Questions?

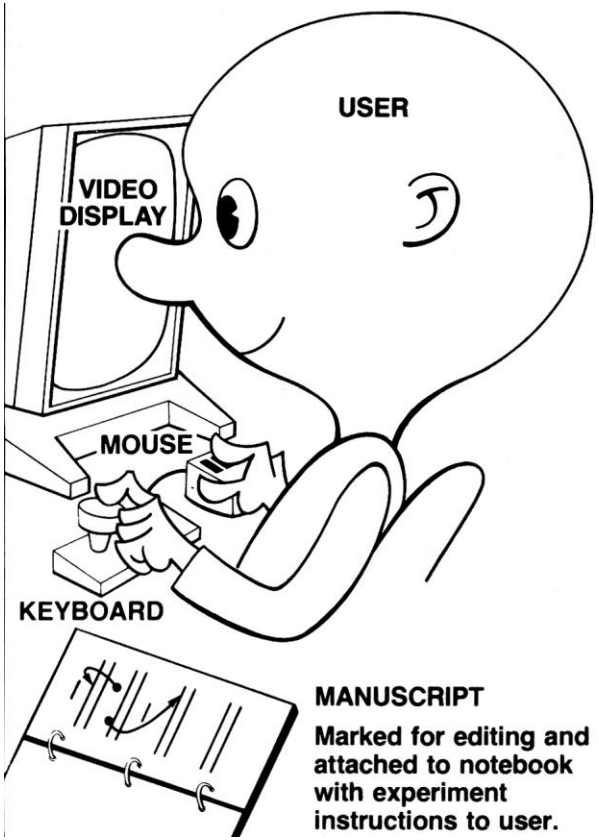
- Midterm results
- Project step 2 available

GOMS (Card et al.)

- Family of methods (KLM, CMN-GOMS, NGOMSL, CPM-GOMS)
- Describe the user behavior in term of
  - Goals
    - *A thing to do*
    - *Like a function name – independent of application (i.e., "print page" works in any word processor)*
  - Operators
    - *Elementary perceptual, motor or cognitive actions.*
  - Methods
    - *Sequences of sub-goals and operators that can accomplish a goal.*
    - *Like the body of a function – implements a goal.*
  - Selection rules
    - *Used if several methods are available for a given goal*
    - *Not subjective – GOMS should run like a program*
- For skilled users only only
  (models cognitive tasks, not problem-solving)

GOMS example I

- Setting



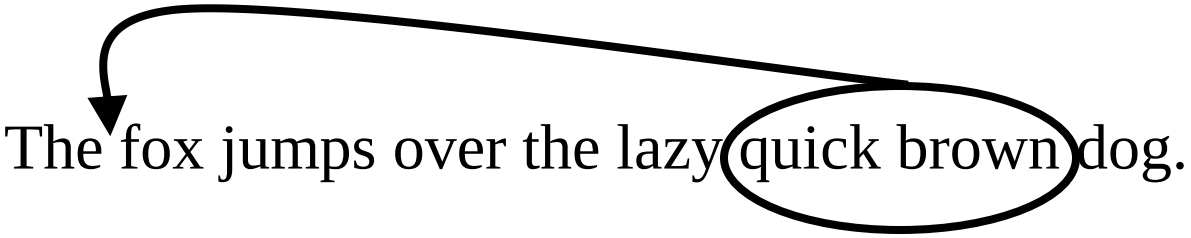
- Analysis

```
GOAL: EDIT-MANUSCRIPT
. GOAL: EDIT-UNIT-TASK          repeat until no more unit tasks
. . GOAL: ACQUIRE-UNIT-TASK
. . . GET-NEXT-PAGE             if at end of manuscript page
. . . GET-NEXT-TASK
. . GOAL: EXECUTE-UNIT-TASK
. . . GOAL: LOCATE-LINE
. . . . [select: USE-QS-METHOD
                 USE-LF-METHOD]
. . . GOAL: MODIFY-TEXT
. . . . [select: USE-S-COMMAND
                 USE-M-COMMAND]
. . . . VERIFY-EDIT .
```

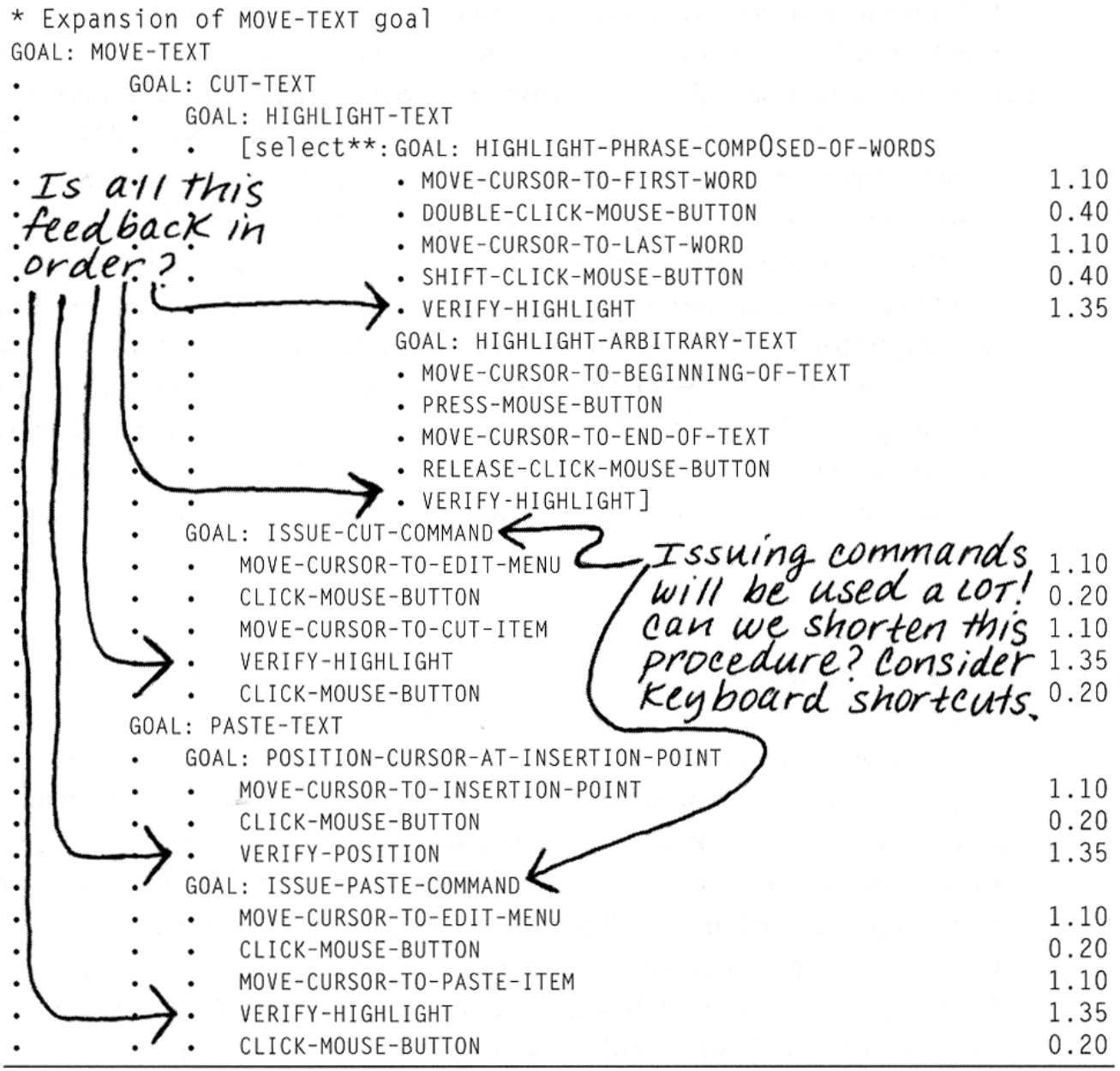
GOMS example II

(From HCI Models, Theories and Frameworks, J. Carroll)

- Using a text editor to edit the following text as shown



- Goals and sub-goals?
- Operators?
- Methods?
- Selection rules?


* Expansion of MOVE-TEXT goal
GOAL: MOVE-TEXT
GOAL: CUT-TEXT
GOAL: HIGHLIGHT-TEXT
[select**: GOAL: HIGHLIGHT-PHRASE-COMPOSED-OF-WORDS
• MOVE-CURSOR-TO-FIRST-WORD 1.10
• DOUBLE-CLICK-MOUSE-BUTTON 0.40
• MOVE-CURSOR-TO-LAST-WORD 1.10
• SHIFT-CLICK-MOUSE-BUTTON 0.40
• VERIFY-HIGHLIGHT 1.35
GOAL: HIGHLIGHT-ARBITRARY-TEXT
• MOVE-CURSOR-TO-BEGINNING-OF-TEXT
• PRESS-MOUSE-BUTTON
• MOVE-CURSOR-TO-END-OF-TEXT
• RELEASE-CLICK-MOUSE-BUTTON
• VERIFY-HIGHLIGHT]
GOAL: ISSUE-CUT-COMMAND
• MOVE-CURSOR-TO-EDIT-MENU 1.10
• CLICK-MOUSE-BUTTON 0.20
• MOVE-CURSOR-TO-CUT-ITEM 1.10
• VERIFY-HIGHLIGHT 1.35
• CLICK-MOUSE-BUTTON 0.20
GOAL: PASTE-TEXT
GOAL: POSITION-CURSOR-AT-INSERTION-POINT
• MOVE-CURSOR-TO-INSERTION-POINT 1.10
• CLICK-MOUSE-BUTTON 0.20
• VERIFY-POSITION 1.35
GOAL: ISSUE-PASTE-COMMAND
• MOVE-CURSOR-TO-EDIT-MENU 1.10
• CLICK-MOUSE-BUTTON 0.20
• MOVE-CURSOR-TO-PASTE-ITEM 1.10
• VERIFY-HIGHLIGHT 1.35
• CLICK-MOUSE-BUTTON 0.20
TOTAL TIME PREDICTED (SEC) 16.25
Is all this feedback in order?
Issuing commands will be used a LOT! Can we shorten this procedure? Consider keyboard shortcuts.

Keystroke Level Model (KLM)

- Focused on expert user – no selection rules
- Describe the task using the following operators:
  - K: pressing a key or pressing (or releasing) a button

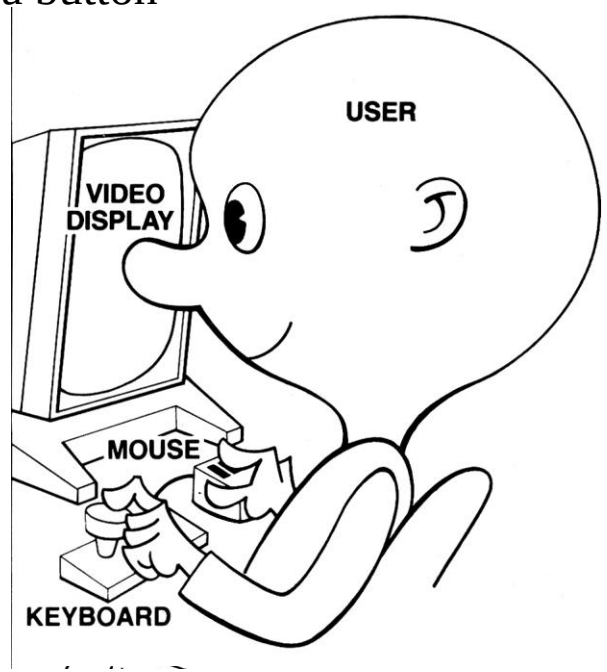
    t_K =*0.2 sec*
  - P: pointing

    t_P = *1.1 sec (without button press)*
  - H: Homing (switching device)

    t_H = *0.4 sec*
  - M: Mentally prepare

    t_M = *1.35 sec*
  - R(*t*): system response time

    t_R = *t*



How to use KLM

- Encode using all physical operator (K, P, H, D(n,l), R(t))
- Apply KLM rules [0-4] to add M's
- Transform R followed by an M
  - If $t \leq t_M$: R(t) $\rightarrow$ R(0)
  - If $t_M < t$: R(t) $\rightarrow$ R($t - t_M$)
- Compute the total time by adding all times
  - Will describe expert user behavior

KLM Heuristics (Raskin p. 77)

0: Insert M

- *In front of all K*
- *In front of all P's selecting a command*

1: Remove M between *fully anticipated* operators

- *PMK → PK*

2: if a string of MKs belong to *cognitive unit* delete all M but first

- *4564.23: MKMKMKMKMKMKMK → MKKKKKKK*

3: if K is a *redundant terminator* then delete M in front of it

- *↵↵: MKMK → MKK*

4a: if K terminates a constant string (command name) delete the M in front of it

- *cd↵: MKKMK → MKKK*

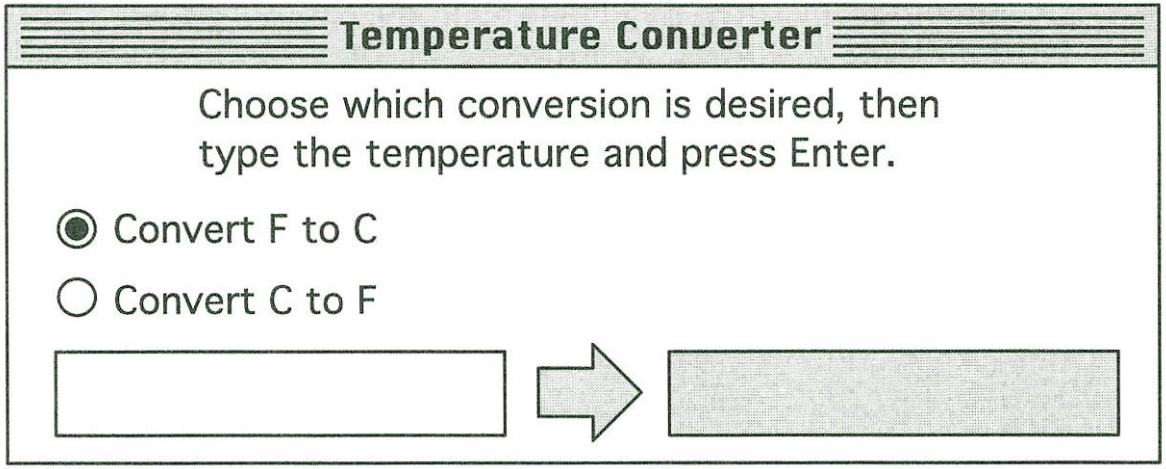
4b: if K terminates a variable string (parameter) keep the M in front of it

- *cd class↵: MKKKMKKKKKMK → MKKKMKKKKKMK*

Converting Temperature

("Humane Interface", Raskin)

- Convert 92.5F to Celsius



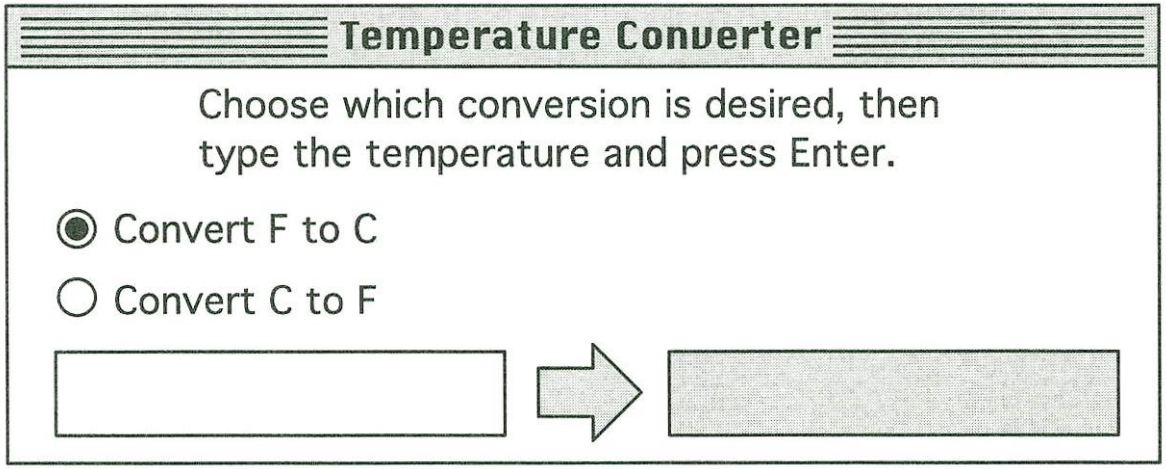
Assume :

- the focus is on the dialog box
- 4 characters for temperature

Converting Temperature

("Humane Interface", Raskin)

- Convert 92.5F to Celsius



Assume :

- the focus is on the dialog box
- 4 characters for temperature

- MKKKKMK (3.7s)
- HMPKHMKKKKMK (7.15s)

=> Average: 5.4s

Converting Temperature

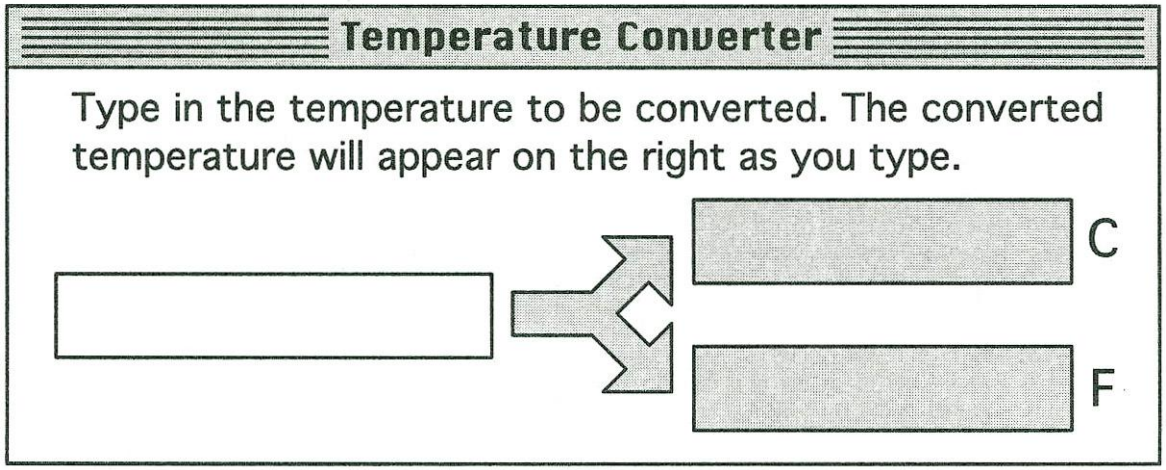
- Your design. Can you do better?
- Design interface in pairs
- Perform KLM analysis and report

Try Google:

- 92.5f in c
- 37c in f

Converting temperature: Raskin's Redesign

("Humane Interface", Raskin)

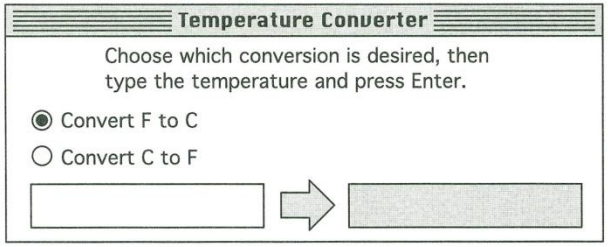


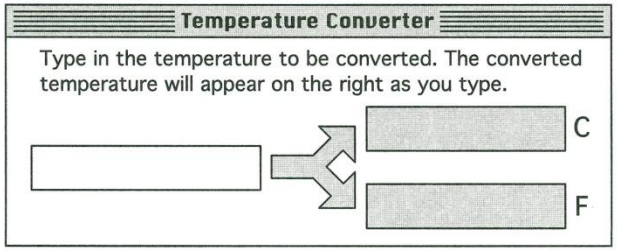
MKKKK => 2.15s

Pros and Cons

What are other factors?

- Learnability
- Accuracy
- Cognitive load





GOMS: Application and limitations

- Applications
  - CAD system
  - Telephone operator (CPM-GOMS)
  - Text editing with keyboard and mouse (KLM)

- Limitations
  - Skilled users
  - Does not deal with error
  - Does not deal with skill acquisition
  - Does not deal with high level issues (Functionality, workload, Fatigue)
  - Better for relative than absolute timing

NYNEX Example

Worked well, but:

- Compared to marketing data
- Compared to very expensive field trial
- Individual Goal estimates very inaccurate (~50% off)
- Core analysis obvious in retrospect
  (savings not in bottleneck don't help)

Was GOMS necessary, or could an expert analysis have revealed this?

Value of KLM/GOMS?

- Possibly good for high value decisions
- Possibly good for making strong argument
- Definitely good for helping designers develop an intuition about works and doesn't and the impact of design decisions on speed

- Look at www.hcibib.org for work on GOMS