SI 388 Human Information Processing (HIP) Model

WEEK 3-1 (MON 18 SEP) – CHRISTOPHER WICKENS' ET AL

MARK THOMPSON-KOLAR, MSI, MA

Agenda Today (Monday 9/18)

- Feedback from in-class Assignment 1
- Lecture: Human Information Processing model *overview*
- **Describe In-class Assignment 2**

Learning Objectives

After today's lesson, students should:

- ❑ More insights into the mechanics and concepts involved in in-class Assignment 1
- ❑ Understand at a high level the Human Info Processing model elements of…
  - ❑ Perception
  - ❑ Attention
  - ❑ Working Memory, and
  - ❑ Long-term Memory
- ❑ Be able to explain "bottom-up" and "top-down" processing, and "unitization"
- ❑ Have seen the prompt for in-class Assignment 2

Feedback from in-class Exercise 1

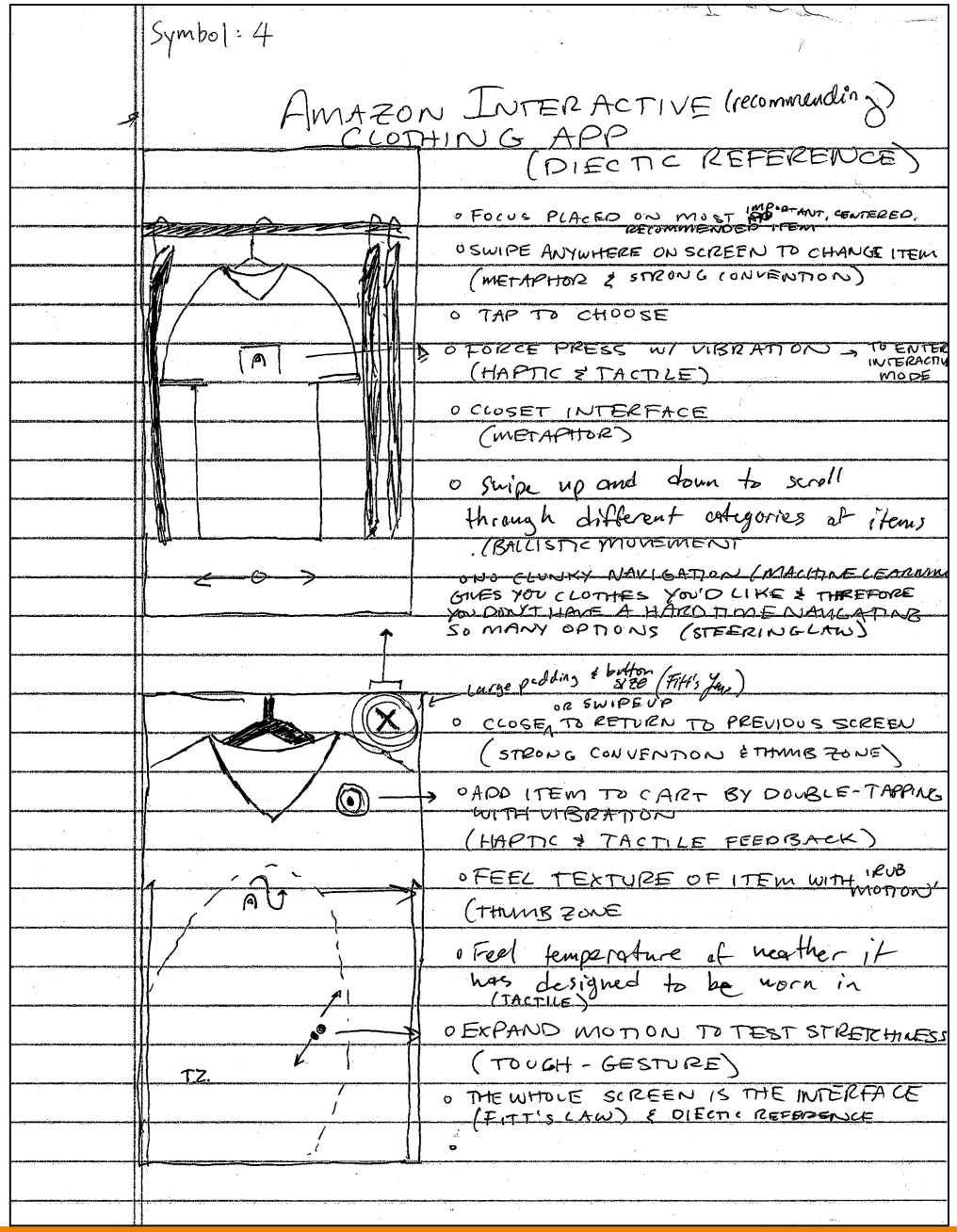
Positives

- Very creative, many were nicely detailed/thorough – obvious thought and effort
- Some did a great job explaining clearly how the design element related to the lecture concepts
  - This is the most valuable part

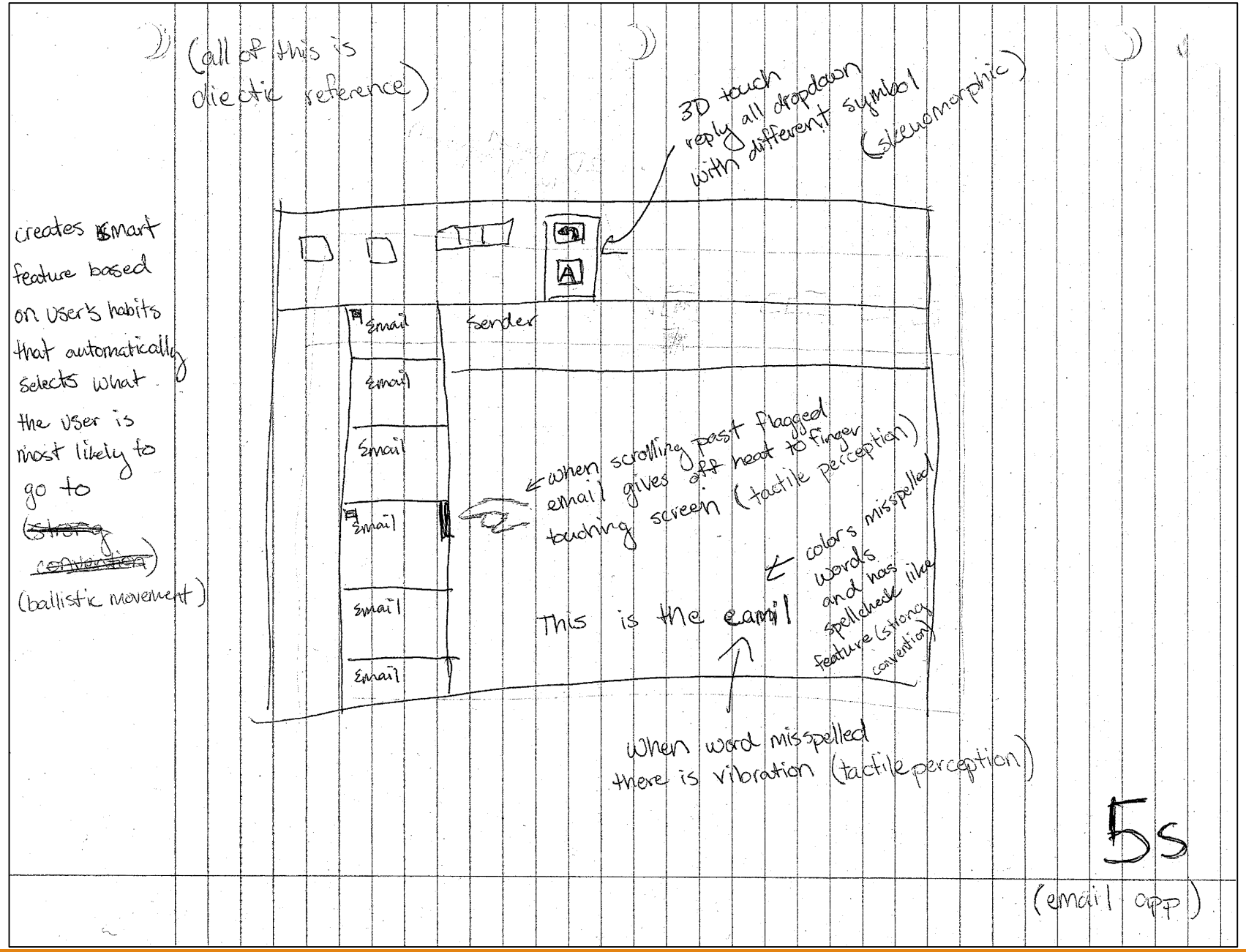
Negatives

- Some were almost entirely design but vague on concepts
- Some *listed* the concepts but didn't indicate clearly how they connected to elements of design
  - Suggestion: Write the concepts into the description.
- A few had sketches that I had difficulty connecting to written concepts or descriptions.
  - Suggestion: Number them for correspondence
  - Suggestion: Underline / color / italicize concepts so they really stand out

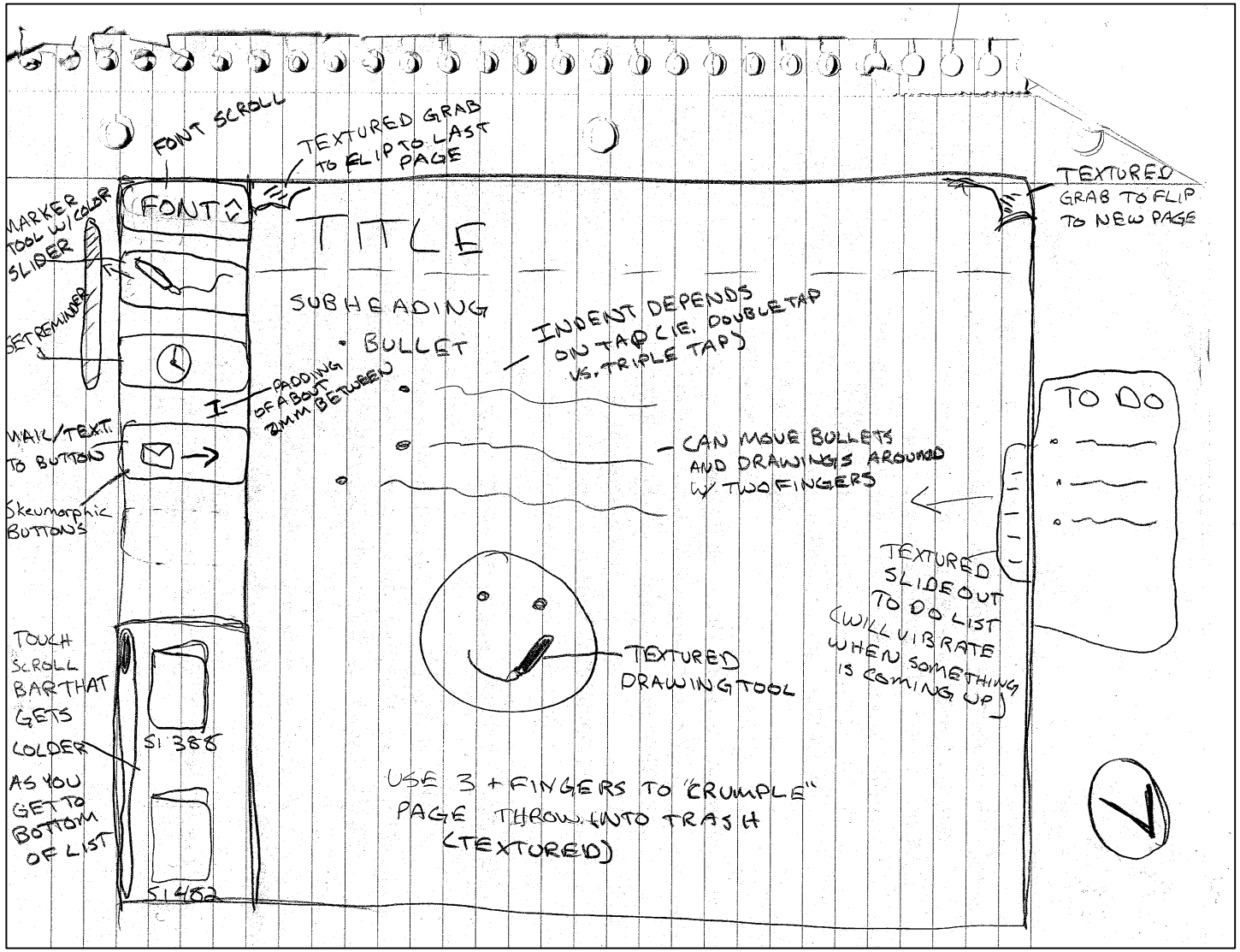
Example


Symbol: 4
AMAZON INTERACTIVE (recommending) CLOTHING APP (DIECTIC REFERENCE)
o FOCUS PLACED ON MOST IMPORTANT, CENTERED, RECOMMENDED ITEM
o SWIPE ANYWHERE ON SCREEN TO CHANGE ITEM (METAPHOR & STRONG CONVENTION)
o TAP TO CHOOSE
o FORCE PRESS W/ VIBRATION → TO ENTER INTERACTIV MODE (HAPTIC & TACTILE)
o CLOSET INTERFACE (METAPHOR)
o swipe up and down to scroll through different categories of items (BALLISTIC MOVEMENT
o NO CLUNKY NAVIGATION (MACHINE LEARNIN GIVES YOU CLOTHES YOU'D LIKE & THEREFORE YOU DON'T HAVE A HARD TIME NAVIGATING SO MANY OPTIONS (STEERING LAW)
Large padding & button size (Fitt's law)
OR SWIPE UP
o CLOSE TO RETURN TO PREVIOUS SCREEN (STRONG CONVENTION & THUMB ZONE)
o ADD ITEM TO CART BY DOUBLE-TAPPING WITH VIBRATION (HAPTIC & TACTILE FEEDBACK)
o FEEL TEXTURE OF ITEM WITH 'RUB MOTION' (THUMB ZONE
o Feel temperature of weather it has designed to be worn in (TACTILE)
o EXPAND MOTION TO TEST STRETCHINESS (TOUGH - GESTURE)
o THE WHOLE SCREEN IS THE INTERFACE (FITT'S LAW) & DIECTIC REFERENCE
TZ

Example


(all of this is
dieetic reference)
3D touch
reply all dropdown
with different symbol
(skeuomorphic)
creates smart
feature based
on users habits
that automatically
selects what
the user is
most likely to
go to
(ballistic movement)
email
sender
email
email
email
email
email
when scrolling past flagged
email gives off heat to finger
touching screen (tactile perception)
This is the email
colors misspelled
words
and has like
spellcheck
feature (strong
convention)
When word misspelled
there is vibration (tactile perception)
5s
(email app)

Example



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CONCEPTS WE USED:

- HAPTIC PERCEPTION AND KINESTHETIC FEEDBACK
  - TEXTURE TO HELP YOU UNDERSTAND YOU ARE SUPPOSED TO DRAG OR THAT YOU ARE DRAWING ON THE SCREEN
  - VIBRATION USED TO ALERT YOU
  - TEMP ON SCROLLS TO INDICATE PLACE ON LIST
- METAPHORS
  - FOLDERS THAT PEOPLE WILL KNOW TO USE TO ORGANIZE NOTES
  - PAGE TURNING FROM CORNERS
- STRONG CONVENTION
  - DRAW ICON THAT PEOPLE HAVE SEEN BEFORE
- GESTURES
  - DOUBLE TAPS FOR BULLET INDENTATION
- METAPHOR
  - USING 3+ FINGERS TO CRUMPLE PAPER (ALSO HAS TEXTURE FOR HAPTIC PERCEPTION) TO THROW AWAY NOTES
- FITT'S LAW
  - BUTTONS ARE LARGE ENOUGH AND IMPORTANT ONES ARE CLOSE TO THE EDGE
- STEERING LAW
  - PAGE TURNS CAN BE DRAGGED IN WIDE PATH

Future in-class Assignments

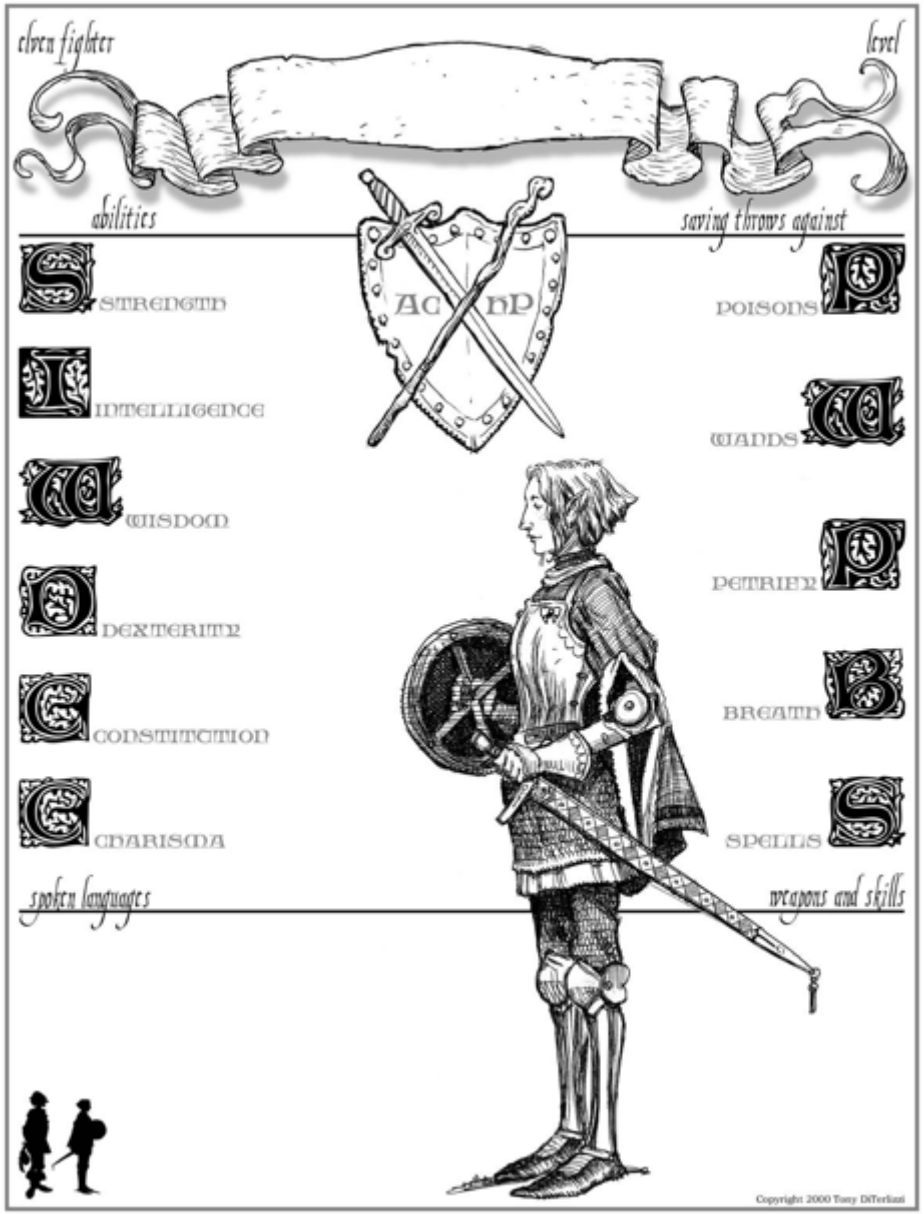
I'm open to ideas for what you'd like to design.

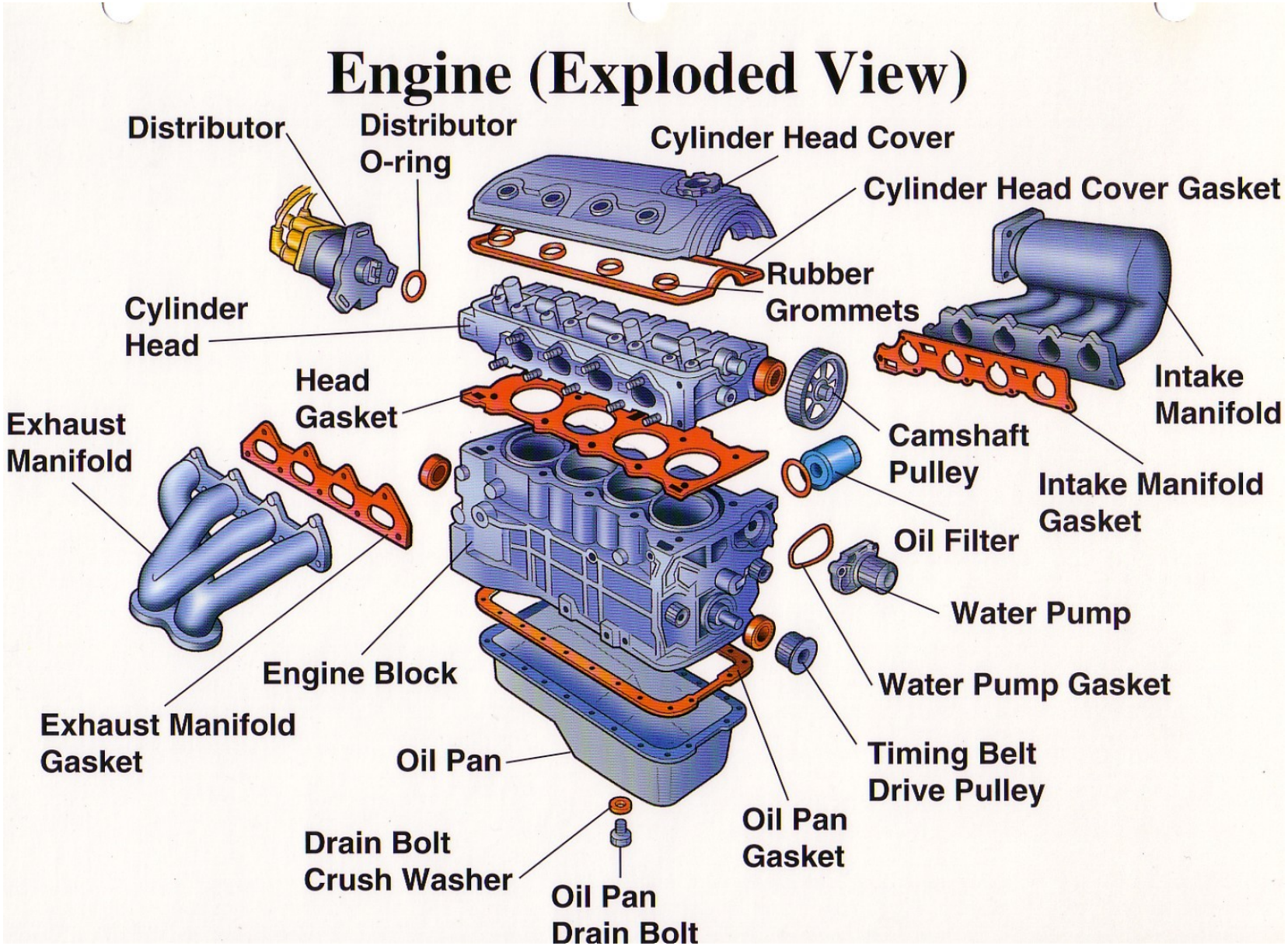
Some might not be "designs" – might be "find examples" exercises

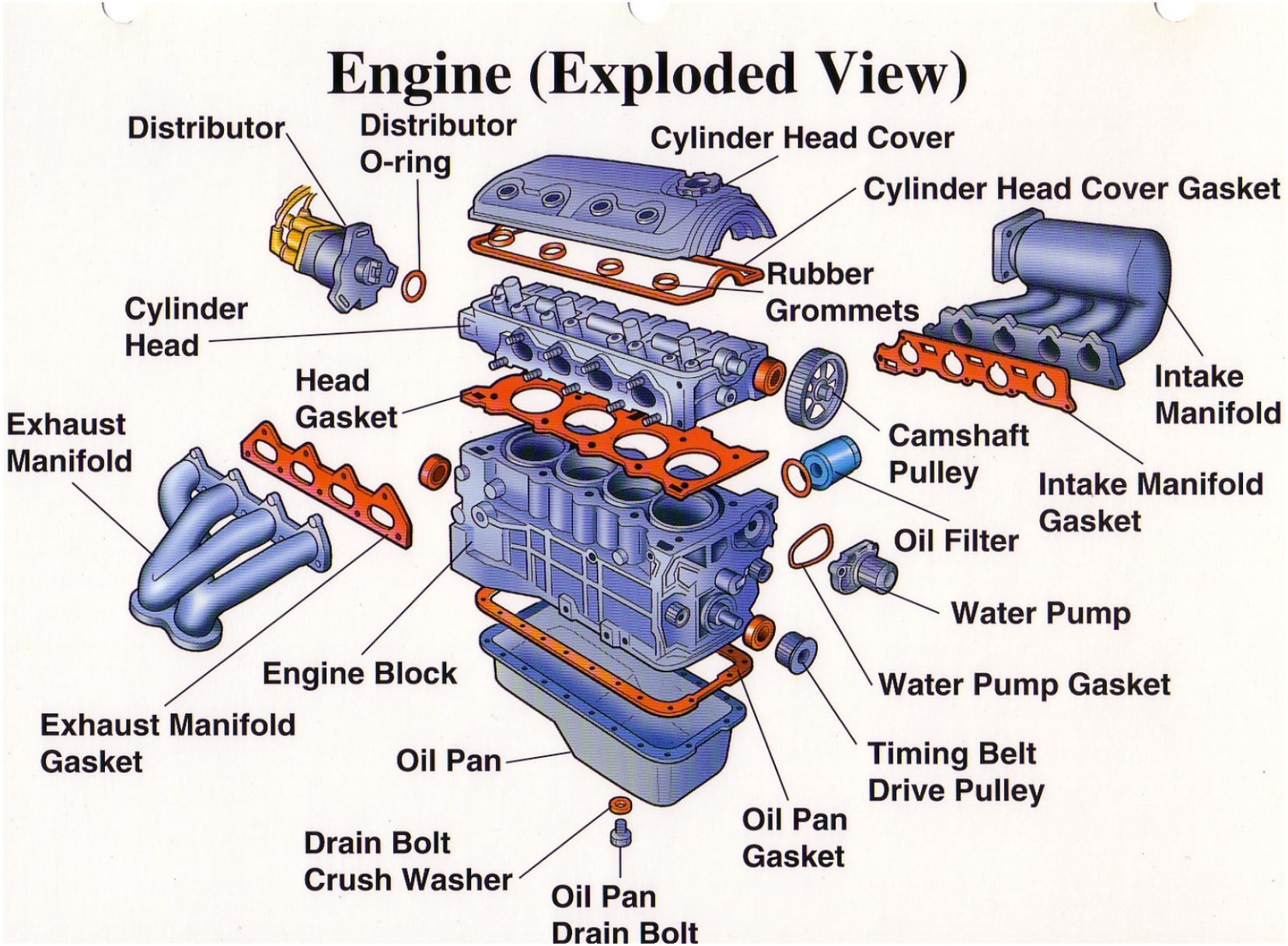
Let me know if you have ideas for exercises YOU would like to do.

Onward to today's lecture

How to Think About How ‘Users’ Function?




Engine (Exploded View)
Distributor
Distributor O-ring
Cylinder Head Cover
Cylinder Head Cover Gasket
Rubber Grommets
Cylinder Head
Intake Manifold
Head Gasket
Exhaust Manifold
Camshaft Pulley
Intake Manifold Gasket
Oil Filter
Water Pump
Engine Block
Water Pump Gasket
Exhaust Manifold Gasket
Oil Pan
Timing Belt Drive Pulley
Oil Pan Gasket
Drain Bolt Crush Washer
Oil Pan Drain Bolt


Engine (Exploded View)
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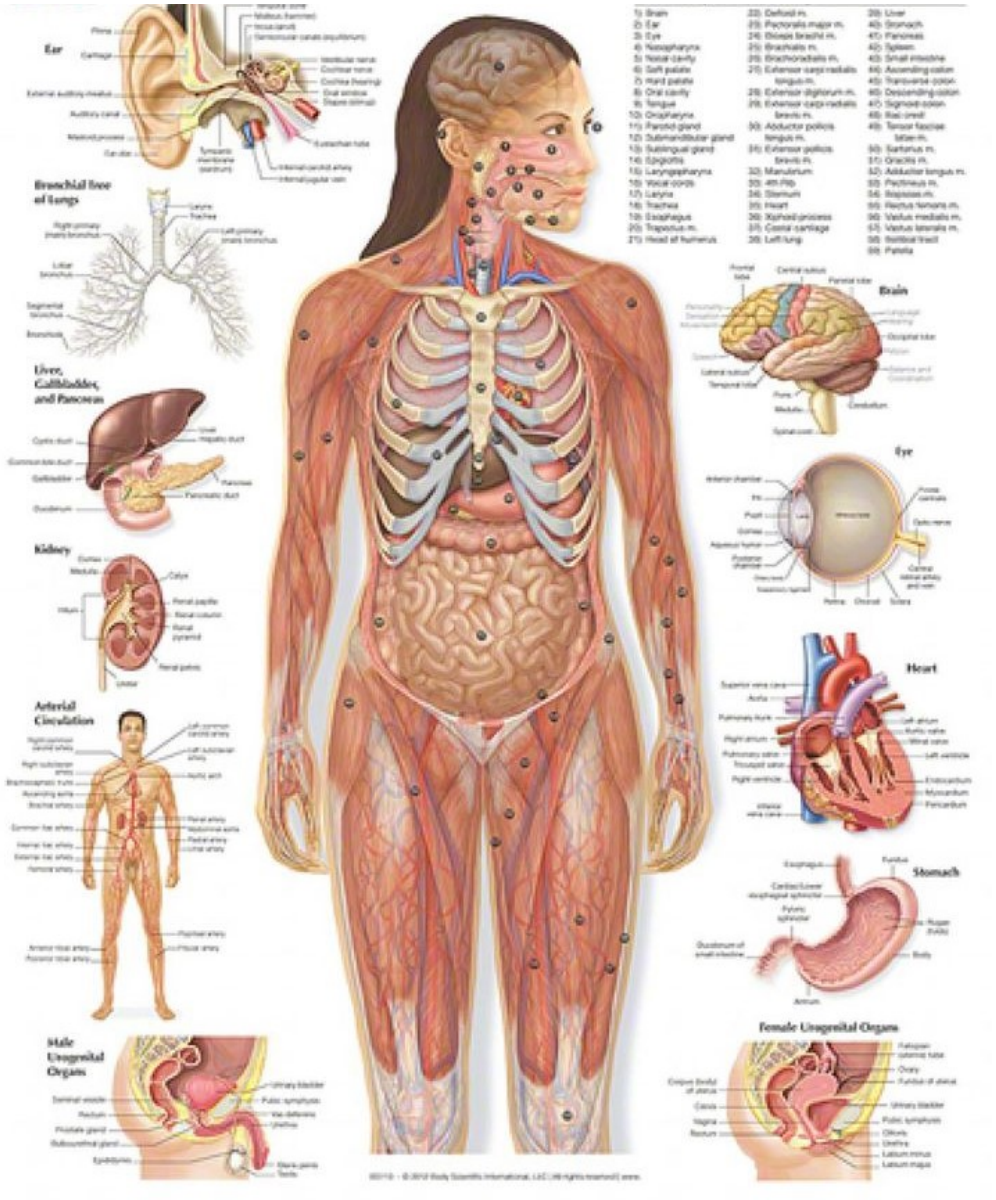
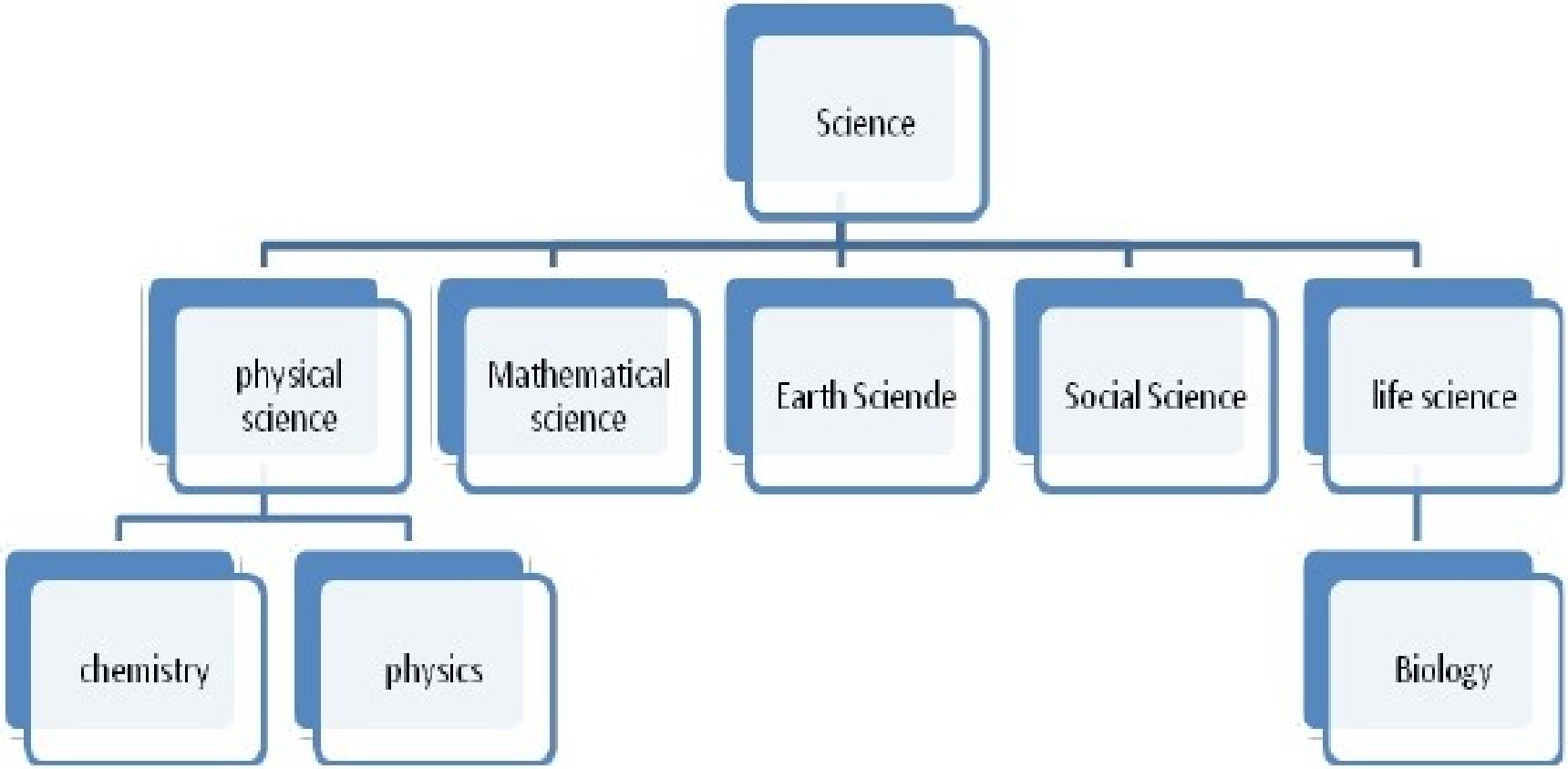
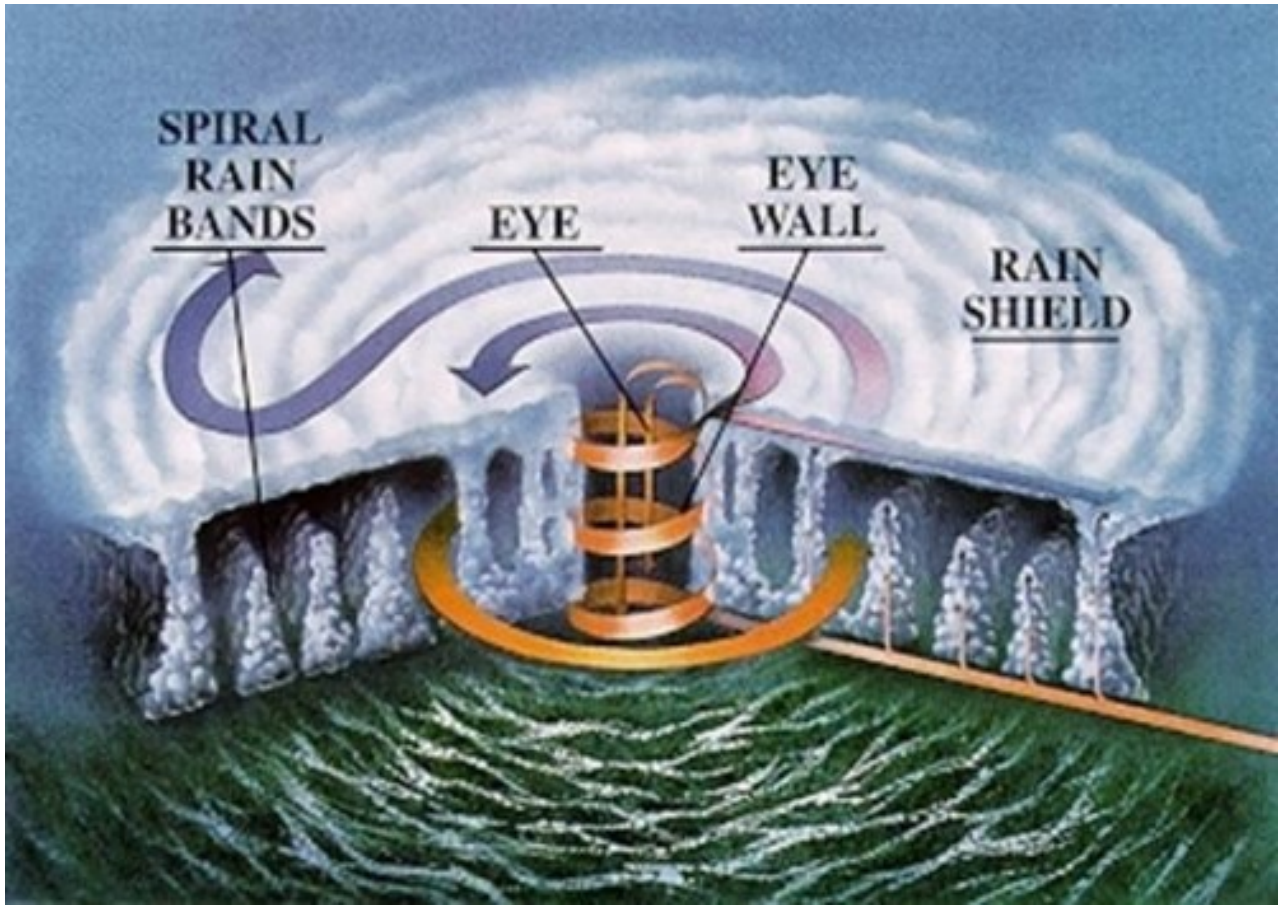
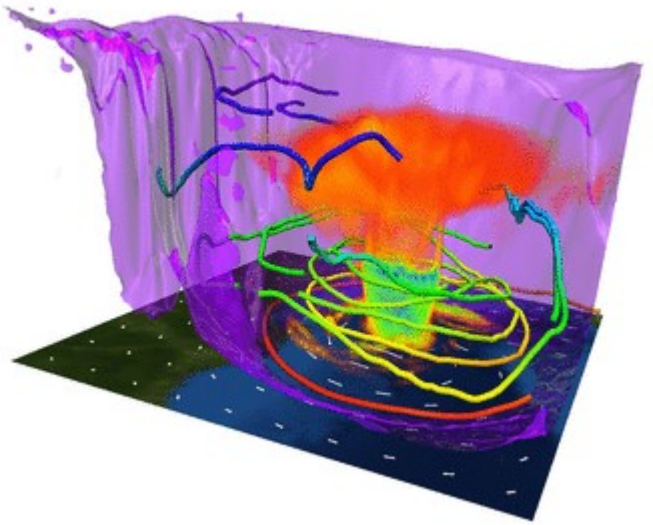
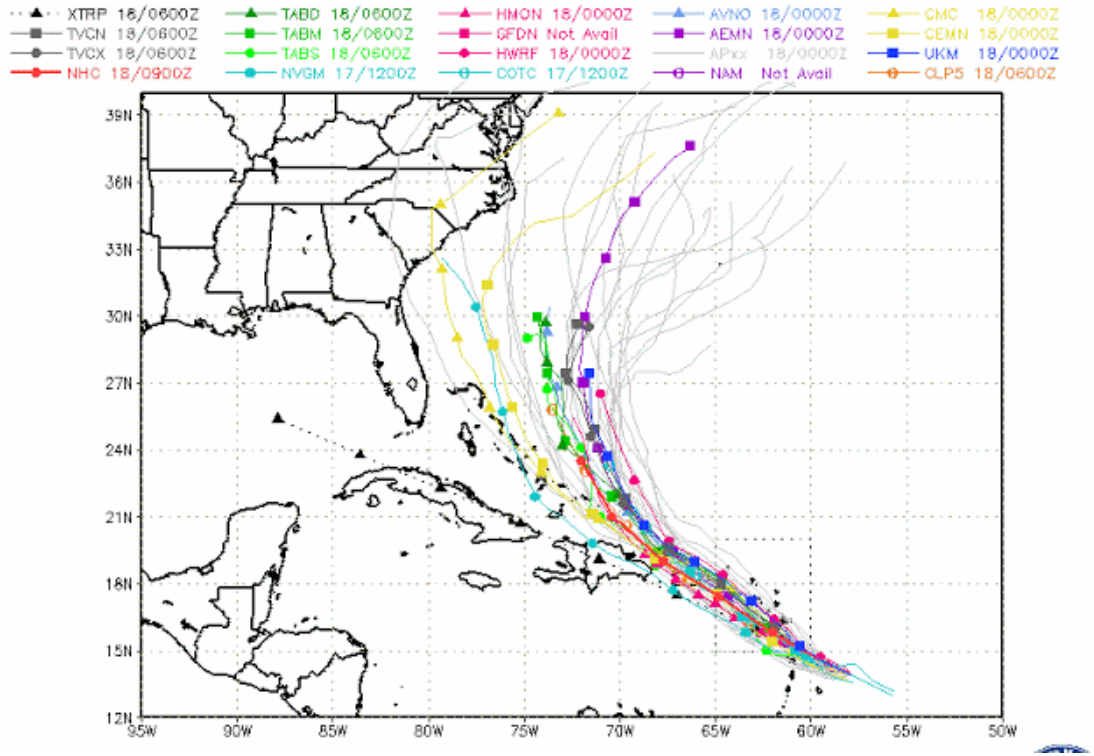

Ear
Bronchial tree of lungs
Liver, Gallbladder, and Pancreas
Kidney
Arterial Circulation
Male Urogenital Organs
Brain
Eye
Heart
Stomach
Female Urogenital Organs

BRANCHES OF SCIENCE




SPIRAL
RAIN
BANDS
EYE
EYE
WALL
RAIN
SHIELD




XTRP 18/0600Z
TVCN 18/0600Z
TVCX 18/0600Z
NHC 18/0900Z
TABD 18/0600Z
TABM 18/0600Z
TABS 18/0600Z
NVGM 17/1200Z
HMON 18/0000Z
GFDN Not Avail
HWRF 18/0000Z
COTC 17/1200Z
AVNO 18/0000Z
AEMN 18/0000Z
APxx 18/0000Z
NAM Not Avail
CMC 18/0000Z
CEMN 18/0000Z
UKM 18/0000Z
CLP5 18/0600Z
39N
36N
33N
30N
27N
24N
21N
18N
15N
12N
95W
90W
85W
80W
75W
70W
65W
60W
55W
50W

Information Processor Model Approach

Model is based on premise that humans **process** the info they receive, don't merely respond to stimuli.

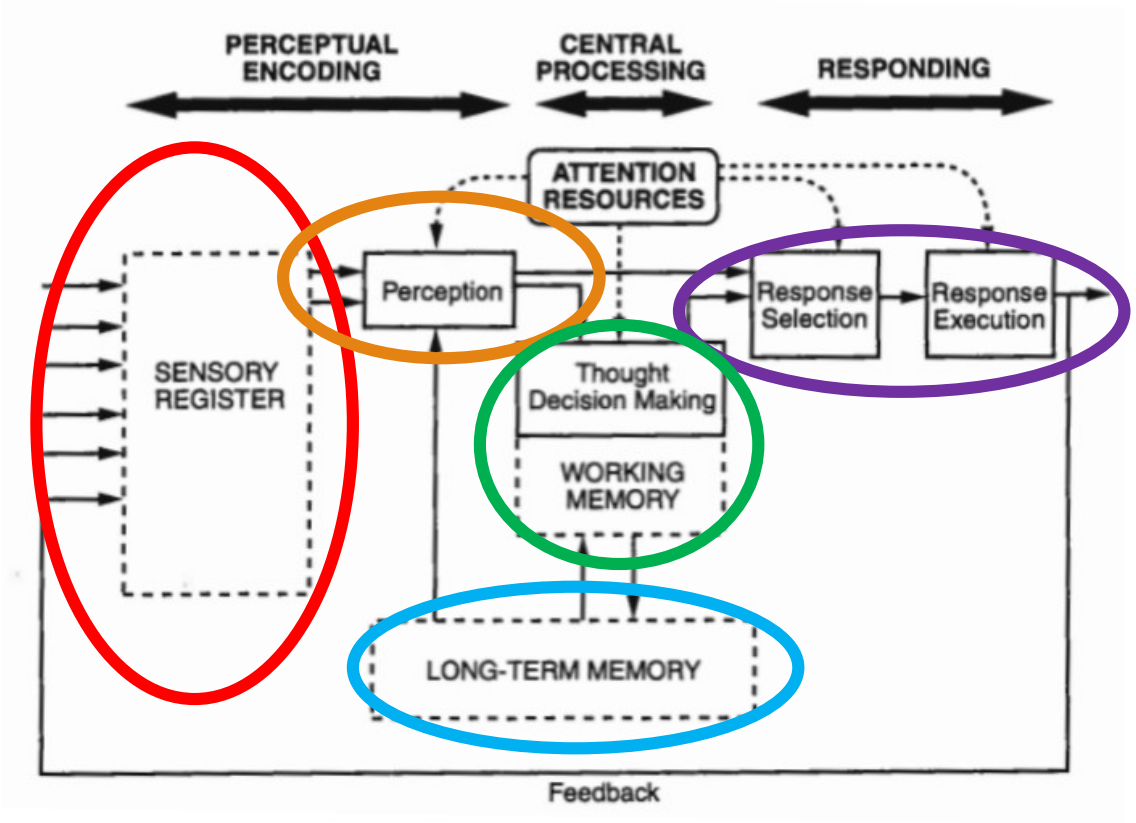
The cognitive perspective asserts that:

- complex mental states affect human learning and behavior
- such mental states can be scientifically investigated.
- Computers, which process information, also have internal states that affect processing.

Computers therefore provide a model of possible human mental states that give researchers clues and direction for understanding human thinking and learning ***as information processing***.

https://en.wikipedia.org/wiki/Information_processing_theory

HIP Model – An Introduction

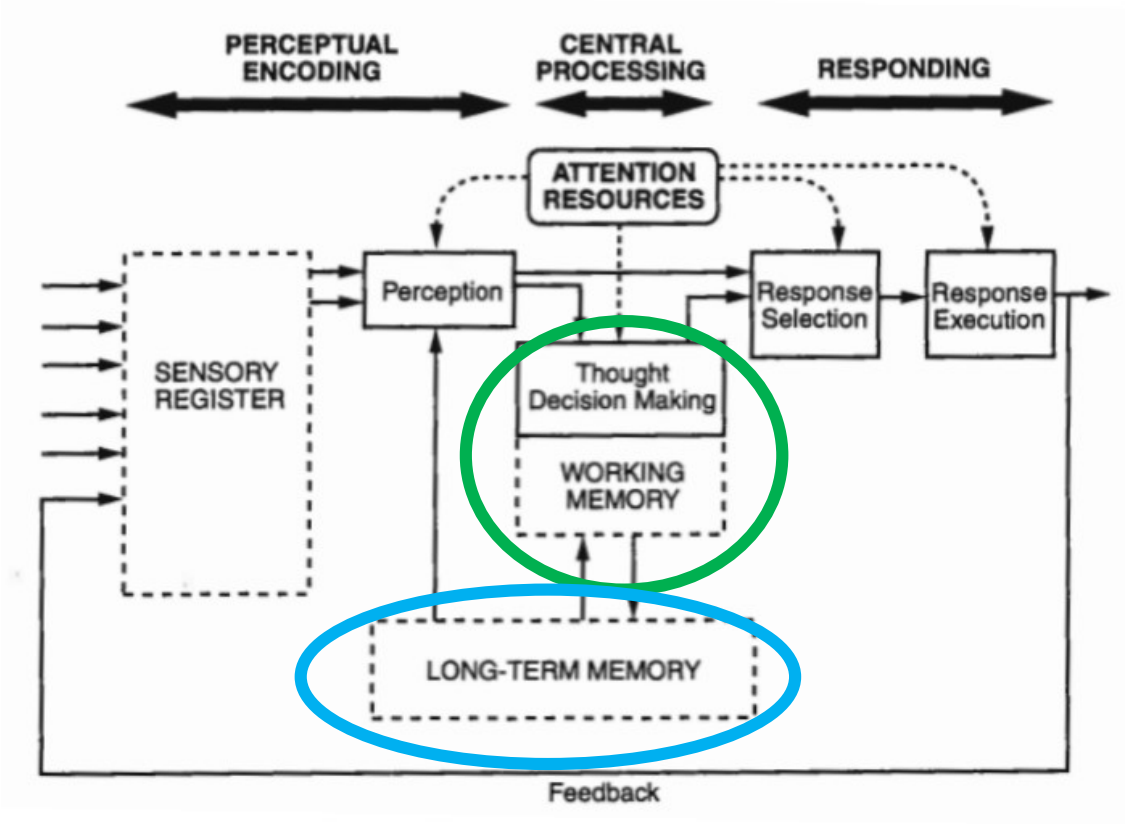


- Senses take in information continually.
- Brain perceives the sensory information
- Brain filters out most of the sensory info.
- Brain provides a meaningful interpretation of what is sensed.
- Interpretation is aided by prior knowledge that is stored in the long-term memory.

Top-down processing

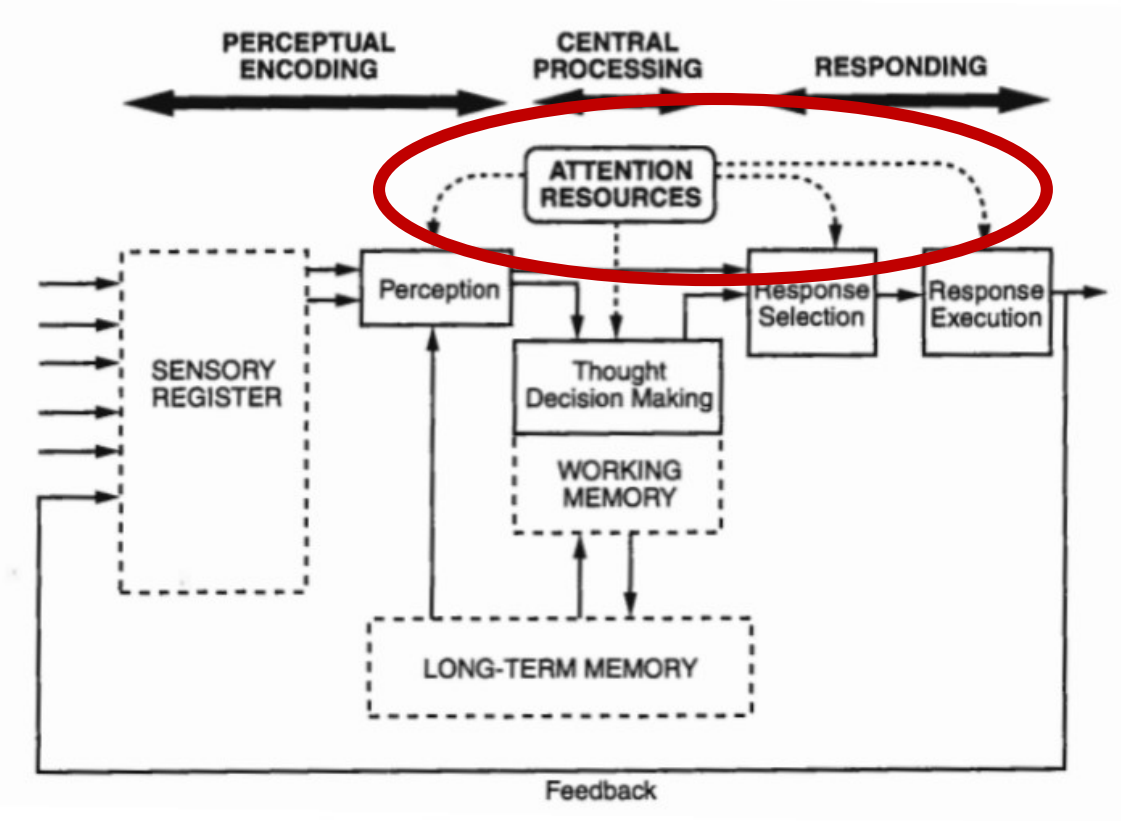
- Finally, selection and execution of response.

HIP Model Overview



- Working Memory processes information:
  - Rehearsing, planning, understanding, visualizing, decision making, and problem solving.
- Working Memory is a temporary, effort-demanding store.
- Also, creates a more permanent representation of the information in Long-term Memory, for later retrieval.

HIP Model Overview

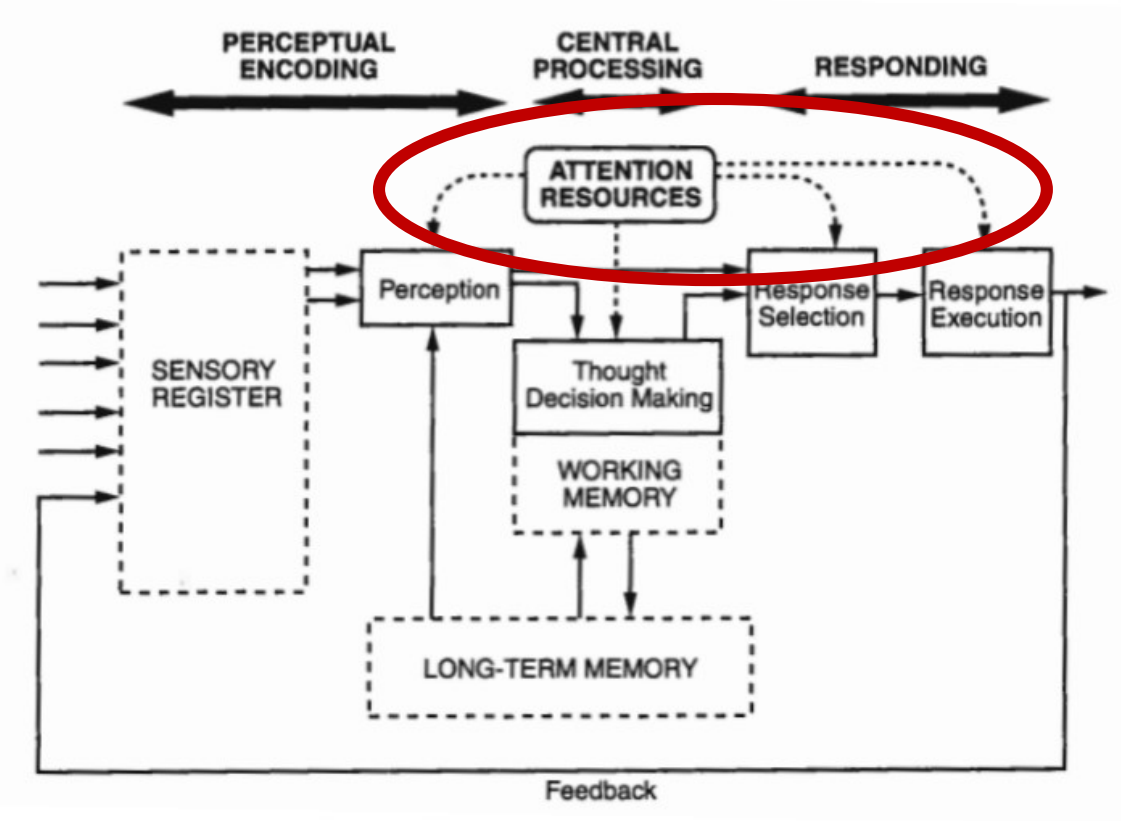


- **Cognitive resources** = capacity for attention or mental effort
- Allocated to processes as required

Limited

- The demand an interface puts on human cognitive resources often called **cognitive load.**

HIP Model Overview



- **Selective Attention** = attention resources are limited and are allocated by identifiable characteristics. Way of categorizing them…
  - Salience
  - Expectancy
  - Effort
  - Value

Attention is Selective

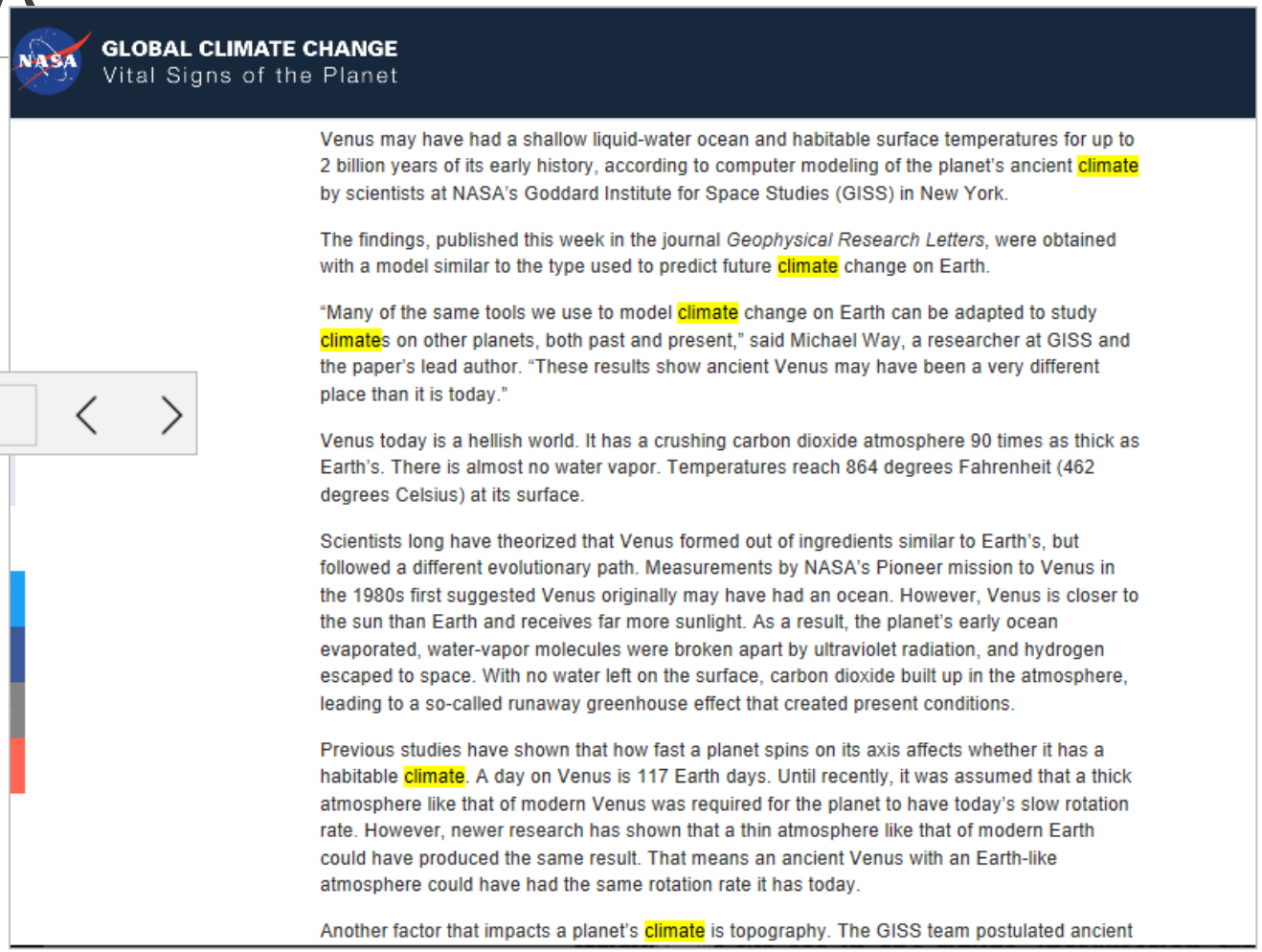
- **Salience.** Also known as *attentional capture*. Bottom-up process. Distracting, captures attention. Examples:

  - **Flashing lights**
  - **Loud noises**
  - **Sirens**
  - **Warm colors**
  - **Movement**

Bottom-up process = Pieced together from sensory inputs, not relying on prior memories.

Attention is Selective

- **Salience**



GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Venus may have had a shallow liquid-water ocean and habitable surface temperatures for up to 2 billion years of its early history, according to computer modeling of the planet's ancient climate by scientists at NASA's Goddard Institute for Space Studies (GISS) in New York.

The findings, published this week in the journal *Geophysical Research Letters*, were obtained with a model similar to the type used to predict future climate change on Earth.

"Many of the same tools we use to model climate change on Earth can be adapted to study climates on other planets, both past and present," said Michael Way, a researcher at GISS and the paper's lead author. "These results show ancient Venus may have been a very different place than it is today."

Venus today is a hellish world. It has a crushing carbon dioxide atmosphere 90 times as thick as Earth's. There is almost no water vapor. Temperatures reach 864 degrees Fahrenheit (462 degrees Celsius) at its surface.

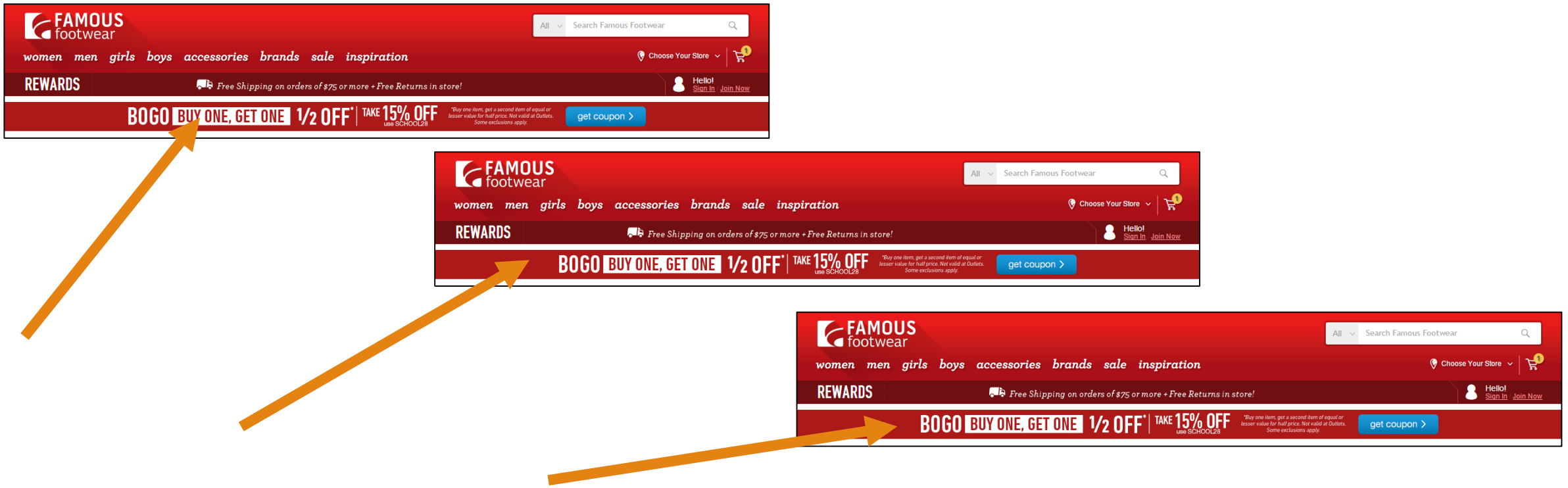
Scientists long have theorized that Venus formed out of ingredients similar to Earth's, but followed a different evolutionary path. Measurements by NASA's Pioneer mission to Venus in the 1980s first suggested Venus originally may have had an ocean. However, Venus is closer to the sun than Earth and receives far more sunlight. As a result, the planet's early ocean evaporated, water-vapor molecules were broken apart by ultraviolet radiation, and hydrogen escaped to space. With no water left on the surface, carbon dioxide built up in the atmosphere, leading to a so-called runaway greenhouse effect that created present conditions.

Previous studies have shown that how fast a planet spins on its axis affects whether it has a habitable climate. A day on Venus is 117 Earth days. Until recently, it was assumed that a thick atmosphere like that of modern Venus was required for the planet to have today's slow rotation rate. However, newer research has shown that a thin atmosphere like that of modern Earth could have produced the same result. That means an ancient Venus with an Earth-like atmosphere could have had the same rotation rate it has today.

Another factor that impacts a planet's climate is topography. The GISS team postulated ancient

Attention is Selective

- *Opposite* of Salience is **Change Blindness** ("Banner Blindness").



Attention is Selective

- **Expectancy.** *Top-down process*. Attention to items **we expect to be present**. Examples?...

  Global navigation buttons, photos of popular products…

- **Value.** *Top-down process*. Attention to items **we think important**. Examples?...

  Sports scores on ESPN homepage, road signs for our exit…

- **Effort.** *Top-down process*. Humans are wired to reserve energy. May not pay attention if it's expected to take extra effort to attend.

  Long passages of text, especially if low on relevant info-carrying words

HIP Model: Perceptual Processes

High-level overview

We'll cover Perception in more depth in upcoming lectures.

Bottom-up feature analysis	Unitization	Top-down processing
• Construct elements individually from senses	• Familiar • Rapid, automatic • Instant recognition	• Meaning derived from long-term memory (largely expectations)

HIP Model: Perceptual Processes

- Optimize bottom-up processing:

  Design implication: **Make items visually clear and explicit.**
  - Highly legible, large-enough fonts, plenty of contrast.

- Optimize unitization: mix of bottom-up and top-down

  Design implication**: Emphasize similarity & consistency.**
  - Use *familiar* icons, fonts, imagery, lower-case letters, words not abbreviations.
  - Don't vary *appearance* of symbols, styles, icons unless necessary

- Optimize top-down processing:

  Design implication: **Use prior experiences & metaphors.**
  - Use *controlled vocabulary* (same words, repeatedly), rely on prior experiences with brand, operating system, visualizations, familiar context of use.

HIP Model: Working Memory

High-level overview

We'll cover Memory in more depth in Week 5.

Visuospatial sketch pad	Phonological loop
• Information held in spatial form in the brain	• "Rehearsed" in audio form by repeating it

HIP Model: Working Memory

Basic limits to working memory:

Capacity

- 7 ± 2 *chunks* of information (Miller 1956) OR 4 ± 1 (Broadbent 1975; Mastin, 2010)

- **Chunk** = *an organizational unit in memory*.
- **Chunking =** creating *meaningful* and *visually distinct* content units that make sense in the context of the larger whole.
  - C A R is 3 chunks but "CAR" is 1 chunk.
  - 7345558370 vs 734-555-8370
- **Maintenance rehearsal** = repeating/reviewing the chunks in memory

HIP Model: Working Memory

Limits to working memory:

Confusability

- Specifics about similar items are lost more quickly:
  - Phone numbers:

    734-269-2078 Pierce Hall
    734-269-2087 Peirce Hall

Attention

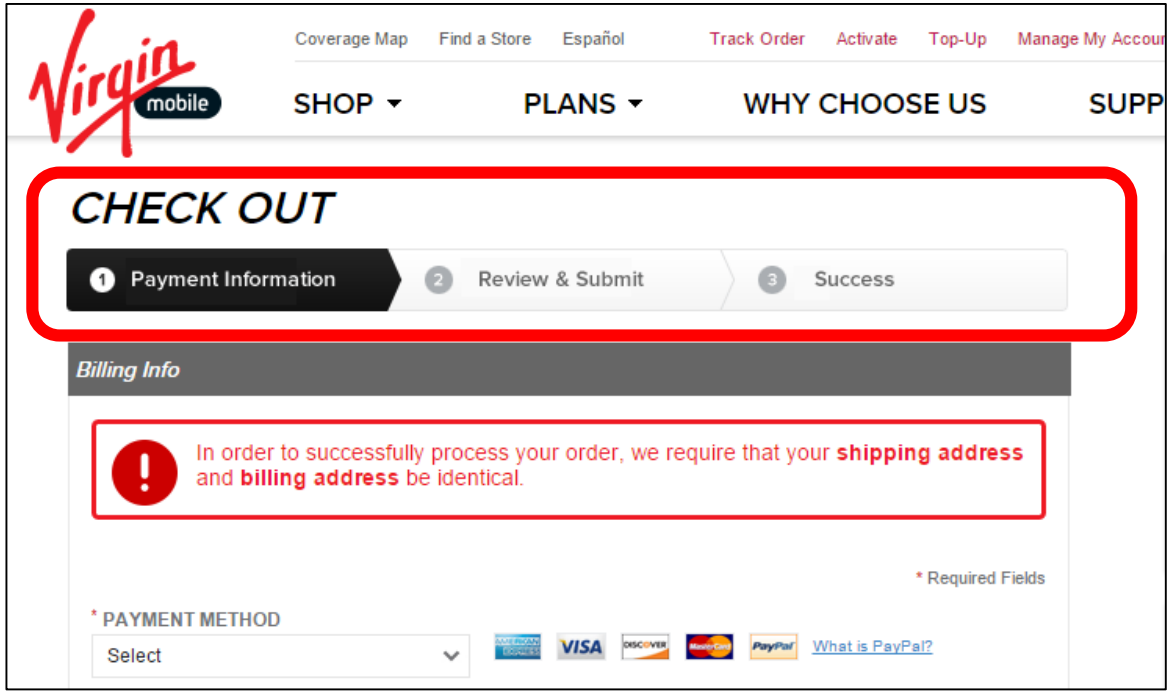
- Interruptions reallocate attention resources, halt rehearsal→faster decay

HIP Model: Working Memory

Design implications:

- Minimize load on working memory. *Let computers do the remembering*.
- Provide explicit placeholders for step-by-step processes.

(more)



HIP Model: Working Memory

Practical tips for UX designers:

- *Anticipate confusability and memory limits*
- Use formatting to group alphanumeric codes
- Separate letters from digits when possible. Ex: AA 3129
- Keep text as short as practical, esp. instructions and error messages.
- Display reminder items, such as display of Search *queries* with results

HIP Model: Long-term Memory

Types of long-term memory

- **Semantic memory =** facts, procedures, discrete item.
- **Event memory =** specific events.

Effectiveness of long-term memory determined by:

- Strength (“vividness”)
- Associations (context/prior experiences)

More on Unitization

- Ability to **perceive** familiar features as whole units, informed by long-term memories
- The fact they occur together is already stored in long-term memory
- Perception is faster and more 'automatic' than bottom-up processing

- Examples:
  - Ability to read letters and symbols
  - Recognition of locations on familiar map
  - Identification of logos

Perceptual Priming

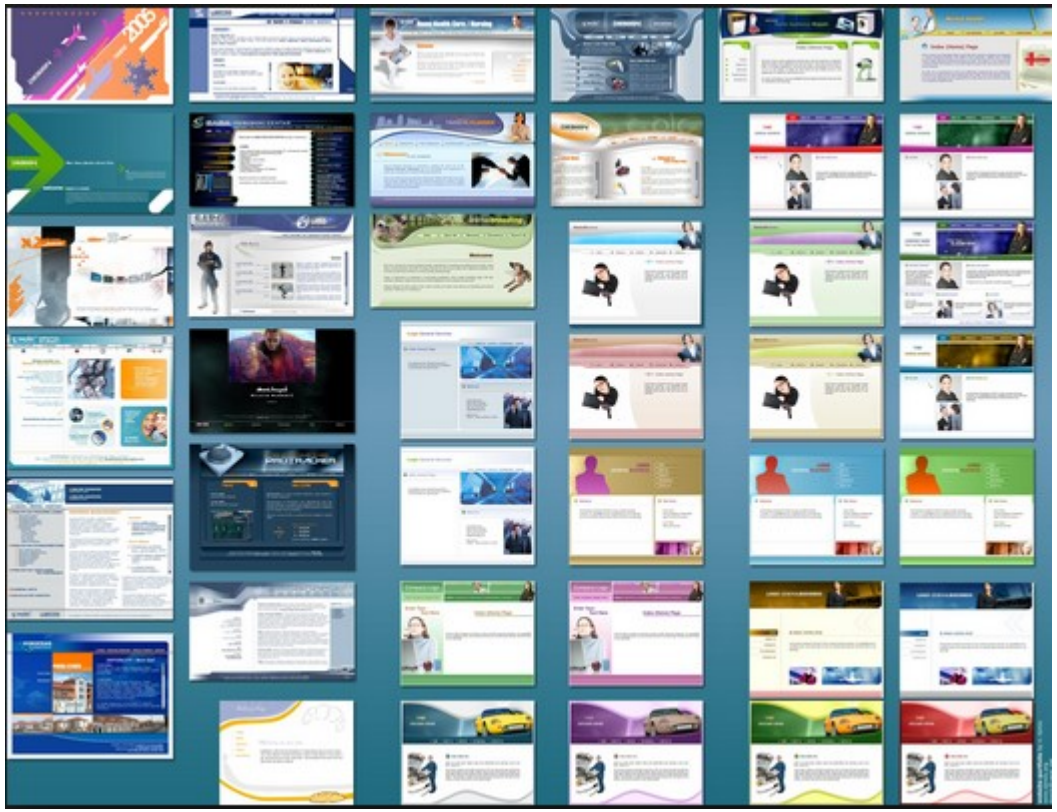
- Perception is strongly influenced by expectations
- Expectations are based on long-term memories + sense info (perceptions)
- The LTMs set context
- Lots of top-down processing + some bottom-up processing
- Can involve any/all the senses

Artandperception.com

Perceptual Patterns (Frames)

- Perceptual patterns (frames) = bias our perceptions based on what we expect to find

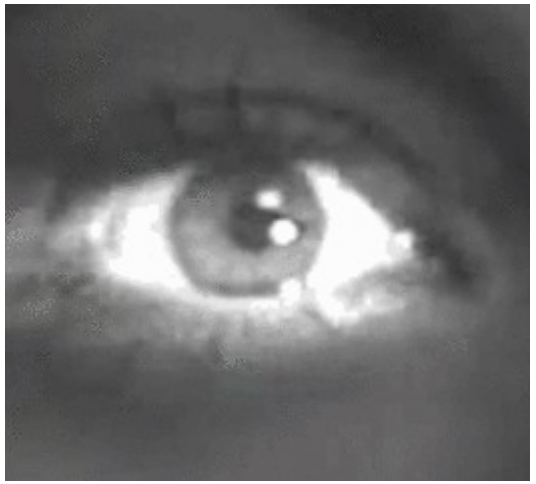
Our expectations about every new website/app are conditioned by ***every other website/app we've ever visited***



Webdesign.tutsplus.com

Attention Blink

- Attention locks down for 0.15-0.45 second
- Any concurrent or immediately following stimuli is ignored
- Why?Attention resources are **fully** occupied, briefly
- Example: Interface alters its layout and simultaneously alters some text onscreen (such as a note about shipping costs).



Really bad practice: Instead, build in tiny delay between visual changes.

Perception Biased by Goals

- **Filtering.** Brain filters out elements we're not interested in (hold low Value to us).
- **Guiding.** Brain helps us locate elements that help us achieve our goals (hold high Value to us).
- Example:

Locate the Maps app in this screenshot

Author J. Johnson on Perception

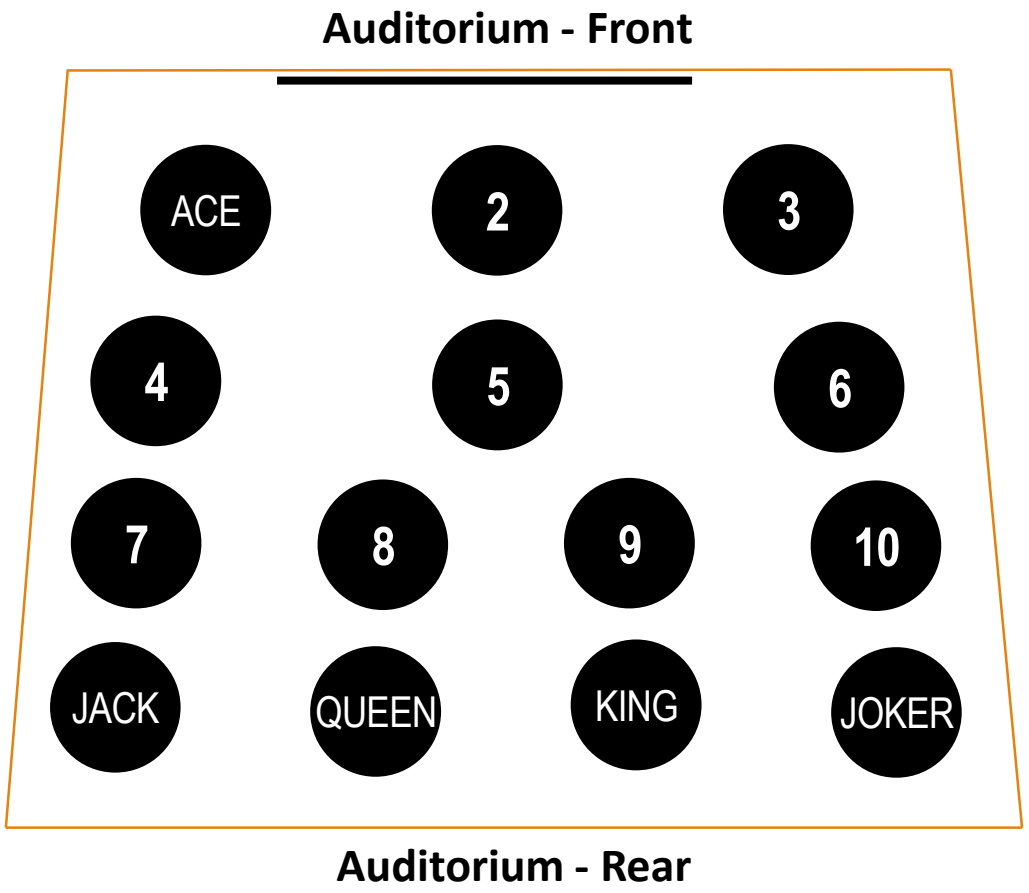
Practical tips for UX design

- **Avoid ambiguity.** Find ways to ensure terminology, controls, icons, symbols, etc. make sense to all or at least your primary intended users.
- **Leverage consistency.** Positioning, shape, color, interactivity, size all affect contextual frames and top-down processing.
- **Understand users' goals.** Goals influence what users perceive, and thus their ability to effectively use the app, site, device, etc.

Assignment: In-class group exercise - setup

1. You will be in groups of 5-6 students
   - Take a playing card, pass deck along
   - Gather with your same-numbers/symbol (7's, Jacks, etc.) as on the diagram (next screen)
2. Put all group members' names on a blank title sheet only
3. Put the group's playing card symbol on the **title sheet** and **deliverable**
4. *1 hour (until 11:15):* Do the exercise on paper—sketching and hand-printed
5. Pick a speaker to verbally present the debrief
6. *30 minutes:* Speaker talks for 2 minute to describe your design and how it achieves the assignment
7. Make sure all names are on the title sheet
8. Instructor collects title sheets and deliverables

Group Locations



Finish design by 11:15 a.m.

Assignment: In-class design exercise

1. Design a new app for a mobile device or a laptop computer (your choice). It can be either a) map/direction provider, b) apartment finder, or c) restaurant finder. Be creative.

It should meet these requirements:

- ❑ Shows users their current location.
- ❑ Shows directions to a destination they've entered.
- ❑ Displays locations users have visited previously.
- ❑ Helps users discover places they have not previously visited.
- ❑ Helps users learn about history that happened at the locations shown

2. Clearly connect several concepts from Monday's lecture to main features of your design. *This should demonstrate you really understand the concepts. Part 2 is more important than Part 1.*

Some possible concepts

- Attention resources
- Top-down processing
- Bottom-up processing
- Perceptual priming
- Chunking
- Current context
- User goals
- (Perceptual) filtering
- Salience
- Expectancy, Value, Effort
- Working memory
- Unitization

(Also many are in the course readings or the lecture.)

Grading Rubric

____ Design fully meets all the stated requirements (3)

____ *Several* concepts from lesson (and/or readings) are used (3)

____ Concepts are explicitly related to design elements (3)

____ Entire submission is clear, easy for grader to understand (1)

____ Total out of 10

Notes, etc. for Exercise 2

Lorem

Wrapup for Today

Make sure all your names are on the paper

Turn in your paper to me before you leave

See you Monday