063

THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME: LEVEL 05
FINAL EXAMINATION: SEMESTER 2 - 2015/2016
CPU3243: PRINCIPLES AND TECHNIQUES OF ARTIFICIAL INTELLIGENCE

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

DATE: **15.01.2017** TIME: **1.30 p.m. to 4.30 p.m.**

Answer FOUR Questions ONLY.

Q1.

(a) "The Turing test is a test, developed by Alan Turing in 1950, of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human." Briefly explain the Turing test experiment in your own words.

(b) "Reasoning is the process of arriving at a conclusion from a given set of premises."

(i) Compare and contrast *deterministic* and *dynamic* reasoning.

(ii) Explain seven types of reasoning techniques with suitable examples.

(iii) Describe three successful stories in AI by considering suitable AI techniques.

(c) Which of the following is/are true? In each case, justify your answer.

(i) We build hardware as complex as the brain.

(ii) Inductive reasoning can be used to develop a helping system to identify computer problems that can provide information about software and hardware errors.

(d) eChannel is an AI based software development company in Sri Lanka. They are going to develop a mobile application for channeling doctors with online payment options.

(i) Which type of reasoning method is best for the above application?

(ii) Which reasoning technique/techniques can be used to develop the above application?

(iii) What is the reasoning technique that cannot be used to solve the above application? Explain your answer.

Q2.

(a) "Logic plays a fundamental role in Computer Science." Do you agree with this statement? Briefly explain.

(b) "Propositional logic is not powerful enough to represent all types of assertions that are used in Computer Science and Mathematics."

(i) Briefly explain the syntax and semantics in propositional logic.

(ii) Compare and contrast *propositional logic* and *predicate logic*.

(iii) Which of the following formulae is a tautology? Use truth tables to justify your answer.

1. $[P \wedge (P \rightarrow Q)] \rightarrow Q$
2. $\big((P \vee Q) \wedge (\neg P \vee R)\big) \rightarrow (Q \vee R)$

(iv) Translate the following propositional logic statement into an English language statement.

$$A \leftrightarrow (B \rightarrow \neg C)$$

(c) Consider the following statements:

- It is not sunny this afternoon and it is colder than yesterday.
- We will go swimming only if it is sunny.
- If we do not go swimming, then we will take a canoe trip.
- If we take a canoe trip, then we will be home by sunset.

Using inference rules or truth tables show that "we will be home by sunset."

Q3.

(a) "Propositional logic is not powerful enough to represent all types of assertions that are used in Computer Science and Mathematics. Predicate logic addresses these issues successfully."

(i) What are the limitations of propositional logic and how are they handled in predicate logic?

(ii) Write an equivalent predicate logic sentence for each of the followings.

1. Some sleepy students do not answer any question.
2. All students get good grade if they study.

(b) Which of the following is/are true? In each case, justify your answer.

1. $\neg\exists(x)\,(Q(x) \wedge R(x)) \equiv \forall(x)\,(\neg Q(x) \vee \neg R(x))$
2. If (PVQ) is TRUE, and (P VR) is TRUE then (Q V R) must be TRUE

(c) "Conjunctive Normal Form (CNF) is a conjunction of clauses, where each clause is a disjunction of literals." Answer the questions given below.

(i) What are the steps in converting predicate logic formula into CNF?

(ii) Use the following statements and conclude, that "Someone in this class has visited Sigiriya."

- There is someone in this class who has visited Dhambulla.
- Everyone who has visited Dhambulla has visited Sigiriya.

Q4.

(a) "Prolog is a general-purpose logic programming language associated with artificial intelligence and computational linguistics."

(i) Compare and contrast *object oriented programming languages* and *Prolog*.

(ii) Explain facts, rules and variables in Prolog.

(iii) Use the following Prolog codes and explain how Prolog searches the knowledge base to see if a query (Example: k(X)) is satisfied.

```
f(a).
f(b).
g(a).
g(b).
h(b).
k(X) :- f(X), g(X), h(X).
```

(b) Consider the following Prolog database and answer the questions given below.

```
item(1001,'Computer Mother board', 8, 12500).
item(1001,'Intel i7 Processor', 5, 17500).
item(1001,'4 GB DDR3 RAM ', 10, 2500).
```

(i) Prolog has two database manipulation commands *assert* and *retract*. Explain their functionalities.

(ii) Write Prolog procedures to do the following.

1. `add_new_item/0` - to add a new item from keyboard
2. `delete_item/1` - to delete an item (Item id is given as an argument)
3. `change_item/1` - to change quantity and unit price of a given item (Item id is given as an argument)

Q5.

(a) Any language needs a way to handle collections of objects and Prolog is no exception. A list in Prolog can look like this: [a, b, c, d, e].

(i) "Recursion is a successful way to travel in a list." Explain.

(ii) Write Prolog procedures to do the following list operations.

1. `print_rev/1` prints list in reverse order
2. `delete_item/3` deletes a given item from a list
3. `get_average/2` gives average of the given list of numbers

(b) Prolog is a great language for modeling of puzzle solving problems. Consider the following scenario.

A farmer and his goat, wolf, and cabbage come to the West bank of a river that they wish to cross. There is a boat, but it has room for only two, and the farmer is the only one who can row. If the goat and the cabbage get in the boat at the same time, the goat will eat the cabbage. Similarly, if the wolf and the goat are together without the farmer, the goat will be eaten. Devise a series of crossings of the river so that all concerned make it across safely to the East bank. Figure 1 shows the summary of the farmer goat, wolf, and cabbage problem.

To solve this problem in Prolog, one can encode the configuration of the 4 objects (farmer, wolf, goat, cabbage) as a list.

If w denotes the West bank and e denotes the East bank, then the initial state is: [w,w,w,w] (everyone is on the West bank).

The desired final configuration is: [e,e,e,e] (everyone is on the East bank).

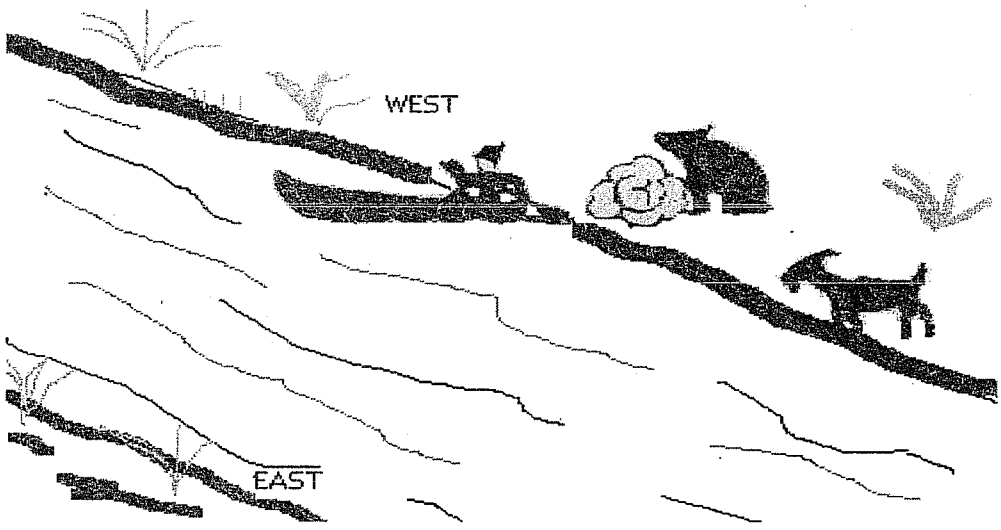

Figure 1: farmer goat, wolf, and cabbage problem

You can also use the following predicates.

```
member(X,[X|_]).
member(X,[_|T]):-member(X,T). printLst([]).

printLst([H|T]) :- printLst(T),write(H),nl.
go(Start,Goal) :- path(Start,Goal,Start).

path(Goal,Goal,L) :-  write('Solution Path is: ' ), nl,
                      flatten(L,X),printLst(X).
path(State,Goal,L) :- move(State,Next), not(member(Next,L)),
                      path(Next,Goal,[Next|L]),nl,!.
unsafe(state(X,Y,Y,_)) :- opp(X,Y).
unsafe(state(X,_,Y,Y)) :- opp(X,Y).

opp(e,w). opp(w,e).

move(state(X,X,G,C), state(Y,Y,G,C)) :- opp(X,Y),
           not(unsafe(state(Y,Y,G,C))),
           write('try farmer takes wolf'),nl.

move(state(F,W,G,C), state(F,W,G,C)) :- fail.
```

Answer the questions given below.

(i) Briefly explain the predicates, `member/2`, `printLst/2` and `flatten/2`.

(ii) What is the process of the following predicate?

```
move(state(F,W,G,C), state(F,W,G,C)) :- fail.
```

(iii) Use `move(State1, State2 )` predicate and implement the following operations.

1. Farmer takes self.
2. Farmer takes cabbage.

(iv) Briefly describe how this program runs on the following predicate.

```
go(state(e,e,w,e), state(e,e,e,e)).
```

Q6.

(a) Fuzzy logic is an approach to compute based on "degrees of truth" rather than the usual "true or false" state. Explain briefly.

(b) "Intelligent agent (IA) is an autonomous entity which observes through sensors and acts upon an environment using actuators."

(i) What is meant by a **PEAS description** of an agent?

(ii) Present the PEAS description of the following automated agents.

i. An intelligent air-conditioner system for a bed room
ii. Medical diagnosis system

(iii) Compare and contrast *learning agent* and *simple reflex agent*.

(c) "Agents exist in an environment." Explain the following environments stating which one is easy for constructing an intelligent agent.

(i) Fully observable and partially observable environments.
(ii) Deterministic and non-deterministic environments.
(iii) Static and dynamic environments.