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CSE(Data Science)

Experiment No 3

AIM: Implement Logic Programming using PROLOG

Theory:

Logical Programming

Logic programming is a programming paradigm that is based on logic. This means that a logic programming language has sentences that follow logic, so that they express facts and rules. Computation using logic programming is done by making logical inferences based on all available data.

Prolong Programming

Prolog stands for programming in logic. In the logic programming paradigm, prolog language is most widely available. Prolog is a declarative language, which means that a program consists of data based on the facts and rules (Logical relationship) rather than computing how to find a solution. A logical relationship describes the relationships which hold for the given application.

To obtain the solution, the user asks a question rather than running a program. When a user asks a question, then to determine the answer, the run time system searches through the database of facts and rules.

Prolog is a declarative language that means we can specify what problem we want to solve rather than how to solve it. Prolog is used in some areas like database, natural language processing, artificial intelligence, but it is pretty useless in some areas like a numerical algorithm or instance graphics.

The applications of prolog are as follows:

- Specification Language
- Robot Planning
- Natural language understanding
- Machine Learning
- Problem Solving
- Intelligent Database retrieval
- Expert System
- Automated Reasoning

Prolog Clauses

In Prolog, the program contains a sequence of one or more clauses. The clauses can run over many lines. Using a dot character, a clause can be terminated. This dot character is followed by at least one 'white space' character. The clauses are of two types: facts and rules.

Fact

We can define fact as an explicit relationship between objects, and properties these objects might have. So facts are unconditionally true in nature. Suppose we have some facts as given below −

- Tom is a cat
- Kunal loves to eat Pasta
- Hair is black
- Nawaz loves to play games
- Pratyusha is lazy.

So these are some facts, that are unconditionally true. These are actually statements, that we have to consider as true.

Following are some guidelines to write facts −

- Names of properties/relationships begin with lower case letters.
- The relationship name appears as the first term.
- Objects appear as comma-separated arguments within parentheses.
- A period "." must end a fact.
- Objects also begin with lower case letters. They also can begin with digits (like 1234), and can be strings of characters enclosed in quotes e.g. color (penink, ‘red’).
- phoneno (agnibha, 1122334455). is also called a predicate or clause.

Syntax

The syntax for facts is as follows −

- relation (object1, object2...).

Example

Following is an example of the above concept −

- cat(tom).
- loves_to_eat (kunal, pasta).
- off-colour (hair, black).
- loves_to_play_games(nawaz).
- lazy(pratyusha).

Study rule.

We can define rule as an implicit relationship between objects. So facts are conditionally true. So when one associated condition is true, then the predicate is also true. Suppose we have some rules as given below −

- Lili is happy if she dances.
- Tom is hungry if he is searching for food.
- Jack and Bili are friends if both of them love to play cricket.
- will go to play if school is closed, and he is free.

So these are some rules that are **conditionally** true, so when the right hand side is true, then the left hand side is also true.

Here the symbol (: -) will be pronounced as “If”, or “is implied by”. This is also known as neck symbol, the LHS of this symbol is called the Head, and right hand side is called Body. Here we can use comma (,) which is known as conjunction, and we can also use semicolon, that is known as disjunction.

Syntax

rule_name (object1, object2, ...): - fact/rule (object1, object2, ...)

Suppose a clause is like:

P: - Q; R.

This can also be written as

P: - Q.

P: - R.

If one clause is like:

P: - Q, R; S, T, U.

Is understood as

P: - (Q, R) ;(S, T, U).

Or can also be written as:

P: - Q, R.

P: - S, T, U.

Example

happy(lili): - dances(lili).

hungry(tom): - search_for_food(tom).

friends (jack, bili) :- lovesCricket(jack), lovesCricket(bili).

goToPlay(ryan) :- isClosed(school), free(ryan).

Queries

Queries are some questions on the relationships between objects and object properties. So question can be anything, as given below −

Is tom a cat?

Does Kunal love to eat pasta?

Is Lili happy?

Will Ryan go to play?

So according to these queries, Logic programming language can find the answer and return them.

Knowledge Base in Logic Programming

Well, as we know there are three main components in logic programming − Facts, Rules and Queries. Among these three if we collect the facts and rules as a whole then that forms a Knowledge Base. So we can say that the knowledge base is a collection of facts and rules.

Now, we will see how to write some knowledge bases. Suppose we have our very first knowledge base called KB1. Here in the KB1, we have some facts. The facts are used to state things, that are unconditionally true of the domain of interest.

Lab Experiment:

Write a fact for the following statements using Prolog

1. john is son

Fact-son(john)

2. john is son of Mary

Fact- son (john, Mary).

3. Alice likes john

Fact-like (Alice, John)

4. john likes Mary

Fact-likes (John, Mary)

Write a program to study rule

1. john is a boy if he is son of Mary

Rule- boy(john): - son (john, Mary)

2. Alice and John are friends if Alice likes John and John likes Alice

Rule-friends (Alice, John): -likes (John, Alice), likes (Alice, John)

Lab Assignments to complete in this session

1.Write the Facts, Rules & Goals for the following: -

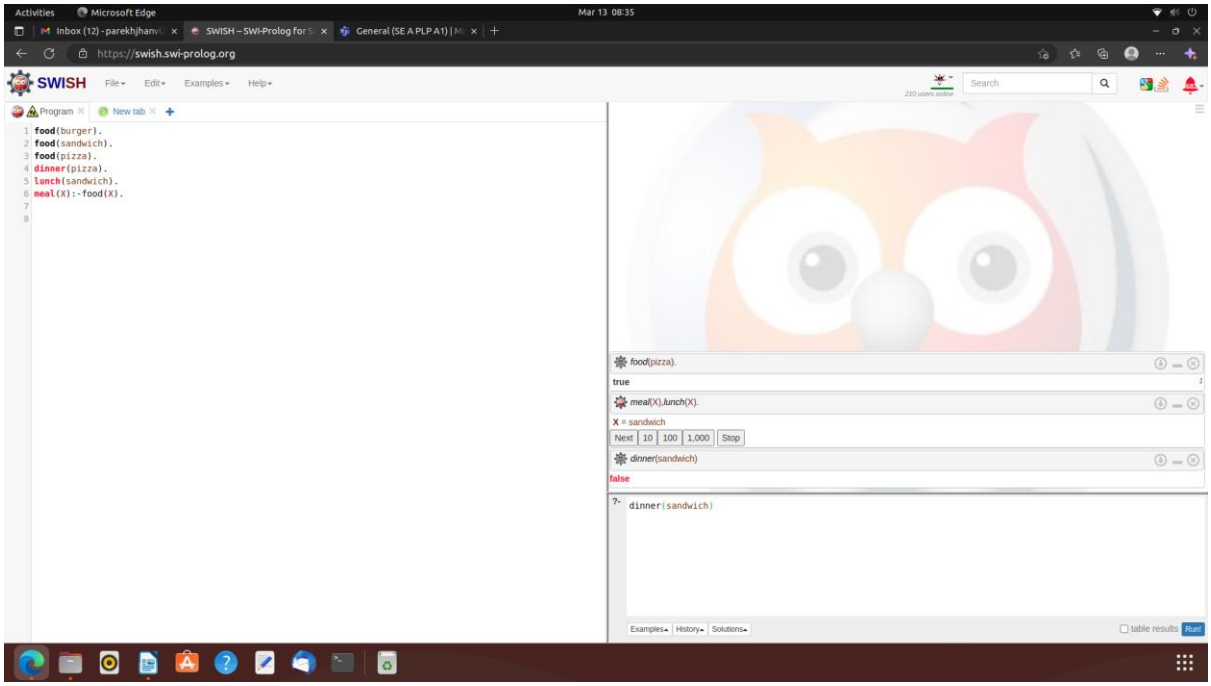
English meanings of Facts, Rules & Goals

// burger is a food
// sandwich is a food
// pizza is a food
// sandwich is a lunch
// pizza is a dinner

// Every food is a meal OR Anything is a meal if it is a food

// Is pizza a food?

// Which food is meal and lunch? ORWhat is both meal and lunch?
// Is sandwich a dinner?



2.Write the Facts, Rules & Goals for the following: -

Charlie studies csc135
Olivia studies csc135
Jack studies csc131
Arthur studies csc134

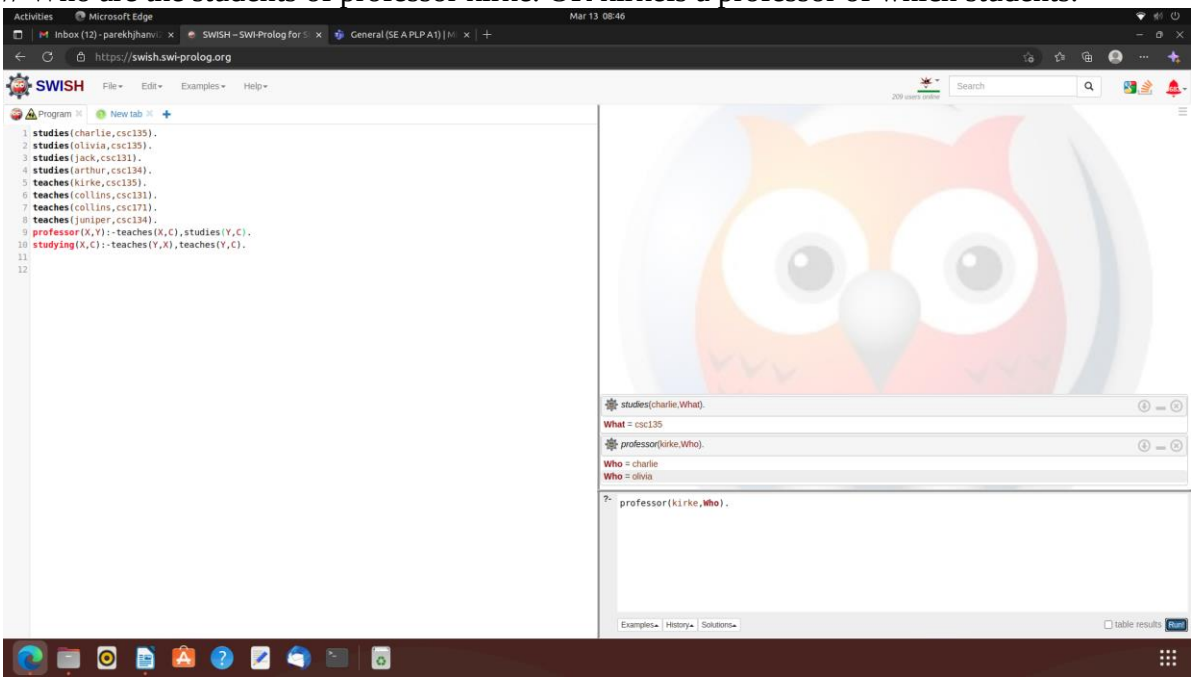
Kirke teaches csc135
Collins teaches csc131
Collins teaches csc171
juniper teaches csc134

X is a professor of Y if X teaches C and Y Studies C

X is a Studying C if Y teaches X and Y teaches C

//Charlie studies what? OR What does Charlie study?

// Who are the students of professor kirke. OR kirkeis a professor of which students.



Question 3 Write the Facts, Rules & Goals for the following:

English meanings of Facts, Rules & Goals

// jack owns bmw car

// john owns chevy car

// olivia owns civic car

// jane owns chevy car

// bmw car is sedan

// civic car is sedan

// chevy car is truck

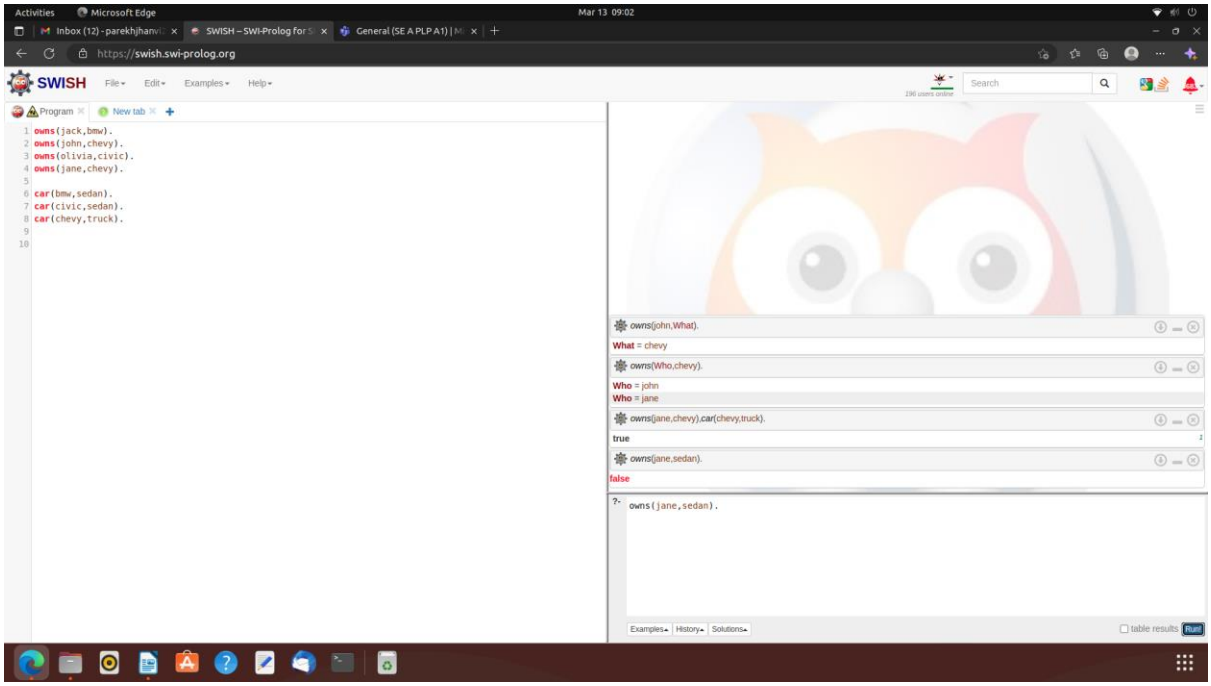
// What does john own?

// Does john own something?

// Who owns car chevy?

// Does jane own sedan?

// Does jane own truck?



Question 4: -

Create Family Tree Based on Above Facts

1. Write Facts for following Statements

jack is male.

oliver is male.

ali is male.

james is male.

simon is male.

harry is male.

helen is female.

sophie is female.

jess is female.

Lily is female.

jack is parent_of jess.

jack is parent_of lily.

helen is parent_of jess.

helen is parent_of lily.

Oliver is parent_of James.

sophie is parent_of james.

jess is parent_of simon.

ali is parent_of simon.

lily is parent_of harry.

james is parent_of harry.

2.Write the rules for following statements considering above Facts: -

1.X is father of Y if X is Male and Y is parent of X

2. X is grandfather of Y if X is male and Z is parent of Z and Z is parent of Y

3. X is sister of Y if X is female X and F is Father of Y and F is Father of X and X is not same as Y

4. X is uncle of Y if Y is parent_of Z and X is brother of Z.