THE OPEN UNIVERSITY OF SRI LANKA
BSc DEGREE PROGRAMME: LEVEL 05
FINAL EXAMINATION: SEMESTER 2 - 2019/2020
CSU5317/CSU5308: ARTIFICIAL INTELLIGENCE

DURATION: **TWO HOURS** (2 HOURS)

DATE: **11.02.2021** TIME: **1.30 p.m. to 3.30 p.m.**

Answer FOUR Questions ONLY.

Q1.

(a) "In 1950, Alan Turing proposed the Turing test, which was designed to provide a satisfactory operational definition of intelligence."

(i) Briefly explain the **Turing test**.

(ii) The computer would have some capabilities in order to pass the Turing Test. Name three (03) of them.

(b) Artificial Intelligence has inherited many ideas, viewpoints, and techniques from other disciplines.

Give one inherited viewpoint/technique for each of the following disciplines:

- Mathematics
- Neuroscience
- Psychology

(c) Fill in the blanks with suitable answers.

The propositional logic and predicate logic are considered under (i) _____ mechanisms. In this reasoning the decisions are made in terms of two-fold logic which evaluates to be true or false.

Propositional logic and predicate logic do not capture all the techniques of reasoning which seem to be so effective in humans. (ii) _____, such as multi valued logic, allows us to use predicate logic but with truth values such as 'unknown.'

(iii) _____ process allows us to draw conclusions based on incomplete and inconsistent information about our rapidly changing environment and goals.

(d) Write three (03) differences between **Inductive reasoning** and **Deductive reasoning**.

Q2.

(a) Is the following well formed formula (WFF) **valid**? Justify your answer using a truth table.

$$[(P \vee Q) \wedge (Q \vee R)] \rightarrow (P \vee R)$$

(b) Which of the following formulas are **equvalent**?

(i) $P \vee \neg Q$

(ii) $\neg(\neg P \wedge Q)$

(iii) $(P \wedge Q) \vee (P \wedge \neg Q) \vee (\neg P \wedge Q)$

(iv) $(P \wedge Q) \vee (P \wedge \neg Q) \vee (\neg P \wedge \neg Q)$

(c) Transform the following formula into **conjunctive normal form**.

$$(A \vee B) \rightarrow (C \wedge D)$$

Q3.

(a) Explain, using an example, how predicate logic addresses the limitations of propositional logic.

(b) Translate the following statements into **predicate logic**.

(i) Brothers are siblings

(ii) Every student loves music

(iii) Some CSU5300 students love music

(c) Transform the following formula into **prenex normal form**.

$$(\forall x)\, P(x) \rightarrow (\exists x)\, Q(x)$$

(d) State whether the following formulas are true or false.

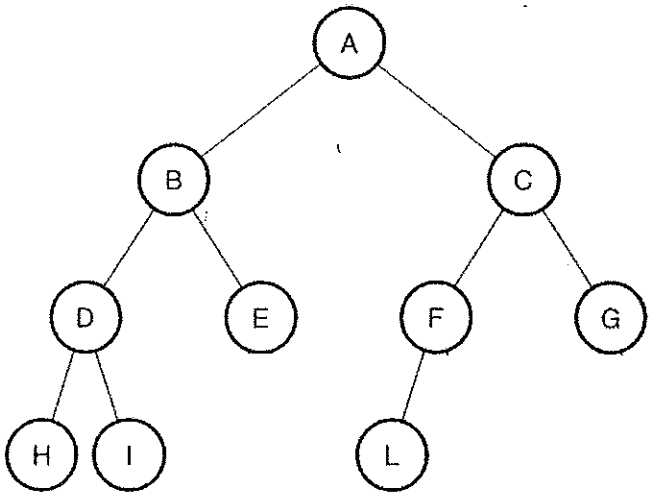
(i) $\forall x P(x) \equiv \neg \exists x \neg P(x)$

(ii) $\exists x P(x) \equiv \neg \forall x P(x)$

(iii) $\forall x \exists y P(x, y) \equiv \exists x \forall x P(x, y)$

Q4.

Consider the following binary tree. Answer the questions from (a) to (d).



(a) In which order the nodes would be visited when the **depth first search** is used?

(b) Which data structure is used to implement the **depth first search**?

(c) Which of the following search strategies needs a very large memory space to store the search tree?

- Breadth-first search
- Depth first search

(d) Which of the following search algorithms are **optimal**? Justify your answer.

- Breadth-first search
- Depth first search
- Bi-directional search

Q5.

(a) What is the difference between the **table-driven agent program** and **simple reflex agent**?

(b) Briefly explain what a **problem-solving agent** does.

(c) Define the following components of a problem.

(i) Initial State

(ii) State Space

(iii) Successor Function

(iv) Optimal Solution

(d) Define the following components for a **vacuum cleaner world**.

- Initial state
- Successor function
- Goal test
- Path cost

Q6.

(a) Explain the meaning of the following built-in predicates of Prolog.

(i) assert

(ii) retract

(iii) setof

(b) Consider the following database written in Prolog. How does Prolog answer the queries given in the questions (i) and (ii)?

(Note: Each time that Prolog returns an answer, the user inputs `';'` to ask for another answer.)

```
:-dynamic product/4.

product('P01', 'Processor', 50, 8500).
product('P02', 'Hard Disk', 50, 4500).
product('P03', 'Ram', 50, 2500).
product('P06', 'Monitor', 50, 12000).
product('P05', 'Printer', 50, 5600).
product('P04', 'Key board', 50, 600).

printList([]).
printList([H|T]) :- product(H,PN,Q,_),write(PN),
                    write('    '), write(Q),
                    nl,printList(T).

printProList:- setof(PID, PN^Q^UP^product(PID,PN,Q,UP),L),
printList(L).
```

(i) `?- product(A,B,C,D).`

(ii) `?- printProList.`

(c) Create the following Prolog rules.

```
son/2, daughter/2, mother/2, father/2
```

(Assume that, all these rules have the standard meanings as their names imply.)