Logic Programming

Introduction

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"What" vs "How"

Declarative vs Procedural Programming

Procedural programming

- ► The programmer has to specify how to get the output for the range of required inputs.
- ► The programmer must know the appropriate algorithm.

Declarative programming

- ► Requires a more descriptive style.
- ► The programmer must know what relationships hold between various entities.

Example: List Concatenation

In procedural style:
```
list procedure cat(list a,list b)
{
  list t = list u = copylist(a);
  while (t.tail != nil) t = t.tail;
  t.tail = b;
  return u;
}
```

In declarative style:
```
cat([], L, L).
cat([H|T], L, [H|Z]) :- cat(T, L, Z).
```

Logic Programming

- A declarative style programming paradigm.
- Computation through logical deduction.
- Uses the language of logic to express data and programs.
- Most of current logic programming languages use first order logic (FOL).
- Prolog – the most popular logic programming language.

Historical Facts

1970-ies:

- Bob Kowalski.
  "Predicate Logic as a Programming Language".
  IFIP Congress, Stockholm
- Alain Colmerauer and his group.
  Interpreter of the first logic programming language Prolog.
  Marseille

Prolog

- ▶ The main subject of this course
- ▶ Used in Artificial Intelligence, Natural Language Processing, Automated Reasoning, XML Querying...
- ▶ Exists in many dialects (Sicstus Prolog, SWI Prolog, Prolog IV, BinProlog, Ciao Prolog, Prolog LPA, Visual Prolog, YAP Prolog, Strawberry Prolog...)
- ▶ (Almost) all the dialects agree on the "core" part (ISO Standard for Prolog)

Prolog in Industrial Applications

Clarissa:

- A fully voice-operated procedure browser.
- Developed at NASA.
- Used on the International Space Station.
- Enables astronauts to give full attention to the task while they navigate through complex procedures using spoken commands.
- Implemented in SICStus Prolog.

Prolog in Industrial Applications

Some other solutions:

► FleetWatch – fully integrated operations control and schedules planning solution. Used by 21 international airlines, among them Comair (USA), Italian branch of Lauda Air, Malev (Hungary), DHL Europe, Asiana (South Korea), Hainan (China), Royal Jordanian, Kuwait Airways, Cimber Air (Denmark), etc.

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- ▶ SCORE – a long term airport capacity management system for coordinated airports. Successfully Used at IATA Scheduling Conferences. Users in more than 20 countries.

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- ▶ ARGOS – a Decision Support System (DSS) for enhancing Crisis Management for incidents with Chemical, Biological, Radiological, and Nuclear (CBRN) releases.

Useful Links

- SWI-Prolog:
  http://www.swi-prolog.org/

- SWI-Prolog Editor (Windows only):
  http://arbeitsplattform.bildung.hessen.de/fach/informatik/swiprolog/index

- Prolog mode for (X)Emacs:
  http://turing.ubishops.ca/home/bruda/emacs-prolog/

- Prolog newsgroup:
  https://groups.google.com/d/forum/comp.lang.prolog

- Links from SWI-Prolog Web page:
  http://www.swi-prolog.org/Links.html