國立交通大學試題紙

九十九學年度第一次
博士班資格考

科目：人工智慧(A)　　日期：100 年 1 月 26 日　第 1 頁 共 2 頁

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* 請將答案依題號順序寫入答案卷

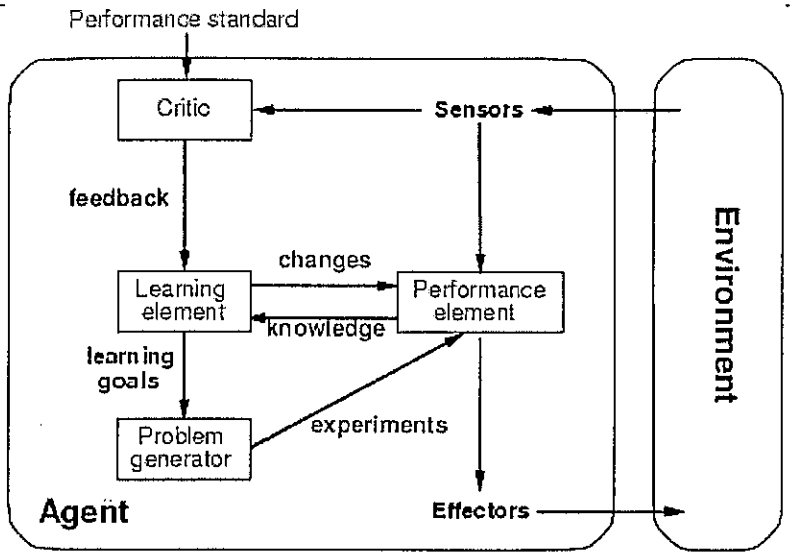
答題時字跡需工整，否則不予計分。Write your answers legibly; otherwise you will get zero score.

1. (4%) Describe the differences and similarities between problem solving and planning.

2. (9%) The monkey-and-bananas problem is faced by a monkey in a laboratory with some bananas hanging out of reach from the ceiling. A box is available that will enable the monkey to reach the bananas if he climbs on it. Initially, the monkey is at *A*, the bananas at *B*, and the box at *C*. The monkey and box have height *Low*, but if the monkey climbs onto the box he will have height *High*, the same as the bananas. The actions available to the monkey include *Go* from one place to another, *Push* an object from one place to another, *ClimbUp* onto or *ClimbDown* from an object, and *Grasp* or *Ungrasp* an object. Grasping results in holding the object if the monkey and object are in the same place at the same height.
   A. (3%) Write down the initial state description.
   B. (6%) Write down STRIPS-style definitions of the six actions.

3. (9%) Define in your own words the following terms with respect to machine learning:
   A. (3%) Supervised learning;
   B. (3%) Reinforcement learning;
   C. (3%) Overfitting.

4. (12%) Explain the functionality of the following modules in the figure:
   A. (3%) The performance element;
   B. (3%) The critic;
   C. (3%) The learning element;
   D. (3%) The problem generator.



5. (16%) In this question we consider decision trees with continuous input attributes $A_1,\ldots, A_n$ and a Boolean output attribute Y. In such trees, the test at each internal node is an inequality of the form $A_i > c$, where c, the split point, may be any real number (to be chosen by the learning algorithm). The value at each leaf is true or false. In a test-once tree, each attribute may be tested at most once on any path in the tree; in a test-many tree, each attribute may be tested more than once on a path. Suppose we are given the following four examples in the table:

A_1	A_2	Y
3	3	false
6	13	true
15	14	true
14	22	false

A. (4%) Draw a test-once decision tree that classifies the examples correctly.

B. (2%) Write down the information gain of your root test (your answer may contain logs; numerical evaluation not required).

C. (4%) Suppose we sort the examples by their value for attribute A_i. (See, e.g., the values for A_2 in the table above.) Explain why the best (i.e., highest information gain) split point for A_i never falls directly between two examples with the same output classification. (E.g., for A_2 in the table, it could not be between 13 and 14.)

D. (2%) True/False: Every non-noisy training set can be correctly classified by a test-once decision tree.

E. (4%) Can every non-noisy training set be classified correctly by a test-many tree? Why (not)?

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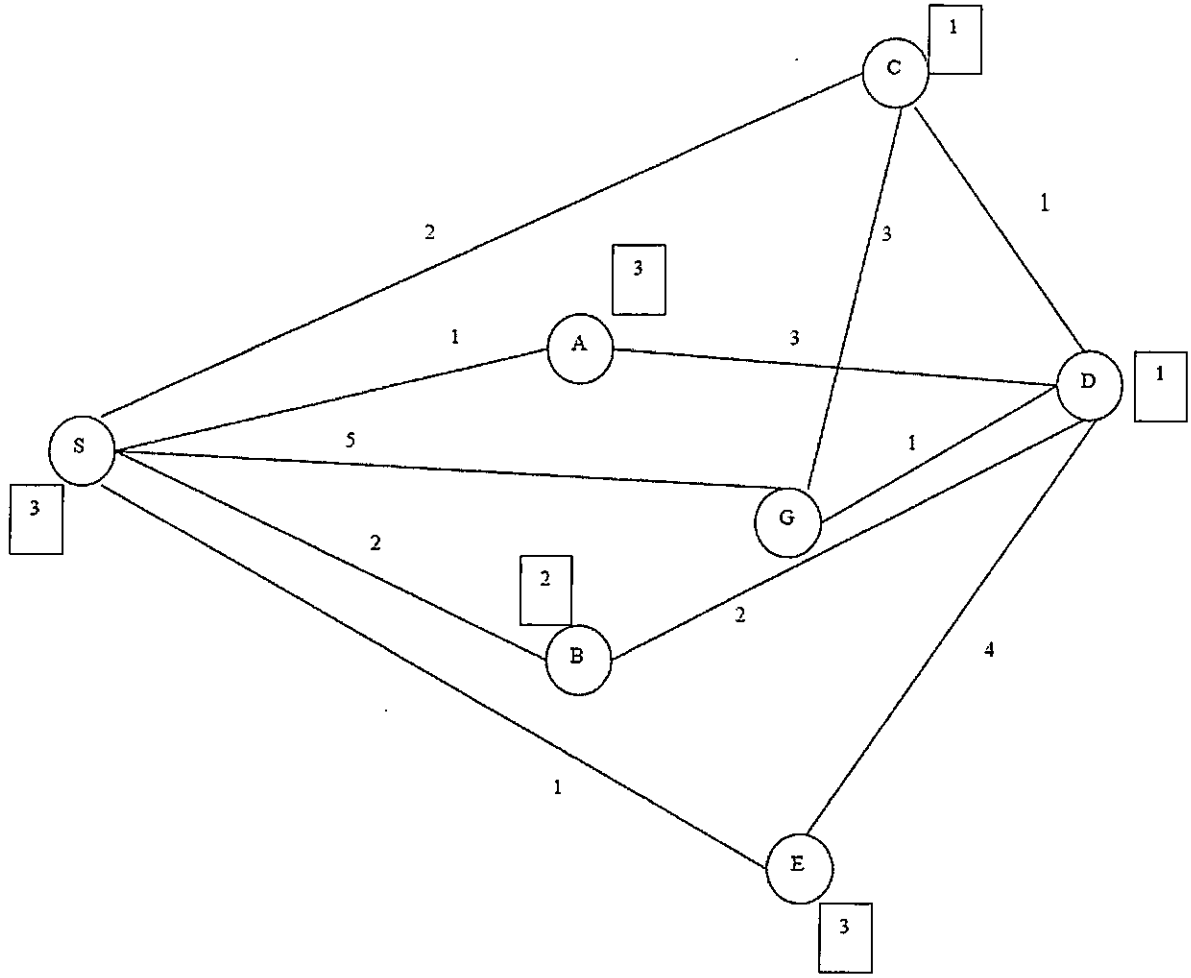
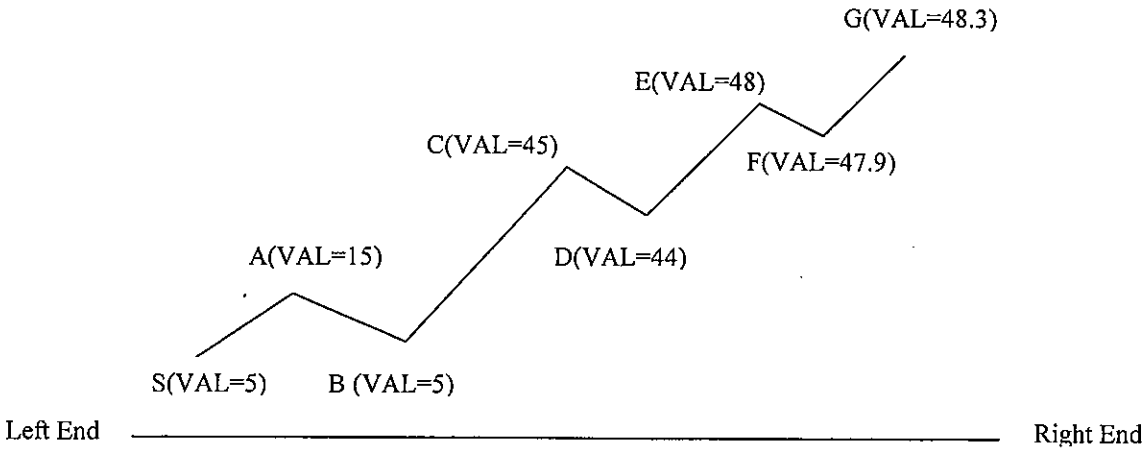
1. (12pts total) For the state space below, the path costs are shown on the links and the heuristic costs are shown in boxes beside each node. The start state is S and the goal state is G. All search strategies are assumed to obey the following rules:
   - when a node is expanded in the search tree, the parent is not added as a child
   - when 2 nodes have the same cost in the queue, they are expanded in alphabetical order

   Draw the search tree which results from applying each of the following strategies.
   (a) (3pts)Hill-climbing
   (b) (4pts)Uniform-cost
   (c) (5pts)A*



2. (23pts total) Simulated annealing is one way to get away with local optima. Perform simulated annealing search in the following search space starting from S, assuming the higher VAL, the better. Note that in this problem, you are only allowed to either move to an adjacent state or stay where you are. Also note that a good move, i.e. VAL is increased and you are closer to right end, is always accepted (Prob=1.0); a bad move is accepted with probability Prob=$e^{\Delta VAL/T}$, where ΔVAL = VAL(next) - VAL(current), or else it will stay at the current state.



The temperature schedule is:

Time	1-100 sec	101-200 sec	201-300 sec
Temperature (T)	10	1.0	0.1

Assume that the timer increases one second at a time.

The table of values of e may be useful.

X	0.0	-1.0	-4.0	-40.0
e^x	1.0	≈0.37	≈0.02	≈4.0e -18

(a) (2pts each row, 14pts total) Analyze the following possible moves in the search. The first one is done for you as an example.

Time	From	To	T	ΔVAL	ΔVAL/T	Prob
57	A	B	10	-10	-1	0.37
78	C	B				
132	C	B				
158	C	D				
194	E	D				
238	E	D				
263	E	F				
289	G	F				

(b) (1pt) At Time=3, is the search more likely to be in state A or in state C? _____

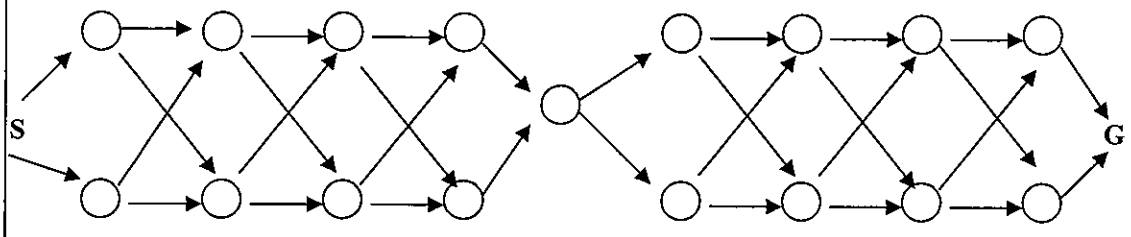
(c) (3pts) At Time=3, what is the probability of staying at state A? _____

(d) (3pts) At Time=3, what is the probability of staying at state C? _____

(e) (1 pt) At Time=100, is the search more likely to be in state A or C (ignore E, G)? _____

(f) (1 pt) At Time=300, is the search more likely to be in state A, C, E or G? _____

3. (10pts total) Given the following directed graph, S is the starting state and G is the goal.



(a) (4pts) You are performing a bi-directional bread-first search with a memory list available to make sure you NEVER expand a state more than once, where S is the initial state, and G is the goal state. That is, one search starts from the left and produces all paths of depth 1; then, another search starts from the right, goes against the arrows, and produces all the paths of depth 1. The two searches then alternate, adding additional layers to their search trees (i.e. search level by level), until an expansion from the left produces

a fringe shares some node with a fringe produced from an expansion from the right.
How many states will be expanded before the search stops? _____

(b) (6pts) Now suppose you do NOT check if you visit a state already (i.e. you always merge all the children), and the search stop when an expansion produces a path from the left shares some node with a path from the right. In this case, how many states will be expanded before the search stops ? _____

4. (5pts total) Let a, b, c be 3 propositions. Assume a knowledge base, KB, includes $a \vee b$, $a \rightarrow c$, $b \rightarrow c$.
   a) (1pts) Does KB entail c ? (Y/N) ___
   b) (2pts) By applying modus ponens, is it possible to derive c ? (Y/N) ___
   c) (2pts) Modus ponens is sound because (A or B) ___
      A. it can prove anything that is entailed.
      B. whatever it can prove is correct.