國立陽明交通大學試題紙

111學年度第一學期
博士班資格考

科目：人工智慧 A　　日期：112 年 1 月 10 日　第 1 頁 共 2 頁

請 "✓" 明　　✓不可看書　　可看書

* 請將答案依題號順序寫入答案卷

答題時字跡需工整，否則不予計分。Write your answers legibly; otherwise you will get zero score.

1. (10 pts total) Consider a concept learning problem in which an instance x (i.e. a data entity) is a real number, and the hypothesis (i.e. model) language is an interval over the real numbers, e.g. $a < x < b$, where a and b are constants. For example, a hypothesis $3.2 < x < 10.86$ will classify any instance between 3.2 and 10.86 as positive, and any other as negative.
   a. (5 pts) Explain why there cannot be a maximally specific consistent hypothesis for any set of positive training instances (Be precise and concise).
   b. (5 pts) How will you modify the hypothesis language a bit so there can be a maximally specific consistent hypothesis for any set of positive training instances?
2. (25 pts total) Given a data table of employees as shown below, you are asked to apply *1-nearest* neighbor to predict ID#8's Income.

NOTE. You are required to show your calculation process, but no need to present the exact numbers.

ID#	Years of past experience	Years of grad-level education	Working hours per year	Height (mm)	Income (H or L)
1	0	1	480	1700	L
2	0	0	510	1500	L
3	5	2	500	1600	H
4	5	5	510	1700	H
5	5	5	460	1500	H
6	1	0	490	1600	L
7	4	1	460	1600	L
8	4	2	500	1500	?

   a. (5 pts) According to Minkowski L_1 distance, what is your prediction?
   b. (10 pts) Identify two issues from your prediction above (e.g., prediction reasonable to you? relevance? scales? Etc.) Be precise and concise.
   c. (10 pts) How are you going to resolve the issues? Be precise and concise.
3. (15 pts total) You've already grown a classification tree from a training data set. Both the tree and training data are shown below. To avoid overfitting, you decide to perform postpruning based on a validation data set also provided below, starting with the left-most bottom subtree.
   (a) (3 pts) Is the tree consistent with the training data?
   (b) (6 pts) Will you keep or remove the left-most bottom subtree? Briefly explain why.
   (c) (6 pts) Show the simplest tree after you check the left-most subtree, and mark the predicted class for each leaf of the new tree.

◎請用深黑色鋼筆或原子筆出題

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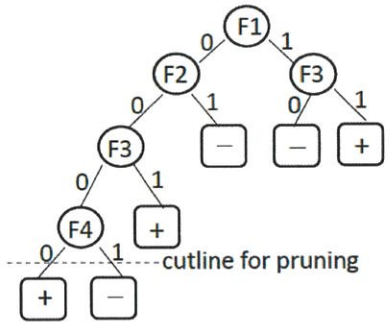

Training data set

	F1	F2	F3	F4	F5	F6	T
#1	0	0	0	0	0	0	+
#2	0	0	0	1	0	0	−
#3	0	0	1	0	0	0	+
#4	0	1	0	0	0	0	−
#5	1	0	0	0	0	0	−
#6	1	1	0	0	0	0	+
#7	0	0	0	0	0	1	+

Validation data set

	F1	F2	F3	F4	F5	F6	T
&1	0	0	0	1	0	1	+
&2	0	0	0	0	1	0	+
&3	0	0	0	1	1	1	+
&4	0	0	1	0	0	1	+
&5	0	1	0	0	0	0	−
&6	1	0	0	0	1	1	−
&7	1	0	1	1	1	1	−

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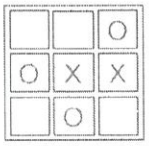
1. [8%] For breadth-first search, depth-first search, and A* algorithms:
(a) Give the pseudo-code of each. Clearly explain the information you use.
(b) What are the standard data structures used for the frontier in each?
(c) Describe the form of the evaluation function used in A*. What condition(s) are required to ensure that it finds an optimal path?

2. [12%] For a n-queen problem:
(a) Describe, in general English, what a n-queen problem is.
(b) Give a state specification of a n-queen problem, so that it can be solved by a search algorithm.
(c) Define a cost function of a n-queen problem, and then describe a local search algorithm that finds the solution of a n-queen problem by cost minimization. Be specific about the steps used in your algorithm.

3. [15%] From this game state of the tic-tac-toe game, and the next player (MAX) is 'X':



(a) Draw the 2-ply game tree.
(b) Use the following evaluation function to compute values of the leaf nodes in (a):
"*the count of the player's unblocked two-in-a-lines, minus the count of the opponent's unblocked two-in-a-lines*"
Note: An unblocked two-in-a-line is any line (vertical, horizontal, or diagonal) where two spaces are occupied by the same player and the third space of the line is still unoccupied.
(c) Use the minimax rule to determine the action to be taken by X. Note: If there are multiple actions that are equally good, indicate them all.

4. [15%] Inference in first-order logic:
(a) Consider this English sentence:
A cat that catches mice is a good cat.
Give the equivalent sentence in the form of first-order logic.
(b) Describe the meanings and differences between "functions" and "predicates" in first-order logic. Also indicate all the functions and predicates, if any, that are used in your answer in (a).
(c) For this fact, also convert it to first-order logic:
Tommy, Mary's cat, catches mice.
(d) Use the sentences in (c) and (d) to prove that Tommy is a good cat.
(e) Name the inference rules used in (d), and give their general forms.

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