Universal Concepts/Principles and Methods of Design

Examples from Class Handouts

Overview
(Class Handouts in Parentheses)

- Mental Model – (H12)
- Chunking – (H10)

- Affordance – (H11)

- Mapping – (H35)
- Visibility – (H34)
- Recognition over Recall – (H9)

- Fitts' Law – (H20)
- Hick's Law – (H21)

- Hierarchy of Needs – (H13)
- 80-20 Rule – (H23)

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Mental Model

People understand and interact with systems and environments based on mental representations developed from experience.

Interaction Model for Conventional Brakes

On slick surfaces...
- depress the brake pedal smoothly
- pump brakes to prevent brakes from locking up
- do not steer while braking, except to counter-steer
- noise and vibration are signs that something is wrong

INCORRECT INTERACTION
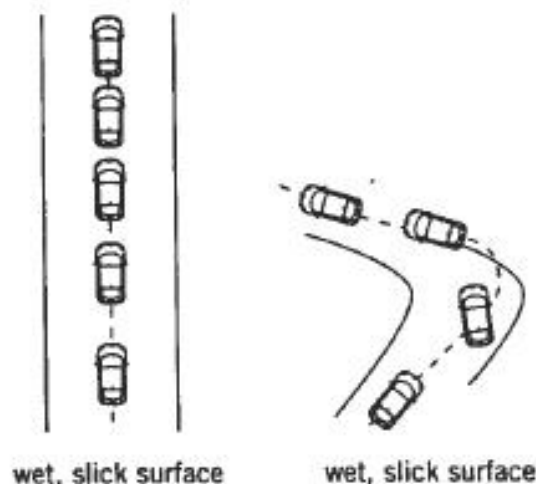### slamming brakes/steering while braking
Car will take a longer time to stop and will not make the turn

wet, slick surface   wet, slick surface
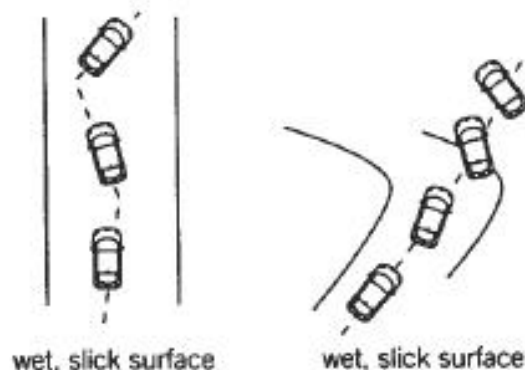
CORRECT INTERACTION
pumping brakes
Car will take a shorter time to stop and may make the turn

wet, slick surface   wet, slick surface
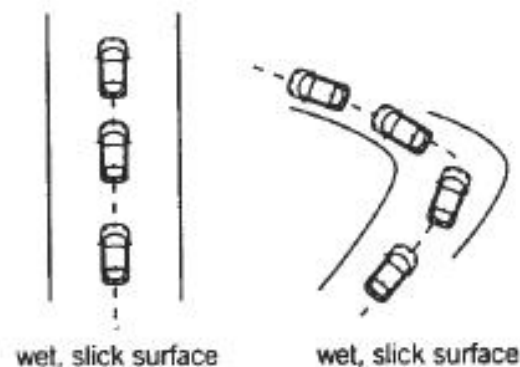
Interaction Model for ABS Brakes

On slick surfaces...
- depress the brake pedal fast and hard
- do not pump brakes
- steer while braking
- noise and vibration are signs that the system is operating properly

CORRECT INTERACTION
slamming brakes/steering while braking
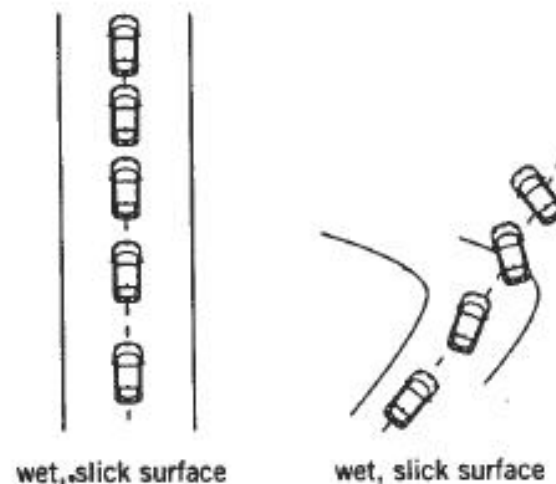Car will properly stop and make the turn

wet, slick surface   wet, slick surface

INCORRECT INTERACTION
pumping brakes
Car will take a longer time to stop and will not make the turn

wet, slick surface   wet, slick surface

Chunking

A technique of combining many units of information into a limited number of units or chunks, so that the information is easier to process and remember.

Chunking

292635732   7045556791

292-63-5732   (704) 555-6791

Large strings of numbers are difficult to recall. Chunking large strings of numbers into multiple, smaller strings can help. Most people can remember their Social Security number and frequently called phone numbers.

List 1	List 2
angry	thrunced
hoarse	rooped
snuggle	croodle
search	poosk
fatigue	quanked
stutter	maffle
scorch	brizzle
warning	gardyloo
teenager	haspenald
anxious	cark

Familiar words are easier to remember and chunk together than unfamiliar words. Of the two lists, list 1 is easier to recall.
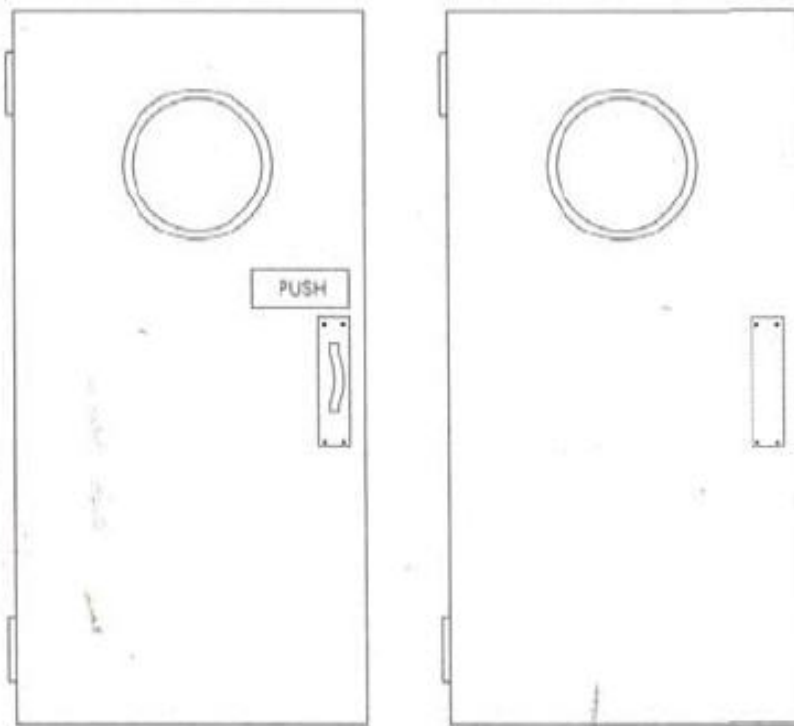
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Affordance

A property in which the physical characteristics of an object or environment influence its function.

Affordance

Door affordances frequently conflict, as shown in the door on the left. The "push" affordance of the door is knowable only because of the sign, which conflicts with the powerful "pull" affordance of the handle. By replacing the handle with a flat plate, the conflict is eliminated and the sign is superfluous.

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Mapping

A relationship between controls and their movements or effects. Good mapping between controls and their effects results in greater ease of use.[1]

Mapping
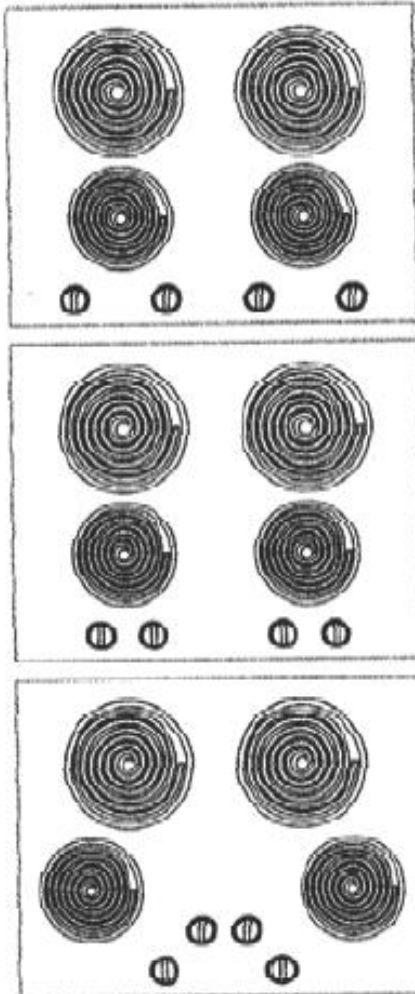
The relationship between stovetop controls and burners is ambiguous when the controls are horizontally oriented and equally spaced (poor mapping). The relationship becomes clearer when the controls are grouped with the burners, but the horizontal orientation still confuses which control goes with which burner (poor, but improved mapping). When the layout of the controls corresponds to the layout of the burners, the control-burner relationships are clear (good mapping).

Visibility

The usability of a system is improved when its status and methods of use are clearly visible.

Visibility

Three Mile Island Unit 2
Harrisburg, Pennsylvania
March 28, 1979, 4:00 A.M.

Visibility of complex systems is essential for problem solving—especially in times of stress. An analysis of key events of the TMI accident reveals a number of blind spots in the system that made understanding and solving the problems exceedingly difficult.

To further complicate matters, alarms were blaring, lights were flashing, and critical system feedback was routed to a printer that could only print 15 lines a minute—status information was more than an hour behind for much of the crisis.

Secondary Loop

Primary Loop

Control Room
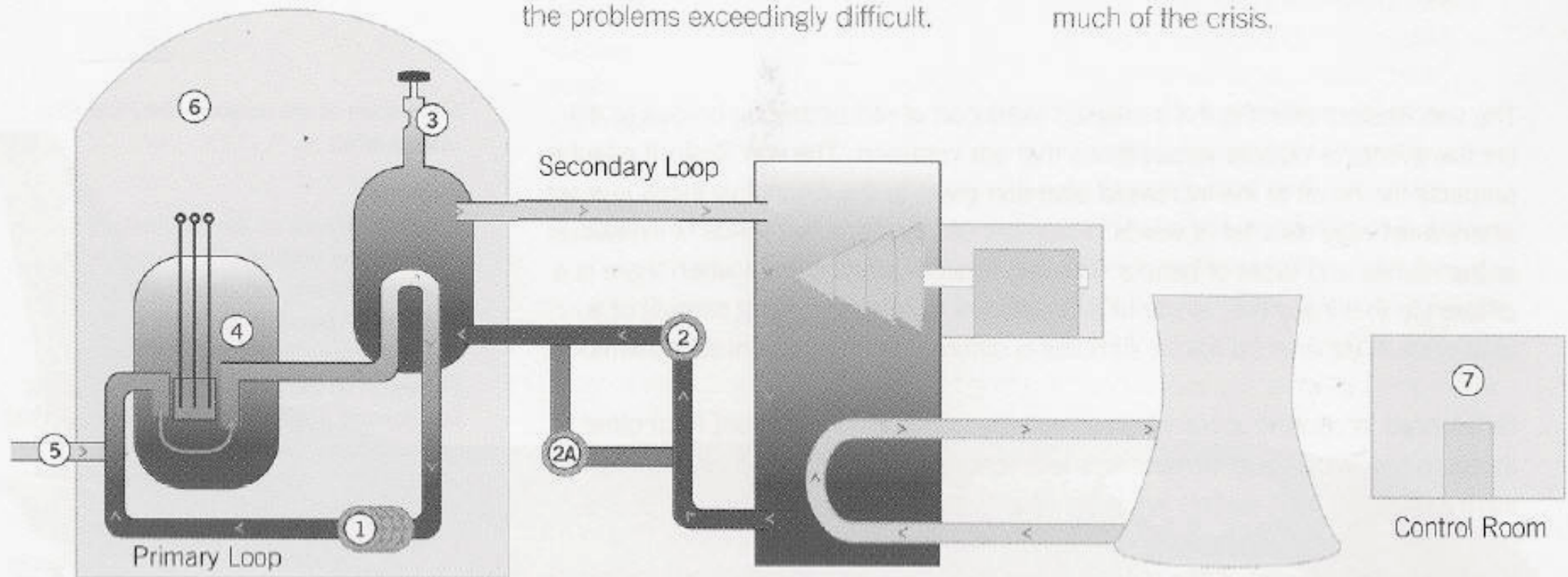
Recognition Over Recall

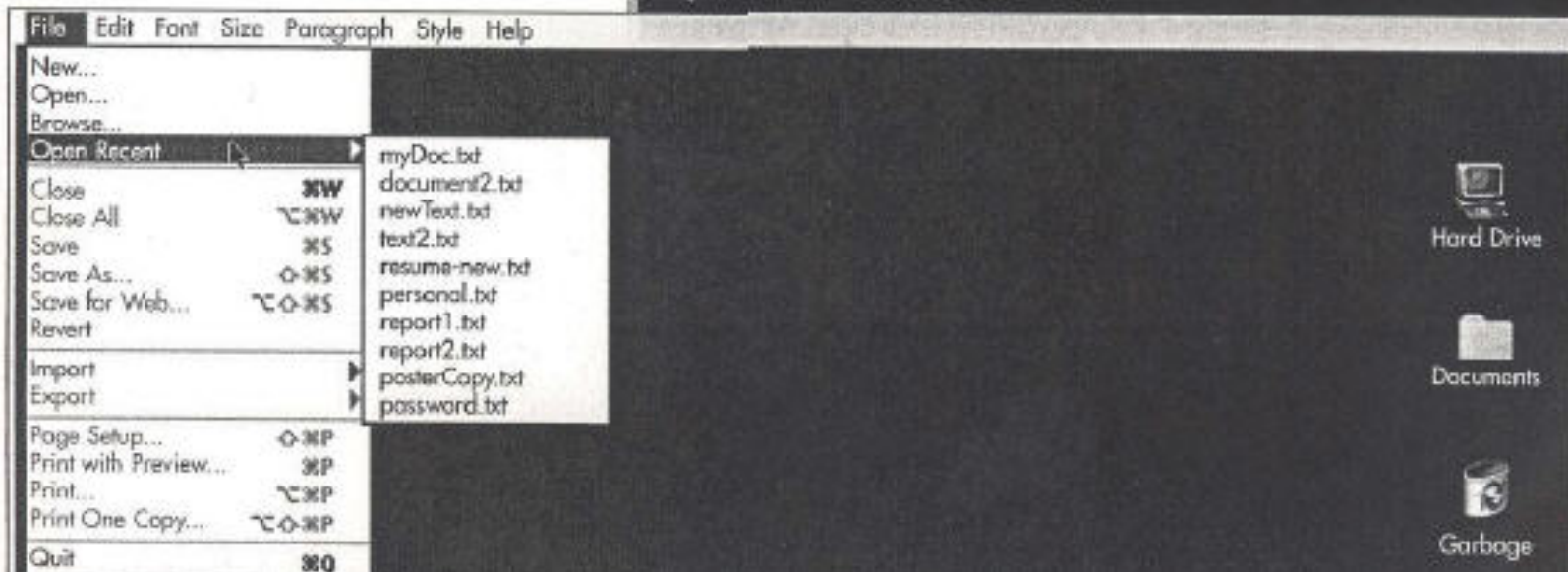Memory for recognizing things is better than memory for recalling things.

Early computers used command-line interfaces, which required recall memory for hundreds of commands. Graphical user interfaces eliminated the need to recall the commands by presenting them in menus. This innovation leveraged the human capacity for recognition over recall, and dramatically simplified the usability of computers.

```
[4:00am tmi2] pwd
/usr/group/juser/xxx1
[4:00am tmi2] ls -la
total 5
drwxr-x---  2 juser           540 Mar 28 03:45 .
drwxr-x--- 20 juser          4423 Mar 28 03:46 ..
[4:01am tmi2] cp ~juser/test.txt  .
[4:02am tmi2] cp ~juser/test/txt  text2.txt
[4:03am tmi2] ls -la
total 7
drwxr-x---  2 juser           512 Mar 28 03:45 .
drwxr-x--- 20 juser          3584 Mar 28 03:46 ..
-rw-r-----  1 juser          1522 Mar 28 04:03 test1.txt
-rw-r-----  1 juser          1522 Mar 28 04:02 test2.txt
[4:03am tmi2] pwd
/usr/group/juser/xxx1
[4:03am tmi2] cd..
[4:03am tmi2] pwd
/usr/group/juser
[4:04am tmi2] cp text.dat  ~juser/xxx1/test.dat
[4:05am tmi2] cp text.dat  ~juser/xxx1/testnew.dat
[4:06am tmi2] cd..
[4:07am tmi2] ls -la
```

| File | Edit | Font | Size | Paragraph | Style | Help |

New...
Open...
Browse...
Open Recent ▶
Close   ⌘W
Close All   ⌥⌘W
Save   ⌘S
Save As...   ⇧⌘S
Save for Web... ⌥⇧⌘S
Revert
Import   ▶
Export   ▶
Page Setup...   ⇧⌘P
Print with Preview... ⌘P
Print...   ⌥⌘P
Print One Copy... ⌥⇧⌘P
Quit   ⌘Q

myDoc.txt
document2.txt
newText.txt
text2.txt
resume-new.txt
personal.txt
report1.txt
report2.txt
posterCopy.txt
password.txt

:52 .
:46 ..
:04 test.dat
:03 test1.txt
:02 test2.txt
:05 testnew.dat
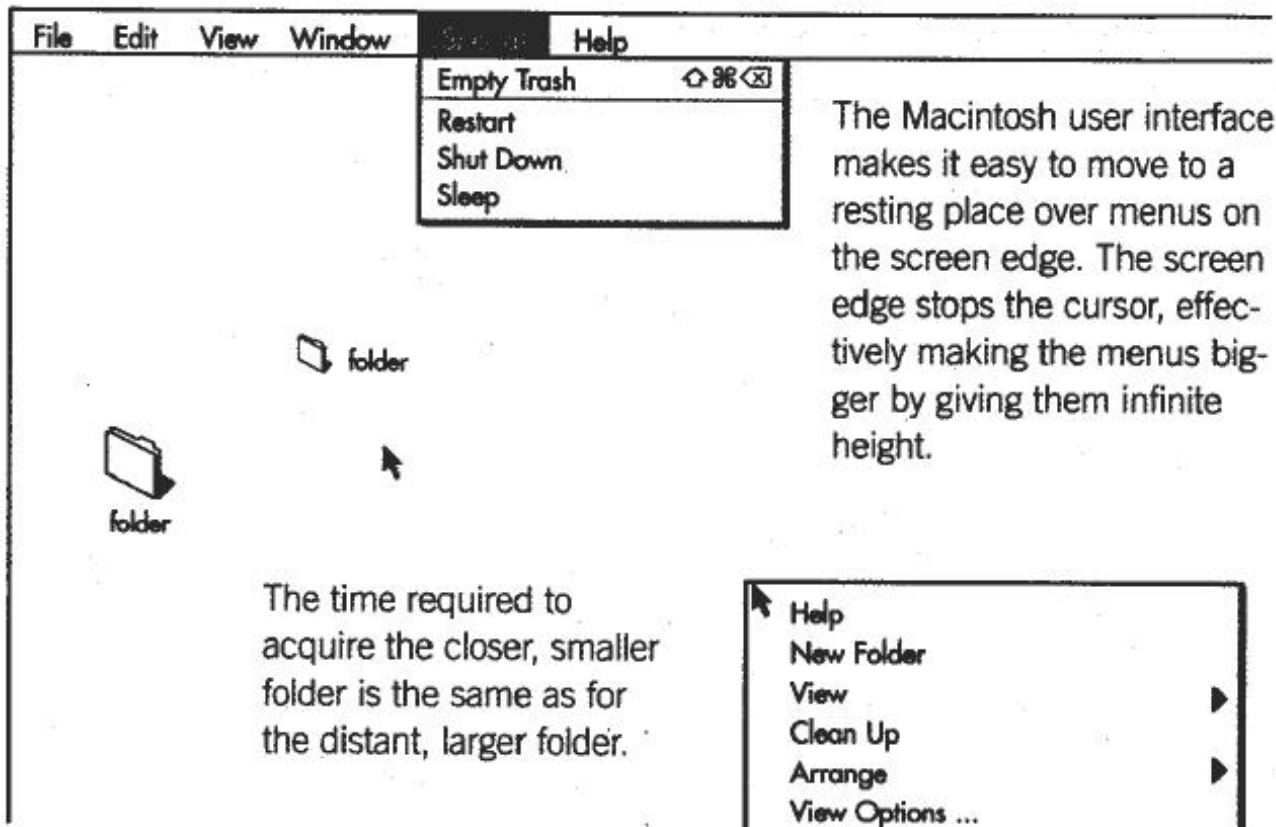
Hard Drive

Documents

Garbage

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Fitts' Law

The time required to move to a target is a function of the target size and distance to the target.

Fitts' Law

File　Edit　View　Window　~~Special~~　Help

Empty Trash	⇧⌘⌫
Restart	
Shut Down	
Sleep	

The Macintosh user interface makes it easy to move to a resting place over menus on the screen edge. The screen edge stops the cursor, effectively making the menus bigger by giving them infinite height.

📁 folder

📁 folder

The time required to acquire the closer, smaller folder is the same as for the distant, larger folder.

Help	
New Folder	
View	▶
Clean Up	
Arrange	▶
View Options ...	

The Microsoft Windows user interface presents pop-up menus when you press the right mouse button. Since the distance between the cursor position and the pop-up menu is minimal, menu items are quickly acquired.

Hick's Law

The time it takes to make a decision increases as the number of alternatives increases.[1]

Hick's Law
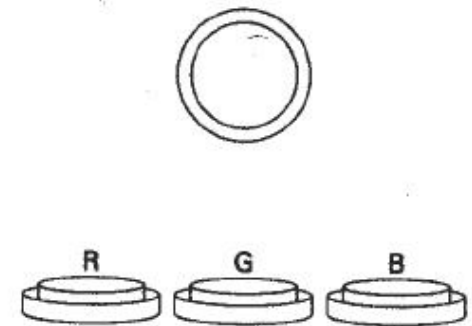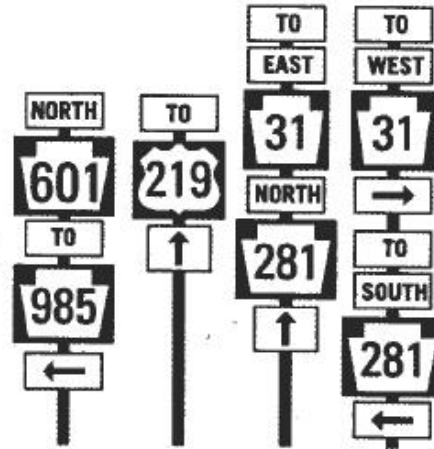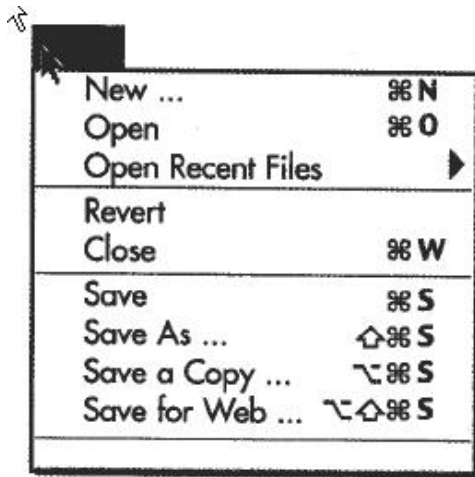
Menus
The time for a person to select an item from a simple software menu increases with the number of items. However, this may not be the case for more complex menus involving a lot of text or submenus.

Road Signs
As long as road signs are not too dense or complex, the time for a driver to make a turn based on a particular road sign increases with the total number of road signs.

Simple Tasks
The time for a person to press the correct button (R, G, or B) depending on the color of the light (red, green, or blue) increases with the number of possible colors.

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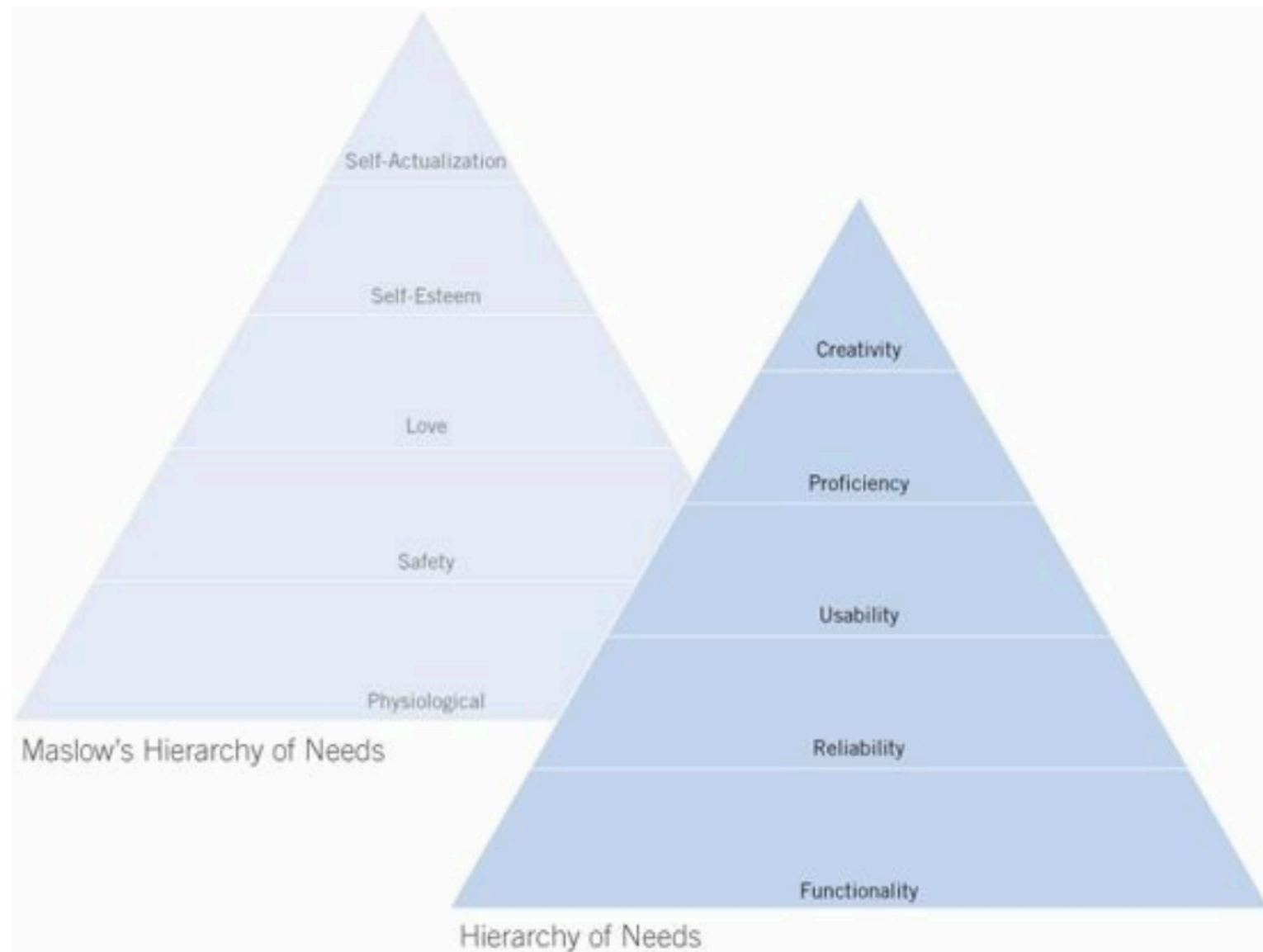- Brainstorming – (H27)
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Hierarchy of Needs

In order for a design to be successful, it must meet people's basic needs before it can attempt to satisfy higher-level needs.[1]

[1] The *hierarchy of needs* is based on *Maslow's Hierarchy of Needs*.

[2] The seminal work on the concept of a hierarchy of needs is *Motivation and Personality* by Abraham Maslow, Addison-Wesley, 1987 [1954].

Self-Actualization

Self-Esteem

Love

Safety

Physiological

Maslow's Hierarchy of Needs

Creativity

Proficiency

Usability

Reliability

Functionality

Hierarchy of Needs

The hierarchy of needs specifies that a design must address lower-level needs before higher-level needs can be addressed. The perceived value of a design corresponds to its place in the hierarchy—i.e., higher levels in the hierarchy correspond to higher levels of perceived value. The levels of hierarchy are adapted from Maslow's Hierarchy of Needs.

80/20 Rule

A high percentage of effects in any large system are caused by a low percentage of variables.[1]

80-20 Rule
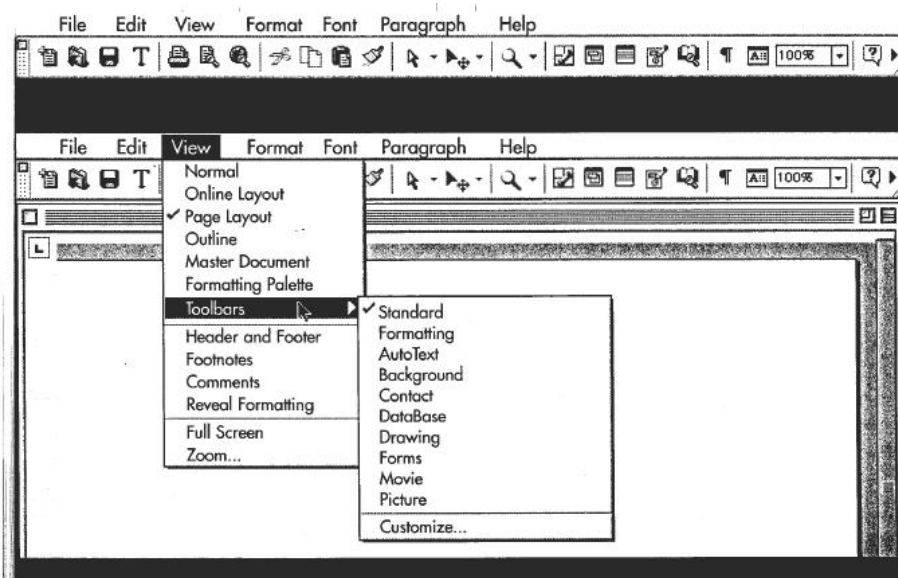
Graphical user interfaces conceal most of their functions in drop-down menus (bottom image). This reduces the complexity of the display, but also makes frequently used functions more difficult to access. Identifying the critical 20 percent of the functions and making them readily available in toolbars solves the problem (top image).

80 percent of a product's usage involves *20* percent of its features.

80 percent of a town's traffic is on *20* percent of its roads.

80 percent of a company's revenue comes from *20* percent of its products.

80 percent of innovation comes from *20* percent of the people.

80 percent of progress comes from *20* percent of the effort.

80 percent of errors are caused by *20* percent of the components.

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01 A/B Testing

Design Phase: ① ② ③ ④ **⑤**

Use A/B testing to compare two versions of the same design to see which one performs statistically better against a predetermined goal.[1]

80 Stakeholder Maps

Design Phase: **①** ② ③ ④ ⑤

Stakeholder maps help to visually consolidate and communicate the key constituents of a design project, setting the stage for user-centered research and design development.

08 Brainstorm Graphic Organizers

Design Phase: **1** **2** **3** 4 5

Beyond creating lists of new ideas and concepts, brainstorm graphic organizers help in the creation of new knowledge by visually structuring a deep dive into a problem space.

Brainstorming has traditionally been used to spur group creativity with the intention of generating concepts and ideas regarding a specific challenge. "Go for quantity over quality," "withhold judgment and criticism," "build on each other's ideas," and "welcome oddity" are a few of the widely accepted rules of brainstorming.[1] The intention of these guidelines is to create a safe forum for the expression and free association of creative ideas, and quell any inhibitions of the participants by providing a judgment-free zone to explore new concepts.

CS-185 Course page has links to Study Guide and Possible Exam Questions

-John