Eastern University, Sri Lanka

Department of Mathematics

Special Degree Examination in Computer Science - (2013/2014)

(March/April, 2016)

CSS02: Knowledge Based System and Logic Programming

Answer all questions

This paper has 6 questions in a total of 3 pages

llowed: Three Hours

a) Explain how you would convert *predicate calculus* expressions into *clauses*. [3

b) Consider the following scenario:

- `Anyone who rides any Pulsar is a rough character.`
- `Every biker rides either a Pulsar or a Fazer.`
- `Anyone who rides any Fazer is a yuppie.`
- `Every yuppie is a lawyer.`
- `Any nice girl does not date anyone who is a rough character.`
- `Mary is a nice girl and John is a biker.`

i. Express the above story as predicate calculus expressions. [10%

ii. Convert each of the above expressions in part (i) into clause form. [3%

iii. Prove using resolution procedure, that `"If John is not a lawyer, then Mary does not date John".` [2%

(a) State clearly what is meant by *semantic nets* and what is meant by *partitioned semantic nets*. [3%

(b) Consider the following scenario:

- `John gave Mary a book.`
- `The book was not the one Mary likes, so she punched John.`
- `That made her feel sorry for him, so she then kissed him.`

i. Represent the above as *semantic nets* suitably. [10%

ii. Drawing inferences from a semantic net involves searching for particular patterns. Discuss briefly how you would use your representation stated in part (i) to find out `Why did Mary kiss John?`. [3%

3. (a) Describe what an *expert system* is and state clearly what its limitations ar

   (b) Consider the following fact, a set of rules and a query:

   Fact:

   - F_1: `A Suzuki SX4 is a saloon.`

   Rules:

   - R_1: `If C is a car then C has an engine.`
   - R_2: `If C is a saloon then C has four doors.`
   - R_3: `If C is a saloon then C is a car.`

   Query:

   - Q_1: `Does Suzuki SX4 has an engine?`

   Describe clearly how the following inference mechanisms would work to to the above query:

   i. Forward-chaining.

   ii. Backward-chaining.

4. (a) Consider the following prolog code and the questions given beneath:

```
what1([], []).
what1([H|T], [H1|T1]):- H1 is 2*H, what1(T, T1).
```

   i. Write the response to each of the following queries:

   (α) `what1([3], Lo).`

   (β) `what1([2,5,4], L1).`

   ii. State clearly the purpose of the predicate `what1`.

   (b) i. Write a predicate `increaseBy10` to produce a new list increasing given marks-list by 10.
   For example, a query `increaseBy10([56, 45, 73, 83, 94, 18]` spond with `NL=[66, 55, 83, 93, 104, 28]`.
   Also, `increaseBy10([], NL).` would respond with `NL=[]`.

   ii. Write a predicate `increaseBy10Ltd` that would respond as inc that the marks 90 or more would be replaced by 100.

a) Describe briefly the *frame-based knowledge representation* and point out the merits and demerits of this representation.

b) Consider the following:

- Animals have two eyes.
- Mammals and Birds are animals.
- Mammals have four legs.
- Man is a mammal but has two legs.
- Cat is a mammal.
- Penguin is a bird.
- Mouser is a cat.
- Fidget is a bat.
- Opus is a penguin.
- John is a person.

Show how you would represent the above as frames and their instances.

Explain how it would be possible to derive each of the following facts:

i. Mouser has four legs.

ii. Opus has two flippers.

iii. John has two legs (not four).

Also discuss briefly about the facilities and difficulties of multiple inheritance by considering an exceptional animal like 'penguin' (a bird that cannot fly), or 'bat' (not a bird but can fly!).

a) Briefly explain the primitive concepts in a *conceptual dependency* (CD) graph.

b) Represent each of the following as CD graphs that capture the differences between their semantics:

i. Emma slapped Esmy.

ii. Emma punched Esmy.

iii. John sold his house to James.

iv. Charles cut down the tree with an axe.

v. The big man gave the black book to the little girl.

vi. Romeo told Juliet that he would not go to the movies with her.