Week 4 - Lecture 1

• What is in a user model

• Classes of components

• Management of uncertainty

• Case studies - generic modelling systems

• Student modelling approaches

• Omissions: group models
## components - beliefs about the user

<table>
<thead>
<tr>
<th>Description of meaning of a component</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The system believes the user ...</strong></td>
<td></td>
</tr>
<tr>
<td>likes large fonts in screen displays</td>
<td>preference</td>
</tr>
<tr>
<td>dislikes Carr-Boyd music</td>
<td>preference</td>
</tr>
<tr>
<td>prefers to learn from examples rather</td>
<td>preference</td>
</tr>
<tr>
<td>than abstract descriptions of ideas</td>
<td></td>
</tr>
<tr>
<td>knows the undo command of the text editor</td>
<td>knowledge</td>
</tr>
<tr>
<td>believes that the sun rotates around the earth</td>
<td>knowledge</td>
</tr>
<tr>
<td>knows that if (x =&gt; y) and (y =&gt; z) then (x =&gt; z)</td>
<td>knowledge</td>
</tr>
<tr>
<td>believes text editors have a facility for undo-ing the last action</td>
<td>knowledge</td>
</tr>
<tr>
<td>wants to listen to new music</td>
<td>goals</td>
</tr>
<tr>
<td>wants to learn about the text editor</td>
<td>goals</td>
</tr>
<tr>
<td>was born in 1990</td>
<td>attribute</td>
</tr>
<tr>
<td>has low vision</td>
<td>attribute</td>
</tr>
</tbody>
</table>
Preferences

• Example: large fonts

• cf flags or preferences

• minimalist user modelling

• Example: Carr-Boyd music

• foundation for browsing, filtering and retrieval

• prefers to learn from examples
Knowledge

• knows the undo command

• believes the sun rotates around the earth

• knows $x \Rightarrow y, y \Rightarrow z$ means $x \Rightarrow z$

• believes text editors have undo

• knowledge v belief

• power of modus ponens

• user’s default assumption
Goals

• wants to listen to new music

• wants to learn about the sam text editor

• commonly built into assumptions in system

• eg. music recommender site

• foundation of teaching system - or teacher

• cf - wants to pass the exam
Other attributes

• was born in 2000

• has low vision

• => large fonts, children’s music
Management of uncertainty

- Inconsistency part of domain
  - esp modelling people’s knowledge
  - learning, forgetting
  - tastes change over time
  - interests change temporarily
  - eg. news item read once,
    - trip to Italy
    - music preferences while working

- Noisy data about the user

- Uncertain inferences about user

- Lack of data about the user
  - start up problem
  - lack of data after user changes
Management of uncertainty

- External sources cause inconsistency
  - unreliable sensors
  - users make slips
  - user misunderstands question

- External sources cause inconsistency
  - Internal interference
  - Beethoven IV ++, Beethoven VI –
  - predict Beethoven V?
  - user states Beethoven V –
  - foundational reasoning v coherence reasoning
Grundy - stereotypes

A stereotype represents a collection of attributes that often co-occur in people. ... they enable the system to make a large number of plausible inferences on the basis of a substantially smaller number of observations. These inferences must, however, be treated as defaults, which can be overridden by specific observations. (Rich, 1989:35)

- user self-description ==> book recommendations
  - eg athletic

- trigger

- inferences
  - eg motivated by excitement
  - attributes of strength and perseverance
  - interested in sports
  - each with a strength rating

- recommended books matching those properties

- user responses used to adjust ratings

- double stereotype (Chin, Unix consultant)
  - user’s actions ==> expertise
  - expertise level ==> predicted knowledge
BGP-MS

• Belief, Goal and Plan Maintenance System (Kobsa et al)

• concepts in inheritance hierarchy
  – role predicate for relations allowed
  – restrictions on attributes for an instance
  – modality - attribute necessary?

• concepts organised into partitions
  (also in inheritance hierarchy)
  – SB, UB, ShB
  – SBUBSBUBUB...
  – SBUW

• sophisticated stereotype
  – trigger, retraction

• implicit inference rules
UMT

- UM-tool
- database of user models
- stereotypes in multiple inheritance hierarchy
- database of possible models for current user
- rule-base of constraints
- inference rules
- consistency manager ATMS-like for possible models, each a self-consistent view of the user
Doppelganger

- news of the future

- user model server with a centralised database of user models

- many sensors collecting information about the user

- toolkit of learning techniques

- models - Lisp-like special purpose language

- domain models eg news preferences

- conditional models eg. morning news preferences

- context-aware approach - active badge, smart chair

- community models - recomputed each night
  - probabilistic membership
Student modelling

- knowledge and misconceptions
- executable models
- cognitive validity
- overlay
- differential
- bug model
TAGUS

• simulation of the learner’s reasoning

• beliefs, goals, problem solving capabilities and strategies

• stereotypes

• reasoning maintenance system

• Examples of beliefs
  - planet
  - earth
  - moon
  - planet(earth)
  - revolves-around(moon, earth)

• Simulated reasoning
  – eg modus ponens

• User monitor behaviour eg give up on hard tasks

• maintained consistency
THEMIS

• focus on inconsistency
  – changed of mind
  – hold contradictory beliefs

• some belief revision

• model kept in extended Prolog
  – values: true, false, unknown or fail

SMMS

• belief revision

• only applied to deductive reasoning

• not to stereotypes

• represented concepts as \{novice, average, expert, unknown\}
## Summary

<table>
<thead>
<tr>
<th><strong>Thing modelled is whether the user ...</strong></th>
<th><strong>System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>is an athletic person</td>
<td>GRUNDY</td>
</tr>
<tr>
<td>is motivated by excitement</td>
<td>GRUNDY</td>
</tr>
<tr>
<td>has attribute of strength and perseverance</td>
<td>GRUNDY</td>
</tr>
<tr>
<td>is interested in sports</td>
<td>GRUNDY</td>
</tr>
<tr>
<td>knows the concept <em>otitis media</em> (with strength 75)</td>
<td>UMFE</td>
</tr>
<tr>
<td>has a goal to invest 10,000 dollars</td>
<td>GUMAC</td>
</tr>
<tr>
<td>wants to print a document</td>
<td>BGP-MS</td>
</tr>
<tr>
<td>believes that inkjet printers are printers</td>
<td>BGP-MS</td>
</tr>
<tr>
<td>and system have a mutual belief that</td>
<td></td>
</tr>
<tr>
<td>Peter gave Mark a book</td>
<td>BGP-MS</td>
</tr>
<tr>
<td>nationality is French</td>
<td>UM-tool</td>
</tr>
<tr>
<td>has general interest in literature</td>
<td>UM-tool</td>
</tr>
<tr>
<td>has the name <em>Jon Orwant</em></td>
<td>Doppelganger</td>
</tr>
<tr>
<td>is interested in the Olympics</td>
<td>Doppelganger</td>
</tr>
<tr>
<td>likes the source <em>USA today</em></td>
<td>Doppelganger</td>
</tr>
<tr>
<td>knows about the notions of a planet and its moon</td>
<td>TAGUS</td>
</tr>
<tr>
<td>believes the earth is a planet</td>
<td>TAGUS</td>
</tr>
<tr>
<td>believes that moons revolve around a planet</td>
<td>TAGUS</td>
</tr>
<tr>
<td>believes the moon revolves around the earth</td>
<td>TAGUS*</td>
</tr>
<tr>
<td>believes Paris is in a torrid zone</td>
<td>THEMIS</td>
</tr>
<tr>
<td>believes the Lisp <em>car</em> function returns a list</td>
<td>SMMS</td>
</tr>
<tr>
<td>... containing the first element of the given list</td>
<td></td>
</tr>
<tr>
<td>knows the concept of recursion</td>
<td>SMMS</td>
</tr>
</tbody>
</table>