Lecture 6:  
HCI, advanced course,  
Task Analysis & GOMS  

To read: John & Kieras: The  
GOMS family of user interface  
analysis techniques
Motivation

• GOMS models
  – make predictions
  – cover a range of behaviour in HCI tasks
  – are easy to learn
  – are usable for designers
  – give fairly good approximations of behaviour
What is a GOMS model?

- A description of the knowledge that a user must have in order to carry out tasks on a device or a system
- A representation of the “how to do it” knowledge that is required by a system in order to get the intended tasks accomplished
Characteristics for GOMS

- Combines cognitive aspects with an analysis of a task
- Results in quantitative predictions of time
- Qualitatively
  - GOMS can explain the predictions
  - focus on methods to accomplish goals
When is GOMS analysis used?

- It applies to situations in which users will be expected to perform tasks they have already mastered
- Routine work
  - registration tasks
  - when time is crucial
Restrictions for GOMS

- Procedural knowledge, “how-to-do-it”
- Routine tasks, “skilled behaviour”
- A list of relevant tasks is needed
GOMS terminology

- Goals - what the user wants to accomplish
- Operators - the means that leads to a goal at a detailed level
- Methods - sequences of operators
- Selection rules - rules (general or personal) for choosing a certain method
GOMS - Example

• Goal: Edit an article
• Operators
  – Use arrow keys
  – Use mouse
  – Use other keys

• Method: Delete text (sub-goal)
  – Positioning: 1) arrow key 2) mouse
  – Marking: 1) double click 2) use mouse
  – Delete (and add text): 1) start writing 2) press delete, then write new text

• Selection rules: if close, use arrow key etc.
Keystroke Level Model - KLM

• The simplest of the GOMS-techniques, serial model
• When a specified method exists, (other GOMS-techniques might predict a method)
• Uses duration estimates for keystroke-level operators
• Quantitatively – predicts time for skilled users
• Qualitatively highlights new ideas
KLM – keystroke operators

- K = key press
- P = pointing
- H = home hands
- D = drawing a line
- M = mental thinking
- R = system response time
- $T_{\text{total}} = K + P + H + D + M + R$
CMN-GOMS

- CMN means Card, Moran & Newell who introduced GOMS in HCI
- When operators are strictly sequential
- Breadth-first until relevant level of detail, could be at a keystroke level
Example

GOAL: DELETE-FILE
  .  GOAL: SELECT-FILE
  .   [select:  GOAL: KEYBOARD-TAB-METHOD
  .   .  GOAL: MOUSE-METHOD]
  .   VERIFY-SELECTION
  .  GOAL: ISSUE-DELETE-COMMAND
  .   [select*:  GOAL: KEYBOARD-DELETE-METHOD
  .   .  PRESS-DELETE
  .   .  GOAL: CONFIRM-DELETE
  .   .  GOAL: DROP-DOWN-MENU-METHOD
  .   .   MOVE-MOUSE-OVER-FILE-ICON
  .   .   CLICK-RIGHT-MOUSE-BUTTON
  .   .   LOCATE-DELETE-COMMAND
  .   .   MOVE-MOUSE-TO-DELETE-COMMAND
  .   .   CLICK-LEFT-MOUSE-BUTTON
  .   .  GOAL: CONFIRM-DELETE
  .   .  GOAL: DRAG-AND-DROP-METHOD
  .   .   MOVE-MOUSE-OVER-FILE-ICON
  .   .   PRESS-LEFT-MOUSE-BUTTON
  .   .   LOCATE-RECYCLING-BIN
  .   .   MOVE-MOUSE-TO-RECYCLING-BIN
  .   .  RELEASE-LEFT-MOUSE-BUTTON]

*Selection rule for GOAL: ISSUE-DELETE-COMMAND
  If hands are on keyboard, use KEYBOARD-DELETE-METHOD,
  else if Recycle bin is visible, use DRAG-AND-DROP-METHOD,
  else use DROP-DOWN-MENU-METHOD
CPM-GOMS

- CPM - Cognitive Perceptual Motor, or Critical Path Method, see example
- Based on MHP, i.e. Model Human Processor, involving parallel processing
- Uses operators as in CMN-GOMS
MHP – Model Human Processor
MHP – Model Human Processor

Senses

Perceptual Processor

Visual Image Storage

Auditory Image Storage

Working Memory

Long-Term Memory

Cognitive Processor

Motor Processor

Movement Response (arms, legs, mouth, eyes, etc.)

Perceptual Subsystem

Cognitive Subsystem

Motor Subsystem
Example

Current Workstation

operators removed from slack time

Proposed Workstation

none of the removed operators were along the critical path (shown in bold)
Conclusions

- TA - focus on tasks/actions
- KLM – key-stroke level
  - simple key-pressing tasks
- GOMS – simple tasks, could be more complex than just pressing keys
  - Comparing systems
  - When time is crucial