

Logic Programming

Mestrado Integrado em Engenharia Informática e Computação

Rui Camacho
(LIAAD)

Daniel Silva
(LIACC)

Nuno Fonseca
(CiBIO)

FEUP - Faculdade de Engenharia da Universidade do Porto
rcamacho@fe.up.pt, dcs@fe.up.pt

1st Semester of 2019-2020

Logic Programming Course Presentation

Objectives

- Extend the student's knowledge and experience in the paradigm of Declarative Programming
- Develop skills for abstract reasoning and of declarative problem representations
- Learn and experiment with Logic Programming
- Learn and experiment with Constraint Logic Programming
- Learn Prolog
- Learn Constraint Logic Programming

Learning outcomes

At the end of this course, students should be able to:

- Identify classes of problems where (Constraint) Logic Programming is particularly relevant
- Apply Prolog programming and constraint logic programming techniques
- Build full Prolog applications, with possible connections to other programming languages.

students should have acquired programming skills useful for other courses in the domain of Artificial Intelligence

Course Contents (I)

- Foundations of Logic Programming
 - Propositional logic
 - Predicate logic
 - Inference rules
 - Horn clauses. Unification
 - Resolution
 - Conjunctive normal form
 - From logic to logic programming
 - Origins of Prolog

Course Contents (II)

- Logic Programming
 - Clauses, Predicates, Facts
 - Queries
 - Rules
 - Logic variables
 - Instantiating
 - Logic programming and databases
 - Recursion
 - Lists, Trees
 - Symbolic expressions
 - Computation model of a logic program
 - The unification algorithm
 - Abstract interpreter
 - Traces
 - Search trees
 - Negation

Course Contents (III)

- The Prolog Language
 - Execution model
 - Backtracking
 - Rule and goal order
 - Termination
 - Arithmetic
 - Iteration
 - Structure inspection
 - Meta-logical predicates
 - Control: cuts and negation
 - Extra-logical predicates
- Advanced Prolog Programming Techniques
 - Non-deterministic programming
 - Incomplete data structures
 - Meta-interpreters
 - Search techniques

Course Contents (IV)

- Constraint Logic Programming
 - Constraints
 - Constraint satisfaction
 - Constraints in finite domains
 - Constraint logic programming (CLP)
 - Search control
 - Variable and value ordering
 - Modeling problems in CLP
 - Constraint programming using SICStus Prolog

Bibliography

Main references:

- Sterling, Leon; The Art of Prolog. ISBN: 0-262-69163-9
- Marriot, Kim; Programming with constraints. ISBN: 0-262-13341-5
- Clocksin, W. F.; Programming in prolog. ISBN: 0-387-58350-5

Complementary references:

- Christopher Hogger, Essentials of logic programming, Oxford University Press, 1990 ISBN:0-19-853832-4
- Torres, Delfim Fernando Marado; Introdução à programação em lógica. ISBN: 972-8021-93-3
- Bratko, Ivan; Prolog programming for artificial intelligence. ISBN: 0-201-40375-7
- O.Keefe, Richard A.; The craft of Prolog. ISBN: 0-262-15039-5
- Stuart Russell, Peter Norvig; Artificial intelligence. ISBN: 978-0-13-207148-2

Software

- SICStus Prolog (<http://www.sics.se/sictus/>)
- Yap Prolog (<http://www.dcc.fc.up.pt/~vsc/Yap/>)
- SWI Prolog (<http://www.swi-prolog.org/>)

Teaching Procedures

Two Types of lectures:

- Theoretical classes are used for exposition of the main (constraint) logic programming concepts, presentation and discussion of practical examples.
- Practical classes are used to solve programming exercises and for assisting students on their practical assignments.

Student's Assessment (I)

- Two intermediate “exams” made using Moodle (E1, E2)
- Two project Assignments (TP1, TP2)

Important Dates:

20th October TP1 intermediate report

17th November TP1 final evaluation + source code

19th/20nd November first exam E1 (Prolog)

5th January 2020 TP2 report + source code

8th/9th January 2020 second exam E2 (PLR)

Compulsory minimal classification:

TP1 minimum mark of 7 in 20

TP2 minimum mark of 7 in 20

E1 minimum of 7 in 20

E2 minimum of 5 in 20

Student's Assessment (II)

Final Grade decomposition:

Final Grade: = 50% Exams (E1,E2) + 50% Assignments (TP1,TP2)

Exam's grades:

Exams = 65% Exam E1 + 35% Exam E2

Assignments grades:

Assignments = 65% Assignment 1 (TP1) + 35% Assignment 2 (TP2)

TP1 = 25% (Intermediate report of TP1) + 75% (final eval. of TP1)

Prolog Applications

- Artificial Intelligence:
 - Game Playing
 - Knowledge Based Systems
 - Natural Language Understanding
 - Checking VLSI circuits
- Multi-relational Data Mining: (comprehensible models)
 - Rational Drug Design
 - Genomics Applications (Bioinformatics)
 - Predicting [3D] structures of proteins
(Chemoinformatics/Biology)
 - *Inductive Logic Programming* Systems
 - Prediction of Adverse drugs side effects