



UNIVERSITY OF SCIENCE  
HO CHI MINH CITY

# UI Learnability and Efficiency

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Adapted from materials of

- MIT CS Course 6.813/6.831
- Jakob Nielsen, Usability Engineering, 1994

# Outline

- Usability dimensions overview
- Learnability
  - Human memory
  - Models
  - Learnability principles
- Efficiency
  - Human information processing
  - Pointing efficiency
  - Design principles
- UI Hall of Fame or Shame

# Usability definition

## ■ Usability

- How well users can use the system's functionality

## ■ Dimensions

### □ Learnability

- How easy it is to learn and use?

### □ Efficiency

- How quickly users perform tasks using the UI?

### □ Memorability

- How easy it is for users to reestablish proficiency?

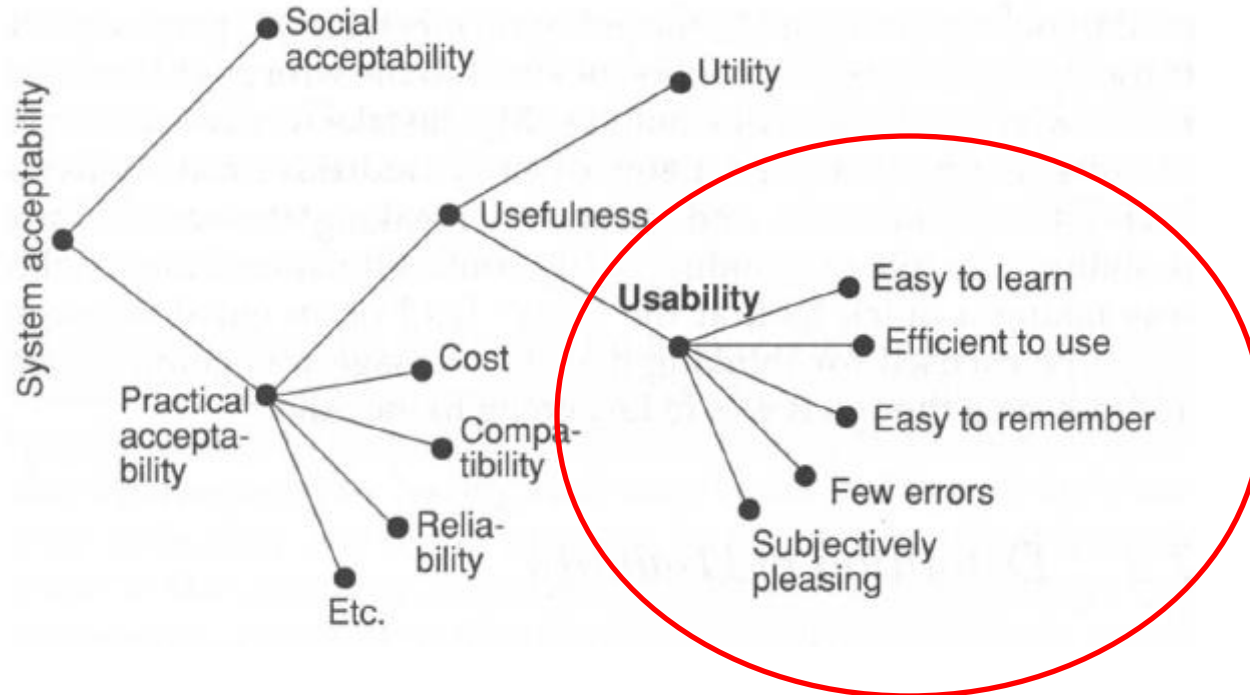
### □ Errors

- Are the errors committed by users often? Is it easy to recover from errors?

### □ Satisfaction

- Are users satisfied with the UI?

# Usability is only one attribute



(Jakob Nielsen, Usability Engineering, 1994)

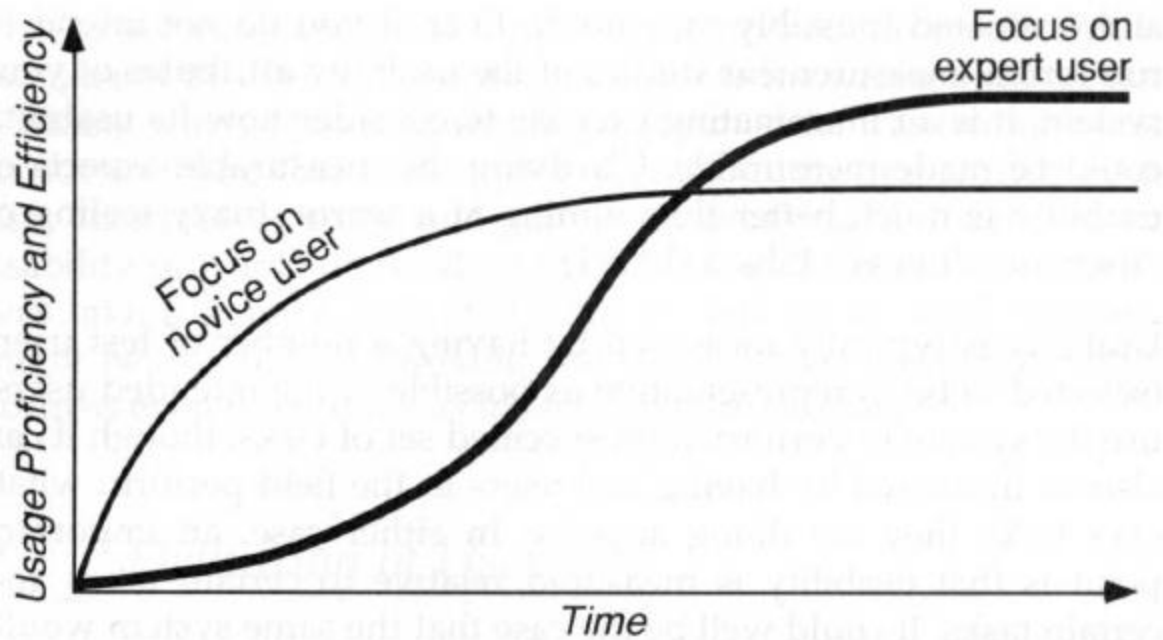


# Learnability

# Outline

- Learning curve
- Human memory
- Models relevant to UI design
- Learnability principles

# Learning curve



(Jakob Nielsen, Usability Engineering, 1994, page 28)

# Mini experiment

- Try to remember items below as many as you can





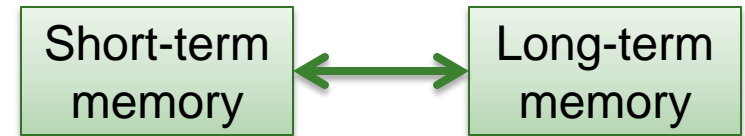
# Mini experiment (cont'd)

- How many items do you remember?
- How could you remember them?
  - familiar?
  - funny?
  - attracting your attention?
  - related?
  - repeating them?

# Memory

- Short-term memory (working memory)

- Small: ~ 7 items or “chunks”
- Short-lived: ~10 seconds
- Repeating helps retain chunks
  - Distraction does the opposite



- Long-term memory

- Unlimited size and duration
- Elaborative rehearsal helps transfer chunks from short-term to long-term memory

- Learning

- A process of transferring and putting information from short-term to long-term memory

# Chunking

- Chunk is a unit of memory or perception
  - Depends on how the information is presented

H A P P Y V A L E T I N E ← Hard to remember all

HAPPY VALENTINE ← Easy remember all

- Depends on what you already know
  - Linking with the past experience

# Recognition and Recall

## ■ Recognition

- ❑ Remembering with the help of a visible cue (evidence – bằng chứng)
- ❑ e.g., you recognize someone when looking at his face or photo

## ■ Recall

- ❑ Remembering with no help
- ❑ e.g., you remember a person when someone refers to him

## ■ It is easier to recognize than recall things

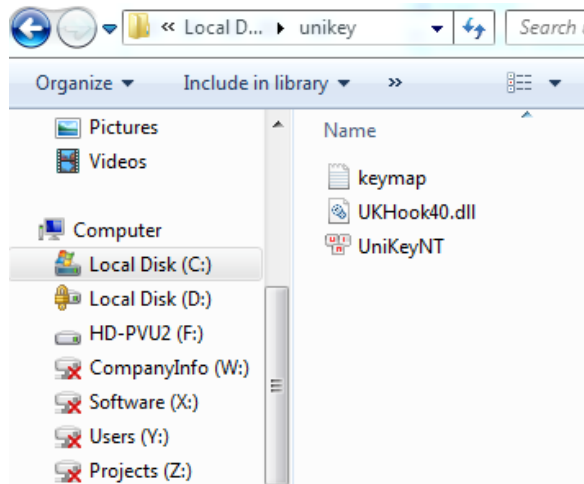
- ❑ You don't remember every items in the File menu of Notepad, do you?
- ❑ But you recognize their functions when you look at them

# Recognition and Recall (cont'd)

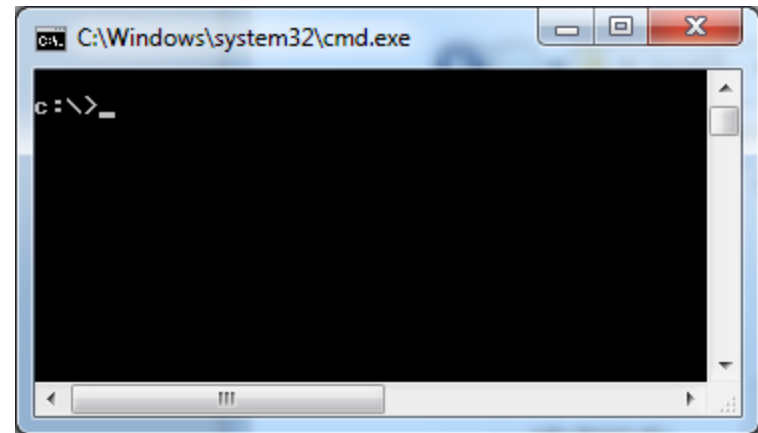
## ■ Implications

- ❑ Performing operations via visual presentation is more learnable than via command line
- ❑ Direct manipulation is more learnable than other styles of interfaces

Delete a file name keymap.txt



Delete a file name keymap.txt

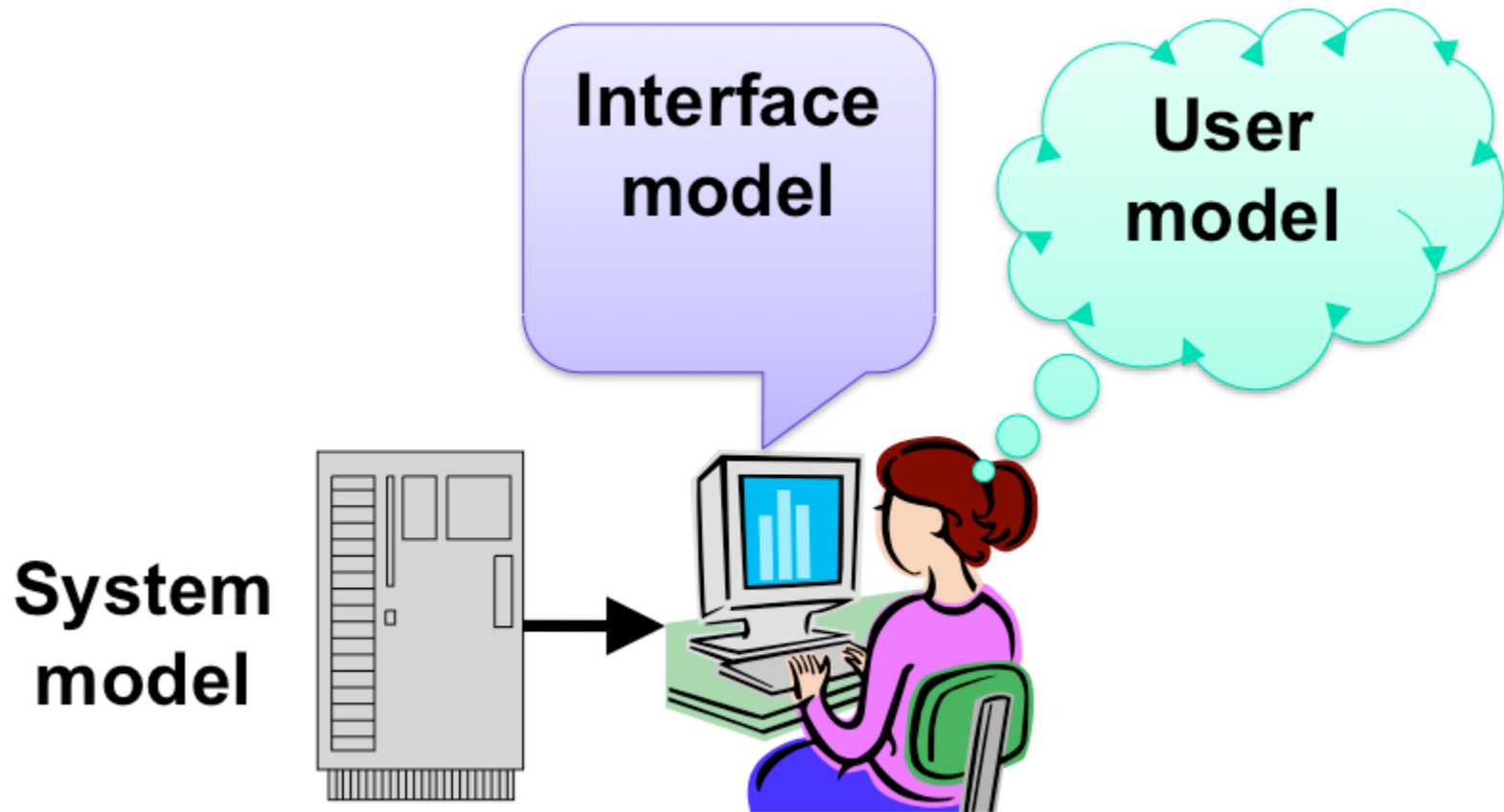


What do you need to remember to do?

# Models

- Model of a system is a presentation of its operations
  - Elements of a system
  - How these elements work together to carry out its operations
- Three kinds of models relevant to UI design
  - System model or implementation model
    - Internal structure and interactions of the system's operations
    - How system works internally
    - Visio's objects vs. Photoshop's images
  - Interface model
    - How system works through its interface
    - Command line vs. Menu
    - Editing Visio's objects vs. editing Photoshop's images
  - User model or mental model or conceptual model
    - How the user thinks the system works

# Models (cont'd)



(Source: MIT CS Course 6.813/6.831)

# Models (cont'd)

- Interface model encapsulates or hide system model
  - It should be simple and appropriated
- Interface model should closely reflect user model
  - Does this beautiful dog do searching?
- User model may be wrong
  - So, errors happen



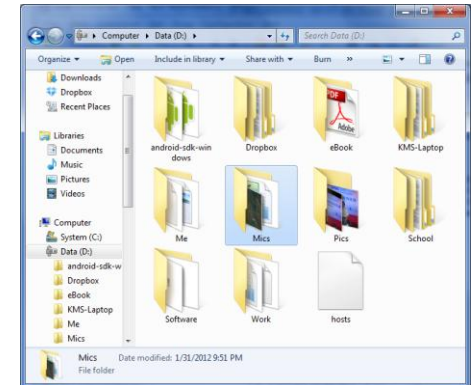


# Learnability Principles

- Ways to communicate and present the system model
  - ❑ Affordances
  - ❑ Natural mapping
  - ❑ Visibility
  - ❑ Feedback
- Consistency
  - ❑ Internal, external, and metaphorical
  - ❑ Speak the user's language
  - ❑ Metaphors
  - ❑ Platform standards

# Affordances

- "Perceived and actual properties of a thing" – *Don Norman*
- "Perceived" may be different from "actual"



# Natural mapping

- Physical arrangement of controls matches arrangement of their operations
- It's best to map directly, but not always have to be
  - Light switches
  - Car's turn signals



# Visibility

- Operations should be visible to users
  - Unix commands are very invisible vs. Windows' menus
  - Right click menus are not very visible
    - A reason why iOS does not support much right-click
  - Drag-drop is not either
    - But it's a direct manipulation style reflecting real world

# Feedback

- Actions should have immediate effects
  - e.g., push buttons, scroll bars, mouse icons
- Feedback types
  - Audio
  - Visual
  - Haptic (giving a feeling, e.g., vibration of a mouse click)

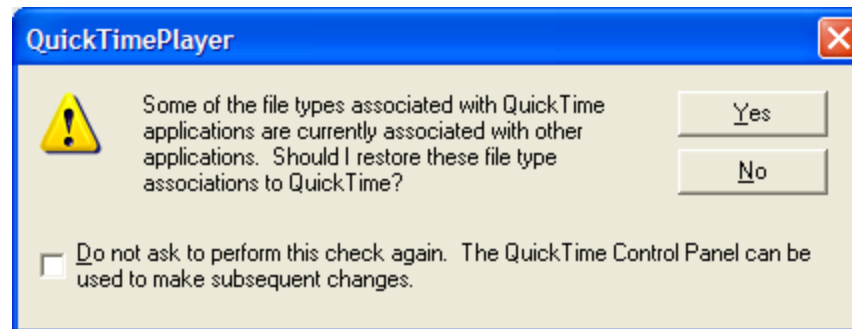
# Consistency

- Similar things should work similarly
- Different things should look different
- Consistency types
  - Internal: within the system
  - External: across different systems
  - Metaphorical: reflecting real-world objects
    - A print icon is a metaphor of the printer



# Concistency (cont'd)

- Speak the user's language
  - Use common words, avoid slangs and jargon
  - But avoid wordy and overly verbose



# Metaphors

- Metaphor is a presentation of real-world in user interface
- Advantages
  - Highly learnable
  - Connect with user's existing model easily
- Problems
  - Hard to design metaphors that are appropriate
  - Potentially deceptive and misleading
  - May not be used consistently everywhere
  - Culturally dependent (localization issue)





# Platform standards

- Follow guidelines of platforms
  - MS Windows user interface guidelines
  - Apple user experience guidelines
- Follow frameworks
  - Various frameworks have their own looks and feels guidelines
- Learn from existing applications

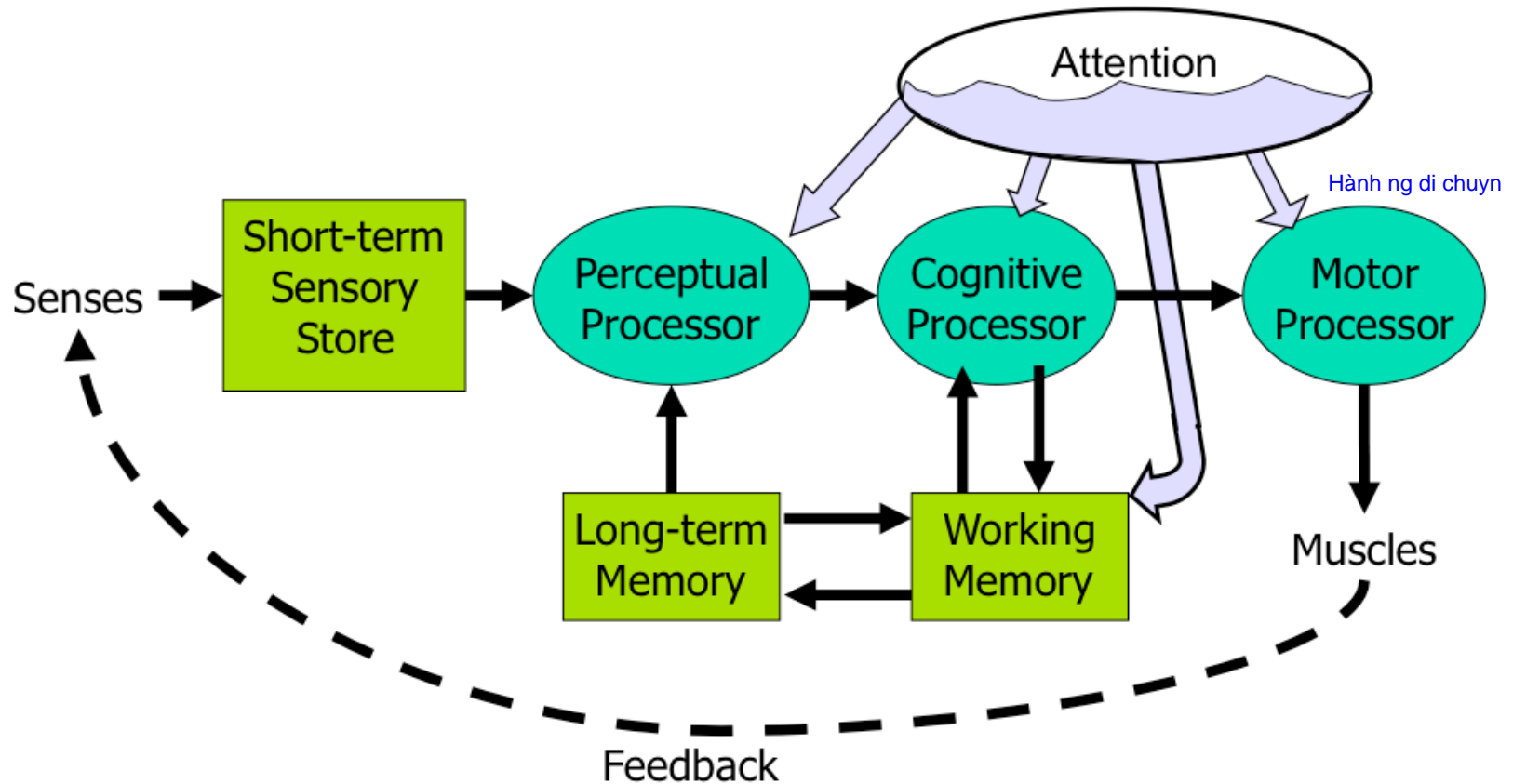


# Efficiency

# Outline

- Human information processing
- Pointing efficiency
- Design principles

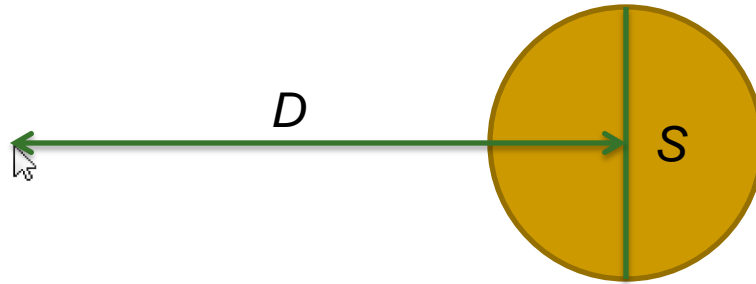
# Human information processing



(Source: MIT CS Course 6.813/6.831)

# Fitts's law

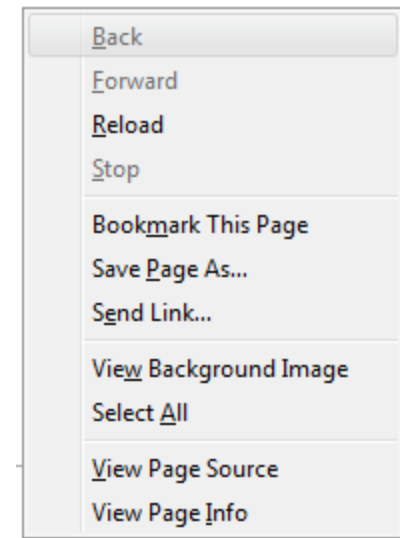
- Time  $T$  to move hand to a target of size  $S$  at distance  $D$  away from the mouse pointer is  
$$T = a + b * \log (D/S + 1)$$



- $a$  and  $b$  are constants S càng lớn thời gian càng nhanh
- $T$  is dependent only on  $\log (D/S + 1)$
- $\log (D/S + 1)$  is defined as *index of difficulty*

# Implications of Fitts's law

- Similar targets should be grouped *Doi tuong tuong dong thi gop lai*
- Targets at screen edge are easy to hit
- Pie menu is faster to use than linear menu
  - It's faster 15-20% according to a study by Callahan, 1994
- Lengthy menus should be avoided



(Callahan et al. 1994, "An empirical comparison of pie vs. linear menus," CHI 1991)

# Power law of practice

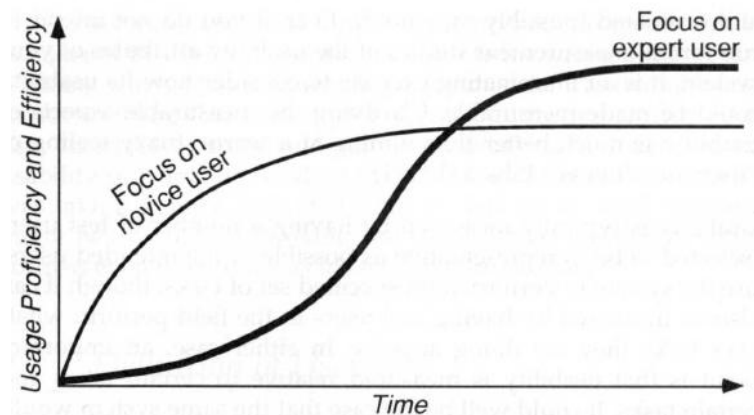
- Time  $T_n$  to do a task the  $n$ th time is

$$T_n = T_1 * n^{-a}$$

$a$  is typically from 0.2 to 0.6

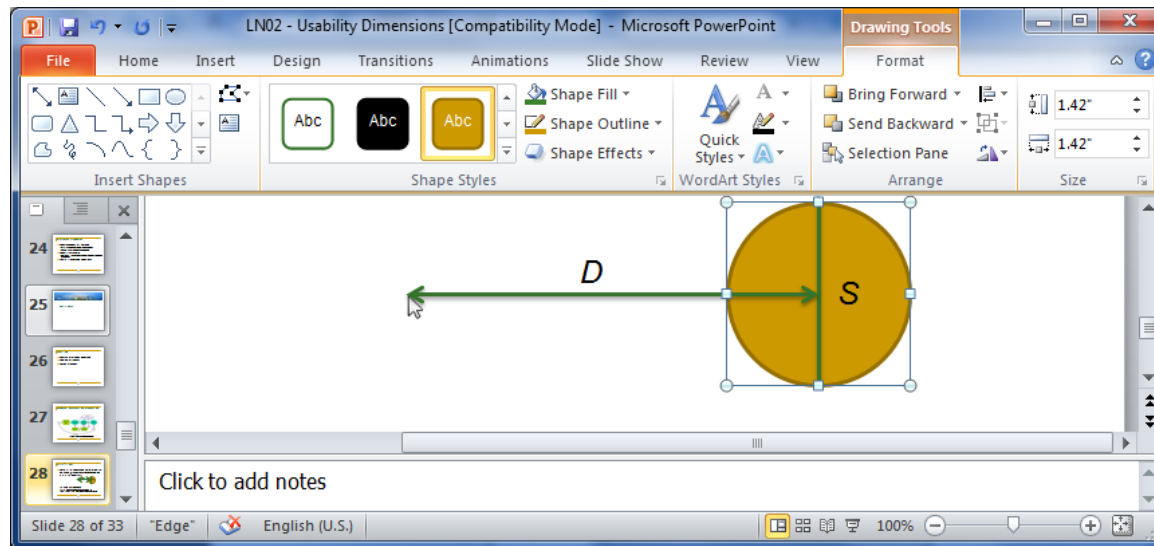
- Implications

- With practice, novices get better
- But their performance becomes nearly flat
- Remember the Nielsen's Learning curve?



# Principles to improve efficiency

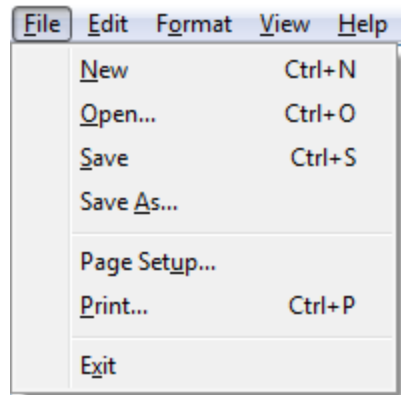
- Make often-used targets big
- Group targets that are used together
  - Grouped toolbar buttons, menu items, etc.
- Place oftenly-used menu items on top of menu
- Use screen corners and edges





# Principles to improve efficiency (cont'd)

- Use keyboard shortcuts and menu accelerators

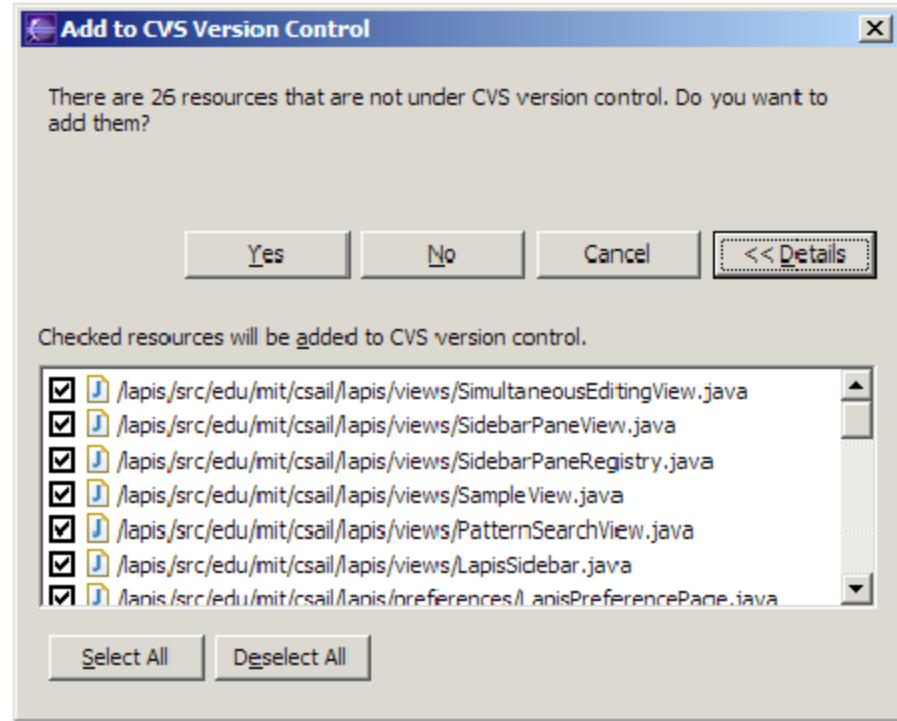


- Predefine a group of styles



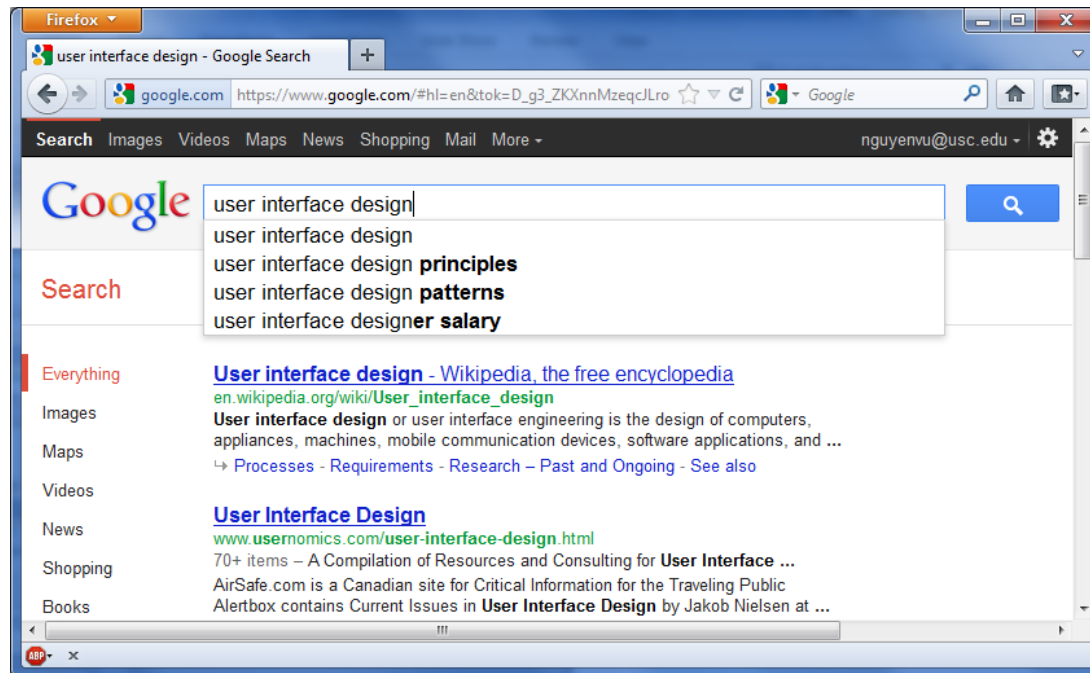
# Principles to improve efficiency (cont'd)

- Aggregating and choose most common selections by default
- Use defaults



# Principles to improve efficiency (cont'd)

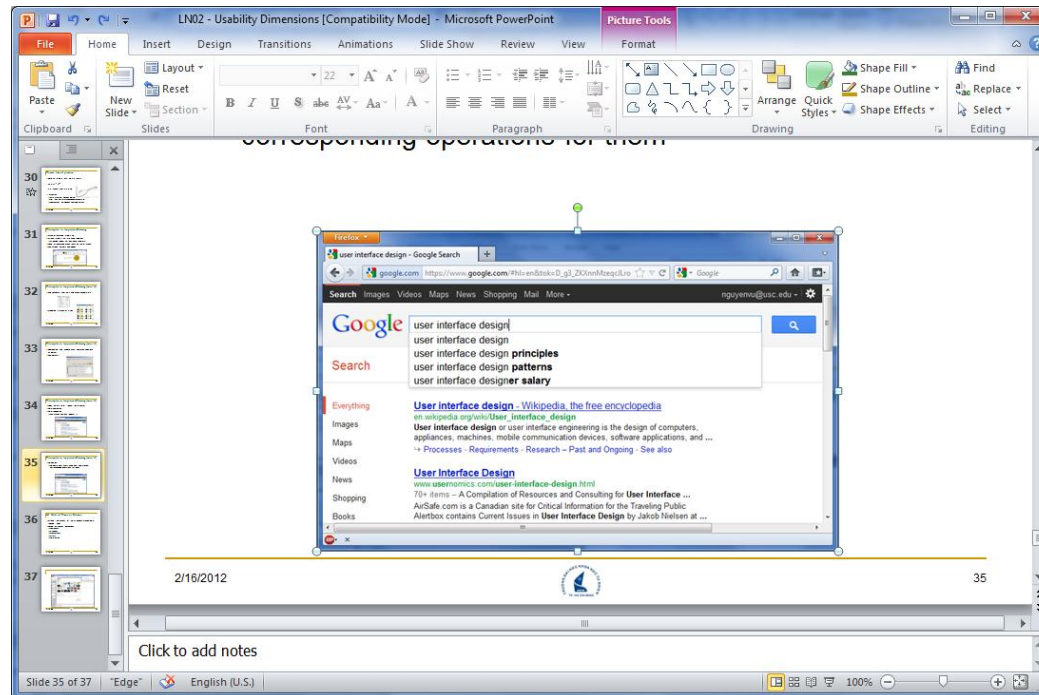
- Keep history (e.g., recent files in Word)
- Auto completion
- Auto suggestion
  - This makes you lazy, doesn't it?



# Principles to improve efficiency (cont'd)

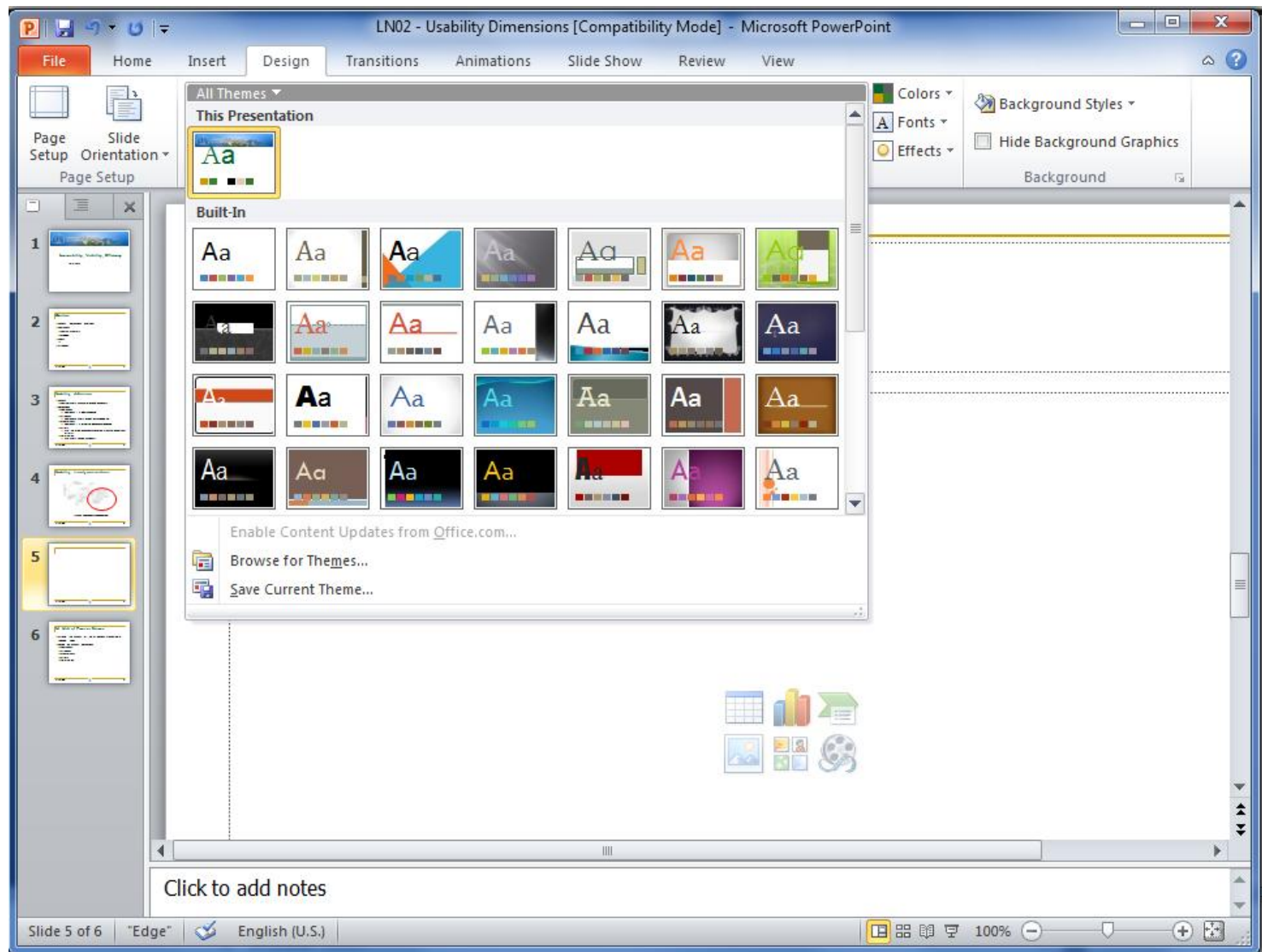
## ■ Anticipation

- ❑ Anticipate what users will do next and present corresponding operations for them

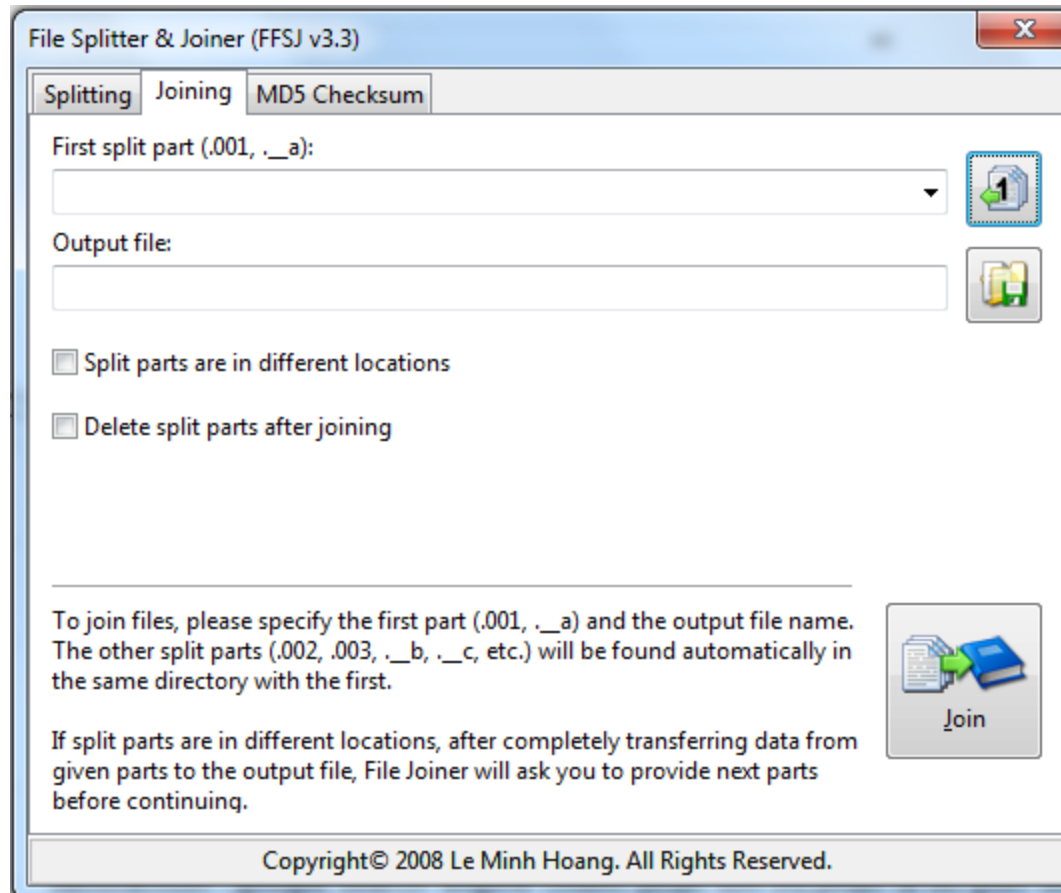


# UI Hall of Fame or Shame

- Critique the usability of the UI designs presented in following slides
- Based on usability dimensions
  - Learnability
  - Efficiency
  - Memorability
  - Errors
  - Satisfaction



# UI Hall of Fame or Shame



Credit: Nguyễn Hữu Đức

# UI Hall of Fame or Shame

- HCMC's bus



Credit: Huỳnh Công Toàn