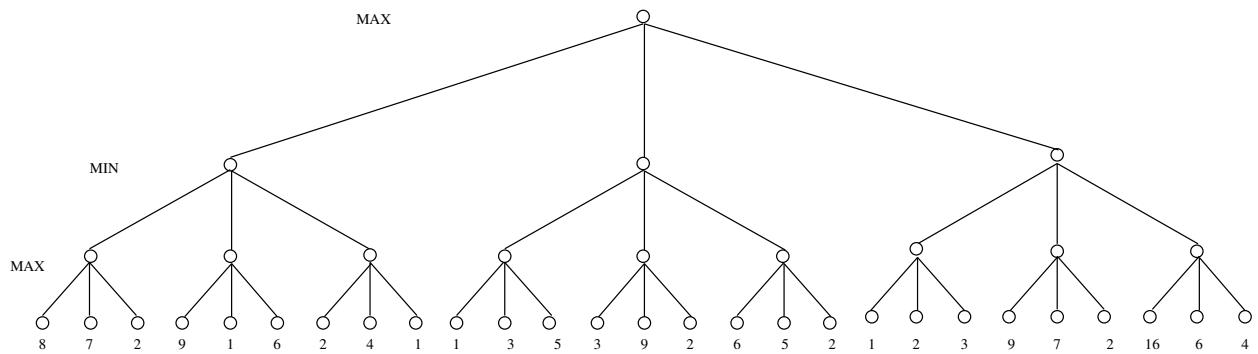


6. (10pts) In the constraint graph above, the constraints are shown as tables rather than sets of tuples for clarity. The rows of a table show the valid combinations of values for the variables.
- (a) Make the graph arc consistent (show by crossing off values in the domains of the variables).

(b) Give a solution to the constraint satisfaction problem the graph represents.

7. (5pts) Suppose someone tells you they have created a new search, M^* , that for any problem and heuristic finds the shortest path and expands fewer nodes than A^* . What would be your response?

8. (10pts) For each of the game trees below, show which branches would be pruned using α - β minimax.



9. (10pts) Represent each of the following in first-order predicate calculus: If something cannot be represented in FOPC, then say why.

(a) John hates everything that Mary hates.

(b) This statement is true.

(c) Everyone loves someone.

(d) Where there is smoke, there is fire.

(e) If cats hate dogs means that cats avoid dogs, then cats and dogs do not live together.

10. (10pts) Convert each of the following to conjunctive normal form (CNF):

(a) $\forall x \text{ Dog}(x) \wedge \neg(\text{Poodle}(x) \vee \text{Chihuahua}(x)) \longrightarrow \neg \text{HighStrung}(x)$

(b) $\forall x \exists y \exists z \text{Pred1}(x, y) \wedge \text{Pred2}(y, z) \longrightarrow \text{Pred3}(x, y, z)$

(c) $\forall x A(x) \vee B(x) \longrightarrow C(x)$

(d) $\forall x A(x) \vee B(x) \wedge C(x)$