THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME: LEVEL 05
FINAL EXAMINATION: SEMESTER 2 - 2016/2017
CPU3243: PRINCIPLES AND TECHNIQUES OF ARTIFICIAL INTELLIGENCE

DURATION: **THREE HOURS** (3 HOURS)

DATE: **10.01.2018** TIME: **1.30 p.m. to 4.30 p.m.**

Answer FOUR Questions ONLY.

Q1.

(a) What is **Artificial Intelligence**? Briefly explain it in your own words.

(b)
(i) What is the **Turing test**?
(ii) "A computer would have some capabilities to pass the Turing test." Give three (03) of them.

(c) Identify which of the following is/are true? In each case, justify your answer.
(i) The field of study of human intelligence is called Sociology.
(ii) Turing test is an example of a system that thinks like humans.

(d) What is **reasoning**? Explain it using an example.

(e) Describe the following classifications of reasoning.
(i) Deterministic reasoning
(ii) Dynamic reasoning
(iii) Non-deterministic reasoning

(f)
(i) "There are seven types of reasoning techniques other than the 03 classifications given in question (e)." Briefly explain them.

(ii) Which reasoning technique is most suitable for solving each of the following problems? Explain your answer.
a. Develop a computer program to find the students' z-score using the given A/L result sheet.
b. Develop a 'help system' to identify human desires.
c. Solving a set of mathematical equations using relevant approximations.
d. An electrician finding a fault with an electrical equipment.

Q2.

(a) Briefly explain the terms, **tautology**, **contradiction**, **model assignment** and **counter example** using truth tables.

(b) P and Q are two propositions. Which of the following logical expressions are equivalent? Use truth tables to justify your answer.

(i) $P \vee \neg Q$

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

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

(c) Translate the following propositional logic statements into English language statements.

(i) $A \leftrightarrow (B \vee C)$

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

(d) Using propositional logic, prove (D) from (A,B,C):

A: $P \rightarrow (Q \leftrightarrow R)$

B: $\neg(Q \leftrightarrow R)$

C: $(S \wedge Q) \rightarrow P$

D: $\neg P \wedge (S \rightarrow \neg Q)$

(e) Transform the following formulas into conjunctive normal form (CNF).

(i) $A \leftrightarrow B$

(ii) $(A \wedge B) \leftrightarrow (A \vee B)$

(iii) $A \wedge (A \rightarrow B) \rightarrow B$

Q3.

(a)

(i) Differentiate between **propositional logic** and **predicate logic**.

(ii) Describe how predicate logic addresses the limitations of propositional logic.

(b) Translate the following sentences in natural language into first-order-logic statements.

(i) There exist some numbers which are either real OR rational.

(ii) All real numbers are rational.

(iii) There exist some numbers which are both real AND rational.

(iv) There exist some numbers for which rational implies real.

(c) Suppose that the following two statements are true.

A: Every AI student loves Star Trek or Star Wars.

B: Some AI students do not love Star Trek.

Based on the above two statements conclude, that "there exists some AI students who love Star Wars."

(d)

(i) What is meant by **prenex normal form**?

(ii) Transform the following formulas into prenex normal form.

a. $(\forall x)A(x) \rightarrow (\exists x)B(x)$

b. $(\forall x)\Big((\forall y)\Big((\forall z)\big(A(x,y,z) \wedge B(y)\big) \rightarrow \big((\forall x)C(x,z)\big)\Big)\Big)$

c. $(\exists x)\Big(S(x) \wedge (\forall y)\big(L(y) \rightarrow A(x,y)\big)\Big)$

Q4.

(a) Complete the following figure (Fig. 1) by using appropriate words.

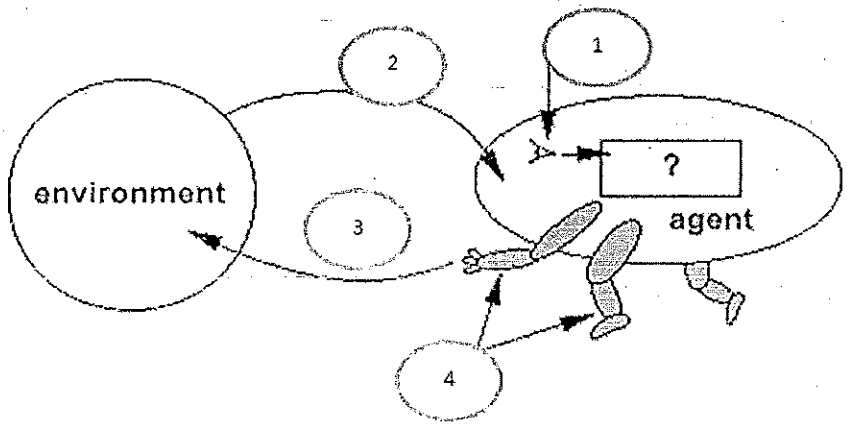


Fig 1: Interaction of the human agent

(b) Briefly explain the following terms of an agent.

(i) Percept

(ii) Percept sequence

(iii) Agent function

(c) Consider the following states (Fig 3) of the vacuum cleaner (Fig 2).

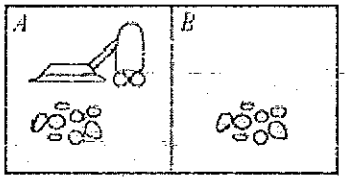


Fig 2: Vacuum cleaner world with two locations

Percepts: location and its contents,
Eg. **[A, Dirty]**

Actions: Left, Right, Suck, NoOP

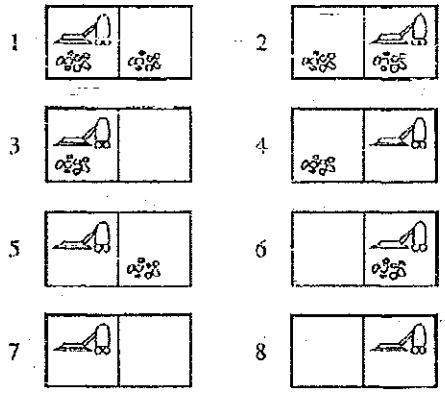


Fig 3: The eight possible states of vacuum world

Start with state (1) or (2) and the end goal is state (7) or (8). Write the lowest possible steps of percepts sequence with their actions.

(d)

(ii) What is meant by **PEAS description**?

(iii) Give PEAS descriptions for the following agents.

a. Automated taxi driver

b. Medical diagnosis system

(e)

(i) "All agent's environment shares a common set of characteristics." Briefly explain the following characteristics.

a. Partially observable

b. Deterministic

c. Sequential

d. Static

(ii) Characterize the following task environments with the following possible characteristics.

Characteristics:

Observable: fully/partial
Deterministic: deterministic /stochastic
Episodic: episodic/sequential
Static: static/semi-dynamic/dynamic

Task environments: crossword puzzle, Taxi driver, Image analysis

Q5.

(a) Describe the following agents using your own words.

(i) Simple-reflex agents

(ii) Goal-based agents

(iii) Model-based reflex agents

(b) "Problem-solving agents are one kind of the goal-based agents."

(i) Explain the term "problem-solving agents" in your own words.

(ii) Consider the following example of the problem-solving agent.

Eg. Travelling agent

a. Briefly explain *goal test*, *path cost* and the *solution* of the above example.

b. Describe how the above agent maximizes its performance.

(c) Define the following search algorithms.

(i) Breadth-first search
(ii) Depth-first search

(d) Give the advantages and disadvantages of the above search algorithms given in question (c).

(e) Describe the completeness and the optimality of the following search algorithms.

(i) breadth-first search
(ii) Depth-first search
(iii) Iterative Deepening Depth-first Search
(iv) Bidirectional Search

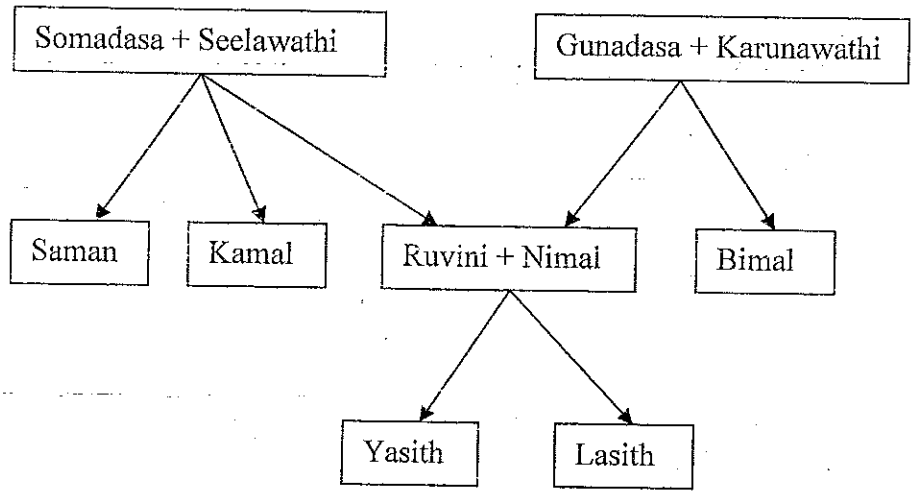
Q6.

(a) What are the differences between **PROLOG** and **other programming languages**?

(b) Briefly explain the following terms in the context of PROLOG.

(i) Data, facts and variables
(ii) Predicates and rules

(c) Consider the relationship diagram given below.



(i) Create the following PROLOG rules.

`parent/2`, `mother/2`, `farther/2`, `grandfather/2` and `grandmother/2`

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

(ii) Explain how PROLOG would answer the following queries.

a. `?- mother(X, Saman).`

b. `?- grandmother(Seelawathi, Yasith).`

(iii) Create a rule named `aboutme/2` that gives the possible relation of a given person.
(***Hint:*** *Your predicate may give at least the following information*)

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?- aboutme(Yasith)
   Saman is a male
   Mother is Ruvini
   Father is Nimal
   Grand father is Somadasa
```