Model Based Evaluation

GOMS Models

Focus given on the ways to improve interaction – required to **somehow measure** the **quality of the interaction**

GOMS stands for goals, operators, methods, and selection rules. It is a family of techniques for analyzing user interfaces by modeling the user's behavior in performing familiar tasks (Hochstein, 2002). Thus, GOMS simulates expert performance

GOMS Models

- GOMS is a family of predictive models of human performance that can be used to improve the efficiency of human-machine interaction by identifying and eliminating unnecessary user actions

GOMS Models

Objective – to make **a priori** prediction on the quality of interaction **without actually developing any "working system, prototype or mock-up"**

GOMS Model

- Goals, Operators, Model, Sequence
- Four Variants
  - **KLM(Key stroke level)**
  - CMN (Card, Moran, Newell model)
  - NGOMSL(Natural GOMS language)
  - CPMGOMS(Critical Path Model or Cognitive Perceptual Model)

Underlying Assumption

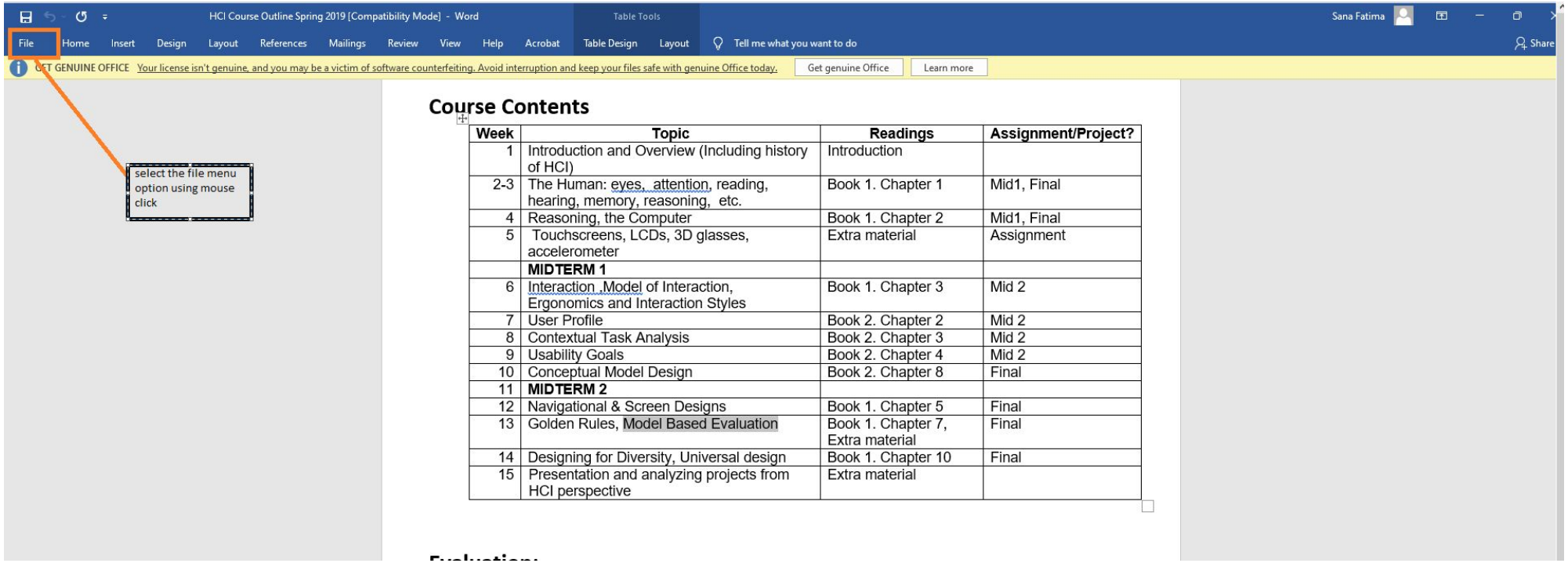
All models have one thing in common: the way information is assumed to be processed in the human mind (in other words, the **process of cognition**)

- The term **information** used in the context of execution of the **interaction tasks**

Example

- Suppose you are using a text editor to write an article
- You have already written a few lines and want to save it
- You wish to use the menu options for the purpose

Example

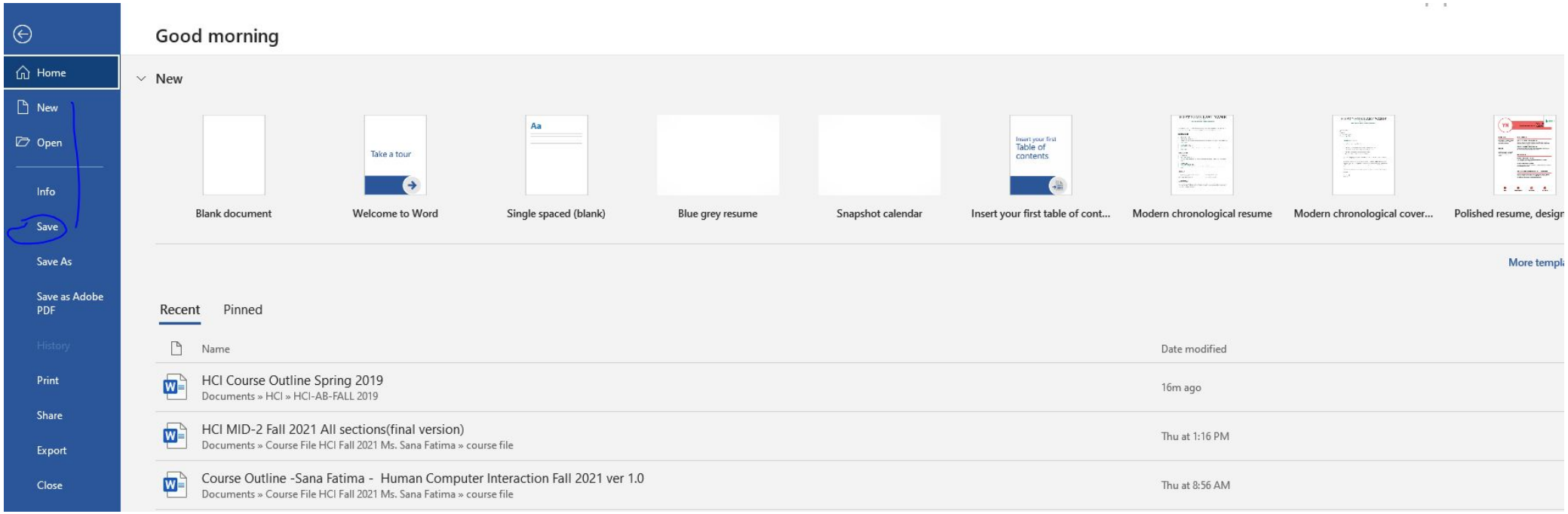


Course Contents

Week	Topic	Readings	Assignment/Project?
1	Introduction and Overview (Including history of HCI)	Introduction	
2-3	The Human: eyes, attention, reading, hearing, memory, reasoning, etc.	Book 1. Chapter 1	Mid1, Final
4	Reasoning, the Computer	Book 1. Chapter 2	Mid1, Final
5	Touchscreens, LCDs, 3D glasses, accelerometer	Extra material	Assignment
	MIDTERM 1		
6	Interaction ,Model of Interaction, Ergonomics and Interaction Styles	Book 1. Chapter 3	Mid 2
7	User Profile	Book 2. Chapter 2	Mid 2
8	Contextual Task Analysis	Book 2. Chapter 3	Mid 2
9	Usability Goals	Book 2. Chapter 4	Mid 2
10	Conceptual Model Design	Book 2. Chapter 8	Final
11	**MIDTERM 2**		
12	Navigational & Screen Designs	Book 1. Chapter 5	Final
13	Golden Rules, Model Based Evaluation	Book 1. Chapter 7, Extra material	Final
14	Designing for Diversity, Universal design	Book 1. Chapter 10	Final
15	Presentation and analyzing projects from HCI perspective	Extra material	

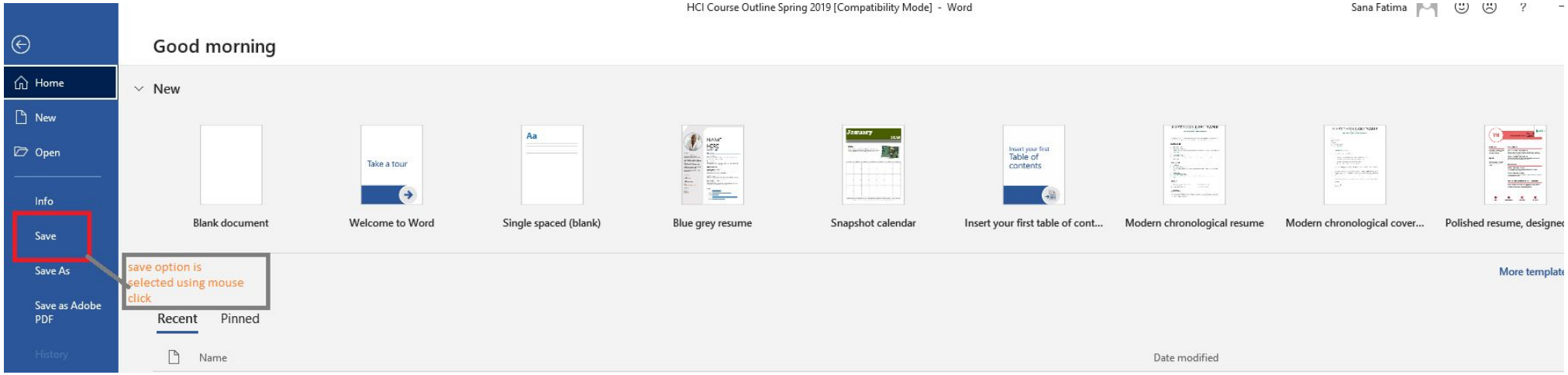
Example

- Locate save option



Example

- Save option is selected using mouse click



Example

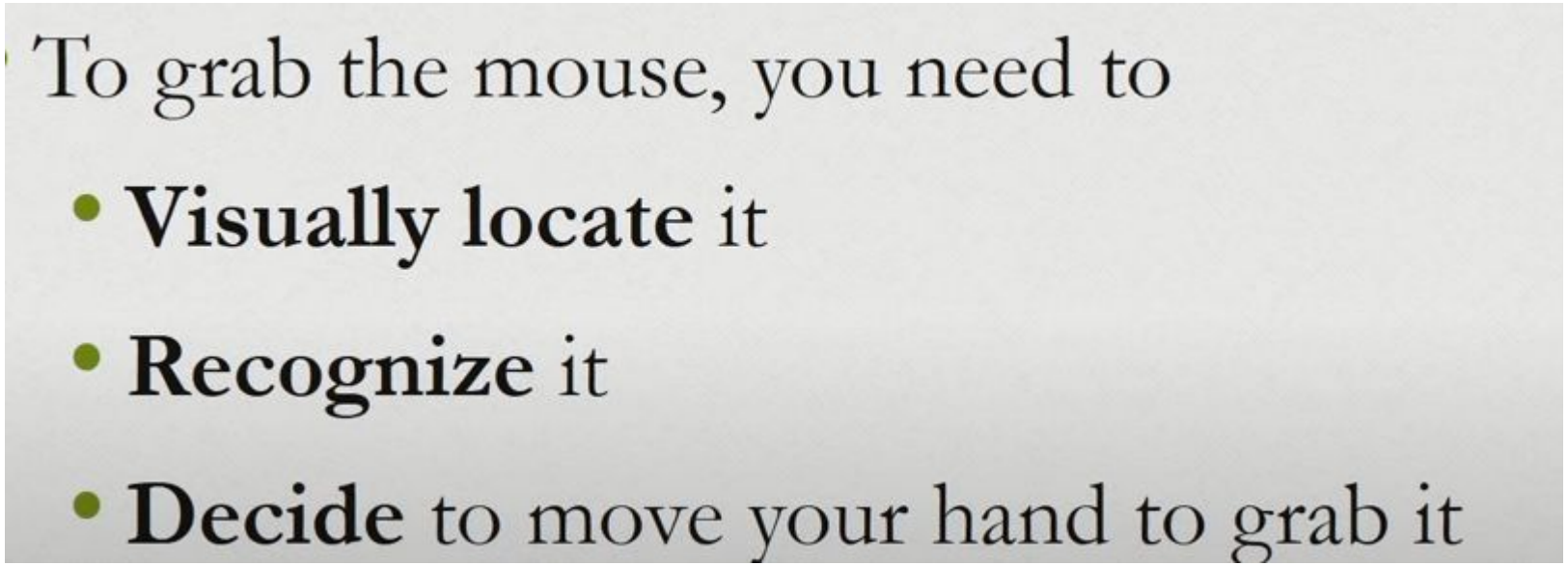
- First, you need to grab the mouse
- Next, you need to move the pointer to “FILE” menu option
- You click the left mouse button
  - The screen with all options under file menu options appears
- You move the mouse pointer to the “SAVE” option
- You click the option
  - Assuming file already has a name

What else we do?

- Along with the physical activities, you are likely to perform a number of mental(cognitive) activities.

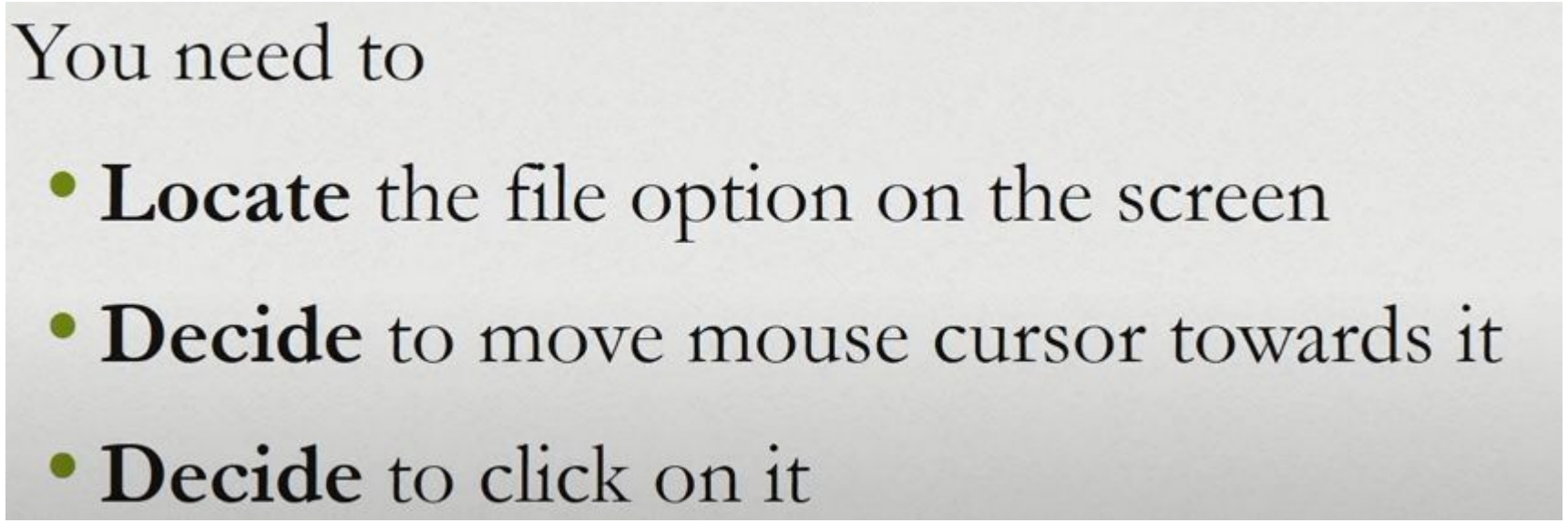
What else we do?

- Mental/cognitive activities



What else we do?

- Mental/cognitive activities



GOMS Model

- Mental activities + physical activities

To do so, it is assumed **any interactive task can be broken down into a series of cognitive and physical tasks performed in sequence**

KLM Model (keystroke level model)

KLM

- Earliest predictive models to be used for analysis and evaluation
- Primary objective is to allow a designer **predict the time** it takes for a user to perform an interaction task using an interface and interaction method(the task execution time)

KLM

- KLM of an interaction task is a set of **operators arranged in a sequence**
- Operators represents low level cognitive activity with a pre-determined and fixed execution time.
- As we know task involves both computer and human which essentially means our task involves cognitive process(mental activities)

KLM operators

- Total seven operators organized into three groups(D and R Operator is no longer used now)

Operator Group	Operator Name	Brief Description	Execution Time (seconds)
Physical-motor	K	The operator represents the task of (any) "key press".	0.12 (good typist)
			0.28 (poor typist)
			1.20 (non-typist)
	B	A mouse button press/release is represented by this operator.	0.10
	P	Pointing task, i.e., moving a pointer to a target.	1.10
	H	The "homing" task (i.e., switching hand between keyboard and mouse or any other device).	0.40
	D	**Drawing a line using mouse (not used much now).**	**Not important**
Mental	M	The thinking/decision making task.	1.35
System response	**R**	**The system response time (not very relevant now).**	**Not important**

KLM

- Purpose is to evaluate interface design
- Step by step process
  - Choose task
  - Build KLM
  - Compute execution time

KLM

Step sequence	Step name	Step description
1	Choose Task	Choose one or more representative task/tasks that is/are frequently performed by the users
2	Build KLM	Identify the operators (K,P,B,H,M) and arrange them in proper order
3	Compute execution time	Add up individual operator times

Example-1

- “Text saving task” with file menu option.

Example-1

- We have a set of 5 operators K,B,P,M,H
- We don’t perform any key press
- Assume we do need to switch from keyboard to mouse
- Remaining we have B,P,M,H

Example-1

- Once operators are chosen arrange them in sequence then add up operator values (MHPBBMPBB)

Operator	Explanation
M	To decide to select the "FILE" menu option and think of the steps required to do it.
H	Switch hand from keyboard to mouse.
P	Move the mouse pointer to the menu option.
BB	Click on the menu option to select. As a "mouse click" involves the "pressing" of the button followed by its "release", we require two B's in sequence: one each for the press and release.
M	To decide to select the "Save" option from among all the menu options and to think of the steps required to achieve the goal.
P	Move the mouse pointer to the menu option.
BB	Click on the menu option to select.

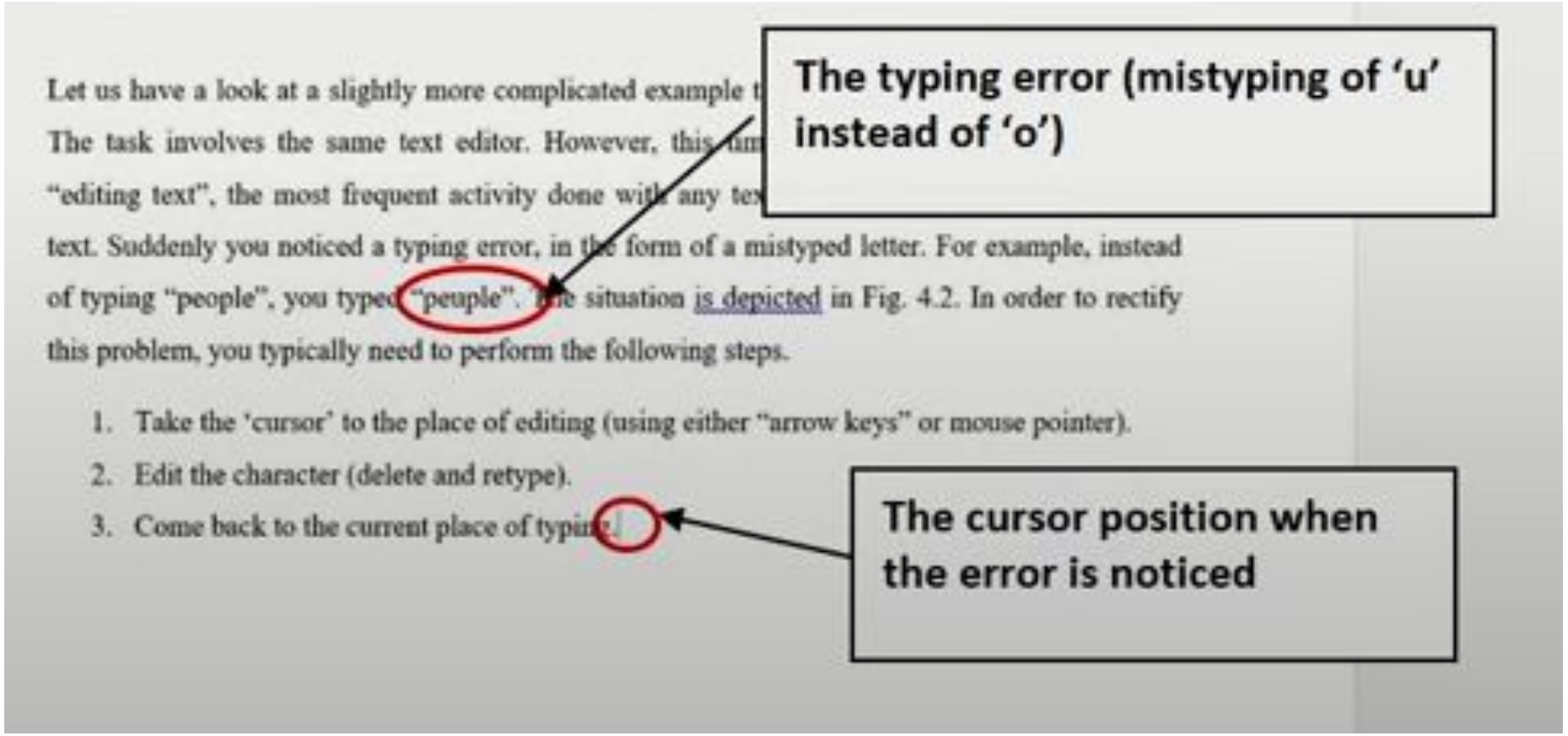
Final KLM: MHPBBMPBB

Task execution time: 5.7 seconds (by adding up the operator values in the sequence)

Example-2

Suppose you are typing a text. Suddenly you noticed a typing error, in the form of a mistyped letter

Example-2


Let us have a look at a slightly more complicated example t
The task involves the same text editor. However, this tim
"editing text", the most frequent activity done with any tex
text. Suddenly you noticed a typing error, in the form of a mistyped letter. For example, instead
of typing "people", you typed "peuple". The situation is depicted in Fig. 4.2. In order to rectify
this problem, you typically need to perform the following steps.
1. Take the 'cursor' to the place of editing (using either "arrow keys" or mouse pointer).
2. Edit the character (delete and retype).
3. Come back to the current place of typing.
The typing error (mistyping of 'u' instead of 'o')
The cursor position when the error is noticed

Example-2

- Take the cursor to the place of editing (MHPBB)
- Perform editing(MHKK)
- Place the cursor back to its original position.(MHPBB)
- Total time 8.09

M Placement rules

Rule 0: Insert M in front of all the key press operators (K) and the pointing actions (P) done for "command" selection. However, do not place M before a P that is used to place "argument"

Typically, the term "command" refers to the mouse-operated widgets (like the buttons, check boxes, radio buttons and so on) and "argument" refers to the text entry task

M Placement rules

- The rule says that M be placed before any P that is used to select buttons or other widgets
- No M is required if we intend to perform a text entry task after the P operator

M Placement rules

Rule 1: if an operator following an M is "fully anticipated" in an operator immediately preceding that M, then the M should be deleted

So, operator sequence BBMK since any key press should be preceded by an M as per Rule 0

According to Rule 1, delete the M inserted as a consequence of Rule 0 (BBMK becomes BBK)

M Placement rules

Cognitive unit is predetermined chunk of information

Rule 2: if a string of M's belong to the same "cognitive unit", remove all the M's except the first

Suppose you wish to type 101 (that means, you have already **decided** to type the number)

The KLM operator sequence as per the Rule 0 should be MKMKMK

As per Rule 2 - MKKK is the right sequence since the number is a "cognitive unit"

M Placement rules

Rule 3: do not place M before consecutive terminators (similar to the idea of Rule 2)

Suppose you are typing a line and terminate it with a full stop

You follow this up with a carriage-return (i.e., the "Enter" key press)

M Placement rules

Although it may look like two key presses with two M's (Rule 0), you actually need to place one M before the key press representing the typing of the full stop

- No M is required for the next K (representing the "Enter" key press)

M Placement rules

- If K i e M Infront of it.

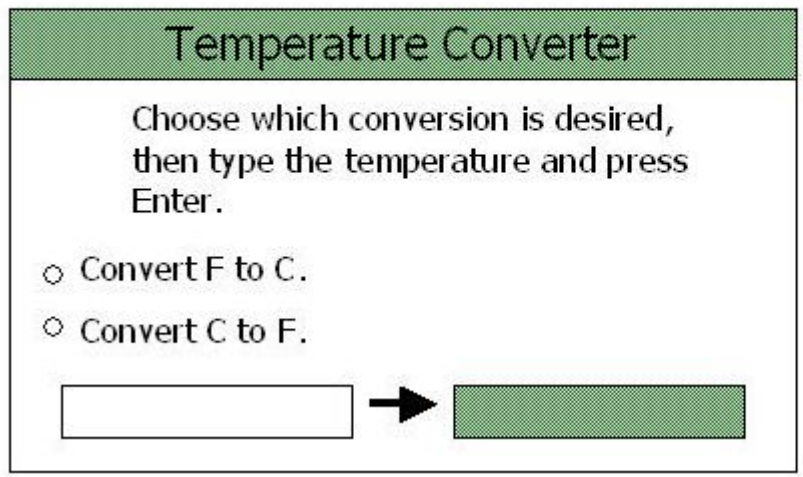
M Placement Heuristics

- **Rule 4:** If a key press (K) represents a delimiter that follows a constant string, a command name (like "copy"), or something that is the same every time you use it, then delete the M in front of it (placed due to Rule 0). **However, if the K terminates a variable string, do not delete the M in front of it.**

Conclusion

KLM allows us to **analyze the quality of our design**: by predicting the task execution time

Homework



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