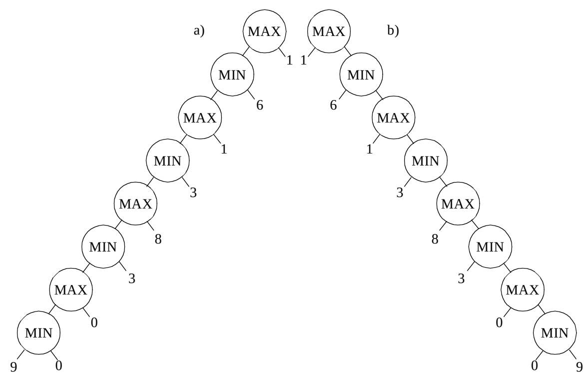
Midterm Preparation - Second Midterm.

The midterm will focus on topics discussed after the first midterm, including some planning topics (including partial-order planning and SAT planning), game-tree search, knowledge representation and reasoning and, if we get to it before the second midterm, probabilities. Notice that the following questions are a sample of the kind of questions that could be on the midterm. However, they certainty do not cover everything that could be on the midterm. They are merely intended to give you some idea of the kind of questions that you can expect. The homeworks also give you an idea of the kind of questions that you can expect. In general, you probably want to look at all of the assignments (including sample solutions), handouts, slides, and the book. Please do not forget to bring a calculator to the midterm.

What are the minimax values of the root nodes of the following two game trees? Cross out the node(s), if any, whose value(s) the alpha-beta method never determines, assuming that it always evaluates the leftmost successor node first.



You want to solve a map coloring problem: given the map of some country, you want to color its states so that neighboring states have different colors, using a total of 5 colors. Which AI techniques can be applied to this problem, and why?

Consider the following probabilities.

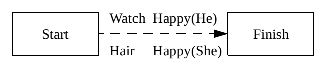
P(PassExam AND WildParty) = 0.2
P(PassExam AND NOT WildParty) = 0.5
P(NOT PassExam AND WildParty) = 0.2
P(NOT PassExam AND NOT WildParty) = 0.1

a) What is P(PassExam)?
b) What is P(WildParty)?
c) What is P(WildParty OR PassExam)?
d) What is P(PassExam | WildParty)?
e) What is P(PassExam | NOT WildParty)?

After your yearly checkup, the doctor has bad news and good news. The bad news is that you tested positive for a serious disease, and that the test is 99% accurate (that is, the probability of testing positive given that you have the disease is 0.99, as is the probability of testing negative given that you don't have the disease). The good news is that this is a rare disease, striking only one in 10,000 people. Why is it good news that the disease is rare? What are the chances that you actually have the disease?

Explain the differences between:
a) situation space planners and plan space planners
b) progressive and regressive planners
c) total and partial order planners.

Consider the following partial-order plan. How many operators does this plan have? Is this plan consistent? Is this plan complete? What are the preconditions of operators that are currently not satisfied (not achieved)? Does the dashed link denote a causal link or an ordering constraint that is not a causal link?



Suppose there is a bomb in your bathroom. Initially, the bomb is armed and the toilet is unclogged. Your goal is to get the bomb disarmed and the toilet unclogged. The only way to disarm the bomb is to dunk it in the toilet, provided that the toiled is unclogged. Note that dunking the bomb will clog the toilet, which can be unclogged by flushing it. Here is a very simple STRIPS encoding of this planning problems:

Initial state: (NOT clogged) AND armed

Goal state: (NOT clogged) AND (NOT armed)
Operators:

DUNK
precond: NOT clogged
effects: (NOT armed) AND clogged

FLUSH:
precond ---
effects: NOT clogged

Trace the partial-order planning algorithm described in class for the given planning problem. Then look back at your trace and mark the partial plans that are not totally ordered. For each of them, explain why this is so. Give an example of an iteration in which the principle of least commitment is illustrated and explain why this is the case.

Explain the advantages and disadvantages of SAT-Plan. Which kinds of planning problems cannot be solved with the version of SAT-Plan discussed in class?'

What are the advantages and disadvantages of solving STRIPS-type planning problems with search methods (such as versions of A*)? In this context, what are the advantages and disadvantages of searching forward from the start state rather than backward from the goal state?

TRUE or FALSE:

"P(x) = Q(x)" is a well-formed sentence of propositional logic (= satisfies its syntax) : true or false.

"EXISTS x P(x)" is a valid sentence of first-order logic: true or false.

A valid sentence is satisfiable: true or false.

Truth tables and resolution are two different tools that can be used to check whether a sentence in propositional logic follows from a given knowledge-base in propositional logic: true or false.

If a propositional sentence is not satisfiable it must be both a tautology and a contradiction: true or false.

"(P IMPLIES Q) AND (NOT P IMPLIES Q)" entails "P": true or false.

"A AND B AND (NOT A) AND (NOT B)": true or false.

It is possible to use A* with a heuristic function that assigns zero to every state: true or false.

(A IMPLIES B) entails B: true or false.

Turn the propositional sentence "NOT ((NOT (P IMPLIES Q)) IMPLIES (R AND S)) into CNF (= conjunctive normal form).

Using resolution, show that "(P IMPLIES Q) AND (NOT P IMPLIES Q)" entails "Q." (meaning that "Q" is true if "(P IMPLIES Q) AND (NOT P IMPLIES Q)" is true).

Using a truth table, show that "(P IMPLIES Q) AND (NOT P IMPLIES Q)" entails "Q."

How can you use resolution to show that a propositional sentence is unsatisfiable (= can never be true)?

Is the following sentence in first-order logic valid, satisfiable but not valid, or unsatisfiable: "FORALL x (P(x) IMPLIES Q(x))" Give an interpretation under which the sentence is true. Give another interpretation under which the sentence is false.

Suppose the only predicate symbols in our first-order logic domain are P (which takes one argument) and Q (which also takes one argument). There is one function symbol, f, which takes one argument, and there are two constant symbols, a and b. How many different possible interpretations are there? Are there infinitely many?

Given the predicates IsPerson(x), IsMale(x), IsParentOf(x,y), and AreMarried(x,y) can you define in first-order logic what an aunt is? If so, how? If not, why not?

Translate into first-order logic:

a) There is a woman who likes all men who are not vegetarians.
b) Germans, Swiss, and Austrians are the only people whose native language is German.
c) All Italians speak the same language.
d) If a person has a sister, the sister is female.
e) If a person has the same mother and father as some other person, then that other person is either the brother or sister of the first person.
f) Politicians can fool some of the people all of the time, and they can fool all of the people some of the time, but they can't fool all of the people all of the time.

Explain different ways of doing inference (reasoning) with semantic networks.

What are the advantages and disadvantages of rule-based expert systems? Name three tasks that you can solve well with them.

Rule-based expert systems repeatedly have to find out which rules can fire. How can one speed up this process?

How can you adapt the minimax algorithm to perfect information zero-sum games that involve an element of chance (say, backgammon, where you roll a pair of dice and the outcome determines which moves you can make)?

Assume that you know that your opponent makes mistakes from time to time. Is is still a good idea to use alpha-beta to determine which move to make? In which situations would you continue to rely on alpha-beta, and in which situations would you use a different algorithm?

Given the same tree, do minimax and alpha-beta always make the same move? If so, argue why. If not, show a tree where they make different moves.

TRUE of FALSE?

Alpha-beta search never expands more nodes than minimax search: true or false.

Games like chess are usually solved with forward search techniques: true or false.

The order in which successor states are generated affects the number of node expansions of minimax search: true or false.