53 (CS 711) ARIN

2016

ARTIFICIAL INTELLIGENCE

Paper : CS 711

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer ***all*** *questions.*

1. *(a)* What is the difference between Artificial Intelligence and Natural Intelligence ? 4

(b) What are the production systems ? Mention the production system for agent's action using the boolean notations. 6

(c) What is the mean of local search algorithm ? Describe the hill climbing search with the algorithm. 10

2. (a) Define the problem reduction search and its formation using AND/OR graph with the dimension and cost. 4

(b) Write down the A* algorithm. 8

(c) Explain Iterative deepening search and, the advantages over Breadth first and Depth first search. 8

3. (a) Explain genetic algorithm and illustrate its with figure to show the standard procedure for canonical genetic algorithm. 8

(b) Explain the key six factors in the genetic algorithm (fitness function, chromosome (population), probability, random number, crossover and mutation). 12

OR

(a) Explain the Expectation-Maximization algorithm. 6

(b) Maximize the function $f(x) = x^2$ over the range of integers from 0....15. Apply a genetic algorithm to solve this problem. Show at least the possible solution (i.e. near to termination criteria).

(**Note** : x represent five-digit unsigned binary integers, $f(x)$ value itself a fitness solution, Coding in binary form having 4-bit string length (represent 15 numbers, Four chromosomes (0110, 1100, 0100, 1001) as initial populations, Decode individual for further evaluation (like fitness i.e. $x^2(1100 = 12 ; 12^2 = 144)$, probability, random number, corssover and mutation). 14

4. (a) Explain the $\alpha - \beta$ pruning algorithm and, also the deep and shallow pruning criteria in $\alpha - \beta$ algorithm. 12

(b) Three missionaries (M) and three cannibals (C) are on one side of a river along with a boat that can hold one or two people. Missionaries must never be outnumbered by cannibals. Find a way to get everyone to the other side, without ever leaving a group of missionaries outnumbered by cannibals.

Give a plan for all to cross the river.

State : <M, C, B>

M : no of missionaries on the left bank,

C : no of cannibals on the left bank,

B : position of the boat (One side of river) : L or R,

Initial state : <3,3,L>,

Goal state : <0,0,R>

Operators : <M, C>, M & C represent No. of missionaries and cannibals on the boat respectively.

Valid operators : <1,0>, <2,0>, <1,1>, <0,1>, <0,2>. 8

5. *(a)* Represent the following sentences in first order logic (FOL or Predicate Calculus) using a consistent vocabulary.

Takes (x, c, s) : student x takes course c in semester s ;

Passes (x,c,s) : student x passes course c in semester s ;

Grade (x,c,s) : the grade obtained by student x in course c in semester s ;

AI and SP : specific AI and SP courses

$x > y$: x is greater than y ;

Student (x) : Predicates satisfies by members of the corresponding categories.

Student *(x)*, course *(x)*, & semester *(s)*.

(i) Few students took AI in even semester 2015.

(ii) Every student who takes AI passes it.

(iii) Only one student took SP in odd semester 2015.

(iv) The best grade in AI is always higher than the best grade in SP.

(v) Students can pass some of the courses all the semesters, and they can pass all of the courses some of the semesters, but they can't pass all of the courses in all the semesters. 10

(b) Decide whether each of the following sentences is VALID, SATISFIABLE, or neither. Verify your decisions using truth tables or the equivalence rules.

(i) $Pass \Rightarrow Pass$

(ii) $Pass \Rightarrow Study$

(iii) $(Pass \Rightarrow Study) \Rightarrow (\neg Pass \Rightarrow \neg Study)$

(iv) $Pass \vee Study \vee \neg Study$

(v) $((Pass \wedge Toper) \Rightarrow Study) \Leftrightarrow ((Pass \Rightarrow Study) \vee (Topper \Rightarrow Study))$

(vi) $(Pass \Rightarrow Study) \Rightarrow ((Pass \wedge Topper) \Rightarrow Study))$

(Hint : Given Truth Table (Standard logical equivalences). The symbols α, β, and γ stand for arbitary sentences of propositional logic.

Standard logical equivalences :

$(\alpha \wedge \beta) \equiv (\beta \wedge \alpha)$ (commutativity of $\wedge$)

$(\alpha \vee \beta) \equiv (\beta \vee \alpha)$ (commutativity of $\vee$)

$((\alpha \wedge \beta) \wedge \gamma) \equiv (\alpha \wedge (\beta \wedge \gamma))$ (associativity of $\wedge$)

$((\alpha \vee \beta) \vee \gamma) \equiv (\alpha \vee (\beta \vee \gamma))$ (associativity of $\vee$)

$\neg(\neg\alpha) \equiv \alpha$ (double negation elimination)

$(\alpha \Rightarrow \beta) \equiv (\neg\beta \Rightarrow \neg\alpha)$ (contraposition)

$(a \Rightarrow \beta) \equiv (\neg\alpha \vee \beta)$ (implication elimination)

$(a \Leftrightarrow \beta) \equiv ((\alpha \Rightarrow \beta) \wedge (\beta \Rightarrow \alpha))$ (biconditional elimination)

$\neg(\alpha \wedge \beta) \equiv (\neg\alpha \vee \neg\beta)$ (De Morgan's Law)

$\neg(\alpha \vee \beta) \equiv (\neg\alpha \wedge \neg\beta)$ (De Morgan's Law)

$(a \wedge (\beta \vee \gamma)) \equiv ((\alpha \wedge \beta) \vee (\alpha \wedge \gamma))$ (distributivity of $\wedge$ over $\vee$)

$(a \vee (\beta \wedge \gamma)) \equiv ((\alpha \vee \beta) \wedge (\alpha \vee \gamma))$ (distributivity of $\vee$ over $\wedge$)

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