

CMPT 363: User Interface Design

Summer 2021

Week 8: Cognition & Graphical Screen Design

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Recap from Last Lecture

- Design of Everyday Things
 - Fundamental Principles of Interaction, Action Cycle, Gulfs of Execution & Evaluation
- How people learn new things
 - Mental models, metaphors
- Direct manipulation
 - Definition, benefits & limitations
- General design strategies

Today

- Cognition
 - What it is and its importance in interface design
 - Ways to describe them
 - by state of mind
 - by context
 - by kinds of process

Group Project Part 2

- Available on Canvas (<https://canvas.sfu.ca/courses/63144/assignments/653606>)
 - Repeat Component 2 of Part 1 (i.e., context & user identification, functional & non-functional requirements)
 - Use instructor's/TAs' feedback to improve (if applicable)
 - Component 1: 3 LFPs and their descriptions
 - Component 2: 2 MFPs and their descriptions
 - Lesson learned
- Due on **July 16, 11:59p**
- Get Balsamiq for Desktop (use the license key provided in Canvas > Announcement)
- Get Figma for education (<https://www.figma.com/education/>)

Feedback on Group Project Part I

- Overview of task: to design the interface for an online calendar that facilitates different kinds of activities for university students
- User identifications should focus on university students (instructors & TAs are good to have but not the focus)
- Over complicating context & user identifications
 - Context shouldn't take more than 1-2 paragraphs, each persona should only take 1-2 short paragraphs
 - Appendix is for additional screenshots only and should not be exploited by including other essential content
- Each requirement should be 1-2 sentences long and can be presented in point form

About Next Lecture

- Review + Discussion + Group-Instructor Meetings
- Will set up ~8-10 min per group (over Canvas Agenda/Calendar feature)
 - Pick one “presenter” to show some of your findings in Group Project Part 1, or if there’s any questions for Part 2
 - Have someone take notes on discussion
- At least half of the team should be there (those who are absent need to provide reason). Failure to attend will result in 10% off your marks for Part 2
- More details shortly this week! Stay tuned to the Announcement!

Cognition

The process by which knowledge & understanding is developed in the mind
– Oxford Learner's Dictionaries

Why Cognition?

- The study of human cognition can help us understand...
 - How multitasking impacts human behaviour
 - Human's abilities & limitations
- So we can design technologies/interfaces that...
 - Support multitasking
 - Support people's mental process such as attention, perception, and memory
 - Extend human capabilities & compensate for weaknesses



Different Modes of Cognition

- Thinking, remembering, learning, day-dreaming, decision-making, reading, writing, talking, reasoning ...etc.
- Two main kinds* according to Norman (1993)
 - **Experiential cognition** – state of mind where we perceive & react to the events around us efficiently & effectively
 - E.g., driving a car, reading a book, having a conversation, and watching video
 - **Reflective cognition** – state of mind where we compare and contrast, and make decisions
 - E.g., designing, learning, writing reports

*do not capture all thought processes, not completely independent or mutually exclusive

Experiential Cognition

- Requires reaching a certain level of expertise and engagement (becomes natural & intuitive)
- Can be practiced by experiencing this mode of cognition
- Instinctive, reflexive, and effortless, has no sense of voluntary control



Reflective Cognition

- Requires mental effort & attention
- Can be aided by systematic procedures & methods, learned primarily by being taught
- Leads to new ideas, novel responses, and creativity



Other Ways to Describe Cognition

- In terms of context in which the cognition takes place, tools employed, artifacts & interfaces used, and people involved
- In terms of specific kinds of process (Eysenck & Brysbaert, 2018)
 - Attention
 - Perception
 - Memory
 - Learning
 - Reading, speaking, & listening
 - Problem-solving, planning, reasoning, & decision-making

Attention

- A process of selecting things on which to concentrate, at a point in time, from the mass of stimuli around us
- How easy it is depends on
 - Whether the user has a clear **goal** in mind (e.g., do a left turn when driving, find the submit button)
 - Whether the information the user need is **salient** in the environment



Attention – Visual & Audio

- Typical interfaces involve capturing user's visual and/or audio senses (e.g., animated icons, distinctive sounds)
 - Multi-tasking requires the user to switch their attention between the tasks (we are good at focusing on one at a time)



<https://www.youtube.com/watch?v=vjG698U2Mvo>



<https://www.youtube.com/watch?v=iO3jTI0VWuS4>

Attention – Clear Goals

- Knowing what to look for guides the user to focus on relevant things
 - E.g., look for a blue tent versus look for a red sports car



Attention – Saliency

- A quality of how information is displayed for setting something apart from the others
 - E.g., find the price of a double room at the Holiday Inn in Bradley (left) & at Quality Inn in Columbia (right)

Pennsylvania
Bedford Motel/Hotel: Crinaline Courts
(814) 623-9511 S: \$118 D: \$120
Bedford Motel/Hotel: Holiday Inn
(814) 623-9006 S: \$129 D: \$136
Bedford Motel/Hotel: Midway
(814) 623-8107 S: \$121 D: \$126
Bedford Motel/Hotel: Penn Manor
(814) 623-8177 S: \$119 D: \$125
Bedford Motel/Hotel: Quality Inn
(814) 623-5189 S: \$123 D: \$128
Bedford Motel/Hotel: Terrace
(814) 623-5111 S: \$122 D: \$124
Bradley Motel/Hotel: De Soto
(814) 362-3567 S: \$120 D: \$124
Bradley Motel/Hotel: Holiday House
(814) 362-4511 S: \$122 D: \$125
Bradley Motel/Hotel: Holiday Inn
(814) 362-4501 S: \$132 D: \$140
Breezewood Motel/Hotel: Best Western Plaza
(814) 735-4352 S: \$120 D: \$127
Breezewood Motel/Hotel: Motel 70
(814) 735-4385 S: \$116 D: \$118

South Carolina

City	Motel/Hotel	Area code	Phone	Rates	
				Single	Double
Charleston	Best Western	803	747-0961	\$126	\$130
Charleston	Days Inn	803	881-1000	\$118	\$124
Charleston	Holiday Inn N	803	744-1621	\$136	\$146
Charleston	Holiday Inn SW	803	556-7100	\$133	\$147
Charleston	Howard Johnsons	803	524-4148	\$131	\$136
Charleston	Ramada Inn	803	774-8281	\$133	\$140
Charleston	Sheraton Inn	803	744-2401	\$134	\$142
Columbia	Best Western	803	796-9400	\$129	\$134
Columbia	Carolina Inn	803	799-8200	\$142	\$148
Columbia	Days Inn	803	736-0000	\$123	\$127
Columbia	Holiday Inn NW	803	794-9440	\$132	\$139
Columbia	Howard Johnsons	803	772-7200	\$125	\$127
Columbia	Quality Inn	803	772-0270	\$134	\$141
Columbia	Ramada Inn	803	796-2700	\$136	\$144
Columbia	Vagabond Inn	803	796-6240	\$127	\$130

Attention – Saliience (Cont'd)

- Tullis (1997) found that the interface on the left took an average of 5.5 seconds to find the information, where as the interface on the right took only an average of 3.2 seconds
- Main reason is the presence of spacing/grouping
 - **Exercise:** recall the “visual design principles” in the previous lectures and describe how they are applied in the previous example

Attention – Saliency (Cont'd)

- Saliency allows **preattentive** (i.e., prior to conscious attention) awareness of a certain element(s)
 - Can be done quickly, effortlessly, and in parallel
 - Elements that “pop out” so they are noticeable at a glance
 - Particularly important for time-critical interfaces where attention needs to be quickly drawn
- Ways to design saliency (**visual variables**) (Bertin, 1967)
 - Position, size, shape, value, orientation, hue(colour), texture

5min+5min Break

- Watch the following videos about optical & audio illusion
 - Share what you find the most interesting. Have you seen those in UI designs?

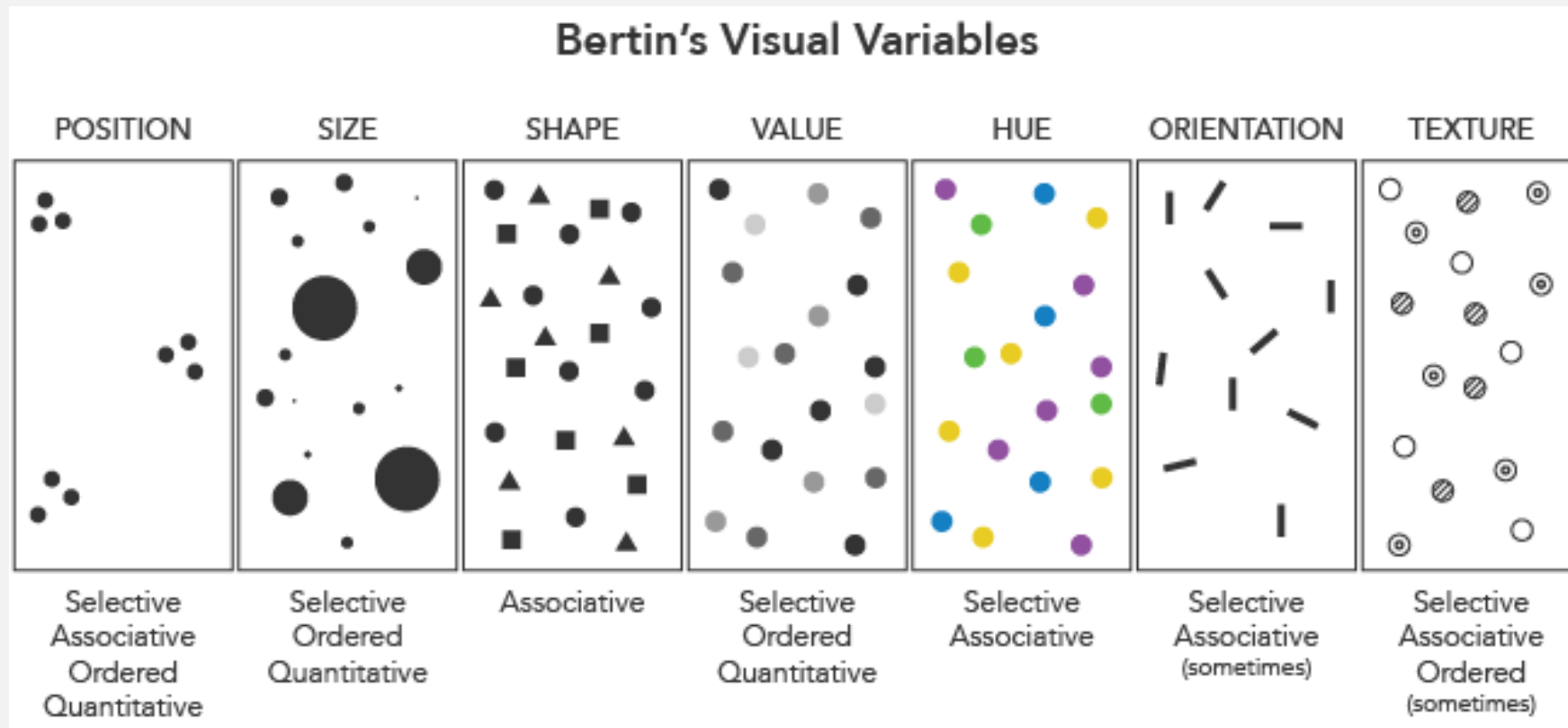


<https://www.youtube.com/watch?v=ZflIMBxylak>



<https://www.youtube.com/watch?v=kzo45hVXRWU>

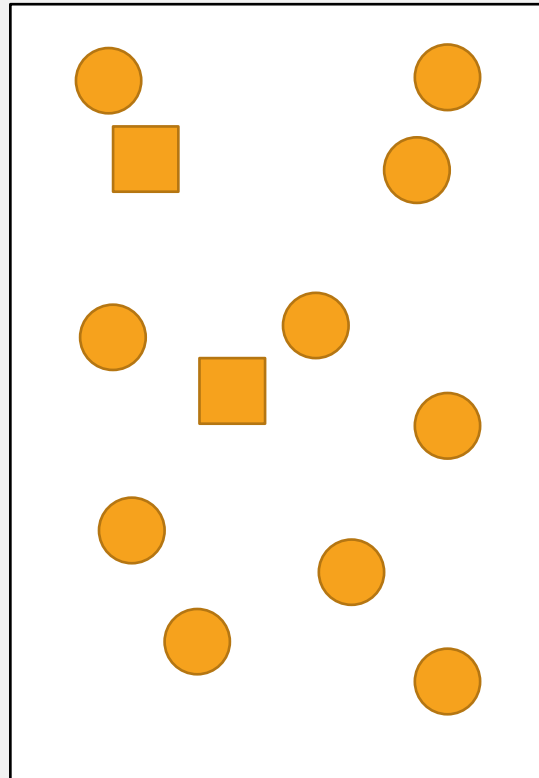
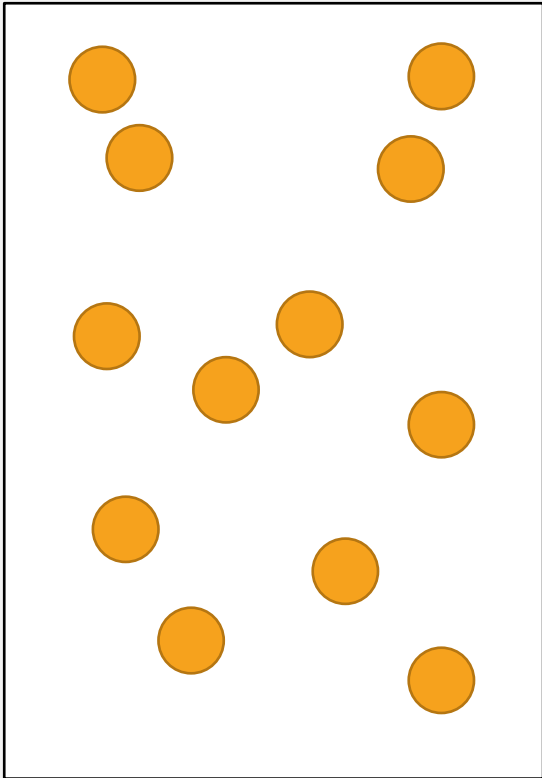
Visual Variables



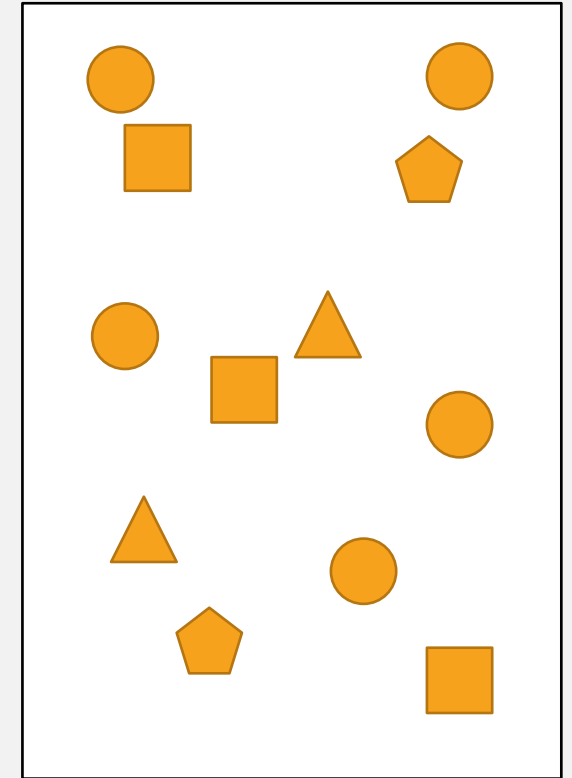
Visual Variables (Cont'd)

- Different characteristics of visual variables
 - **Selective** – how easily a change in this variable makes the element being selected from the others
 - **Associative** – how easily elements with similar values in this variable be grouped across changes in other variables
 - **Quantitative** – whether the difference between two elements in this variable can be interpreted numerically
 - **Order** – whether this variable support comparison between elements
 - **Length** – how many values this variable can have to remain distinguishable from each other
- Visual Saliency is mostly concerned with the “selective” characteristic – how easily an element “pops out”

Selective Visual Variables



Selection
becomes
harder when
there are
more shapes



Design Implications for Attention

- Understand that the attention of a user is limited, and how their attention can be drawn towards/away from
- Structure information to capture user's attention at the right amount & time using visual design & visual variables
- Be selective in providing salient features, reducing clutter/noise

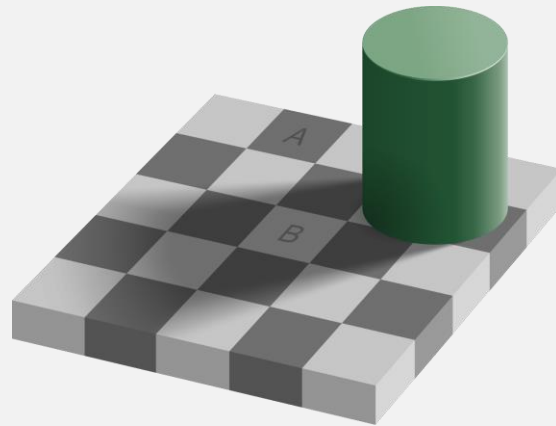


Perception

- Refers to how information is acquired from the environment via our senses and transformed into experiences
- We sense our surrounds via
 - **Sight** – visual stimuli on our eyes
 - **Sound** – audio stimuli on our ears
 - **Touch** – tactile stimuli on our skin
 - **Smell** – olfactory stimuli on our nose
 - **Taste** – gustatory stimuli on our tongue
 - **Kinesthesia** – the awareness of the position and movement of the parts of the body through internal sensory organs

Sensation VS Perception

- Closely related but two separate processes
- **Sensation** – the process by which sensory receptors gather information and send it to the brain
- **Perception** – the process by which the brain makes sense of these sensations



Poll – Which square (A or B) has a darker shade?

More on Perception

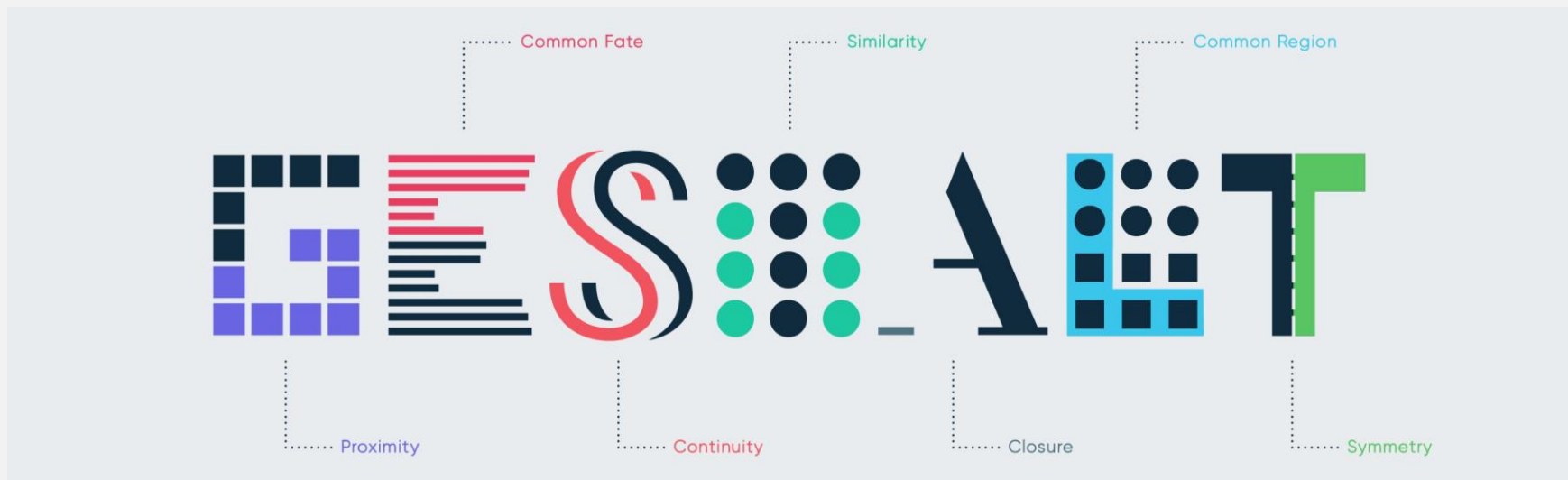
- Not very reliable, affected by many things such as surrounds, physical & mental conditions
 - Example 1: Optical illusions make judgements of length, colour, shape, distance, ...etc. difficult
 - Example 2: Different tunes/pitches are relative (unless you have absolute pitch)
 - Example 3: Food tastes sweeter after you taste something bitter
 - Example 4: Simultaneous senses conflict with each other

McGurk Effect <https://www.youtube.com/watch?v=G-IN8vWm3m0>

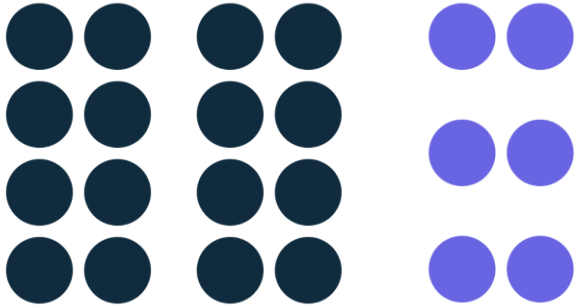


Revisiting Gestalt Principles

- A group of visual perception principles developed by German psychologists in 1920, building on the theory that “an organized whole, is perceived as great than the sum of its parts”



<https://medium.muz.li/gestalt-principles-in-ui-design-6b75a41e9965>

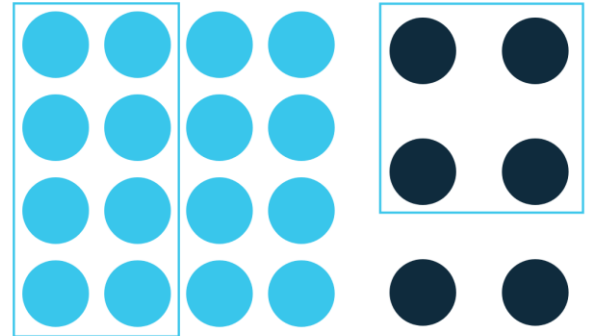


Proximity

Elements that are closer together are perceived as more related.
In UI design, put related items close to each other and unrelated ones further apart.

Common Region

Elements within the same region, especially with visual boundaries, are perceived as more related.
In UI design, dedicate areas to contain items as groups.



Similarity

Elements sharing similar visual characteristics are perceived as more related.
In UI design, use selective visual variables to indicate similarity and anomaly.



Closure

Elements that are often perceived to be a single recognizable form, even when incomplete (i.e., mentally “fill in the blanks”).

In UI design, use closure to minimize visual noise. Particularly useful for icons/logos.

Symmetry

Elements that are symmetric on their own or in arrangement give a sense of balance and completeness. Human also tend to look for them.

In UI design, arrange elements in a symmetric manner to speed up searches.



Continuation

Elements arranged in a line or a soft curve are perceived to be more related.

In UI design, arrange elements in a smooth/linear trajectory to guide viewing direction.

Common Fate

Elements moving/showing a common direction are perceived to be more related.

In UI design, use synchronized movements to indicate relatedness.



Design Implications for Perception

- Help users to **distinguish meanings and structures** using effective graphical representations in GUIs
- Use borders & spaces to effectively provide the **sense of grouping**
- Use audible & distinctive audio cues when possible to **enhance understanding**
- Careful use of visual variables to **improve perceptibility** and **reduce chances of inaccuracy/ambiguity**

Memory

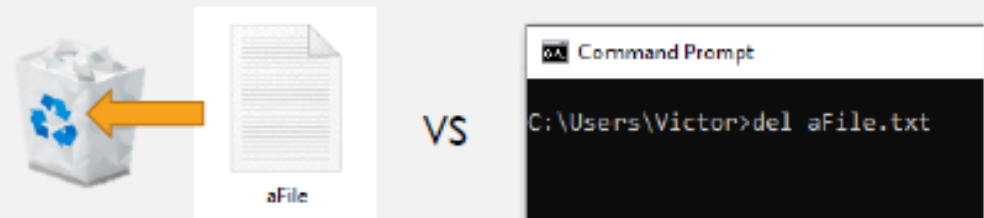
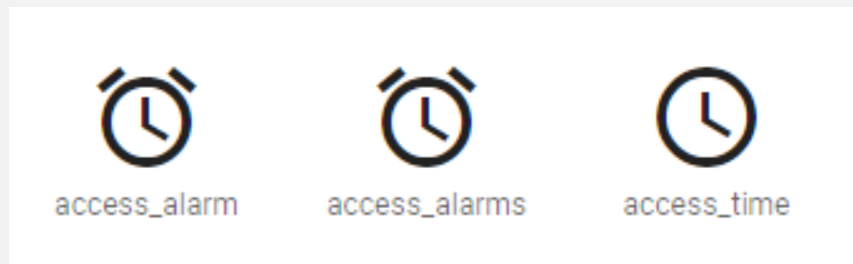
- Refers to the process of **encoding** and later **retrieving** knowledge
 - Encoding – determines which information is paid attention to and how it is interpreted
 - Retrieving – recalling the encoded memory
- Both steps might include some **losses**
 - Encoding involves filtering as we cannot process and remember everything from all our senses
 - Retrieving is impacted by the context (e.g., walking into someone you know in an unexpected context)
- Memory also **fades** when not being retrieved often

More on Memory

- We recognize things much better than being able to recall things
- Early theories postulated 2 separate types of memory (1) **short term** and (2) **long term**
 - Short term has a finite capacity (7 +/- 2 “chunk” of information) and a finite duration (max. 20-30 seconds)
 - Can be increased by “pattern-building” or some other memory tools
 - Long term comes from information gradually transferred from short term through multiple usages and repetition
 - Easier to retain things that we already know about by making mental connection with existing memory
- Generally speaking, the more attention paid and the more it is processed in terms of thinking & comparing the more likely something is remembered
- Deteriorates with age or brain injuries

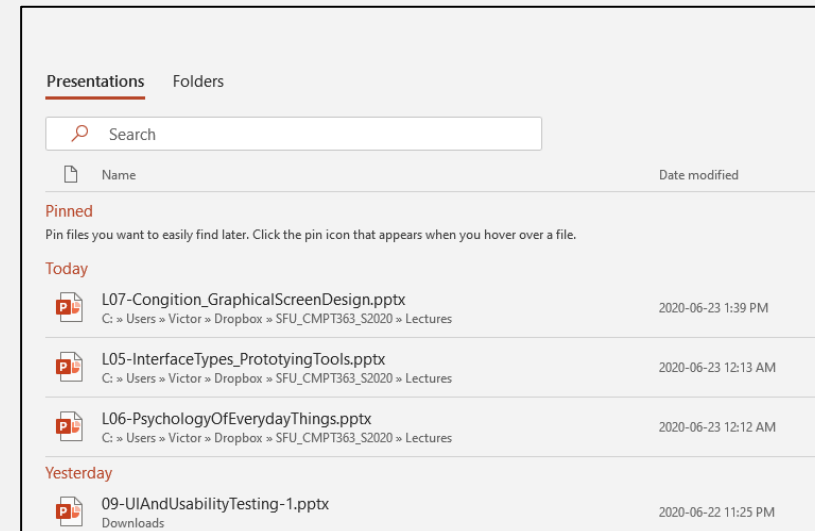
Recognition Rather Than Recall

- This is why it is one of the Nielsen's Heuristics
 - Example 1: Users can quickly find icons or locations of objects of interest once they learn about it
 - Example 2: Users can recognize commands with GUI instead of memorizing commands



Design Implications for Memory

- Don't overload users' memory with complicated procedures for carrying out tasks
- Design interfaces that promote recognition rather than recall
- Provide users with a variety of ways of encoding digital information to help them remember where they have stored them
 - E.g., categories, colour, flags, time-stamps
 - E.g., search box, history list, frequently used list



Design Implications for Memory

- Don't require the user to remember temporary operating states and labels
- Help the user remember how far the current task has progressed
- Help the user remember what the system expects them to do next
- **Think about this:** what Nielsen's Heuristics can promote these?

Summary

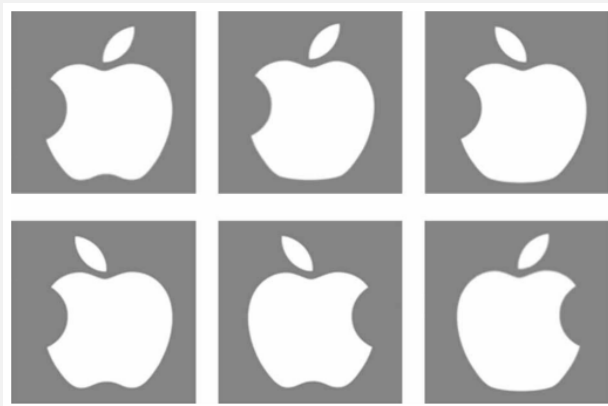
- Cognition – the process by which knowledge & understanding is developed in the mind
 - Allow us to understand how human minds work and thus design interfaces that facilitate those activities
 - Ways to describe them – by state of mind, by context, by kinds of process
 - Design implications for cognition processes

Post-Lecture Activity

- Read/watch these (and those in the slides)
 - ID-Book Ch. 4
 - Shestopalov, S. Optical Effects in User Interfaces: An Illustrated Guide
<https://medium.muz.li/optical-effects-9fca82b4cd9a>
 - Henry, D. UI Sound Design
<https://www.asoundeffect.com/ui-sound-design-henry-daw-small-sounds-make-big-difference/>
- Exercise
 - Look for examples where interfaces help/hinder cognitive process. Use the concepts in this lecture to explain your Good/Bad UI examples

More (Fun) on Memory

- Can you memorize this number: 3.141592653
 - How about “May I have a large container of coffee right now?”
- **Exercise:** Without looking it up (online or your own device), draw the Apple logo



Adam B. Blake, Meenely Nazarian & Alan D. Castel (2015) The Apple of the mind's eye: Everyday attention, metamemory, and reconstructive memory for the Apple logo, *The Quarterly Journal of Experimental Psychology*, 68:5, 858-865, DOI: 10.1080/17470218.2014.1002798