Predicting Task Execution Time on Handheld Devices Using the Keystroke Level Model

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Motivation and goals

- **Keystroke Level Model (KLM)**
  - *A priori* prediction of expert user task time
  - Intensively used on desktop computers
  - Not yet been adapted to handheld devices
    - Limited display size
    - Input device: stylus, touch-screen, hardware buttons
    - Interaction methods: tap, Graffiti, etc.

- **Investigate KLM on handheld UIs**
  - Applicability of model to novel interface modalities
  - Accuracy of model predictions
KLM in brief

- Describe a task by placing operators in a sequence
  - K – keystroke (tap)
  - P – point with mouse (with stylus)
  - H – homing (move hand from mouse to keyboard) (N/A)
  - D (takes parameters) – drawing
  - R (takes parameters) – system response time
  - M – mental preparation

- Five heuristic rules to insert candidate Ms into the sequence
- Task execution time = \( \sum \) all operators involved
Handheld task:
Find information about the MET

1. City map
2. Region map
3. Street map
4. Museums list

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Create KLMs

- One KLM for each of the four methods
- Used CogTool (John, et al 2004)

Diagram:

1. MacroMedia DreamWeaver
   - HTML mockups
   - Modeler mocks up interfaces as HTML storyboard

2. Netscape HTML event handler
   - Interface event messages via LiveConnect
   - Modeler demonstrates tasks on the HTML storyboard

3. Behavior Recorder
   - ACT-Simple code based on KLM
   - ACT-Simple complies code into ACT-R production rules

4. ACT-R Environment
   - KLM Trace
User study

- 10 expert PDA users (Female:Male = 3:7)
- At least one year experience using:
  - Palm series, pocket PC, or smart cell phone
- Instructed to perform the task on a PalmVx
  - Using four different methods (within subject design)
- Training session before real session
  - Repeating each method for 10 times

- Data collection
  - EventLogger: records system events to a log file
  - Videotaped modeler’s behavior for verification
New results since paper published

- Better estimation of system response time
- Latest version of CogTool
- Detailed analysis of model and user traces (140/400 removed)
Conclusion & Future work

- KLMs produced with CogTool are effective for handheld user interfaces:
  - Produces accurate execution time prediction
  - Supports new input modalities: Graffiti

- Future work:
  - Detailed analysis of the user pauses (mental time)
  - Use predictions of pauses to assist energy management
Thank you!

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The CogTool project:
- http://www.cs.cmu.edu/~bej/cogtool/