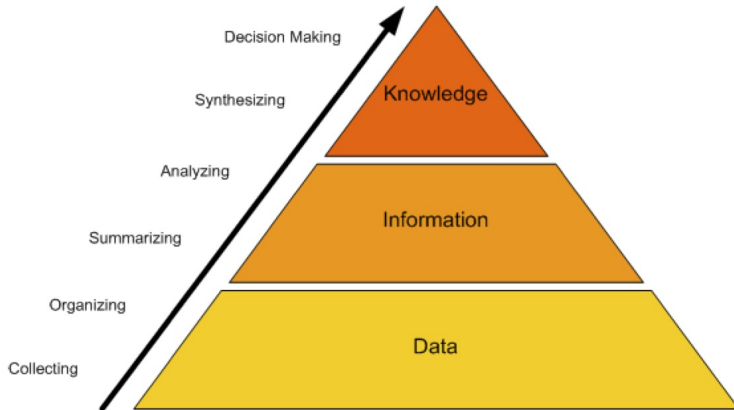


Processing of Declarative Knowledge (Introduction)

Francesco Ricca

Computational Intelligence Curriculum
Institute of Information Systems

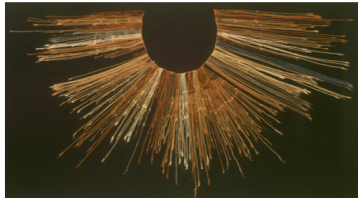
Data, Information and Knowledge Pyramid



Data vs Information

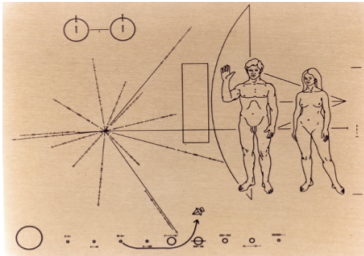
745d51b8683b37806641074955a03d4e

md5sum of debian-7.2.0-amd64-xfce-CD-1.iso

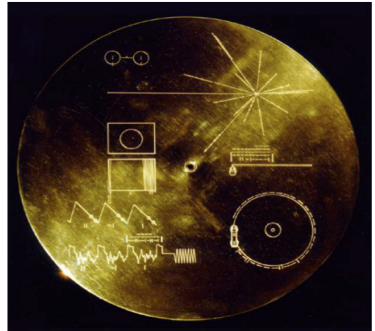


Inca quipu

Information vs Knowledge



Pioneer plaque



Voyager Golden Record

Knowledge Representation and Reasoning

The need for knowledge representation

- e.g., intelligent agents, problem solving ...

Declarative vs Imperative Knowledge

- expressed in declarative sentences or propositions
- the knowledge of how to perform some task
(implicit in some sequence of steps)

How to express/represent declarative knowledge?

- well-known problems of natural language
- formal language → Logic

Processing knowledge to obtain new knowledge

- reasoning

Knowledge Representation and Reasoning

The need for knowledge representation

- e.g., intelligent agents, problem solving ...

Declarative vs Imperative Knowledge

- expressed in declarative sentences or propositions
- the knowledge of how to perform some task (implicit in some sequence of steps)

How to express/represent declarative knowledge?

- well-known problems of natural language
- formal language → Logic

Processing knowledge to obtain new knowledge

- reasoning

Knowledge Representation and Reasoning

The need for knowledge representation

- e.g., intelligent agents, problem solving ...

Declarative vs Imperative Knowledge

- expressed in declarative sentences or propositions
- the knowledge of how to perform some task
(implicit in some sequence of steps)

How to express/represent declarative knowledge?

- well-known problems of natural language
- formal language → Logic

Processing knowledge to obtain new knowledge

- reasoning

Knowledge Representation and Reasoning

The need for knowledge representation

- e.g., intelligent agents, problem solving ...

Declarative vs Imperative Knowledge

- expressed in declarative sentences or propositions
- the knowledge of how to perform some task
(implicit in some sequence of steps)

How to express/represent declarative knowledge?

- well-known problems of natural language
- formal language → Logic

Processing knowledge to obtain new knowledge

- reasoning

Answer Set Programming (ASP) (1)

- **Answer Set Programming (ASP)**

- Declarative paradigm
- Non-monotonic reasoning and logic programming
- Stable model semantics

- **Expressive KR Language**

- Roots in Datalog
- Default negation, Disjunction, Constraints,
- Aggregates, Weak constraints, Functions symbols, etc.
- Can model problems up to Σ_2^P/Π_2^P
 - i.e., problems not (polynomially) translatable to SAT or CSP

Answer Set Programming (ASP) (2)

Idea:

- 1 Represent a computational problem by a Logic program
- 2 Answer sets correspond to problem solutions
- 3 Use an ASP solver to find these solutions

Classic Example

Example (3-col)

Problem: Given a graph assign one color out of 3 colors to each node s.t. adjacent nodes have different colors.

Input: a Graph is represented by *node*(_) and *edge*(_,_).

% Each node X should be colored red or yellow or green.

(r) $col(X, red) \mid col(X, yellow) \mid col(X, green) \text{ :- } node(X).$

% Adjacent nodes cannot have the same color.

(c) $\text{ :- } edge(X, Y), col(X, C), col(Y, C).$

Answer Set Programming (ASP) (3)

- **Applications in several fields**

- Artificial Intelligence, Knowledge Representation & Reas.,
- Information Integration, Data cleaning, Bioinformatics, ...
- employed for developing industrial applications

- **Robust and efficient implementations**

- DLV, Clasp, and others
- *continuous improvement*
(see the ASP competitions)

Course Goals (1)

Declarative knowledge

- expressed by means of declarative sentences in a symbolic language

Processing declarative knowledge

- obtained by running a procedure that works on these sentences

Goals:

- Study foundations and practicalities of a logic-based declarative formalism for KR& R
- Focus on Answer Set Programming

Course Goals (2)

What will you bring at home with you?

- an understanding of the foundations of ASP
- a methodology for developing ASP programs
- an overview of the evaluation algorithms
- tools for problem solving with ASP

Disclaimer:

The coverage of ASP is not extensive, and may reflect my own biased view

ECTS Breakdown

3 ECTS = 75 Hours

- Introduction to course: 0.5h
- Entry test: 1h
- Lecture: 22.5h
- Additional reading and preparation for exam 51h
- Final exam 3h

Exam

- processing of exercises
- research of literature
- preparation of a short report

Course dates

- 1 14:00-16:00 04-04-2014 HS 8 Heinz Parkus
- 2 17:00-19:00 08-04-2014 EI 8 Pötzl HS
- 3 14:00-16:00 11-04-2014 HS 8 Heinz Parkus
- 4 17:00-19:00 29-04-2014 HS 8 Heinz Parkus
- 5 14:00-16:00 02-05-2014 EI 3 Sahulka HS
- 6 17:00-19:00 06-05-2014 EI 5 Hochenegg HS
- 7 14:00-16:00 09-05-2014 Hörsaal 15
- 8 17:00-19:00 13-05-2014 EI 8 Pötzl HS
- 9 16:00-20:00 20-05-2014 EI 8 Pötzl HS
- 10 17:00-19:00 26-05-2014 EI 5 Hochenegg HS
- 11 16:00-19:00 27-05-2014 EI 8 Pötzl HS

Entry Test