

THE OPEN UNIVERSITY OF SRI LANKA  
 B.Sc DEGREE PROGRAMME: LEVEL 05  
 FINAL EXAMINATION: SEMESTER 2 - 2014/2015  
**CPU3243: PRINCIPLES AND TECHNIQUES OF ARTIFICIAL INTELLIGENCE**



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

DATE: **26<sup>th</sup> October, 2015**

TIME: **1.30 p.m. – 4.30 p.m.**

**Answer FOUR Questions ONLY.**

**Q1.**

- a) Define the following terms which are used in genetic algorithms.
  - i. Chromosome
  - ii. Fitness function
  - iii. Crossover
  - iv. Mutation
  
- b) Explain the following in your own words. Give an example for each one.
  - i. Binary encoding
  - ii. Gray coding
  - iii. Permutation encoding
  
- c) Suppose a population (pool) consists of the following two individuals.  
 1123412 and 4231562
  - i. Show the result by performing crossover between the 4<sup>th</sup> and 5<sup>th</sup> digit.
  - ii. Mutation takes place after the crossover is performed. Perform mutation and show the result. Explain how you would perform mutation.

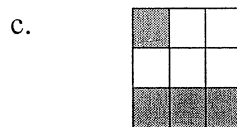
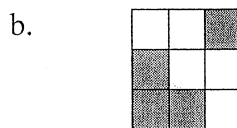
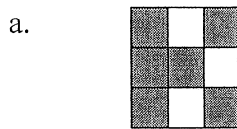
**Q2.**

- a) Explain three (03) benefits of using neural networks.
- b) Define the following neural networks in your own words. Provide an example for each.
  - i. Single layer feed forward neural network
  - ii. Multi layer feed forward neural network
  - iii. Recurrent neural network
  
- c) Explain the following learning methods by giving at least two (02) features of each method.
  - i. Supervised learning
  - ii. Unsupervised learning
  - iii. Reinforcement learning

- d) What is a **firing rule**?
- e) Consider the following patterns of letters N and L. Train a neural network to recognize these patterns and answer the following questions (i) and (ii).



- i. Clearly draw generalized truth tables after training the above patterns.
- ii. Recognize the following patterns using the trained neural network.



### Q3.

- a) Explain the term **reasoning** in your own words.
- b) Explain the seven types of **reasoning techniques**. Give one example for each of them.
- c) XYZ is an AI based software development company in Sri Lanka. They are planning to develop an e-medical system to give medical assistance to the users. This system also provides facilities to channel doctors online.
- i. Which reasoning technique/techniques can be used to develop the above program?
- ii. What is the reasoning technique that cannot be used to solve the above problem? Justify your answer.

- d) Explain the most suitable reasoning technique that can be used to solve each of the following problems.
- 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 finding a fault with electrical equipment

#### Q4.

- a) What is meant by **sylogisms**?
- b) Briefly explain the following terms by using suitable examples.
  - i. Tautology
  - ii. Contradiction
  - iii. Model assignment
  - iv. Counter example
- c) Which of the following formulae is a tautology or contradiction or neither? Use truth tables to justify your answer.
  - i.  $(P \vee Q) \leftrightarrow (\neg P \vee Q)$
  - ii.  $((P \rightarrow Q) \wedge \neg Q) \rightarrow \neg P$
  - iii.  $(P \rightarrow (Q \vee R)) \leftrightarrow ((P \wedge (\neg Q)) \rightarrow R)$
- d) Define the **conjunctive normal form** and the **disjunctive normal form**.
- e) Convert the following formulas into conjunctive normal form.
  - i.  $A \vee (B \leftrightarrow C)$
  - ii.  $(P \vee \neg Q) \rightarrow R$
  - iii.  $(A \rightarrow L) \wedge (L \rightarrow H) \wedge A$

#### Q5.

- a) Explain how predicate logic can address the limitations of propositional logic.
- b) Translate the following sentences into first-order logic.
  - i. Star Trek, Star Wars and The Matrix are science fiction movies.
  - ii. Every AI student loves Star Trek or Star Wars.

- iii. Some AI students do not love Star Trek.
  - iv. All AI students who love Star Trek also love The Matrix.
  - v. Every AI student loves some science fiction movie.
- c) Briefly explain the **prenex normal form**.
- d) Transform the following formulas into prenex normal form.
- i.  $\forall x A(x) \rightarrow \exists x B(x)$
  - ii.  $\forall x \left( \forall y \left( \forall z (A(x, y, z) \wedge B(y)) \rightarrow (\forall x C(x, z)) \right) \right)$
  - iii.  $\exists x \left( S(x) \wedge \forall y (L(y) \rightarrow A(x, y)) \right)$

### 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 and facts
  - ii. Predicates and rules
- c) Consider the following PROLOG predicates to answer the questions (i) and (ii).

```
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).
```

```
male(rathnapala).
male(sunil).
male(gamini).
male(kasun).
male(saman).
male(gunapala).

female(kamala).
female(ruwini).
female(seela).
female(ramani).
female(ramyawathi).
female(tikiri).
```

- 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 would answer the following queries;
- ?- son(X, sunil).
  - ?- daughter(rathnapala, kamala).
- d) 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**

- 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*)
- Create a PROLOG rule named `editProduct/0` and `editCustomer/0` to change the Product and Customer data respectively.
- Create a PROLOG rule named `delProduct/0`, `delCustomer/0`, and `delSales/0` to delete the given Product, Customer and Sales records respectively.

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