CMPSCI 683 Fall '98

Mid-term Exam

1) Anytime A* {f= (1-w) g + w h} – 20 points

   a) Give an explanation why if w=.5, Anytime A* (left to run to completion) and A* expand approximately same number of nodes and in the same order even though they are using different stopping criterion and using a different f to order the open list.

   b) w can be adjusted dynamically during a run in order to change the performance characteristics of the Anytime A* algorithm. Suppose you had the following situations, how would you adjust w? Explain your answer.

      i) The open list has gotten so large that you are running out of memory;
      ii) You are running out of time and you have not yet reached an answer;
      iii) There are a number of nodes on the open list whose h value is very small.

2) Multi-level Search – 21 points

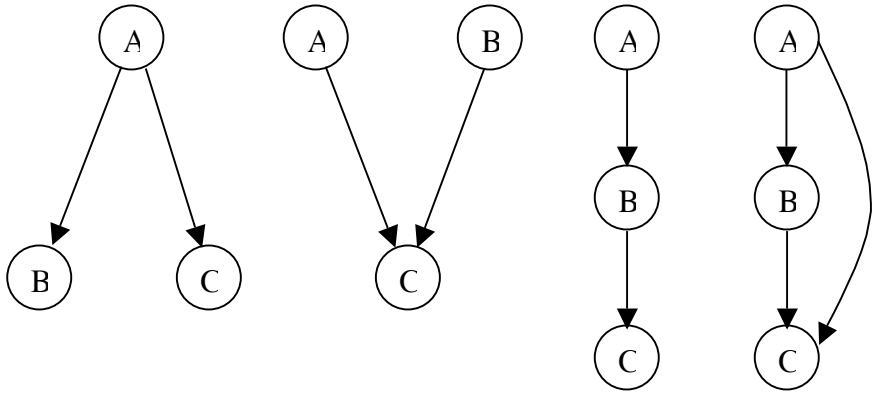
   a) We have examined a number of different approaches to using search on an abstract level to constrain search at the base level (Abstrips, Noah, Knoblock's work, Blackboards, Hierarchical A*, etc). Pick three of these and explain how the search at the abstract level(s) generates information that constrains search at the base level. For each of the choices also explain in which situations this (meta-) search at abstract level(s) is worthwhile in contrast to searching entirely at the base level.

   b) The blackboard search control can move asynchronously among the search at different levels of the blackboard. Explain the potential advantage of this dynamic movement. Can you explain why in the Hearsay-II system this

asynchronous movement among levels only occurred at the word and phrase levels, while at the lower levels the search was completed before moving information up to the next level?

3) Belief Networks – 14 points

Consider the following four belief networks, constructed by introducing the nodes in the order A, B, C:



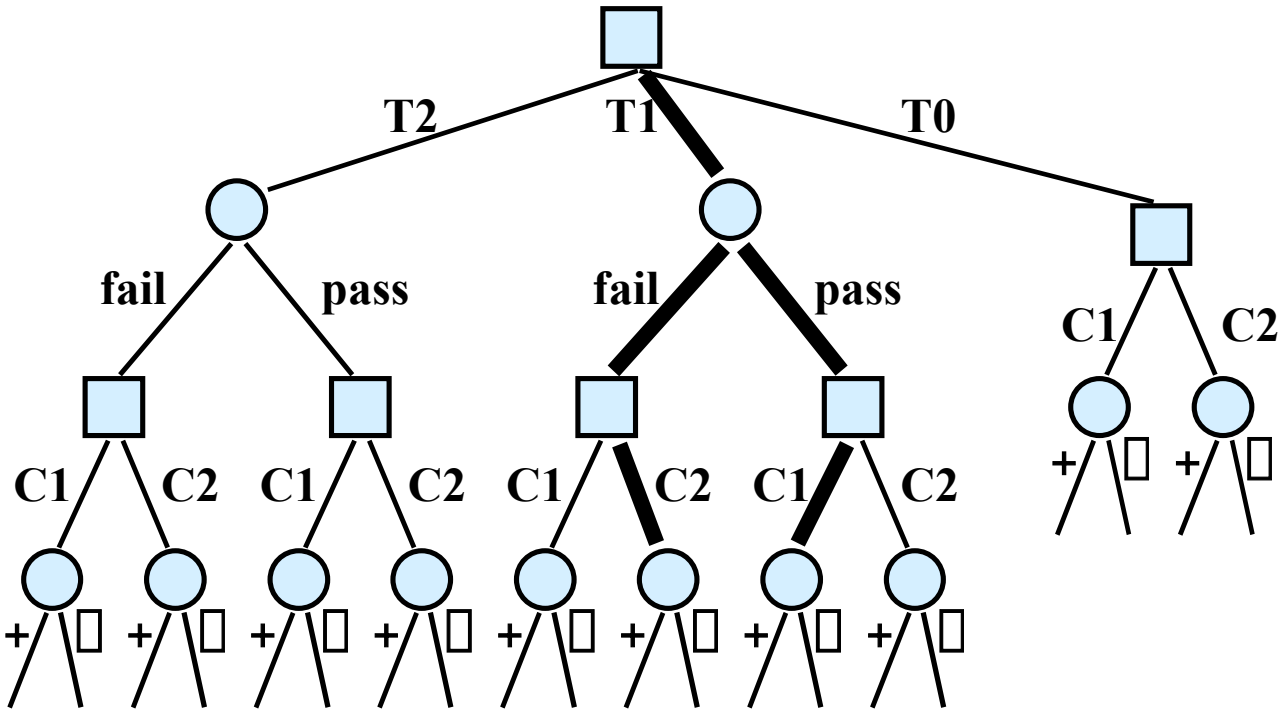
i) ii) iii) iv)

For each of the following statements, say whether it *necessarily* holds in each of the networks (fill in a Y in the boxes where the statement holds):

	i	ii	iii	iv
1. $P(C \mid A,B) = P(C \mid A)$				
2. $P(C \mid A,B) = P(C \mid B)$				
3. $P(B \mid A) = P(B)$				
4. $P(B,C \mid A) = P(B \mid A)P(C \mid A)$				

4) Decision Trees — 12 points

In class we showed the following decision tree for the car-buying example. In this decision tree, we assumed only one test could be completed before a decision was made about which car to buy. Remember test T1 applies only to car 1 and similarly test T2 applies only to car 2. T0 is the case where there is no test.



a) How would this tree change if more than one test could be conducted before buying a car? Draw the modified tree.

b) What new conditional probabilities would be needed to calculate the optimal decision process from the tree?

5) N-SAT – 18 points

Consider the graph-coloring example used in class in discussing variable tightness. It involved six nodes (CT, MA ,ME, NH, RI, VT) with the following adjacency links ME-NH, VT-(NH,MA), NH-

(VT,MA), MA-(VT,NH,CT,RI), CT-(MA,RI) and RI-(CT,MA). Each node can take on one of three colors (red,blue,yellow) and no nodes that are adjacent can be assigned the same color.

a) Sketch out how this problem can be translated into an N-SAT problem. You do *not* need to do the full translation!

b) Suppose someone told you about the idea of using a search heuristic based on variable tightness as a way of solving an N-SAT problem. What would be a heuristic for calculating variable tightness once the problem has been formulated in terms of an N-SAT problem?

c) Do you think it would be a good or bad idea? (Explain your reasoning.) How would it compare with the minimum conflict heuristic? Do you see any potential advantages to either scheme? What type of empirical experiments could you run to test whether it was a good idea?

6) IDA*- 15 points

A variant of IDA* involves increasing the f contour by a fixed amount each time instead of replacing it by the smallest f found that is larger than current f.

a) Explain why this may result in not finding an optimal answer.

b) Would it significantly affect the amount of space or time required?

c) Suppose you wanted to guarantee that you were within 5% of the optimal answer. How would you decide how much to increase the f contour at each stage?