

CS470/670 Candidate Exam Problems

1. Represent the following sentences in first-order logic, using a fixed vocabulary (which you must define):

- 1.1 Not all students take both History and Biology.
- 1.2 Only one student failed history.
- 1.3 Only one student failed both History and Biology.
- 1.4 The best score in History was better than the best score in Biology.
- 1.5 Every person who dislikes all vegetarians is smart.
- 1.6 No person likes a smart vegetarian.
- 1.7 There is a woman who likes all men who are not vegetarians.
- 1.8 There is a barber who shaves all men in town who do not shave themselves.
- 1.9 No person likes a professor unless the professor is smart.
- 1.10 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.

2. Consider the following table of 10 students characterized by the four attributes 'I' for intelligent, 'D' for diligent, 'R' for reads the textbook carefully, and 'P' for being a good programmer. The class label '+' indicates a good performance in a course and '-' a poor performance. Develop a decision tree using the information gain measure.

Training examples				
I	D	R	P	class
y	y	y	y	+
y	y	y	n	+
y	y	y	n	+
n	y	y	y	+
y	n	n	y	+
y	n	n	y	+
n	y	n	y	-
y	y	n	n	-
y	y	n	n	-
n	n	y	n	-

3. Consider the following simple domain—called the “one way rocket domain”. In this domain, we have two packages—A and B that are on earth. We have a single rocket that can go from Earth to Moon. It is a single-use one-way rocket. You can load packages, one by one, into the rocket, unload packages from the rocket (one by one) and fly the rocket to the moon. Give a description of this domain in terms of actions with preconditions and effects. I have helped you out by writing two of the five needed actions. You just need to write the other three.

Load-A

Prec: On-A-E, On-R-E

Eff: ~On-A-E, In-A-R

Load-B

Prec: On-B-E, On-R-E

Eff: ~On-B-E, In-B-R

4. You are building a tree house. You need to **build** the frame, by nailing it together, before **placing it in the tree**. You can't **paint the wood** before nailing it together, since nailing it together would spoil the paint job. But you can't paint it properly once it has been put in the tree, because you won't be able to reach all the wood with the paint brush. The step ladder can be **attached** any time after the frame has been built. Describe this problem with STRIPS operators.

5. Suppose you want to learn a concept. Would you rather have a training set which contained:

- 100 positive examples and no negative examples, or
- 30 positive examples and 30 negative examples, or
- 50 positive examples and 30 negative examples

Do you have enough information to make your choice? if not, what else would you need to know? Explain your reasoning.

6. Decision Tree Learning Algorithm.

6.1 Explain for what kinds of problems this algorithm is appropriate and for what it is not appropriate. Be specific and precise.

6.2 Suppose that some of the data are missing (i.e. you do not have the values of some of the attributes). What could you do?

6.3 Suppose you have a set of training data. How should you decide to use them for training and testing? Explain your reasoning.

7. Neural Network

7.1 Suppose you are given samples whose attributes have non-numeric values (e.g. Italian or French for the type of restaurant). Explain how you could handle them in a neural network.

7.2 Suppose you are given samples from more than two classes. Explain how you would use a neural network to learn how to classify them.

7.3 Suggest how you could modify the learning rate in the back-propagation algorithm during learning to encourage speed of convergence and to reduce instability.

8. For the problem described in the following, explain how you would design a computer program to solve the problem. Keep in mind that your answers must be relevant to the course! Here are some of the major issues you may want to discuss:

- Knowledge representation & acquisition.
- Planning
- Operators
- Search strategy/algorithms.
- Heuristic(s)
- Similar problems

Your job is to prove that you can use your knowledge of AI, so keep this in mind when composing your answers. You should describe some representation including a few examples. There is no predefined set of answers for these questions

"Learning Web Filter" There are a variety of products that can be used to filter access to WWW sites so as to protect children from inappropriate topics (such topics as: Playboy Magazine, how to build a nuclear bomb, or perhaps the minutes of congressional hearings).

A simple approach to building such a system is based on the detection of keywords. These keywords are hard-coded into the system or perhaps the keywords that can be entered by the user. We would like

to create a system that is more powerful (can do more than just detect the presence of any one of a list of keywords) and that can be "trained" by anyone.

The system will be trained as follows: a user acts as the "judge" and spends long hours visiting thousands of web pages. For each page visited the user clicks a button that tells the system whether the page should be considered appropriate or inappropriate. The system must develop general rules that can be applied to unseen web pages. Once the training is complete - the filter can be shipped to schools around the country. Since the WWW is ever-changing, we also want the end-user to be able to adjust the filtering by training the system on additional examples.

One additional feature that is desirable is to have the system be able to explain why it thinks any specific document is, or is not appropriate (it should be able to explain its inference).

9. What do you think is the hardest problem in AI? What makes it so hard? How do you think it will be solved (if at all)? In your answer, make reference to concepts you learned in the course; this should not be the sort of answer you would have written before you took the course (though you may have the same idea about what is hard).