Soar/Tcl-PM: Including a Widely Applicable Eye & Hand in Soar

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cognitive model

Interaction next Frontier for

Developing better Ψ models

Applications
Substitute for users
in studies, games, simulations
Help the user
Evaluation of interfaces
e.g. predict menu use

The Importance of Interaction

Task was just arithmetic
Task now seen as
Arithmetic +
Scanning +
Manipulation

Components of Interactive Models

Display and other output devices
Input devices
User/subject
List of simulation tasks
Input & Link Standard
Task knowledge
Visual knowledge
List of user's tasks

Summary of Interaction Needs

Interfaces or a tool to create interfaces
A way for the cognitive model to interact with the simulation (i.e., a model eye & model hand)
A linkage between the cognitive model & the task simulation

Ways to Tie Models to Interfaces

Function calls (ModSAF)
Simulated interfaces (EPIC)
Embed into specific interfaces (Midas, Apex)
Camera and robot or pixel (St. Amant at NCSU)
Embed into an interface tool
User Interface Management Systems (UIMSs)

- Systems designed to support interface creation (UIIDE)
- Help managing the interaction communication between the user interface & the application
  - A run-time mechanism controls what happens when keys are pressed, mouse buttons are clicked

Cognitive Model Interface Management System (CMIMS)

- Cognitive modeling tool, e.g. a cognitive architecture
  - A cognitive model
  - Linkage mechanism
  - Subject, Task simulation
  - UIMS, CMIMS
  - Cognitive model

Functional Model of Fovea

- Visual Capabilities/Regularities
  - Fovea (2°), parafovea (5°), periphery (rest)
  - Dynamic eye movements & timing
  - Tracking of moving objects
  - Information lost across saccades
  - Object complexity -> Fixation length
  - Perception based on interface & visible to the modeller (~Epic)
  - For all interfaces in UIMS (~ACT-R/PM)

Functional Model of Hand

- Motor Capabilities/Regularities
  - Mouse button event actions: press and hold; release; click; double-click
  - Mouse on screen
  - Max mouse movement speed (e.g. 30 cm/s)
  - Sequential movements
  - Typing speed as a parameter
  - A few more details

Sim-eye & Sim-hand Commands

- moveI <dx> <dy>  n look
- type <character>  n press mouse <s>
- start m-move <dx> <dy>  n release mouse
- update m-move <dx> <dy>  n click m-button <s>
- hand to keyboard  n double click
  m-button <s>
- hand to mouse

Models that Interact

- Simple ATC-like task
  Bass, Baxter & Ritter, 1995
- Tower of Nottingham
  Jones, Ritter & Wood, 2000
- Test EW task
New rule:
If op is add 1+2
then result = 3

Simple model to use Soar/ Tcl-PM
- Search for button
  - Include memory (or not) of found objects
- Press button
  - Move
  - Click
- Get next digit

Testing this Model
- KLM model
  - 23.1 seconds
- NGOMSL model for 11 digits
  - 28.6 seconds
- Informal data
  - About 11 seconds

Time to Dial

<table>
<thead>
<tr>
<th>Eye Size</th>
<th>Memory on</th>
<th>Memory off</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 x 20</td>
<td>15.4</td>
<td>30.2</td>
</tr>
<tr>
<td>50 x 50</td>
<td>15.4</td>
<td>31.5</td>
</tr>
<tr>
<td>100 x 100</td>
<td>16.2</td>
<td>32.3</td>
</tr>
<tr>
<td>150 x 150</td>
<td>16.2</td>
<td>22.3</td>
</tr>
<tr>
<td>200 x 200</td>
<td>16.2</td>
<td>24.3</td>
</tr>
</tbody>
</table>

- Big helps; not memory
- Big hurts; without
General Lessons — Implementations

- Multiple languages and architectures
- Best where model and simulation are in same language
- Control panel & inspectability are important (usability)

General Lessons — Visual Attention

- Interaction is an intricate dance, not capturable by a single rule or function call
- Motor & Perceptual activity is a task not an action
- Need visual knowledge now

General Lessons — Problem Solving

- Some variance in behaviour is based on 1st block seen, menu layout, & nearest plane
- Situates models
  - Dare we say, grounds the models?
- More accurate and/because does task

Future Plans for Interaction Model

- 50 telephone interfaces in Tcl/Tk
- Move towards ACT-R/PM & EPIC
- Additions to the interaction model
  - Difficult to perceive emergent features in the interface
  - Needs more actions in parallel
  - Needs to be sharable

Further Information