CMPSCI 683 **MID-TERM EXAM**
Fall 2000 **V. Lesser**

[1] Short Questions — (32 points)

For each of the following statements, indicate whether it is true or false or only answerable if you make certain assumptions, then justify your answer with a "short" explanation.

a) Real-Time(RT) A* is an example of an anytime algorithm.

b) AnytimeA* will always expand at least as many nodes as A* if left to run to completion.

c) Putting some randomness into a search process is always advisable.

d) For meta-level control to be used successfully, the overall time used in meta-level control has to be significantly less than the time spent searching in the base search space.

e) Heuristic Texture Measures are a very different type of heuristic than the min-conflict heuristic.

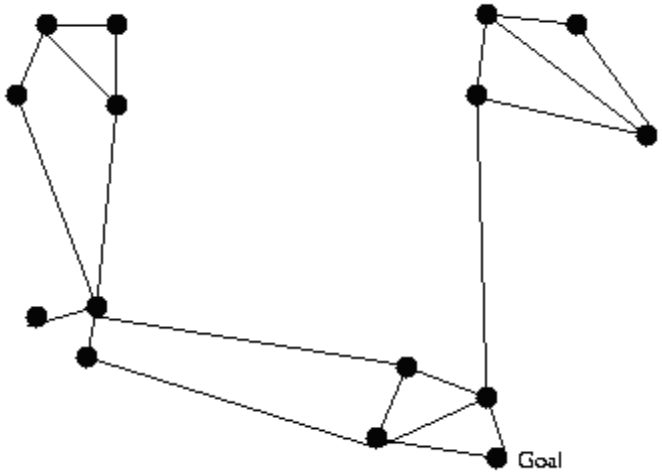
f) When evidence combination involves conflicts, as in assignment to contradictory subsets, the D-S approach resolves such conflicts by renormalization.

g) Like the certainty-factor approach and the D-S approach, fuzzy-logic assumes that sources of evidence are independent.

h) In order to do casual-based diagnostic reasoning, you need to formulate the problem as a belief network.

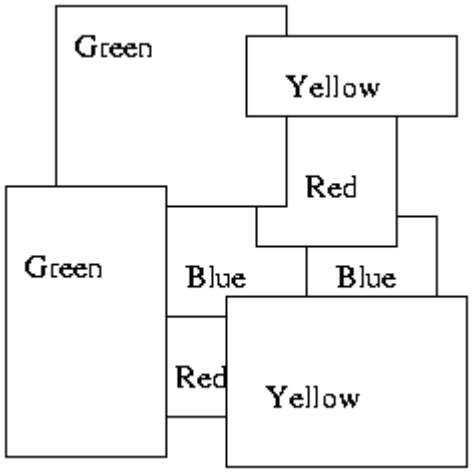
[2] Hierarchical Search — (11 points)

Explain how you would set up a hierarchical search procedure for the following graph.It is desirable to find a path from any node in the graph to the node marked "Goal".



[3] Search Over Complete Solutions – (11 points)

Use the method of min-conflict heuristic repair to solve the problem of coloring the map shown here with four colors (blue, green, red and yellow) such that no two adjacent regions have the same color. Start with the colors shown. (If you cannot solve it in 6 steps, stop there.)



[4] Anytime A* – (13 points)

Consider the anytime A* algorithm using function $f=w*g + (1-w)*h$. In class we discussed how to adjust w value in the following situations:

- the open list has gotten so large that you are running out of memory;
- you are running out of time and have not yet reached an answer;
- there are a number of nodes on the open list whose h value is very small.

Now consider a different adjustment to A* where you can dynamically change the *h* function. Assume there is a set of *h* functions $\{H_i\}$:

Time-to-apply (H_i) < = Time-to-apply (H_{i+1}) [i.e., $H_{i+1}$is always takes a longer time to compute than H_i], and H_i (n) < = H_{i+1} (n) for any node n [i.e., $H_{i+1}$is always a better approximation than H_i of the closeness to the goal].

In order to select appropriate H_i function:

a) What additional information do you need to know about the search space structure?

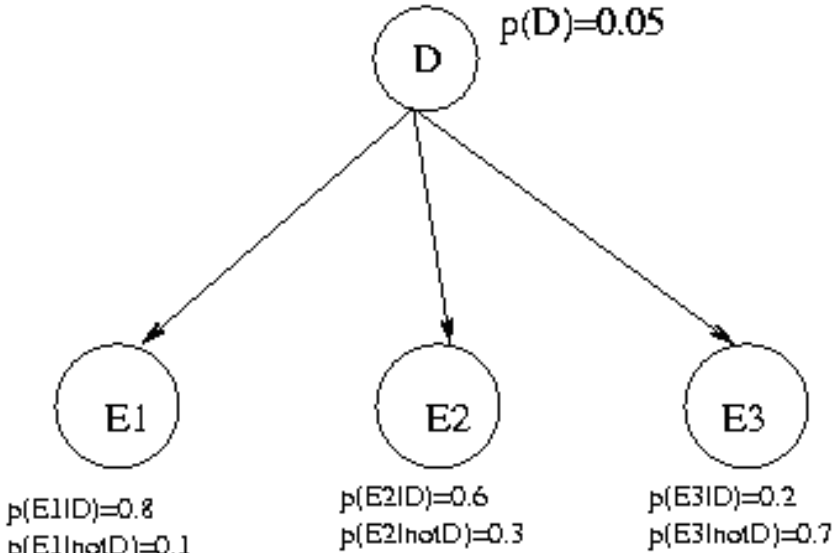
b) What detailed information about H_i and its effectiveness do you need to understand?

c) Given the above information, how would you choose an appropriate H_i in the three different situations described previously?

[5] Value of Information – (16 points)

Suppose you want to do an anytime evaluation of a belief network where the major time is doing diagnostic tests to ascertain the value of evidence nodes. (It is anytime in that you do not know ahead of time when an answer will be required.) Let us suppose for simplicity that all the tests took the same time and cost. The objective of the belief network was to decide whether the patient had disease D. The criterion for choosing which test to do next is based on maximizing |p(D|E)-p(not D|E)|.

Consider the following simple example:



A disease D can cause three symptoms, E1, E2 and E3. There are three tests: t1, t2, and t3, that can be used to test each symptom respectively.

a) **(5) Describe your algorithm for deciding which test to do next.** (Hint: One approach could you an idea similar to the technique of "conditioning" used to handle non-polytope trees).

b) (5) Which test should you choose to do first when you have not done any tests, show the calculation?

c) (6) Given the result of the first test being negative. Which test should you choose to do next, show the calculation?

[6] Blackboards – (14 points)

In the original version of Hearsay-II, the linear-weighted, rating function that was used to evaluate the appropriateness of KS instantiations on the agenda (scheduling queue) took into account as one of its factors the time that the KS would take to execute. The idea behind the use of this factor was to differentiate, for instance, whether to next execute a predict/verify KS working on a moderately-rated phrase hypothesis that involved a small number of words to verify, versus a predict/verify KS working on a more highly-rated phrase hypothesis that involved a large number of words to verify. The original rating function would choose the moderately-rated phrase to work on next.

a. Explain why this seemed a reasonable strategy.

b. We found that using the KS execution time information in the rating evaluation function was not a good strategy based on experimental data. My suspicion why it did not work was that a moderately-rated phrase hypothesis was very often **not** part of the most highly-rated complete solution while a highly-rated phrase hypothesis was very often part of the most highly-rated complete solution.

Based on this suspicion explain why using KS execution time in the rating evaluation was not a good strategy

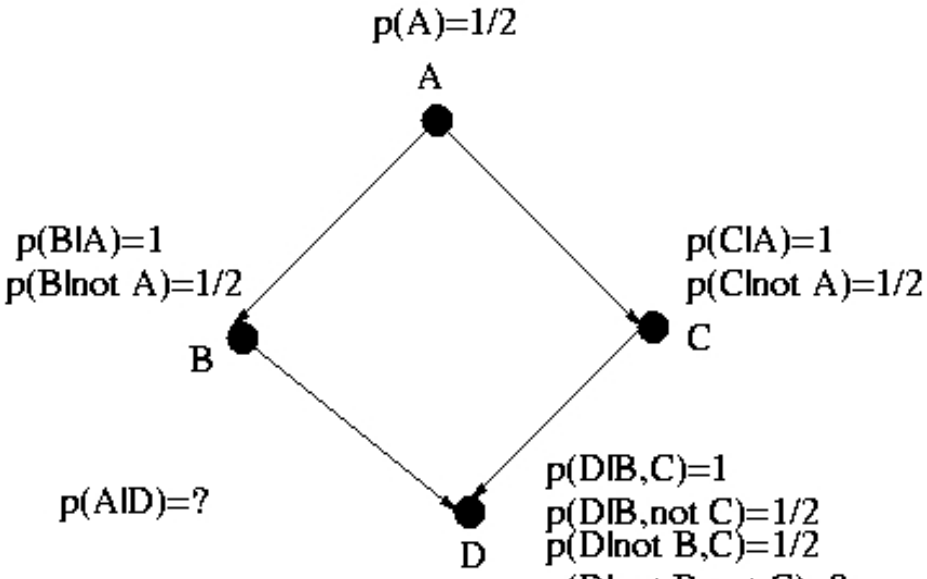
c.There was a proposal for a more sophisticated strategy that was never implemented, which was the following:

> Using the rating function without the KS execution time information. If there were a number of KS instantiations that were highly rated as a result of this step, then use the time that the KS would take to choose which KS to execute.

Do you think this would be a better strategy than the first? In either case, explain your answer.

[7] Probability Inference– (10 points)

An admissions committee for a college is trying to determine the probability that an admitted candidate is really qualified; the relevant probabilities are given in the Bayes network shown here. **Calculate p(A|D).**



A=applicant is qualified
B=applicant has high grade point average
C=applicant has excellent recommendations
D=applicant is admitted