Questions?

- Reading Assignment on KLM
  - chapter 4 “The Humane Interface” by Raskin

High Level Model of Human Behavior

- Model Human Processor (or HIP) for short (isolated) tasks
  - Matching a symbol to memory
  - Determining the fastest speed to type on two different keyboards

- People will become **skilled** and want efficient methods for **routine** tasks

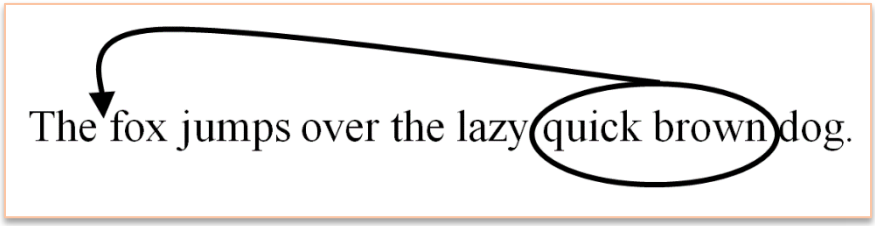
- GOMS are a family of methods used to model the user behavior for complex tasks
- GOMS for quantitative analysis of interface design
  - Predicts how long an **experienced worker** will take to perform an operation with an interface design
  - Models **cognitive skills**, not problem-solving
  - Family of methods (KLM, CMN-GOMS, CPM-GOMS, NGOMSL)

GOMS (Card et al.)

- Describe the user behavior in term of
  - **G**oals
    - *A thing to do*
    - *Like a function name – independent of application (i.e., "print page" works in any word processor)*
  - **O**perators
    - *Elementary perceptual, motor or cognitive actions.*
  - **M**ethods
    - *Sequences of sub-goals and operators that can accomplish a goal.*
    - *Like the body of a function – implements a goal.*
  - **S**election rules
    - *Used if several methods are available for a given goal*
    - *Not subjective – GOMS should run like a program*
- For skilled users only (KLM, CMN-GOMS)
  (models cognitive tasks, not problem-solving)
- CPM-GOMS or NGOMSL takes into account nonexpert behavior such as learning times → more accurate and complete

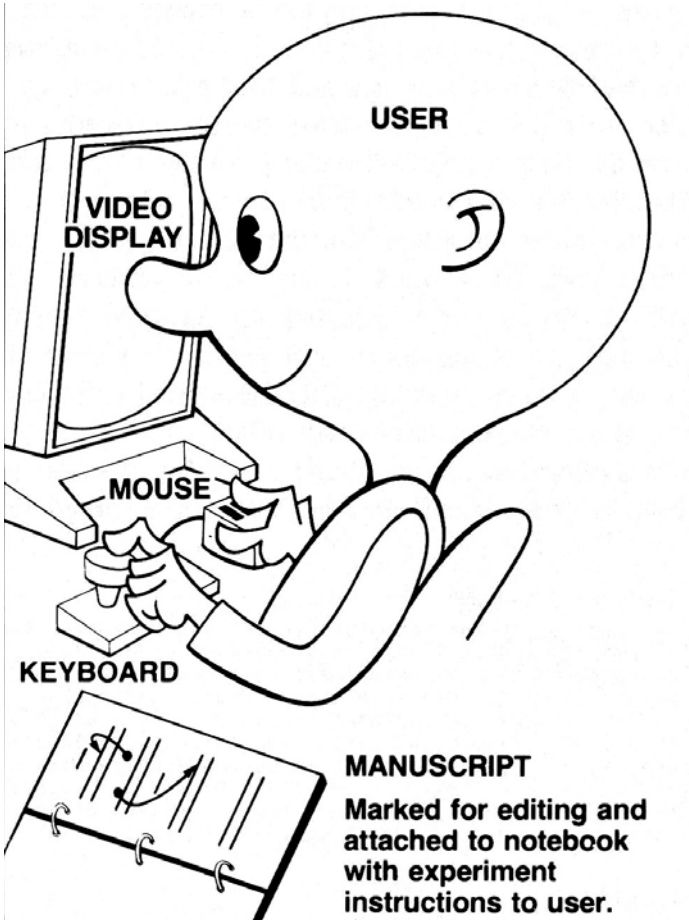
Overview of GOMS

Top-level goal	Edit manuscript, or, more specifically, move "quick brown" to before "fox"
Subgoal	Highlight text
Operators	Move-mouse Click mouse button Type characters (keyboard shortcuts)
Methods	For the editing goal: 1. Delete-word-and-retype (*retype* method) 2. Cut-and-paste-using-keyboard-shortcuts (*shortcuts* method) 3. Cut-and-paste-using-menus (*menus* method) For the highlighting subgoal: 1. Drag-across text (*dragging* method) 2. Double-click first; shift-click last (*all-clicking* method)
Selection rules	For the editing goal: If the text to be moved is one or two characters long, use *retype* method Else, if remember shortcuts, use *shortcuts* method Else, use *menus* method For the highlighting subgoal: If the text to be moved is not whole words, use *dragging* method Else, use *all-clicking* method



GOMS example I

- Setting



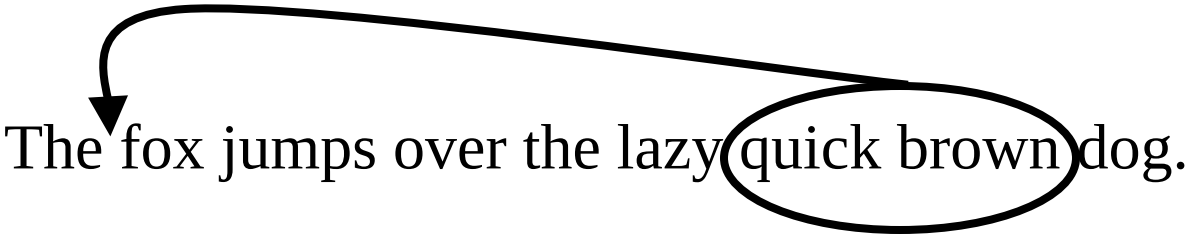
- Analysis

```
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 .
```

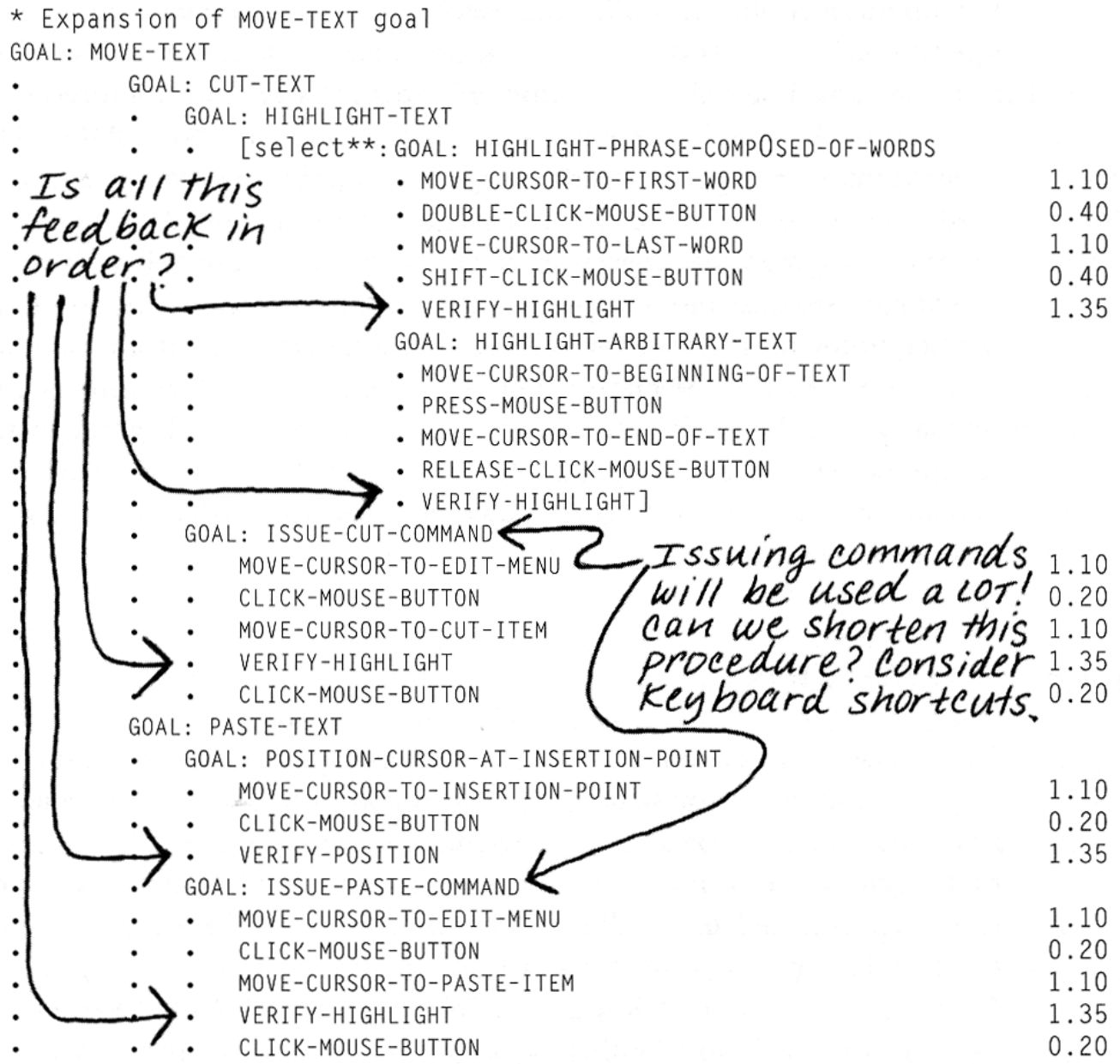
GOMS example II

(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.

CMN-GOMS

Keystroke Level Model (KLM)

- Focused on expert user
  - no selection rules (no decision making)

- Describe the task using the following operators:
  - K: pressing a key or pressing (or releasing) a button

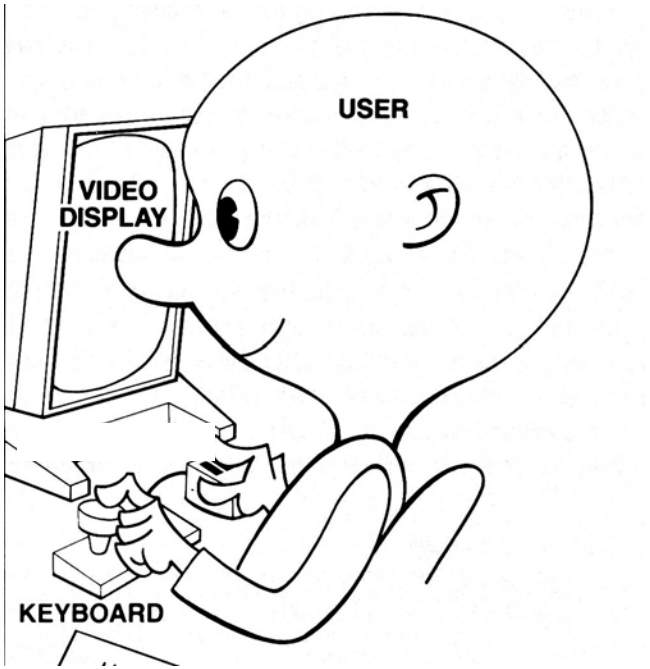
    t_K =*0.2 sec*
  - P: pointing

    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 operators (K, P, H, R(t))
- Apply KLM rules [0-4] to add M's
- Transform R followed by an M
  (computer and user can work at the same time)
  - 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 for Placing M

0: Insert M

- *In front of all K*
- *In front of all P's selecting a command (not arguments)*

1: Remove M between *fully anticipated* operators

- $PMK \rightarrow PK$

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

- *4564.23:* $MKMKMKMKMKMKMK \rightarrow MKKKKKKK$

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

- *↵↵:* $MKMK \rightarrow MKK$

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

- *cd↵:* $MKKMK \rightarrow KKMK$

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

- *cd class↵:* $MKKKMKKKKKMK \rightarrow MKKKMKKKKKMK$

5: Delete overlapped Ms

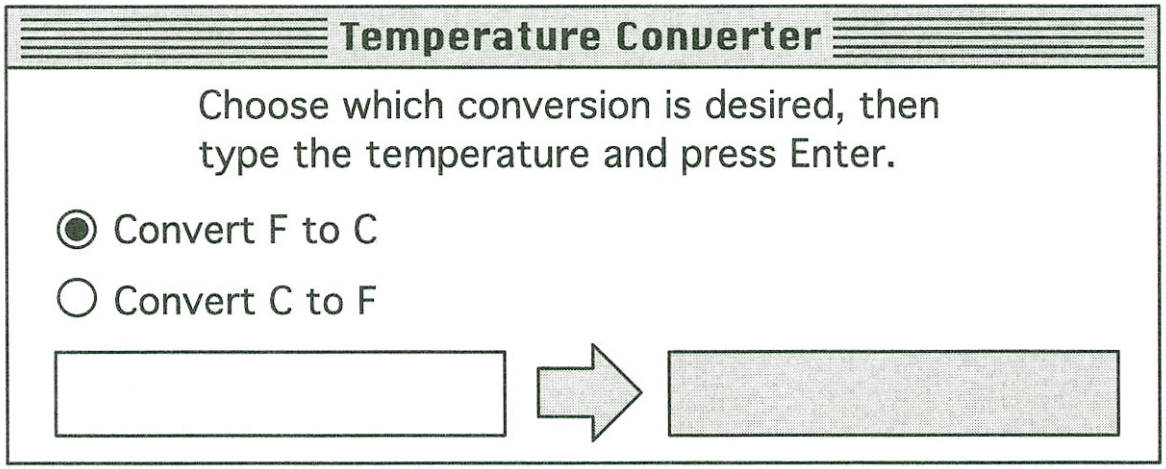
- *do not count any portion of an M that overlaps an R*

Books by Raskin/CMN

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)

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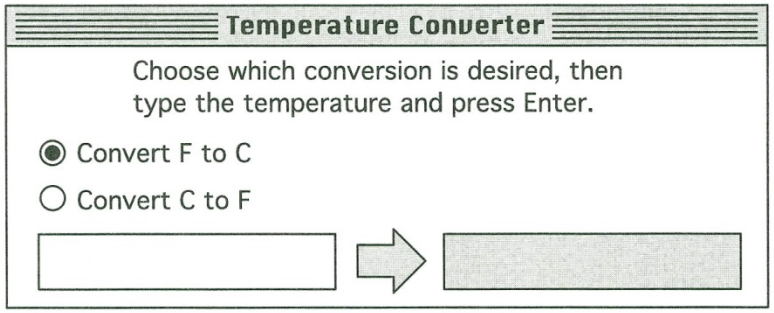

Assume :

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

- F to C: MKKKKMK (3.7s)
- C to F: HMPKHMKKKKMK (7.15s)

=> Average: 5.4s

- Move hand to the GID
  H
- Point to the desired radio button
  HP
- Click on the radio button
  HPK

- Move hands back to the keyboard
  HPKH
- Type the four characters
  HPKHKKKK
- Tap Enter
  HPKHKKKKK

→HMPMKHMKMKMKMKMK

→ HMPKHMKKKKMK

Converting Temperature

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

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 GOMS?

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

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