

科目：人工智慧 A

日期：102 年 1 月 30 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. (10 pts total) Convert FOL sentences to clausal forms. You can add constants or functions if needed.
 - (a) (2 pts) $\forall x \text{ Big}(x) \rightarrow \exists y \text{ Cat}(y)$
 - (b) (2 pts) $\exists x \forall y f(y,x) \rightarrow g(y)$
 - (c) (2 pts) $\sim(\exists x f(x) \wedge g(x))$
 - (d) (4 pts) $\sim(\exists x \forall y f(y,x))$
2. (14 pts total) Write the following sentences in first-order logic, using $S(x)$ for slow, $S(x,y)$ to mean that x is slower than y , $H(x)$ for horse, $B(x)$ for brown, and $W(x,r)$ for horse x winning race r .
 - (a) (2 pts) All brown horses are slow.
 - (b) (2 pts) All slow horses are brown.
 - (c) (2 pts) All slow things are brown horses.
 - (d) (2 pts) Some slow horses are brown.
 - (e) (3 pts) The slowest horse is brown.
 - (f) (3 pts) There is a winner in every race.
3. (26 pts total) You're a taxi driver. Your taxi can hold 4 passengers. Your world is modeled as a graph of locations with distances between them. Some, but not all, of the locations have passengers that you can pick up. Give your best answers to the following questions.
 - (a) (4 pts) Because passengers pay a fixed fee for a ride to the airport, the goal is to pick up 4 passengers and take them to the airport in the smallest number of miles. How do you describe each state in this problem space?
 - (b) (4 pts) What is a good cost function for this problem?
 - (c) (4 pts) Now, consider a case where passengers have to pay according to how far away they are from the airport when they're picked up (note: they don't pay according to how long a ride they take in your taxi, but according to the length of the shortest path from their pickup-point to the airport). Describe each state in this new problem.
 - (d) (7 pts) For question (c), if you also wish to save gas, what is a good cost function?
 - (e) (7 pts) Will uniform-cost search work for question (b)? what about question (d)? Explain briefly.

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- (15 pts) Let D denote the set of training examples, t_d denote the true target value of an example d in D , where d is represented by feature vector (x_1, x_2, \dots, x_n) , and o_d be the predicted value (i.e. output). Define the output function:
$$f(x_1, x_2, \dots, x_n) = w_0 + w_1 x_1 + w_1 x_1^2 + w_2 x_2 + w_2 x_2^2 + \dots + w_n x_n + w_n x_n^2$$

Derive a gradient descent training rule for a single learning unit with the output as defined above.
- (15 pts) Given a binary-class concept learning problem, assuming P positive examples and N negative examples, briefly describe how chi-square test is applied to perform pre-pruning in decision tree learning. Note. You must write down the chi-square formula and explain how it works.
- (20 pts total) Assume each example d is described by a feature vector (x_1, x_2, \dots, x_n) , and let c_i be a class in C , i.e. $c_i \in C$. (a) (10 pts) Write down the expression for the predicted class of d based on the maximum posterior probability. (b) (10 pts) Derive a Naïve Classifier from your result of (a). Try to be clear and precise.

◎請用深黑色鋼筆或原子筆出題

命題老師簽名：