國 立 交 通 大 學 試 題 紙

一百一十學年度第一學期
博士班資格考

科目：人工智慧 A　　日期：111 年 1 月 18 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. (20 pts) Discuss the pros and cons of Decision Tree and Artificial Neural Net in terms of flexibility, accuracy, comprehensibility, learning/prediction efficiency.

2. (15 pts total) You are asked to develop a machine learning system for image classification.
   (i) (8 pts) Discuss what advantages neural network-based approaches (e.g. CNN) have over symbolic learners (e.g. decision tree classifier).
   (ii) (7 pts) Describe why NNs have these advantages but decision trees do not.

3. (15 pts total) Assume there are five hypotheses, $h_1 \sim h_5$, as shown below along with their properties. D is the given data, and F, R and L are the predicted values.

h_i	$P(h_i \mid D)$	$P(F \mid h_i)$	$P(R \mid h_i)$	$P(L \mid h_i)$
h_1	0.4	1	0	0
h_2	0.2	0	1	0
h_3	0.1	0	0	1
h_4	0.1	0	1	0
h_5	0.2	0	1	0

   (i) (5 pts) Based on MAP (Maximum A Posteriori) hypothesis, what is the predicted value?
   (ii) (10 pts) Based on Bayesian optimal classification, what is the predicted value?

◎請用深黑色鋼筆或原子筆出題

國 立 交 通 大 學 試 題 紙

一百一十學年度第一學期
博士班資格考

科目：人工智慧 B　　日期：111 年 1 月 18 日　第 1 頁 共 4 頁

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

This is a closed-book exam. Just write all your answers on the answer sheet. There are 25 questions, with only one correct answer per question. Each correct answer is worth 2 points, and each incorrect answer incurs a deduction of 0.5 point.

1. For a mouse moving in a maze looking for food, which of the following best describes the environment?
(A) dynamic and sequential (B) static and sequential (C) static and episodic (D) dynamic and episodic

2. Letter 'S' in the term "PEAS" description of a task environment represents
(A) sensors (B) speed (C) sources (D) space.

3. Which data structure is suitable for the frontier in a depth-first search?
(A) look-up table (B) FIFO queue (C) priority queue (D) stack

4. Which of the following is true about the relation between IDS and BFS?
(A) IDS involves repeated calls to BFS.
(B) The time complexity of IDS is $O(d)$ times the time complexity of BFS; d is solution depth.
(C) IDS and BFS have the same big-O space complexity.
(D) Tree-search IDS and BFS will find solutions of the same length.

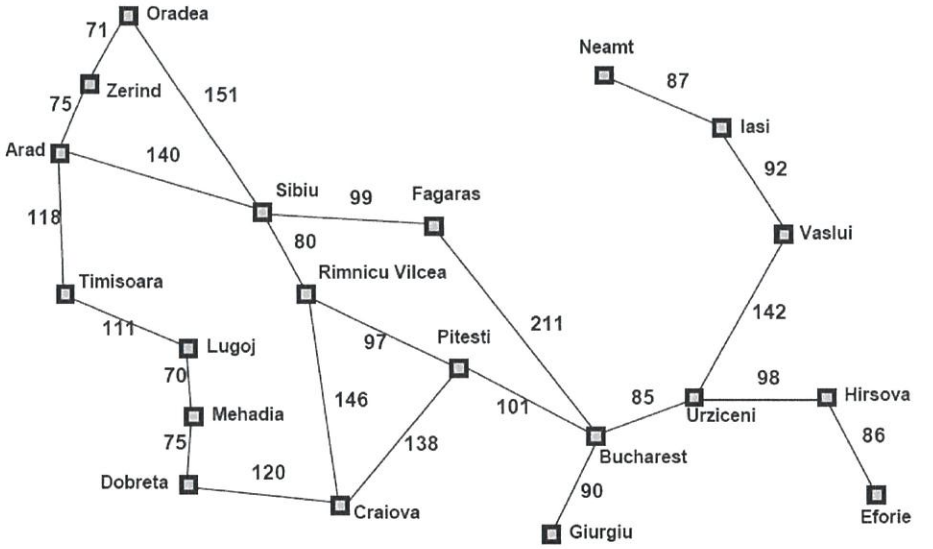
5. [See the Romania map in next page] From Timisoara to Bucharest, what is the number of steps of the path found by breadth-first search?
(A) 3 (B) 4 (C) 5 (D) 6

6. [See the Romania map in next page] To search for a path from Timisoara to Bucharest using uniform-cost search, what is the following is true?
(A) Zerind is expanded before Sibiu.
(B) Zerind is expanded after Dobreta.
(C) The solution path goes through Fagaras.
(D) The path found has the same number of steps as the path found by BFS.

7. [See the Romania map in next page] How many nodes are expanded by A* search when searching for a path from Zerind to Bucharest?
(A) 5 (B) 6 (C) 7 (D) 8

◎請用深黑色鋼筆或原子筆出題

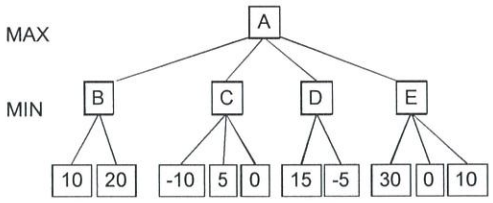
命題老師簽名：



Straight-line distance to Bucharest	
Arad	366
Bucharest	0
Craiova	160
Dobreta	242
Eforie	161
Fagaras	178
Giurgiu	77
Hirsova	151
Iasi	226
Lugoj	244
Mehadia	241
Neamt	234
Oradea	380
Pitesti	98
Rimnicu Vilcea	193
Sibiu	253
Timisoara	329
Urziceni	80
Vaslui	199
Zerind	374

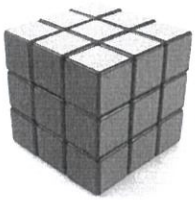
8. We are to use hill-climbing to maximize the function $f(x,y)=(3x+3y-2x^2+2xy-y^2)$, where x and y are integers. In each step, the allowed actions are to change x or y (but not both) by ±1. If the current position is (1,0), which of the following is the next position?
(A) (1,1) (B) (1,–1) (C) (0,0) (D) (2,0)

9. Given the game tree to the right, which action should MAX take?
(A) E (B) C (C) D (D) B

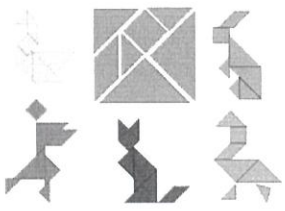


10. To handle stochastic games, what type of nodes is added to the game tree?
(A) random (B) chance (C) evaluation (D) minimax

11. Which of the following game is not a constraint satisfaction problem (CSP)?
(A) magic cube (B) Sudoku (C) word puzzle (D) tangram (七巧板)



5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9



12. Which of the following aspect of AI is the objective of Turing test?
(A) acting rationally (B) acting humanly (C) thinking humanly (D) thinking rationally

◎請用深黑色鋼筆或原子筆出題

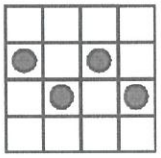
命題老師簽名：

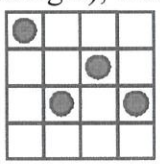
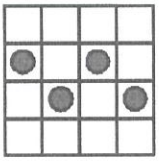
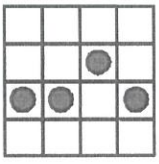
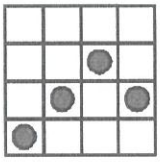
Questions 13-14: This is a CSP problem. The variables a, b, c, d, and e are single-digit integers that satisfy the following constraints: a is even, b>a, c>7, d=2b, e=c-3, e≠a, |d-e|=1

13. After applying only the unary constraints, which variable should we assign first according to the minimum-remaining-value heuristic?
(A) b (B) c (C) e (D) a

14. If the first assigned variable is d=2, this will lead to no solution. What method can we use to detect this failure before any other variable is assigned?
(A) degree heuristic (B) forward checking (C) maintaining-arc-consistency algorithm (D) local search

15. We are using the Min-Conflicts heuristic to solve the 4-queen problem. If we have selected the queen in the leftmost column to move from the current state (shown to the right), which one below is the state after the move?



(A)  (B)  (C)  (D) 

16. Which of the following propositional logic sentences is valid?
(A) p⇔¬p (B) p∨(p⇒q) (C) (p∨q)⇒(p∧q) (D) p∧q

17. Truth values of propositional symbols A, B, C and D are related to truth values of P and Q according to the given truth table. Which of them is entailed by P?
(A) A (B) B (C) C (D) D

P	Q	A	B	C	D
F	F	F	F	T	T
F	T	T	T	T	F
T	F	F	T	T	T
T	T	T	F	F	T

18. Which of the following sentence is in CNF?
(A) (Big ∨ Dumb) ∧ ¬Dumb
(B) (Big ∧ Dumb) ∨ ¬Dumb
(C) Smoke ⇒ Fire
(D) (Smoke ⇒ Fire) ∨ (Heat ⇒ Fire)

19. Inference by forward-chaining involves repeated application of which inference rule?
(A) modus ponens (B) and-elimination (C) standardizing-apart (D) resolution

20. We start with these sentences in the KB: E, A∧B⇒C, A∧F⇒C, F⇒A, B⇒D, E⇒F. Which of the following cannot be proved true using forward-chaining?
(A) F (B) D (C) A (D) C

21. Which of the following is false regarding the statement "entailment of FOL sentences is semidecidable"?
(A) If no function is involved, entailment in FOL is decidable.
(B) If a given sentence is entailed by a FOL KB, we can prove this in finite steps.
(C) If a given sentence is not entailed by a FOL KB, we can prove this in finite steps.
(D) There are complete and sound inference rules for FOL.

22. Which of the following is logically equivalent to "$\exists x \neg P$"?
(A) $\neg\exists x\, P$ (B) $\forall x \neg P$ (C) $\neg\forall x\, P$ (D) $\neg\forall x \neg P$

23. Which of the following statements best matches the FOL sentence
" $\forall x\, [\exists y\, (Likes(x, y) \wedge Dog(y)] \vee [\exists z\, (Likes(x, z) \wedge Cat(z)]$ "?
(A) Some people like all dogs and cats.
(B) Not everyone likes both dogs and cats.
(C) Everyone likes either all dogs or all cats.
(D) Everyone likes at least a dog or a cat.

24. Which of the following FOL sentence best matches the statement "Two persons are roommates if and only if they live in the same room"?
(A) $\forall x,y\, [\, \exists r\, Roommate(x, y) \wedge LivesIn(x, r) \wedge LivesIn(y, r) \wedge Room(r)\,]$
(B) $\forall x,y\, Roommate(x, y) \Leftrightarrow [\, \exists r\, LivesIn(x, r) \wedge LivesIn(y, r) \wedge Room(r)\,]$
(C) $\exists r\, \forall x,y\, Roommate(x, y) \Leftrightarrow LivesIn(x, r) \wedge LivesIn(y, r)$
(D) $\forall x,y\, Roommate(x, y) \wedge [\, \exists r\, Room(r) \Leftrightarrow LivesIn(x, r) \wedge LivesIn(y, r)\,]$

25. From the sentences "Friend(Bob, y) $\vee$ $\neg$Likes(Bob, y)" and "Likes(x, Father(x))", we can infer "Friend(Bob, Father(Bob))". What is the unifier in this inference?
(A) {x/Bob, y/Father(Bob)}
(B) {x/Bob, y/Bob}
(C) {x/y, Bob/Father(Bob)}
(D) {x/Father(Bob), y/Bob}