國立交通大學試題紙

一百學年度第一次
博士班資格考

科目：人工智慧(A)

日期： 101 年 1 月 16 日 第 1 頁 共 1 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. (15 pts) Suppose that a learning algorithm is trying to find a consistent hypothesis. There are n Boolean attributes plus one Boolean class, and examples are drawn uniformly from all possible examples. Calculate the number of examples required when the probability of finding a contradicting hypothesis with error rate 0.1 reaches 0.5. Note. Just show your expressions and procedures.
2. (12 pts) Suppose that an attribute splits the set of examples E into subset E_i, and that each subset has p_i positive examples and n_i negative examples. Show that unless the ratio $p_i/(p_i + n_i)$ is the same for all i, the attribute has strictly positive information gain.
3. (8 pts) Define maximum-likelihood hypothesis and maximum a posteriori hypothesis. Describe their relationship briefly.
4. (15 pts) In some situation that for any unseen example, the hypothesis space contains as many consistent hypotheses predicting a positive outcome as predicting a negative outcome, how do you relate this dilemma with inductive bias and how do you get away with it?

◎ 請用深黑色鋼筆或原子筆出題

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1. Given a Tree $G(V, E)$ as Figure 1. Let the depth for node $v \in V$ be $d(v)$, and edge cost for edge $e \in E$ be $g(e)$.

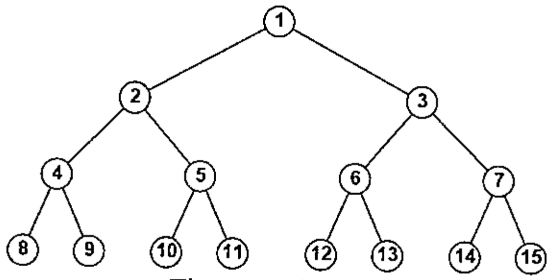

Figure 1: $G(V, E)$

(a) List the order in which nodes will be visited from node 1 to 11 using iterative deepening search. (5 points)

(b) What the evaluation function $f(v)$ can be for implementing DFS in the Figure 1 so that it can show DFS is a special case of Best-first search in which a node v is selected for expansion based on $f(v)$. (5 points).

2. Indicate which statements are false and correct them if false (10 points):

(a) Simplified memory bounded A* algorithm is complete if its all memory M <= depth d.

(b) In most cases, b^d is good estimate of the storage requirement for iterative deepening A* (b is branch and d is depth)

(c) The total number of nodes at depth d is bd for uniform search space of uniform branching factor b.

(d) For reasonable b (say, b is less than 1000), the total number of nodes examined for alpha-beta pruning will be roughly $O(b^d)$

(e) The search space of A* grows exponentially unless the error in the heuristic function grows faster than the logarithm of the actual path cost.

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3. Consider the following database of sentences in FOL:
   (1) $\forall x \quad A(x) \wedge \neg B(x) \Rightarrow \neg F(x)$
   (2) $\forall x \quad B(x) \wedge \neg C(x) \Rightarrow F(x)$
   (3) $\forall x \quad C(x) \wedge \neg D(x) \Rightarrow \neg F(x)$
   (4) $\forall x \quad D(x) \Rightarrow F(x)$

   (a) How the database sentences should be modified if new sentence $E(x) \Rightarrow \neg F(x)$ is added into. (5 points)
   (b) Rewrite the original database so that $E(x) \Rightarrow \neg F(x)$ can be easily added without modifying the original database. (10 points)

4. (1) Represent the following in FOL, using times(X,Y,Z) to represent the fact that X*Y=Z:
   Axioms (5 points):

   a. If X is prime and X divides Y*Z, then either X divides Y or X divides Z.
   b. X*X=square(X)
   c. Times is commutative.
   d. If X*Y=Z, then X divides Z.

   Theorem:
   e. If A is a prime number and A*square(C)=square(B), then A divides B.

   (2.) Find the clausal forms for problem (a-d), and the clausal form for the negation of the theorem (e) (5 points)

   (3.) Draw a proof tree which uses these clauses to prove (e). (5 points)

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