UCS1524 – Logic Programming

Introduction to Logic Programming

Session Meta Data

Author	**Dr. D. Thenmozhi**
Reviewer	
Version Number	1.2
Release Date	16 July 2020

Session Objectives

- Understanding introduction to logic programming
- Know about the course overview, course objectives and course outcomes

Session Outcomes

- At the end of this session, participants will be able to
  - Understand the overview of the course.

Agenda

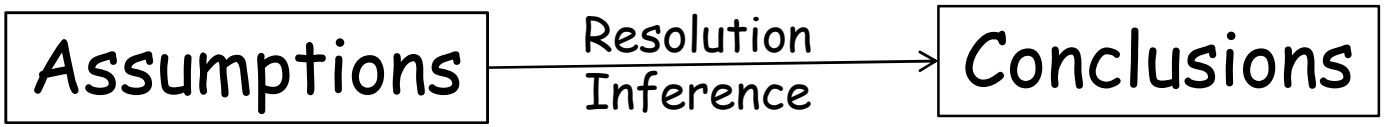
- Introduction to logic programming
- Course overview
- Course objectives
- Course outcomes

Introduction

- Artificial Intelligence (AI) is the ability for an artificial machine to act intelligently.
- Logic Programming is a method that computer scientists are using to try to allow machines to reason because it is useful for knowledge representation.
- In logic programming, logic is used to represent knowledge and inferences used to manipulate it.

Why logic?

- The logic used to represent knowledge in logic programming is clausal form which is a subset of first-order predicate logic.
- It is used because first-order logic is well understood and able to represent all computational problems.
- Knowledge is manipulated using the resolution inference system which is required for proving theorems in clausal-form logic.



First Order Logic (FOL)

- First order logic is an extension of propositional logic.
- First order logic is made up of syntax and semantics.
- The syntax of first order logic is a formal language that is used to express concepts.
- The semantics of first order logic formulae tells us how to determine the truth value of any first order logic formula.

Why Prolog?

- Prolog, PROgramming in LOGic, is a declarative programming language which is based on the ideas of logic programming.
- The idea of Prolog was to make logic look like a programming language and allow it to be controlled by a programmer to advance the research for theorem-proving.
- Many non-logical primitives have been added to the language which are beneficial to programmers.

Example for Reasoning in Prolog

- Example: Given information about fatherhood and motherhood, determine grand parent relationship.

- Facts
  - father(Ram,Anu)
  - Mother(Nithya,Anu)
  - Mother(Selvi,Nithya)
  - Father(Shankar, Nithya)
    - In logic, words like father, mother are called *predicates.*
    - *A statement like father(Ram,Anu) is called an atomic formula called an atom, stating a true fact*
- Express the grand parent relationship:
  - grandparent(X,Z) : parent(X,Y), parent(Y,Z).
  - parent(X,Y) : father(X,Y).
  - parent(X,Y) : mother(X,Y).
  - *These are called conditional statements*

- ?- grandparent(Q,Anu)

Course Overview

- Logics
  - Proposition logic
    - Syntax, semantics and resolution principles
  - Predicate logic or First order logic
    - Syntax, semantics and resolution principles
- Logic Programming
  - Answer generation
  - Horn Clause Programs
  - Semantics of logic program
    - Procedural semantics
    - Model-theoretic semantics
  - Evaluation Strategies

Course Overview

- Programming in Prolog
  - Syntax and semantics
  - Facts, questions and variables
  - Rules and structures
  - I/O and Exception handling
- Prolog and AI
  - Data structures
  - Problem solving strategies in AI
- Prolog and Expert Systems
  - Features, functions, structure
  - Knowledge representation and shell implementations

Course Objective

- To understand the foundations of Logic programming
- To learn programming in PROLOG
- To implement informed and uninformed search algorithms in PROLOG
- To implement Expert system shell in PROLOG

Course Outcome

- Understand the foundations of logic (K2)
- Understand the foundations of logic programming (K2)
- Write programs in PROLOG (K3)
- Implement AI search algorithms in PROLOG (K3)
- Implement a simple Expert system shell in PROLOG (K3)

Books

- **TEXTBOOKS**
  1. Uwe Schoning, “Logic for Computer Scientists”, Birkhauser, 1999 (Units I, II).
  2. Ivan Bratko, “PROLOG: Programming for Artificial Intelligence”, 4th Edition, Pearson, 2011 (Units III, IV, V).

- **REFERENCE BOOKS**
  1. Kees Doets, “From Logic to Logic Programming”, MIT Press 1994.
  2. Patrick Blackburn, Johan Bos, Kristina Streignitz, “Learn PROLOG Now”, College Publications, 2006.
  3. Dennis Merritt, “Building Expert Systemsin PROLOG”, Amzi! Inc. 2000
  4. Helder Coelho, Jose C Cotta, “PROLOG by Example:How to Learn, Teach and Use It”, Springer–Verlag, 2011.
  5. W F Clocksin,C S Mellish, “Programming in PROLOG”, Springer-Verlag,2016.

Summary

- Introduction to logic programming
  - Logic
  - Logic programming
  - Prolog
  - Example
- Course overview
- Course objectives
- Course outcomes