CPSC 433 - Artificial Intelligence

Knowledge Representation Systems: Frames

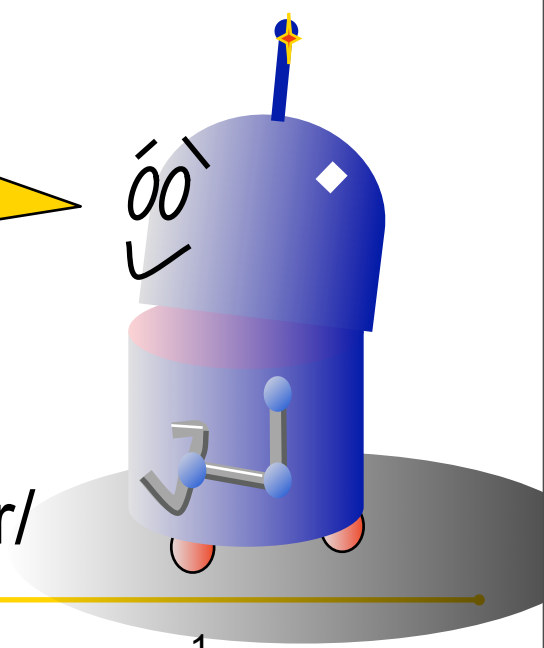
Rob Kremer
ICT 748
kremer@cpsc.ucalgary.ca
http://pages.cpsc.ucalgary.ca/~kremer/

CPSC 433 - Artificial Intelligence

Knowledge Representation Systems: Frames

Rob Kremer
ICT 748
kremer@cpsc.ucalgary.ca
http://pages.cpsc.ucalgary.ca/~kremer/

Adapted from slides by Jörg Denzinger



TOC

- Motivation
- Frames
- XML
- Ontology
- Discussion
- Examples

What day is it anyway?

01/02/03

What day is it anyway?

01/02/03

January 2nd, 2003

What day is it anyway?

01/02/03

January 2nd, 2003

...

What day is it anyway?

01/02/03 February 1st, 2003

January 2nd, 2003

...

What day is it anyway?

March 2nd, 2001

01/02/03

February 1st, 2003

January 2nd, 2003

...

What day is it anyway?

March 2nd, 2001

February 1st, 2003

01/02/03

February 3rd, 2001

January 2nd, 2003

...

What day is it anyway?

March 2nd, 2001

February 1st, 2003

01/02/03

February 3rd, 2001

January 2nd, 2003

3rd February 2001 ...

What Day is it Anyway?

- We want to define data structures with internal meaning:
  - Day of Month - 2
  - Month of Year - March
  - Year - 2001
  - Calendar - Gregorian
- We also want these data structures to be human readable.

Frames

- Slot-and-filler mechanism
- Conditions on filling objects for a slot possible
- Filler can be another frame
- Extend record concept with associated functionality (procedural knowledge)

☞ Predecessor/special case/ more general concept of object-oriented programming

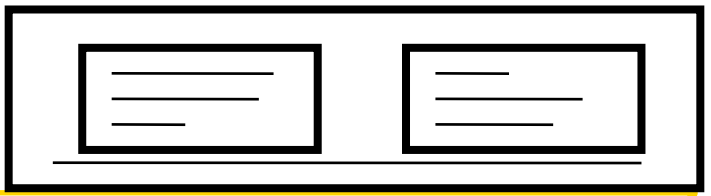
☞ Conditions and procedural knowledge define semantics

Frames

- Slot-and-filler mechanism
- Conditions on filling objects for a slot possible
- Filler can be another frame
- Extend record concept with associated functionality (procedural knowledge)

☞ Predecessor/special case/ more general concept of object-oriented programming

☞ Conditions and procedural knowledge define semantics



XML

- eXtensible Markup Language
- Subset of SGML
- Originally a method for putting structured data in a text file
- Allows to define own terms and markup
  ☞ allows to convey knowledge
- One of the key elements of the Semantic Web (together with Ontologies)

Basic data structures

- tags enclose text
  <Address> 2500 University Drive NW </Address>
- tags can be nested
  <Address>
  <number> 2500 </number>
  <street> University Drive NW </street>
  </Address>
- Tags may have attributes
  <Address type="North-America"> 2500 University Drive NW </Address>

Semantics

- DTD to validate XML expressions
  (or XML Schema, Xlink and Xpointer, …)
- Ontologies to describe meaning of tags
  - Based on concensus between parties on human level
  - Provided to computer by procedures that work on tags

DTD - Document Type Definition

- Part of XML file or described in own file
- Describes logical document structure
- <!ELEMENT name (#PCDATA)>
  ☞ defines tags <name> and </name> and content between tags has to be parsable character data text
- <!ELEMENT Diet (breakfast,lunch)>
  <!ELEMENT breakfast (#PCDATA)>
  <!ELEMENT lunch (#PCDATA)>
  ☞ Diet consists of entries for breakfast and lunch (in this order)

DTD - Document Type Definition

- <!ELEMENT name (#PCDATA)>
  <!ATTLIST name gender (male|female)
  #REQUIRED>
  - ☞ defines attributes for tags
- plus much more syntax

Ontology

- File or document that defines relations among terms
- Typically: taxonomy + set of inference rules
- Formal description mechanism: a modal logic
- Practical use:
  - Taxonomy = DTD file (or other validation scheme)
  - Inference rules = procedures that use elements to produce other elements

☞ Same concept can be expressed by different ontologies

☞ Same taxonomy can have different inference rules and therefore different semantics

☞ Still lots of research necessary (and coming up with norms)

How to get knowledge into the rep. structure

- With ontology:
  state your facts in a file using the provided tags
- Without ontology:
  - Define tags and a DTD for it
  - Provide procedures using tags
  - See above

Discussion

- ✚ Uses the web hype
- ✚ Rather pragmatic
- ✚ Meta concept, very general
- ✚ Easy to read and understand by humans
- ✚ Lots of tools and libraries already available
- – Semantics via ontologies dangerous:
  there are many of them for a subject area and
  Microsoft-like behavior of the humans involved
  has to be expected
  ☞ semantic standards for subject areas needed!

And what about processing data?

- With ontology:
  run procedures that are provided
  ☞ similar to PROLOG (hopefully less problematic with regard to having to know about control)
- Without ontology or if missing certain functionality:
  write procedure for functionality and run it
  ☞ often involves searching through knowledge base

Examples

Model a knowledge base for the items in a warehouse. An item is either in stock or not, it has a name, a price, a manufacturer and a location. The location consists of a row number and a shelf number and optionally a box.