Lecture 11
Models 3 – GOMS and State Transition Models

with reference to sections 7.3 and 7.5 of
The Resonant Interface
HCI Foundations for Interaction Design
First Edition

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Chapter 7 Interaction Design Models

- Model Human Processor (MHP)
- Keyboard Level Model (KLM)
- GOMS
- Modeling Structure
- Modeling Dynamics
- Physical Models
Goal/task models can be used to explore the methods people use to accomplish their goals

- Card et al. suggested that user interaction could be described by defining the sequential actions a person undertakes to accomplish a task.

- The GOMS model has four components:
  - goals
  - operators
  - methods
  - selection rules
GOMS

• **Goals** - Tasks are deconstructed as a set of goals and subgoals.

• **Operators** - Tasks can only be carried out by undertaking specific actions.

• **Methods** - Represent ways of achieving a goal
  – Comprised of operators that facilitate method completion

• **Selection Rules** - The method that the user chooses is determined by selection rules
CMN-GOMS can predict behavior and assess memory requirements

- CMN-GOMS (named after Card, Moran, and Newell) - a detailed expansion of the general GOMS model
  - Includes specific analysis procedures and notation descriptions

- Can judge memory requirements (the depth of the nested goal structures)

- Provides insight into user performance measures
CNM-GOMS example

GOAL: CLOSE-WINDOW
.   [select GOAL: USE-MENU-METHOD
.       .   MOVE-MOUSE-TO-FILE-MENU
.       .   PULL-DOWN-FILE-MENU
.       .   CLICK-OVER-CLOSE-OPTION
.   GOAL: USE-CTRL-W-METHOD
.       .   PRESS-CONTROL-W-KEYS]

For a particular user, U1:

Rule 1: Select USE-MENU-METHOD unless another rule applies
Rule 2: If the application is GAME, select CTRL-W-METHOD

So here we have one Goal with either of two Methods, one of which requires a sequence of three Operators, the other requires just one Operator; for U1 we have 2 Selection rules
GOMS – *Other GOMS Models*

- **CPM-GOMS** represents
  - Cognitive
  - Perceptual
  - Motor operators

- **CPM-GOMS** uses Program Evaluation Review Technique (PERT) charts
  - Maps task durations using the critical path method (CPM).

- **CPM-GOMS** is based directly on the Model Human Processor
  - Assumes that perceptual, cognitive, and motor processors function in parallel
**GOMS – Other GOMS Models**

- Program Evaluation Review Technique (PERT) chart Resource Flows
Understanding the temporal aspects of interaction design is essential to the design of usable and useful systems

- Interaction designs involve dynamic feedback loops between the user and the system
  - User actions alter the state of the system, which in turn influences the user’s subsequent actions
- Interaction designers need tools to explore how a system undergoes transitions from one state to the next
Modeling Dynamics – *State Transition Networks*

- **State Transition Networks** can be used to explore:
  - Menus
  - Icons
  - Tools

- **State Transition Networks** can show the operation of peripheral devices
Modeling Dynamics – *State Transition Networks*

- State Transition Network

- STNs are appropriate for showing sequential operations that may involve choice on the part of the user, as well as for expressing iteration.
State transition networks (STN) – example

- circles - states
- arcs - actions/events

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<table>
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<th>Start</th>
<th>Menu</th>
<th>Circle 1</th>
<th>Circle 2</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>select 'circle'</td>
<td>click on centre</td>
<td>rubber band</td>
</tr>
<tr>
<td>Line 1</td>
<td></td>
<td>select 'line'</td>
<td>click on first point</td>
<td>rubber band</td>
</tr>
<tr>
<td>Line 2</td>
<td></td>
<td></td>
<td>click on point</td>
<td>draw line</td>
</tr>
</tbody>
</table>
```
The Three-State Model can help designers to determine appropriate I/O devices for specific interaction designs.

- The TSM can reveal intrinsic device states and their subsequent transitions.
  - The interaction designer can use these to make determinations about the correlation between task and device.
  - Certain devices can be ruled out early in the design process if they do not possess the appropriate states for the specified task.
Modeling Dynamics – *Three-State Model*

- **The Three-State Model (TSM)** is capable of describing three different types of pointer movements
  - **Tracking**: A mouse device is tracked by the system and represented by the cursor position
  - **Dragging**: A mouse also can be used to manipulate screen elements using drag-and-drop operations
  - **Disengaged movement**: Some pointing devices can be moved without being tracked by the system, such as light pens or fingers on a touchscreen, and then reengage the system at random screen locations
Uses of State-Transition Networks

• Not well-suited to complete models of modern GUIs
  – Too many options (transitions) from any given state – combinatorial explosion (in fact, that’s just the flexibility a good GUI is supposed to give)

• Better for limited/embedded user interfaces
  – Automated teller machine
  – Digital watch
  – Car key/alarm device

• Excellent for checking completeness of design
  – Be sure that all transitions are represented (and hence will get coded and tested in implementation)