MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

SIT 211: INTRODUCTION TO LOGIC PROGRAMMING

DATE: 8/5/2019 **TIME: 2.00-4.00 PM**

INSTRUCTIONS

Answer **question ONE and any other TWO questions.**

QUESTION ONE (30 MARKS)

a) i Prolog is a declarative programming language. Explain. (2 marks)

ii Differentiate between a rule and a query as used in prolog programming (2 marks)

iii Define a predicate sumlist(L,N) which, given a list of integers L, returns the sum N of all the elements of L. (2 marks)

b) With an aid of an example in each case explain the following terms as used in Prolog programming

i. Variable (2 marks)

ii. Constants (2 marks)

iii. Structures (2 marks)

iv. Arity (2 marks)

c) Assume given a set of facts of the form father(name1,name2) (name1 is the father of name2).

i. Define a predicate brother(X,Y) which holds iff X and Y are brothers. (1 mark)

ii. Define a predicate cousin(X,Y) which holds iff X and Y are cousins. (1 mark)

iii. Define a predicate grandson(X,Y) which holds iff X is a grandson of Y. (1 mark)

iv. Define a predicate descendent(X,Y) which holds iff X is a descendent of Y. (1 mark)

v. Consider the following genealogical tree:

```
father(a,b).  % 1
father(a,c).  % 2
father(b,d).  % 3
father(b,e).  % 4
father(c,f).  % 5
```

whose graphical representation is:

```
    a
   / \
  b   c
 / \  |
d  e  f
```

Say which answers, and in which order, are generated by your definitions for the following queries. (2 marks)

```
?- brother(X,Y).
?- cousin(X,Y).
?- grandson(X,Y).
?- descendent(X,Y).
```

d) The *member* function is used in Prolog to determine if an item occurs in a list. Give a definition of the member function using Prolog (2 marks)

e) Given that a database contains the following list of pets, their names and age.

```
aged(simba,12).
aged(mambo, 5).
aged(jari,2).
aged(dano,5).
aged(saimo, 22).
```

i. Use the bagof predicate then return a list of pets whose age is equal 5. (2 marks)

ii. Write a rule that returns sorted list of age without duplicates for all the pets in the database (2 marks)

f) For each of the queries below, state the answer that prolog would give ("yes", "no", or a variable binding). (4 marks)

```
?- foo(B,B)=foo(car,Y).
?- (x, b) = (D, b).
```

?- X = 23+5.

?- X is 23+5.

QUESTION TWO (20 MARKS)

a) Discuss functional and procedural programming paradigms, giving examples of languages in each case. (4 marks)

b) Suppose we have the following database:

p(1).

p(2) :- !.

p(3).

Write all of Prolog's answers to the following queries:

i) **?-** p(X). (2 marks)

ii) **?-** p(X),p(Y). (2 marks)

iii) **?-** p(X),**!**,p(Y). (2 marks)

c) Distinguish between forward chaining and backward chaining. (3 marks)

d) Classify the following sequences of characters as atoms, variables, or neither? Giving reasons. (3 marks)

cHARLES

Textmassage

Variable01

_Jules

'_Jules'

3names

e) Giving example in each case explain the built-in predicate ***read*** and ***write*** as used in prolog programming. (4 marks)

QUESTION THREE (20 MARKS)

a) With an aid of a diagram explain the process of evaluating a goal in Prolog. (7 marks)

b) Discuss how backtracking can be controlled in prolog programming (5 marks)

c) How many *facts, rules, clauses, and predicates* are there in the following knowledge base? What are the heads of the rules, and what are the goals they contain? (8 marks)

woman(mary).

```
woman(mia).
man(jules).
person(X) :- man(X); woman(X).
loves(X,Y) :- knows(Y,X).
father(Y,Z) :- man(Y), son(Z,Y).
father(Y,Z) :- man(Y), daughter(Z,Y).
```

QUESTION FOUR (20 MARKS)

a) Given:

Pete is the parent of Mike.

Pete is the parent of Julie.

Pete is the parent of Amanda.

Mary is the parent of Julie.

Mary is the parent of Amanda.

Mary is female.

Julie is female.

Amanda is female.

Mike is male.

Pete is male.

A male parent is a father.

A female parent is a mother.

A male sibling of someone is a brother of that person, unless the person in question is yourself.

A female sibling of someone is a sister of that person, unless the person in question is yourself.

Construct a family Knowledge base in prolog. (7 marks)

b) Give the syntax for prolog comments (2 marks)

c) Given a Prolog list, for example L=(12, 25, 55, 8, 16). Write a recursive procedure that gets the sum of the items in such a list. (4 marks)

d) Explain the following inbuilt predicates giving example of its use. (4 marks)

(i) reverse predicate

(ii) append predicate

e) Use the name predicate to define and test a predicate remove_final that removes any final spaces from a string. (3 marks)

QUESTION FIVE (20 MARKS)

a) Give the syntax for rules in Prolog and explain its elements (4 marks)

b) Given the following Prolog database, where the first argument is the company name, the second argument is the share price, and the third argument is the dividend paid out.

```
share(equity,3.5,0.2).
share(safaricom,9,2.0).
share(kcb,48,1).
share(cooperative,18,1).
share(famiy,17,0.3).
share(toyota,24,3.5).
```

i. Create a query to extract the names of companies which paid a dividend of two shilling and above. (3 marks)

ii. Use the fail predicate to create a rule to list the companies whose dividend is below 1 shilling. (2 marks)

iii. Create a query that returns a sorted Prolog list containing all the companies in the database. (3 marks)

iv. Prolog associates variables and values using a process known as unification. Outline the rules of unification hence give an example for unification. (3 marks)

c) The following relation classifies numbers into three clauses: positive, zero and negative:

```
class(Number, positive):-Number > 0.
class(0,zero).
class(Number,negative):- Number < 0.
```

Re-define this procedure in a more efficient way using cuts. Specify whether your cut is green or red ! (5 marks)