



THE OPEN UNIVERSITY OF SRI LANKA
 B.Sc DEGREE PROGRAMME: LEVEL 04
 FINAL EXAMINATION: SEMESTER 1- 2015/2016
CSU2280: DEDUCTIVE REASONING AND PROLOG FOR ARTIFICIAL INTELLIGENCE

DURATION: THREE HOURS (3 HOURS)

Date: 27th June, 2016

Time: 9.30 am – 12.30 pm

Answer FOUR Questions ONLY.

Q1.

- a) Using your own words, explain the term “Reasoning”.
- b) What are the seven reasoning techniques? Explain using suitable examples.
- c) “One problem can be solved using different reasoning technologies.” Do you agree with this statement? Briefly explain.
- d) What is the most suitable reasoning technique for each of the following examples? Give a reason for each example.
 - i. Create a mobile application to display a particular place in a map
 - ii. Create a system to diagnose computer hardware problems
 - iii. Solving a set of mathematical equations using relevant approximations
 - iv. An electrician finds a fault with an electrical equipment

Q2.

- a) Using suitable examples explain the vocabulary of propositional logic.
- b) Briefly explain the terms, “Tautology”, “Contradiction”, and “Model assignment” with suitable examples.
- c) Which of the following formulae is a Tautology? Use truth tables to justify your answer.
 - i. $[P \wedge (P \rightarrow Q)] \rightarrow Q$
 - ii. $((P \vee Q) \wedge (\neg P \vee R)) \rightarrow (Q \vee R)$
- d) Translate the following statements in propositional logic into natural English.
 - i. $A \leftrightarrow (B \cup C)$
 - ii. $\neg(P \vee Q) \wedge \neg(P \rightarrow Q)$

Q3.

- a) What are the differences between propositional logic and predicate logic?
- b) Explain how predicate logic can address the limitations of propositional logic.
- c) Using your own words, explain the meaning of the following logic formulae.
 - i. $\exists xF(x, y)$
 - ii. $\forall xP(x) \wedge \forall yF(y) \wedge \exists xF(x, y)$
- d) Use the following two statements (S1 and S2) and the claim (C1) to answer the question (i).

S1: If the airport is closed and the weather is bad, then either we cannot go on the trip.

S2: It is not the case that, if we do not go on the trip then the weather is bad.

C1: Either the weather is good then we go on the trip.

Translate S1, S2, and C1 into propositional logic using appropriate atomic propositions.

- i. Is C1 a valid claim? Justify your answer.
(*Hint: If C1 is valid, then $(S1 \cap S2) \rightarrow C1$ becomes a tautology*)

Q4.

- a) "Resolution is a much more powerful way of making inferences than the use of inference rules". Do you agree with this statement? Explain briefly.
- b) Briefly explain the following terms.
 - i. Skolemisation
 - ii. Unification
 - iii. Horn Clause
- c) What are the nine steps for converting predicates to CNF?
- d) Convert the following predicate into CNF.

$$\forall x(P(x) \rightarrow Q(x) \wedge R(x))$$

Q5.

- a) What are the advantages of PROLOG?
- b) Briefly explain the following terms in the context of PROLOG.
 - i. Source program
 - ii. Predicates and Rules
- c) Consider the following PROLOG predicates to answer the questions from (c) i to (c) iii.

<pre>parent(rathnapala, sunil). parent(rathnapala, kamala). parent(rathnapala, gamini). parent(rathnapala, ruwini). parent(gunadasa, tikiri). parent(ramyawathi, tikiri). parent(gunapala, saman). parent(ramani, saman). parent(seela, gamini). parent(seela, ruwini). parent(kamala, kasun). parent(tikiri, kasun).</pre>	<pre>male(rathnapala). male(sunil). male(gamini). male(kasun). male(saman). male(gunapala). female(kamala). female(ruwini). female(seela). female(ramani). female(ramyawathi). female(tikiri).</pre>
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- i. Create the following PROLOG rules;


```
son/2, daughter/2, husband/2 and wife/2, mother/2,
father/2
```

 (Assume that, all these rules have the standard meanings as their names imply.)
- ii. Explain how PROLOG will answer the following queries;
 - a. ?- son(X, sunil).
 - b. ?- daughter(rathnapala, kamala).
- iii. Create a rule named aboutMe/1 that gives all the possible relations related to a given person.

(Hint: Your predicate should give at least the following information)

```
?- aboutMe(saman)
   Saman is a male person
   Mother is ramani
   Father is gunapala
```

Q6.

a) Briefly explain the following PROLOG predicates;

- i. setof/3
- ii. assert/1

b) Consider the following three tables.

Product ID	Product Name	Quantity	Unit Price
P01	Processor	50	8500
P02	Hard Disk	50	4500
P03	RAM	50	2500
P04	Monitor	50	12000
P05	Printer	50	5600
P06	Key board	50	600

Table 1: Product

Customer ID	Customer Name	Address
C001	Saman Kumara	Galle Rd, Colombo 3
C002	Gamini Silva	No 23, Panadura
C003	Samantha Perera	Nawala Road, Nugegoda

Table 2: Customer

Sales ID	Customer ID	Product ID	Quantity
S01	C001	P01	10
S02	C001	P02	5
S03	C001	P03	3
S04	C002	P01	2

Table 3: Sales

- i. Create PROLOG rules named `addProduct/0`, `addCustomer/0` and `addSales/0` in order to add a new Product, Customer, and Sales record respectively by using the keyboard.
(*Hint: after adding a new sales record you must change the Quantity value in the Product table accordingly*)
- ii. Create a PROLOG rule named `editProduct/0` and `editCustomer/0` to change the Product and Customer data respectively.
- iii. Create a PROLOG rule named `delProduct/0`, `delCustomer/0`, and `delSales/0` to delete the given Product, Customer and Sales records respectively.

- iv. Create a PROLOG rule to display the available product list in the format given below.

Available Products	
Name	Quantity
Processor	38
Hard Disk	45
RAM	47
Monitor	50
.....

- c) Create a PROLOG rule named 'salesinfo/1' to display sales details for a given customer. Your output format should be as follows.

Example:

```
? salesinfo('C001').
```

SALES DETAILS		
Customer Name: Saman Kumara		
Address: Galle Rd, Colombo 3		
Product	Quantity	Price
Processor	10	85000
Hard Disk	5	22500
Ram	3	7500

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