

**CPE/CSC 480 ARTIFICIAL
INTELLIGENCE
FINAL EXAM
FALL 2004**

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This is the Fall 2004 final exam for the CPE/CSC 480 class. It is a take-home exam, and you may use textbooks, course notes, or other material, but you must formulate the text for your answers yourself. You are not allowed to discuss the questions and answers of the exam with other students or anybody else. The use of calculators or computers is allowed for numerical calculations, but not for the execution of algorithms or programs to compute solutions for exam questions.

If you need clarifications about questions, you can contact me via email or during my office hours on Monday Dec. 6, 2-4 pm, and Tuesday, Dec. 7, 2-5 pm. The deadline for the exam is Tuesday, December 7, 2004, at 4:00 pm. You must submit a printed and signed copy of the exam, which you can either leave in the drop box in front of the CSC department office (it is emptied at 4:00 pm), or give it to me on Tuesday before 4:00 pm in my office.

Student Name:

Signature:

Date:

PART 1: MULTIPLE CHOICE QUESTIONS

Mark the answer you think is correct. Unless otherwise noted, there is only one correct answer. Each question is worth 3 points. If you are editing this document for your answers, you can try the style “Multiple Choice Correct Answer” to mark your selection. I’m not sure, however, how well this transfers to different versions of MS Word.

- a) Why are games also referred to as *adversarial search*?
- because the player makes a move, and then the opponent (or adversary) must conduct a search for the next possible move
 - because the two (or more) adversaries involved usually cooperate in the search to find the solution
 - because search methods can be adapted to consider a zero-sum utility function where an advantage for one player results in a disadvantage for the other player
 - it is basically a variation of bi-directional search, where the two opponents start from different initial states, and compete to find the goal
- b) What is the *evaluation function* in the context of game-playing programs?
- a degree of uncertainty, introduced by the presence of an opponent or by chance elements
 - It returns an estimate of the expected utility from a given game configuration.
 - It calculates a numeric value for the outcome of a game.
 - It determines when the game is over.
- c) What is the most important effect of including *chance* (e.g. via rolling dice) in games for the generated search tree?
- the calculation of the evaluation function must include boundaries to reflect the chance factors
 - for each move by a player, another level of nodes is generated to accommodate the possibilities introduced by chance elements
 - pruning of branches becomes more difficult
 - methods like minimax and alpha-beta cannot be modified to deal with chance
- d) Which statement describes the *semantics* of a formal language for knowledge representation?
- It describes how a particular sentence relates to the facts in the world.
 - It allows the generation of new sentences that follow from a set of given sentences.
 - It specifies the admissible configurations of sentences in that language.
 - It makes sure that only truth-preserving sentences are admitted in the language.
- e) What is a *model* in the context of logic?
- A collection of sound inference rules.
 - A world in which a sentence is true under a particular interpretation.
 - A set of sentences from which the sentence to be proved can be entailed.
 - A sequence of applications of inference rules, leading from sentences in the knowledge base, to the sentence to be proved.

- f) What is the role of an *existential quantifier* \exists in a predicate logic sentence?
- It allows statements about some objects in a collection of objects.
 - It allows general statements about every object in a collection.
 - It is used in the specification of the semantics for terms.
 - It can be used to make statements about quantitative aspects of objects, such as length, weight, temperature, etc.
- g) Which statement is the best characterization of *knowledge representation*?
- It describes methods and procedures for drawing conclusions on the basis of existing knowledge.
 - It relies on the storage of relations between individual items according to a fixed scheme applied to a large collection of elementary items.
 - It requires a set of formal inference methods and clearly specified syntax and semantics.
 - It is concerned with methods and techniques for the storage of knowledge and information in a format that is suitable for treatment by computers.
- h) What is the basic idea of inductive learning?
- The agent applies knowledge about general principles to specific examples.
 - It allows the agent to select the most suitable hypothesis from a set of candidate hypotheses.
 - The agent learns about a domain by constructing a hypothesis that approximates a function on the basis of a set of example input/output pairs for the function.
 - It is very easy for computers to generate new logical sentences from existing ones by applying inference methods that use induction.
- i) Which aspect of artificial neurons is the most critical for their learning capabilities?
- The weight of connections between neurons can be changed.
 - The different inputs to a neuron are accumulated through the activation function.
 - Neurons usually only have one output, the axon.
 - The propagation of signals from neuron to neuron.
- j) What is the main reason that it is so much harder to define a learning algorithm for multi-layer neural networks than for perceptrons?
- The weights for the connections leading to the hidden units are fixed, and cannot be changed by the learning algorithm.
 - It is difficult to determine how to change the weights for the connections leading to the hidden units.
 - They are constructed from different types of neurons.
 - They usually have more weights that need to be adjusted.

PART 2: SHORT QUESTIONS

In this part of the exam, you should answer the questions in about one or two paragraphs. Please note that the number of points differs for the questions.

1. Is it possible to use the alpha-beta pruning method for games that involve chance, such as rolling dice? If so, explain the necessary modifications and possible problems; if not, explain why.

5 points

2. What are some important advantages and disadvantages of using neural networks for learning?

5 points

Advantages:

-
-
-
-
-

Disadvantages:

-
-
-
-
-

3. Describe the main differences between propositional logic and predicate logic with respect to the following aspects:

[20 points]

<i>Aspect</i>	Propositional Logic	Predicate Logic
<i>Syntax</i>	<ul style="list-style-type: none"> • • • • • 	<ul style="list-style-type: none"> • • • • •
<i>Semantics</i>	<ul style="list-style-type: none"> • • • • • 	<ul style="list-style-type: none"> • • • • •
<i>Expressiveness</i>	<ul style="list-style-type: none"> • • • • • 	<ul style="list-style-type: none"> • • • • •
<i>Computational Efficiency</i>	<ul style="list-style-type: none"> • • • • • 	<ul style="list-style-type: none"> • • • • •

PART 3: ALLERGIES DECISION TREE

Based on the food journal of a person with allergies, your task is to construct a decision tree that allows the patient to predict if a certain combination of foods will be fine, or will make him sick. The patient knows that three types of food are involved, but can not determine which combinations of the three cause problems.

The patient has collected the following information:

<i>Apple</i>	<i>Beans</i>	<i>Carrots</i>	<i>Outcome</i>
No	Yes	No	Sick
No	Yes	Yes	Sick
No	Yes	No	Sick
Yes	Yes	Yes	Sick
Yes	Yes	No	Fine
No	No	Yes	Fine
Yes	No	No	Fine
No	No	Yes	Fine

Note: This is an artificial example and does not have any medical validity. Please do not use it for actual allergies!

1. Which of the attributes is the best choice to start? Why?

5 points

- Apple
- Beans
- Carrot

Explanation:

•

2. Use the attribute identified as the best starting selection, and construct the decision tree based on the above sample set. Please order the tree by putting the positive branches (“Yes” cases) on the left, and the negative ones on the right. You can use the template below and modify it, or simply delete it and draw your tree from scratch. To modify it, you need to “ungroup” the objects first, and then you can move them around. To delete it, click on the line around the diagram, and delete it.

10 points

- Using a different attribute, construct an alternative decision tree from the same sample set. Select the first attribute in alphabetical order that is different from the one you chose in the previous question. So, if you selected "Apple" above, use "Bean" now, and if you selected "Bean" or "Carrot", use "Apple" now. Please order the tree again by putting the positive branches ("Yes" cases) on the left, and the negative ones on the right.

10 points

4. The patient is planning to have the foods listed below in the next two days. Based on your decision trees, what is the predicted outcome? What is your explanation for the prediction?

5 points

- a) First Tree, starting with attribute _____

<i>Apple</i>	<i>Beans</i>	<i>Carrots</i>	Outcome
Yes	No	Yes	
No	No	No	

Explanation:

- b) Second Tree, starting with attribute _____

<i>Apple</i>	<i>Beans</i>	<i>Carrots</i>	Outcome
Yes	No	Yes	
No	No	No	

Explanation:

5. If you were the allergy patient, would you be confident enough to make decisions according to the trees? If so, which one would you prefer? Explain your answer!

5 points

6. Suppose that the patient misunderstood the directions for collecting the sample data, and only recorded those combinations that led to an allergic reaction. Would it still be possible to construct a useful decision tree? Explain your answer!

5 points

Total Points: