Total number of printed pages–7

53 (CS 711) ARIN

2017

ARTIFICIAL INTELLIGENCE

Paper : CS 711

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* What are main advantages of Artificial Intelligence in relevant areas ?

Contd.

(b) Explain the role of production system in the agent's action. Define it with the boolean algebra notations.

(c) Explain A0* algorithm with the steps. 4+6+10

2. (a) Describe the well-formed-formulas and also explain its interpretation in predicate calculus.

(b) What is the difference between Uninformed and informed search algorithms ?

(c) Write down the capabilities of computer to pass the turing test. 8+8+4

3. (a) Write down the Branch and Bound algorithm in steps.

(*b*) Find the shortest path from the starting state 'S' to the goal 'G'. The graph is shown below in the *Figure (1)*. Apply the Branch and bound (BB) search. List the nodes, after expanding and add to the extended list in order. Distances between the two nodes are shown on edges.

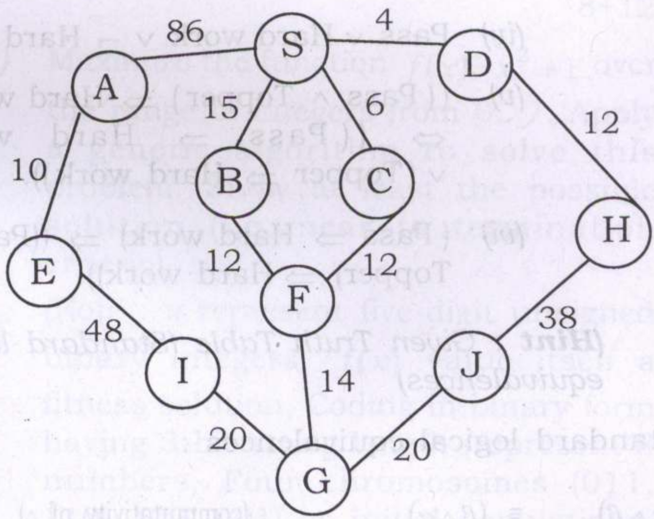

Figure (1)

8+12

4. (*a*) Explain propositional calculus with the atoms and connectives.

(b) Decide whether each of the following sentences is 'VALID' or 'SATISFIABLE'. Verify your decisions using truth tables or the equivalence rules.

(i) Pass $\Rightarrow$ Pass

(ii) Pass $\Rightarrow$ Hard work

(iii) (Pass $\Rightarrow$ Hard work) $\Rightarrow$ ($\neg$ Pass $\Rightarrow$ $\neg$ Hard work)

(iv) Pass $\vee$ Hard work $\vee$ $\neg$ Hard work

(v) ((Pass $\wedge$ Topper) $\Rightarrow$ Hard work) $\Leftrightarrow$ ((Pass $\Rightarrow$ Hard work) $\vee$ (Topper $\Rightarrow$ Hard work)).

(vi) (Pass $\Rightarrow$ Hard work) $\Rightarrow$ ((Pass $\wedge$ Topper) $\Rightarrow$ Hard work)).

***(Hint** : Given Truth Table (Standard logical equivalences)*

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)
$(\alpha \Rightarrow \beta)$	$\equiv (\neg\alpha \vee \beta)$	(implication elimination)
$(\alpha \Leftrightarrow \beta)$	$\equiv ((\alpha \Rightarrow \beta) \wedge (\beta \Rightarrow \alpha))$	(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)
$(\alpha \wedge (\beta \vee \gamma))$	$\equiv ((\alpha \wedge \beta) \vee (\alpha \wedge \gamma))$	(distributivity of $\wedge$ over $\vee$)
$(\alpha \vee (\beta \wedge \gamma))$	$\equiv ((\alpha \vee \beta) \wedge (\alpha \vee \gamma))$	(distributivity of $\vee$ over $\wedge$)

8+12

5. *(a)* Maximize the function $f(x)=x^2+1$ over the range of integers from 0...7. 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 3-bit string length (represent 8 numbers, Four chromosomes (011, 110, 100, 001) as initial populations, Decode individual for further evaluation (like fitness i.e. $x^2+1(110=6\ ;\ 6^2+1=37)$, probability, random number, crossover and mutation).

(b) Write short notes on the following : ***(any four)***

(i) Propositional Calculus

(ii) Depth First Search

(iii) Neural Network

(iv) Artificial Neural Network

(v) Simulated Annealing (Local Search Algo.)

(vi) Predicate Calculus. 10+(2·5×4)

6\. (a) Represent the following sentences in first-order logic, using a consistent vocabulary (which you must define):

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* ;

RO and IP : specific RO and IP courses

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

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

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

(a) Some students took RO in odd semester 2017.

(b) Every student who takes RO passes it.

(c) Only one student took IP in odd semester 2017.

(d) The best grade in IP is always higher than the best grade in RO.

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

(b) What is the role of OPEN and CLOSED in uninformed search (US) algorithm (searching with cost) ? Can be again visit the particular CLOSED node, after reaching on the goal in the US algorithm ? 15+5