



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 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 226: LOGIC PROGRAMMING.

DATE: 17/4/2023

TIME: 11:00 – 1:00 PM

INSTRUCTIONS: Answer Question ONE and other TWO Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the following terms as used in Logic programming; (3 marks)
- i. Propositional Logic
 - ii. Lisp
 - iii. Expert systems
- b) Implement a prolog predicate delete _duplicates/2 that removes all duplicate elements from a list in the first argument and returns the result in the second argument position.
- Example: (5 marks)
- ? – delete _duplicates ([1,2,1,3,4,4], List).
- List = [2,1,3,4]
- Yes

- c) Consider the prolog program given below. the program has some errors.

```
1.lions(zakayo).
2.lions(peace).
3.tiger(jerry).
4.person(mary)
5.person(rose).
6.person(Jesica).
7.loves(mary,jerry).
8.loves(jesica,rose).
9.loves(rose,jerry).
10.search(X):- person(X),\+(loves(X,_)).
11.animallover(Y):-loves(X,Y),lions(Y);loves(X,Y),tiger(Y).
```

From the code above, extract line(s) which would produce errors after compilation and specify the reasons behind the error (s) identified. (3 marks)

- d) Using Non deterministic finite Automata algorithm (NFA) illustrate results with a graph to show the output of a string.

Let {set of all strings that ends with 0}

Use states (A, B).

Use input string to be 100. (5 marks)

- e) Logic programming languages like prolog and Lisp are **declarative** as opposed to other HLL languages like Java and C which are **imperative**. Explain the reason. (2 marks)
- f) Using backtracking algorithm illustrate *state space tree* to arrange the three letters (a, b, c) in such a way that “c” cannot be beside “a”. the solution to this problem would be the ones that satisfy the constraint, which keeps only (a, b, c) and (c, b, a) in the final solution set. (5 marks)
- g) What Is Cut (!) In Prolog programming and What Is the Advantage of ‘cut’ And negation’. (4 marks)
- h) Define a predicate sumlist (L, N) which, given a list of integers L, returns the sum N of all the elements of L. (3 marks)

QUESTION TWO (20 MARKS)

- a) State Swi-prolog answer to the following queries. Use **true**, **error** or **false**.
- i. ?- not (X =a). (1 mark)
 - ii. ?- assert (rose), retract (rose),rose (1 mark)
 - iii. ?- asset (rose), rose (1 mark)
 - iv. ?- Y+5, Z=10, not (Y=Z). (1 mark)
- b) Write a Prolog program to calculate the factorial of a given number. (5 marks)
- c) **Show** that the following Pair of proposition are Logically equivalent **using** truth table.
- i. $(p \wedge q) \vee (\neg p \wedge q)$ and $p \leftrightarrow q$ (4 marks)
- d) Consider the following information about John, Mary, Frank, Jane, sports and friendships.
- Golfers like swimmers.
- Skiers like golfers.
- Mary likes John.
- John is a skier.
- Frank is a golfer.
- Jane is a swimmer.
- If X Likes Y, and Y Likes Z, then X Likes Z.

Use the predicates likes/2, golfer/1, swimmer/1, skier/1, mary/0, john/0, frank/0, and jane/0 to translate the above information in PROLOG clauses. The clauses should be ordered exactly according to the order of the above sentences. (7 marks)

QUESTION THREE (20 MARKS)

- a) Write a prolog program to implement member (X, L): to check whether X is a member of L or not (3 marks)

- b) Consider the following prolog program

```
father(hommer,bart).
father(hommer,jane).
father(bart,rose).
father(bart,john).
mother(jane,ruth).
mother(marge,bart).
mother(marge,ruth).
child(anne,bridget).
child(bridget,caroline).
child(caroline,donna).
child(donna,emily).
sibling(X,Y):- father(T,X),father(T,Y), X\=Y.
onlychild(X):- mother(T,X), \+((mother(T,Y), Y\=X)).
onlychild(X):- father(T,X), \+((father(T,Y), Y\=X)).
descend(X,Y):- descend(Z,Y),child(X,Z).
descend(X,Y):- child(X,Z),child(Z,Y).
descend(X,Y):- child(X,Y).
```

- i. If the query? – *onlychild* (y) is executed on the SWI-prolog prompt what will be the output? (2 marks)
 - ii. If a call to the query? -descend (X, Y) will it be able to terminate or not? Explain your answer. (3 marks)
 - iii. Provide a modification for descend (X, Y) clause so that call to descend (X, Y) will always terminate. (5 marks)
- c) The next-highest member of a list of integers is the second-largest member of the list. Write a PROLOG program to find the next-highest member of a list of integers. For example, the goal nexthi ([1, 4, 1, 5, 2], X) should instantiate X to 4. Your program may assume that the largest member is not repeated in the list. The goal should fail if the next-highest member does not exist. (7 marks)

QUESTION FOUR (20 MARKS)

- a) State the **three** factors that may affect the running efficiency of recursive Rule in Logic programming. (3 marks)
- b) With examples, explain **four** Prolog in built predicates that can be used to manipulate terms (8 marks)
- c) Everyone who Mary loves loves someone who is happy. (3 marks)
Translate English statement into FOL

- d) 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)

QUESTION FIVE (20 MARKS)

- a) With an aid of an example in each case explain the following terms as used in Prolog programming
- i. Variable. (2 marks)
 - ii. Constant. (2 marks)
 - iii. Structures. (2 marks)
 - iv. Arity. (2 marks)
- b) Write a depth-first search procedure (with cycle detection)
Depthfirstl (CandidatePath, Solution) to find a solution path Solution as an extension of CandidatePath. Let both paths be represented as lists of nodes in the inverse order, so that the goal node is the head of Solution. (7 marks)
- c) State the two De Morgan's laws of Boolean operators (2 marks)
- d) Let p, q, and r be the propositions
P: you get an A on the final exam
q: you do every set of home work of this class
r: you get an A in this class
write the following propositions using p, q, and r and logical connectives
To get an A in this class, it is necessary for you to get an A on the final. (3 marks)