

Human Computer Interaction (CSC428)

Tutorial 7

Today

- **Announcements**
- **GOMS**
- **KLM-GOMS**

GOMS: introduction

- **What is GOMS?**
 - Description of the knowledge that a user must have in order to carry out tasks on a device or system
 - Representation of the “how to do it” knowledge that is required by a system in order to get the intended tasks accomplished.
- **What does a GOMS task analysis involve?**
 - Involves defining and then describing the user's
 - Goals:
 - Something that the user tries to accomplish (action-object pair, e.g. delete word)
 - Include context
 - Methods:
 - Well learned sequence of steps that accomplish a task
 - How do you do it on this system? (could be long and tedious...)
 - Selection Rules:
 - Only when there are clear multiple methods for the same goal.
 - Operators:
 - Elementary perceptual, cognitive and motor acts that cause change (external vs. mental)
 - Also uses action-object pair (e.g. press key, select menu, make gesture, speak command...)
 - mostly defined by hardware and lower-level software.

GOMS: example

- **File & directory operations:**
 - Delete a file, move a file, delete a directory, move a directory.
- **GOMS analysis – File & directory operations:**
 - Method for goal: delete a file.
 - Step 1. drag file to trash.
 - Step 2. Return with goal accomplished.
 - Method for goal: move a file.
 - Step 1. drag file to destination.
 - Step 2. Return with goal accomplished.
 - Method for goal: delete a directory.
 - Step 1. drag directory to trash.
 - Step 2. Return with goal accomplished.
 - Method for goal: move a directory.
 - Step 1. drag directory to destination.
 - Step 2. Return with goal accomplished.

GOMS: example

- **GOMS analysis – File & directory operations - a better version:**
 - Method for goal: delete an object.
 - Step 1. drag object to trash.
 - Step 2. Return with goal accomplished.
 - Method for goal: move an object.
 - Step 1. drag object to destination.
 - Step 2. Return with goal accomplished.
- **GOMS analysis – the drag operation**
 - Method for goal: drag item to destination.
 - Step 1. Locate icon for item on screen.
 - Step 2. Move cursor to item icon location.
 - Step 3. Hold mouse button down.
 - Step 4. Locate destination icon on screen.
 - Step 5. Move cursor to destination icon.
 - Step 6. Verify the destination icon.
 - Step 7. Release mouse button.
 - Step 8. Return with goal accomplished.

KLM- GOMS: introduction

- **Calculates task execution time using pre-established keystroke-level primitive operators.**
- **Six types of operators:**
 - K: to press a key or a button
 - P: to point with a mouse to a target on a display
 - H: to home hands on keyboard or other device
 - D: to draw a line segment on a grid
 - M: to mentally prepare to do an action or closely related series of primitive actions.
 - R: to symbolize the system response time during which the user has to wait for the system.
- **Each of the six operators has an estimate time or simple approximation function.**
 - Time to execute is empirically defined:
 - $T_{\text{execute}} = T_k + T_P + T_H + T_D + T_M + T_R$
- **Heuristics for adding M**

KLM- GOMS: operator times

Operator	description	time (sec)
K	press key or button (shift or control key count separately)	
	best typist (135 wpm)	.08
	good typist (90 wpm)	.12
	average typist (55 wpm)	.22
	average typist (40 wpm)	.28
	typing complex codes	.75
P	point with mouse to target on display (Fitts's Law)	1.10
	Clicking the mouse or similar device (B)	.10/.20
H	home hand on keyboard or device	.40
D(n,l)	draw n straight-line segments of total length l cm (calculated for a square .56 cm grid)	$.9n + .16l$
M	mentally prepare/respond	1.35

KLM- GOMS: additional operator times

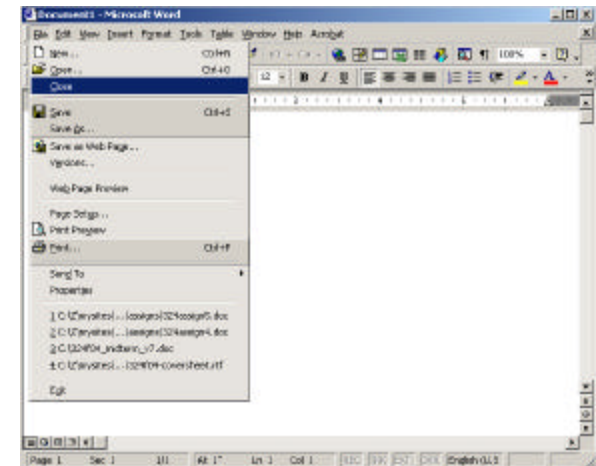
Operator	description	time (sec)
	Move eyes to location on screen	2.3
	Retrieve item from memory	12
	Select among methods	12

KLM- GOMS: example

- Closing a window
 - Either use the close button, or press Ctrl+W

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



- Comparing both techniques (assuming hand starts on mouse)

1. Predict

USE-CTRL-W-METHOD		USE-CLOSE-METHOD	
H[to kbd]	0.40	P[to menu]	1.1
M	1.35	B[LEFT down]	0.1
K[ctrlW key]	0.28	M	1.35
		P[to option]	1.1
		B[LEFT up]	0.1
Total	2.03 s	Total	3.75 s

2. Evaluate

Time using
interface 1

Time using
interface 2

KLM- GOMS: handling M

- **Rule 0: initial insertion of candidate's M's**
 - M before K
 - M before P iff P selects a command
- **Rule 1: deletion of anticipated M's**
 - If an operator following an M is fully anticipated, delete that M
- **Rule 2: deletion of M's within cognitive units**
 - If a string of MK's belongs to a cognitive unit, delete all Ms but the first
- **Rule 3: deletion of M's before consecutive terminators**
 - If a K is a redundant delimiter, delete the M before it.
- **Rule 4: deletion of M's that are terminator of commands**
 - If K is a delimiter that follows a constant string, delete the M in front of it.
- **Rule 5: deletion of overlapped M's**
 - Don't count any M that overlaps an R

KLM- GOMS: handling M - example

Temperature Converter

Choose which conversion is desired,
then type the temperature and press
Enter.

☐ Convert F to C.

☐ Convert C to F.

→

K	0.2
B	.10/.20
P	1.1
H	0.4
D	-
M	1.35
R	-

HPBHKKKKK

Apply Rule 0

HMPMBHMKMKMKMKMK

Apply Rules 1 and 2

HMPBHMKKKKMK

Convert to numbers

.4+1.35+1.1+.20+.4+1.35+4(.2)+1.35+.2

=7.15

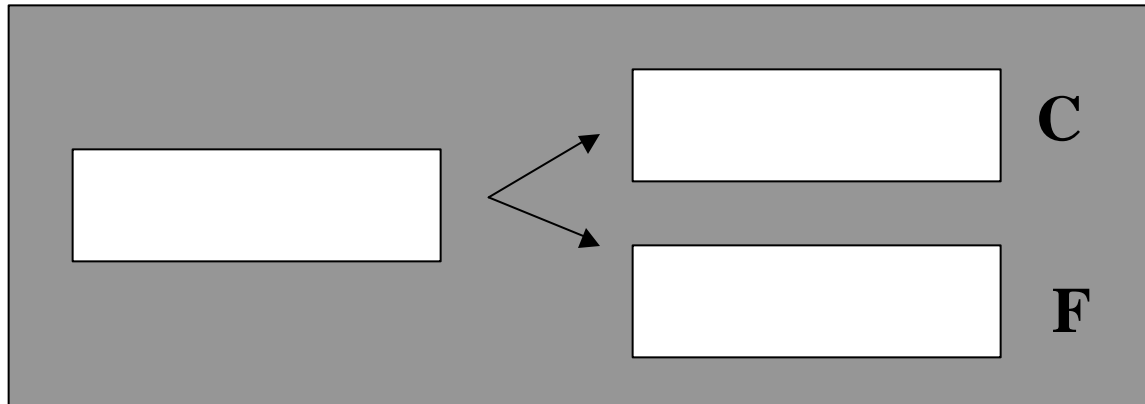
KLM- GOMS: handling M - example

To convert temperatures,
Type in the numeric temperature,
Followed by C for Celcius or
F for Fahrenheit. The converted
Temperature will be displayed.

K	0.2
B	.10/.20
P	1.1
H	0.4
D	-
M	1.35
R	-

$$\text{MKKKKMK} = 3.7 \text{ sec}$$

KLM- GOMS: handling M - example



K	0.2
B	.10/.20
P	1.1
H	0.4
D	-
M	1.35
R	-

MKKKK = 2.15 sec