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)* Explain the role of perception and action in the learning. Draw a diagram of immediate Perception-Action. 6

   (b) What are the needs for computer to pass a turing test ? 6

(c) Three cannibals (C) and three missionaries (M) are on one side of a river along with a boat that can carry one or two people. Missionaries must be more than cannibals at river side or in boat. Find a solution to get everyone after crossing the river on other side, with keeping group of missionaries not less than cannibals. Give a plan for all to cross the river.

State : <**M**, **C**, **B**>

M : no. of missionaries on the left river bank,

C : no. of cannibals on the left river bank,

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

Initial state : <3, 3, L>,

Goal state : <3, 3, R>,

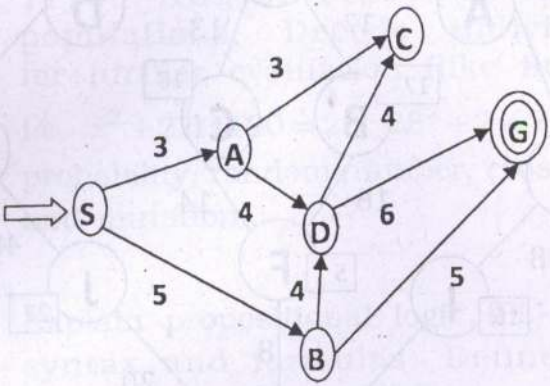
Operators : <M, C>, *M & C represent* No. of missionaries and cannibals on the boat respectively.

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

8

2. *(a)* Write down the uninformed search algorithm with a role definition of OPEN and CLOSED. 8

(b) Solve the given below graph using uninformal search algorithm and Branch and Bound. 12

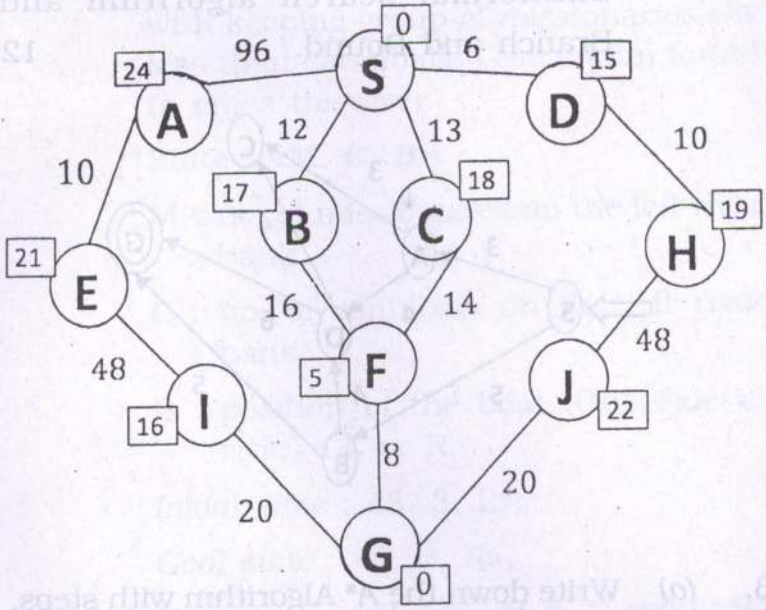


3. *(a)* Write down the *A** Algorithm with steps. 10

OR

Write down the steps of Branch and Bound algorithm.

(b) Find the shortest path from start state (S) to Goal state (G) using A^* algorithm with the mentioned heuristic values inside square bracket. Distances are mentioned on the edges between two nodes. 10



4. (a) Draw a diagram of Genetic algorithm cycle of reproduction and explain each part of this diagram. 10

(b) Maximize the function $f(x) = x^2 + 2$ over the range of integers from 0...31. 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 5-bit string length (represent 32 numbers, Four chromosomes (10110, 11100, 10100, 11001) as initial populations, Decode individual for further evaluation (like fitness i.e. $x^2 + 2\,(11100 = 28 ; 28^2 + 2 = 786)$, probability, random number, crossover and mutation). 10

5. *(a)* Explain propositional logic (PL) with syntax and formulas. Define the interpretation for a sentence or group of sentences with an assignment of truth values in terms of properties of statements. 10

OR

Explain First Order Logic (FOL) with syntax and various connectives. Mention the differences between PL and FOL.

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

a. $Raining \Rightarrow Cloudy$

b. $Raining \Rightarrow Cloudy \wedge Thundering$

c. $Raining \vee Cloudy \vee \neg Thundering$

d. $((Raining \wedge Thundering \wedge Windy) \Rightarrow Cloudy) \Rightarrow ((Raining \Rightarrow Cloudy) \vee (Thundering \Rightarrow Cloudy) \vee (Windy \Rightarrow Cloudy))$

e. $(Raining \Rightarrow Cloudy) \Rightarrow ((Raining \wedge Thundering \wedge Windy) \Rightarrow Cloudy)$

(***Hint :*** *Given Truth Table* (Standard logical equivalences). The symbols α, β, and γ stand for arbitrary 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 $\vee$)
$\neg(\neg \alpha)$	$\equiv$	α	(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 $\wedge$) 10

6. *(a)* Represent the following sentences in first order logic (FOL) ;

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 ;

SP and AI : specific SP and AI 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) Every student took AI in odd semester 2017.

(ii) All students who take AI pass it.

(iii) Only one student fails AI in odd semester 2017.

(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 semester, but they can't pass all of the courses in all the semesters. 10

(b) Write short notes on : ***(any four)*** 2·5×4=10

(i) SKOLEMIZATION

(ii) Iterative Deepening

(iii) Resolution

(iv) STRIPS (Planning)

(v) AO* algorithm

OR

(i) Write down all the rules of inference in predicate calculus, and define Generalized Modus Ponens (GMP).

(ii) The given knowledge base (*KB*) = August month falls with heavy rain, April to September months also fall with rain, and August is a month.

In First Order Logic (FOL), *KB* =

$\exists x$ Month $(x) \Rightarrow$ Falls $(x,$ *Heavy rain*$)$

$\exists x \exists y$ (Month $(x) \wedge$ Falls $(x, y)) \Rightarrow$ Falls (x, y)

Month (August)

Query : Does August month fall with heavy rain ?

(***Hint :*** Use Generalized Modus Ponens (GMP)) 6+4
