國立陽明交通大學試題紙

113學年度第一學期
博士班資格考

科目：人工智慧 A　　日期：114年1月7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) Suppose you are a medical doctor who has AI background. According to the records, 99% of the Lab test for those real cancer patients came out positive, and 97% of the Lab test for normal people came out negative. This indicates the Lab test is quite accurate. Now one of your patients just had a Lab test that came out 'positive', and he is extremely worried. As a doctor, you are also aware of the fact that for any person, the chance to actually have the cancer is 0.000001. How will you comfort this patient based on your AI knowledge?

2. (10pts) Considering the flexibility of reducing the representation complexity by pruning, which hypothesis model will you prefer, decision trees or decision rules? Explain why by examples.

3. (12 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 $(x_1,x_2,\ldots,x_n)$, and o_d be the predicted value (i.e. output). Define the output function:
$f(x_1,x_2,\ldots,x_n) = w_0+w_1x_1+w_1x_1^2+w_2x_2+w_2x_2^2+\ldots+w_nx_n+w_nx_n^2$
Derive a gradient descent training rule for a one-neuron ANN with the output as defined above.

4. (12 pts total) Assume each data entity d is described by a feature vector $(x_1,x_2,\ldots,x_n)$, and let c_i be a class in C, i.e. $c_i \in C$. (a) (6 pts) Write down the expression for the predicted class of d based on the maximum a posteriori (MAP) model. (b) (6 pts) Derive a Naïve Classifier from your result of (a). Try to be clear and precise.

5. (1 pt each, 6 pts total) Consider a binary-class classification problem, where there are equal numbers of positive and negative examples in the data set. Also suppose that the class label (i.e., +/–) is assigned to these examples at random. Now for the following two classification models, estimate their test accuracies based on different estimation methods.
   (i) A perfect decision tree model trained from the training data without pruning.
      (a) Repeated random subsampling method, in which 2/3 of data for training, the rest for testing.
      (b) Stratified 10-fold CV.
      (c) LOOCV.
   (ii) A majority predictor model trained from the training data that always predicts the majority class in training data.
      (a) Repeated random subsampling method, in which 2/3 of data for training, the rest for testing.
      (b) Stratified 10-fold CV.
      (c) LOOCV.

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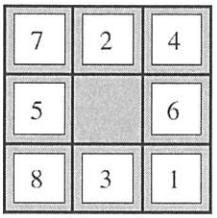
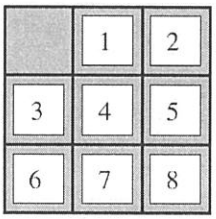
1. [15%] Consider the given state of the 8-puzzel game:
(a) What is the next state using A* search with heuristic function h_1 (the number of misplaced tiles)?
(b) What is the next state using A* search with heuristic function h_2 (the total Manhattan distance of the pieces to their goal-state locations)?
(c) Explain why h1 and h2 are both admissible heuristics. Show the detail of your computation.

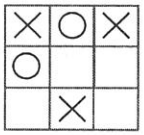


Start State



Goal State

2. [10%] Starting from the game state of tic-tac-toe here, build the whole game tree until terminal states. Give the minimax values of all the nodes.



3. [10%] A propositional KB contains these sentences:
A, B, P⇒Q, L∧M⇒P, L∧B⇒M, A∧B⇒L, A∧P⇒L
(a) Convert them into CNF.
(b) Use resolution to prove Q.

4. [15%] Short Q&A:
(a) For the following three heuristics in constraint satisfaction problems, explain what they are: (1) Minimum Remaining Value, (2) Degree Heuristic, (3) Least Constraining Value
(b) Give the time and space complexity of standard breadth-first search. Clearly indicate the meaning of the symbols.