CS 440 Midterm 1 Instructions

This is a closed book exam. No notes are allowed. Electronic devices must be put out of sight/reach, ideally in a bag.

The exam will end at 9:50, so you have 45-50 minutes of working time.

If you finish early, turn in your exam at the front and then leave the room.

We will be grading scanned copies of the exams using a tool that automatically separates out answers for each question.

> **Your answer to each question must be written inside the box provided.**

> **The backs of sheets will not be scanned.**

Overlong answers may be continued in the box on the last page. You may use the backs of sheets for scratch work.

You may remove this instruction sheet to use as scratch paper. Other than that do not take the exam apart. (If the sheets come apart accidentally, put your name on any loose sheets and warn the proctors when you turn it in.)

Points may be deducted for solutions which are correct but excessively complicated, hard to understand, poorly explained, or excessively hard to read.

Assume that answers require brief justification/work, unless there is clear indication to the contrary (e.g. it's a multiple choice question, it's asking you to repeat back a standard formula).

Please bring any apparent bugs to the attention of the proctors.

Cheating (e.g. looking at another student's exam) is obviously not allowed. Also, you may not do things that look like cheating, such as talking to your neighbor even if the topic is innocent. If your behavior is suspicious, we may take actions such as issuing warnings, reseating you, or having you take a makeup for the exam.

If you have to do something that could be misinterpreted, e.g. pick up a dropped eraser or silence a ringing cell phone, please do it conspicuously so everyone can easily understand what you're doing.

You may not leave the room and then come back and continue working on your exam. If an emergency (e.g. upset stomach) forces you to leave before you have had time to finish, turn in your partial work and we'll schedule you to take a makeup.

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1. (5 points) In the context of testing a classifier, what is "recall"?

2. (5 points) Define what it means for two random variables A and B to be conditionally independent given another random variable C

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3. (5 points) When planning a robot's motion, is it always best to choose the shortest path?

4. (5 points) Here's a famous blocks world planning problem. Why does it cause difficulty for a planner that is hierarchical (i.e. plans each major subgoal independently)?

```
                                        A
                C                       B
    start     B A              goal     C
```

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5. (5 points) In solving a constraint satisfaction problem, how does constraint propagation differ from forward checking?

6. (5 points) I have a library function that implements A* search. How do I use this function to implement uniform-cost search?
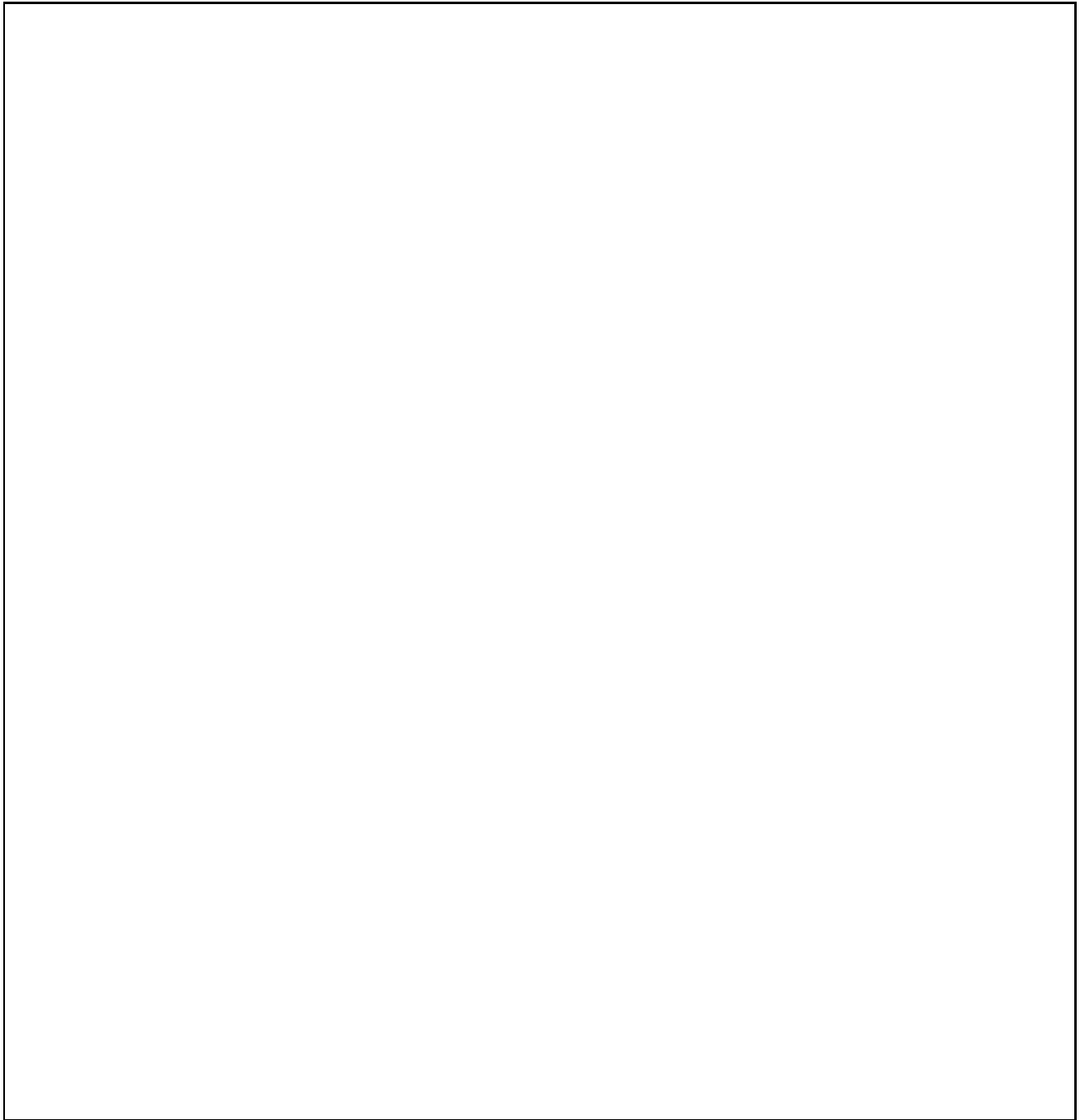
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7. (5 points) In MAP estimation, our main goal is to find the cause that maximizes $P(\text{cause} \mid \text{evidence})$. However, the quantity we actually calculate is $P(\text{evidence} \mid \text{cause}) \cdot P(\text{cause})$. These two quantities aren't equal. Why is this ok?

8. (5 points) BFS and A* exit from the search loop as soon as they find a solution that is guaranteed to be optimal. Under what circumstances should one of these search algorithm keep running until its queue is empty?

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This box is additional answer space. Clearly indicate the problem number.