



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

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: 1/12/2020

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 an atom and a variable 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. Rules (2 marks)
- ii. Query (2 marks)
- iii. Predicate (2 marks)
- c) Consider the following clauses:
- a(1).
- a(a).
- b(2).
- b(3).
- c(X,X) :- a(X).
- c(X,Y) :- a(X),!,b(Y).
- c(X,X) :- b(X).

- List all of the possible solutions to the query `c(A,B)` in order. (4 marks)
- d) Write a prolog program to put facts indicating that a lion, a tiger and a cow are animals into the database and to record that two of them (lion and tiger) are carnivores. (3 marks)
- e) Explain the two circumstances where the cut operator is recommended when using Prolog as a pure logic language. (3 marks)
- f) Given that a database contains the following list of children, their names and age.
- ```
age(peter,7).
age(ann, 5).
age(pat,8).
age(tom,5).
```
- i. Use the `bagof` predicate that return a list of children whose age is equal 5. (2 marks)
- ii. Write a rule that returns sorted list of age without duplicates for all the children in the database (2 marks)
- g) Prolog will automatically backtrack if it's necessary to satisfy a goal. Automatic backtracking is useful because it relieves the programmer of the burden of programming backtracking explicitly. However, uncontrolled backtracking may cause inefficiency in a program. Discuss the method used to control or prevent backtracking. (4 marks)

## QUESTION TWO (20 MARKS)

- a) Define a predicate **copyterms** which reads all the terms in a text file and outputs them as terms to another text file one by one on separate lines. (4 marks)
- b) For each of the queries below, state the answer that prolog would give ("yes", "no", or a variable binding). (6 marks)
- i) `?- X=isa(c1, cup).`
- ii) `?- X = 5+3.`
- iii) `?- X is 5+3.`
- iv) `?- X=5, X is X+3.`
- v) `?- att(cup1, X)= att(Y, white).`
- vi) `?- att(cup1, X)= att(X, white).`
- c) Classify the following sequences of characters as atoms, variables, or neither. Giving reasons. (6 marks)
- i. Footmassage
- ii. variable23
- iii. Variable2000

- iv.     big\_kahuna\_burger
  - v.     'big kahuna burger'
  - vi.    big kahuna burger
- d)     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)     Distinguish between forward and backward chaining. (5 marks)
- c)     Write a predicate **getslice(+List,+Index1,+Index2,-Slice)**, where **List** is a list, **Index1** and **Index2** are integers between 1 and the length of **List**, and **Slice** is a sublist of **List**, which contains all the elements with indices between **Index1** and **Index2**. (8 marks)

### QUESTION FOUR (20 MARKS)

- a)     Consider the following knowledge base.  
         animal(mammal,tiger,carnivore,stripes).  
         animal(mammal,hyena,carnivore,ugly).  
         animal(mammal,lion,carnivore,mane).  
         animal(mammal,zebra,herbivore,stripes).  
         animal(bird,eagle,carnivore,large).  
         animal(bird,sparrow,scavenger,small).  
         animal(reptile,snake,carnivore,long).  
         animal(reptile,lizard,scavenger,small).  
         Devise and test goals to find ;
  - i.     all the mammals, (1 mark)
  - ii.    all the carnivores that are mammals, (2 marks)
  - iii.   all the mammals with stripes, (2 marks)
  - iv.    whether there is a reptile that has a mane. (2 marks)
- b)     Give the syntax for prolog comments (2 marks)
- c)     Define and test a predicate putfirst that adds a specified term to the beginning of a list. (4 marks)
- d)     Explain the following inbuilt predicates giving example of its use. (4 marks)
  - (i)    reverse predicate
  - (ii)   append predicate

- e) Define a predicate to output the values of the squares of the integers from N1 to N2 inclusive and test it with N1 = 6 and N2 = 12. (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 below. (3 marks)
- ii. Use the fail predicate to create a rule to list the companies whose dividend is below 3 shilling. (2 marks)
- iii. Create a query that returns a sorted Prolog list containing all the companies in the database. (3 marks)
- c) Prolog associates variables and values using a process known as unification. Outline the rules of unification hence give an example for unification. (3 marks)
- d) The following is part of a program that defines a predicate **go** which prompts the user to input a series of numbers ending with 100 and outputs a message saying whether each is odd or even.
- ```
go:-repeat,read_and_check(N,Type),
write(N),write(' is '),write(Type),nl,N=:=100.
```
- Complete the program by defining the predicate **read\_and\_check** to obtain output such as that given below. Your program should use at least one cut. (5 marks)

?- go.

Enter next number: 23.

23 is odd

Enter next number: -4.

**-4 is even**

**Enter next number: 13.**

**13 is odd**

**Enter next number: 24.**

**24 is even**

**Enter next number: 100.**

**100 is even**

**yes**