



# Class 1 CS545

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Welcome to Human Computer Interaction.



## Roadmap

- Schedule, class rundown
- About me and about you
- The Project
- HCI overview Current readings: Chapters 1 & 17 in Stone et.al.
- Readings next class: Chapters 2 - 7 in Stone et.al.

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The main discussion this week is understanding the project. Please ask questions in main discussion group or send me email.



## Vesonder's Relevant Bio

- Software for 45+ years
- PhD in Cognitive Psychology - Computer modeling of learning and memory
- 6 year graduate research assistant at Learning Research and Development Center
- 3 years as Personnel Sub System Specialist at Bell Labs
- R&D director for AT&T Watson (speech recognition) and Natural Voices TTS
- [Bell|AT&T] labs for 35+ years
- Dozens of projects
- Architecture Reviewer and served software engineering corporate stint at Bell Labs
- Adjunct at University of Pennsylvania (since 2004)
- Industry Professor at Stevens, was an adjunct at Stevens for 12 years
- YOURS? – please introduce yourself in the main discussion group if you have not already

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This bio emphasizes my HCI roots. A Personnel Sub System Specialist in AT&T's jargon is someone doing HCI. I also worked on a large speech recognition and text to speech project.



## Participation

- Class
- Canvas
- GroupMe – social media

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Since this is a large class I am hoping for some great discussions in the discussion section. Also if you find and design oddities in the physical world or in the virtual world – please post in discussion group or provide a url.



## Term Project

- Team of 4-6 folks
- Select a topic that addresses one of these areas: education, gaming, community apps
- conduct session with users about what the needs are -- there should be **data** collection with questionnaires or structured interview, ...
- Decide on a primary "E" that you will focus on improving
- establish personas-construct a low to medium resolution prototype - could be a paper prototype, ...
- do at least one (more is better) iteration testing usability on the user population, perhaps with several versions, **data driven, User Centered Design**
- construct a "final" design based on the results and have working prototype/simulation (android development kit, mockups, ...)
- Demonstrate and present final design, studies and personas in a short power point presentation according to a script presentation that I will provide
- ***The key is to engage, interact, test and collect data from users***

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I am sure this will result in a bunch of discussion – in fact I will establish a discussion group to, errr, discuss! This should not intimidate you. It really is the only way to learn hci- by doing. And please note that it is all about user testing and interacting with users.

## Evaluate User Experience, 5 E's

DIMENSION	KEY NEEDS	Design Tactics
Effective	Accuracy	Focus on places in the interface for potential error and protect against them. Look for opportunities to provide feedback and confirmations
Efficient	Operational Speed	Present only most important information. Work on smooth, direct navigation. Interaction style should minimize actions required
Engaging	Attract users	Consider what aspects of the product are most attractive and incorporate into design
Easy to learn	Just-in-time instruction	Step by step interfaces that help users navigate through complex tasks. Provide training in small chunks if possible
Error tolerant	Validation	Look for places where selection and calculators can replace data entry. Error messages provide opportunities to correct problems

Quesenberry(2003) in Stone, p.109

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These are the E's I discussed on the previous page. Concerning the project. They are fairly obvious and some cannot be co-optimized. There is an old saying in software engineering, projects can be fast, cheap or good – choose 2 of the 3. You can have it fast and good but not cheap or cheap and fast but not good, well you get the idea. For your project I would like you to select one to improve and part of the selection process should be how you can measure the improvement. Not always as simple as you might think.



## Example Project Choices

- Education
  - Learn math game
  - Learn language
  - Learn electronic circuits
  - Learn countries
- Games
  - Educational
  - AI based – player vs game
- Community
  - Public park info
  - Report an issue (pothole)
  - Energy savings
  - Internet of Things IoT

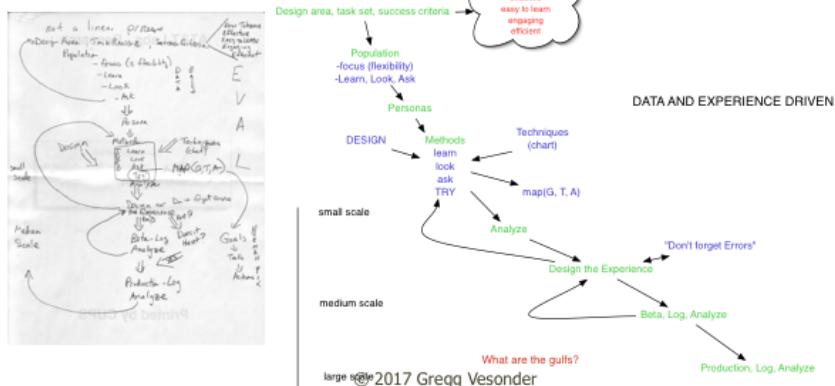
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Some project choices from previous terms

## At The End

- User Experience Design is neither linear nor rigid!



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At one point I was asked by a student to give an overview of the entire usability “process.” The sketch on the left is my original depiction. I cleaned it up on the right. We will go through each of these stages through the semester and review it at the end of the course.



## Physical interfaces and Computer interfaces

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A straightforward way to understand computer interfaces is to understand their physical equivalent.

## Example: Horrid Design

For some reason Coffee Shops excel in this, especially when you are leaving!



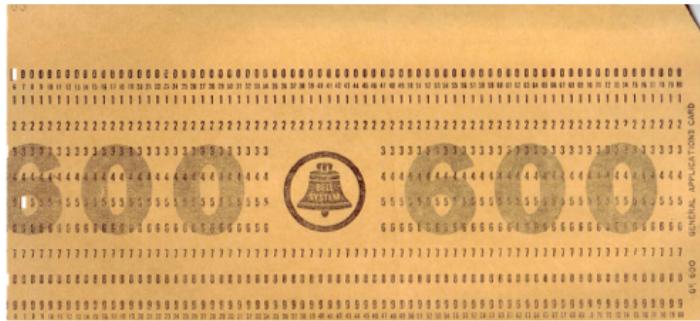
First an abbreviated history of HCI

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And examples of poorly done interfaces are evident in many places in both the physical and virtual worlds. This is a picture taken by one of my students. Why do many coffee shops have you pull the door open as you leave, when your hands are juggling cups of coffee, juice and that precious donut! I realize that it is a convenience for pedestrians -- opening out would block their walk way -- but then that suggests an automatic door or sliding door or ...

## Initial HCI-1



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This was my first human computer interface, it was tangible and fragile – one admonition concerning these cards was – do not fold, spindle (roll up) or mutilate! These next few slides take you through a personal history of the human computer interfaces I experienced.

## Initial HCI-2

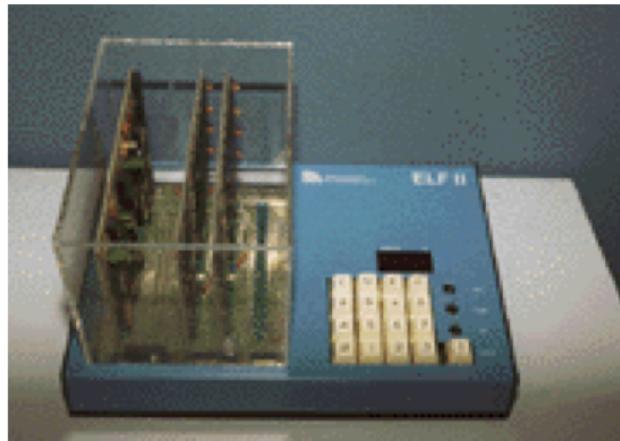


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This was the first computer that I built, it is still in my office at work. I had to toggle the program through the front panel.

## Initial HCI-3



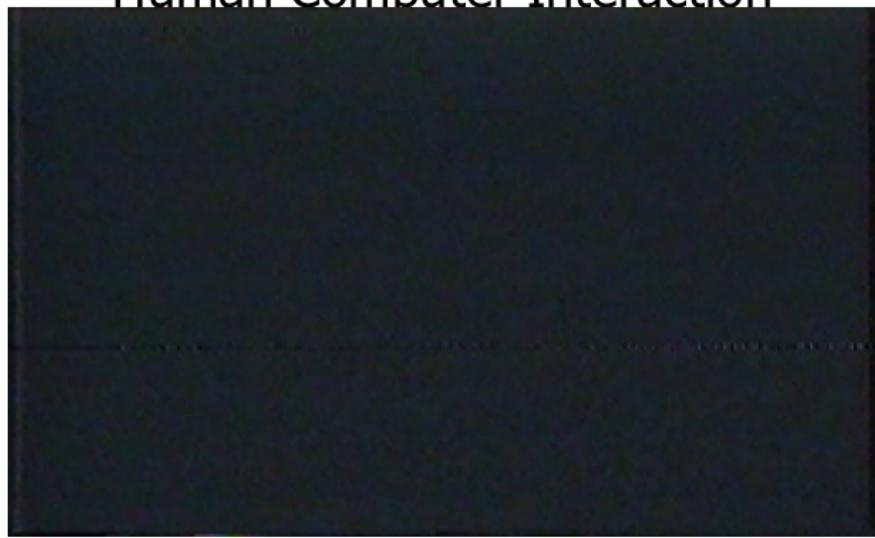
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Kathy gave me this. What an advance! It had a hex key pad to enter programs. Kathy, now my wife, bought this for me as an engagement gift when we were in grad school.



# Human Computer Interaction



**Knowledge Navigator, Apple Computer**

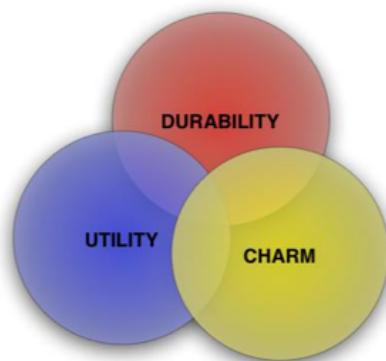
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Check out this video made in 1987. Where did Apple's prediction hit and miss the mark? Our first discussion topic Videos are available in canvas, module 1



## Firmitas, Utilitas, Venustas

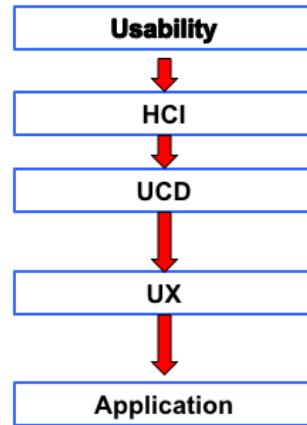


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OUR GOALS – that the user experience we create is robust, useful and enjoyable!

## Disambiguating Terminology



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Basically Usability is about the entire space both physical and virtual but with emphasis on the physical. HCI, Human Computer Interaction deals with humans interacting with computers, usually on a 1 to 1 basis, User Centered Design is focusing on the user as crucial to the design process. User Experience looks at the entire context in which the final application is being used. Note folks differ a bit on their definitions and sometimes say UCD when they mean UX.



## HCI Overview

- Motivation for HCI the Benefits
- Definition of HCI
- Current view of Cognitive Science
- Interaction Design
- User Centered Design
- Evaluation
- Heuristics

Just for grounding

## Why Spend Effort on the UI?

- Increased efficiency
- Improved productivity
- Reduced errors
- Reduced training - strive for game like training
- Improved acceptance

What follows are some slides that elaborate on the 5 E's we have seen previously.  
Again, in most instances we should focus only on 1 or a few of them

## Military Definition

- This definition emphasizes the benefits
- US Military Standard for Human Engineering Design Criteria (1999):
  - Achieve required **performance** by operator, control and maintenance personnel
  - **Minimize** skill and personnel requirements and training time
  - Achieve require **reliability** of personnel-equipment/software combinations
  - Foster **design standardization** w/in and among systems

Fairly self explanatory and it makes sense that the military would emphasize these characteristics

## Yet Another Definition

- But then there are other approaches and motivations
- Raskin: An interface is humane if it is responsive to human needs and considerate of human frailties
  - Boot up - that the user should not be kept waiting unnecessarily is an obvious and humane design principle
  - Users should set the pace of interaction
  - Windows - hitting start to shutdown
- Asimov paraphrase: "A computer shall not harm your work or, through inaction, allow your work to come to harm"
- A computer should not waste your time or require you to do more work than is strictly necessary



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Raskin was the creator of first mac interface. I like the term humane design

## Asimov's Laws of Robotics

- (A soon to be recurring motif that the best interface may be none, with precautions)
- 0. A robot may not injure a humanity or, through inaction, allow humanity to come to harm.
- 1. A robot may not injure a human being or, through inaction, allow a human being to come to harm, except where that would conflict with the Zeroth Law.
- (old 1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.)
- 2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.
- 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

And for completeness, here are Asimov's original laws of robotics, which hopefully detail the boundaries of human computer interaction ☺, the singularity notwithstanding. For those who do not understand the singularity reference, [http://en.wikipedia.org/wiki/Technological\\_singularity](http://en.wikipedia.org/wiki/Technological_singularity).



## YAD

- Stone, et.al.: "... how humans interact with computer systems."
  - Computer system is broadly defined
- Good user interfaces
  - Easy to use
  - Easy to understand
  - Meets users needs
  - Support users tasks
  - Encourages an easy, natural and engaging interaction
  - A safe system
- To users the interface is often the system

Yet another definition

## Interaction Design

- Identify needs and establish requirements for the user experience
- develop alternative designs that meet the requirements
- Build interactive versions of the designs so that they can be communicated and assessed
- Evaluate throughout the process what is being built and the user experience it offers

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Again self explanatory, but note the emphasis on user experience – it is much more than just the interaction between the human and the computer. I included this to stress user experience. Social uses of the computer have transformed our view of human – computer interaction.



## Approach to UI

- So how do we get there?
- The user interface is **the system** to the user- not a novel approach, also known as User Centered Design
  - **Cognitive sciences (including "humanities") \***
  - **Artistic Design**
  - **Ergonomics \***
- User Interface is the point of view of the user! Includes hardware and software
- Do not separate design of functionality from design of interface - remember "**User manual first**" (combines functionality and interface) attitude to interface development
- Overlearning is powerful - sometimes RPN is the right thing!
- Mental model (desktop) vs. conceptual model/design model - have to be closely related
- First a bit about ourselves

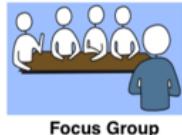
## User Experience!

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What this slide emphasizes is that DESIGN is not paid lip service, it is a critical component and is multi-disciplinary. User manual first, refers to a Japanese technique of producing the user manual before code is written or hardware built, a unique way to emphasize the user. RPN refers to reverse polish notation, e.g., adding numbers by pushing keys in this sequence: 6, 5, + - post fix notation. HP calculators used this extensively and to this day I still often accidentally use port fix key sequence when using standard calculators. First lets discuss the human information processing system.

# HCI Techniques



Focus Group

Side by Side  
(Contextual Inquiry)

Interview



Card Sort



Participatory Design



Paper Prototyping



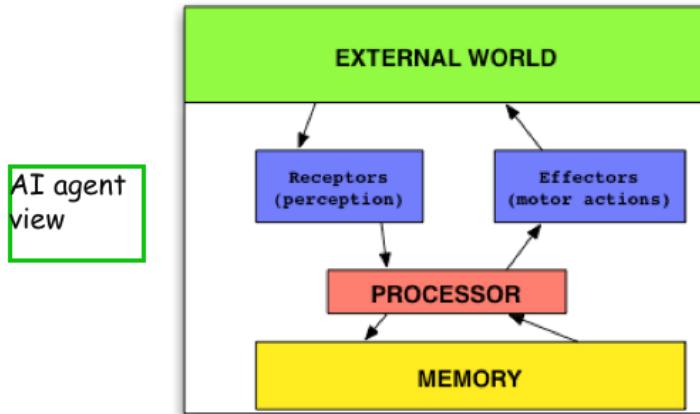
Usability Test



Data Analysis

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## Human Information Processor

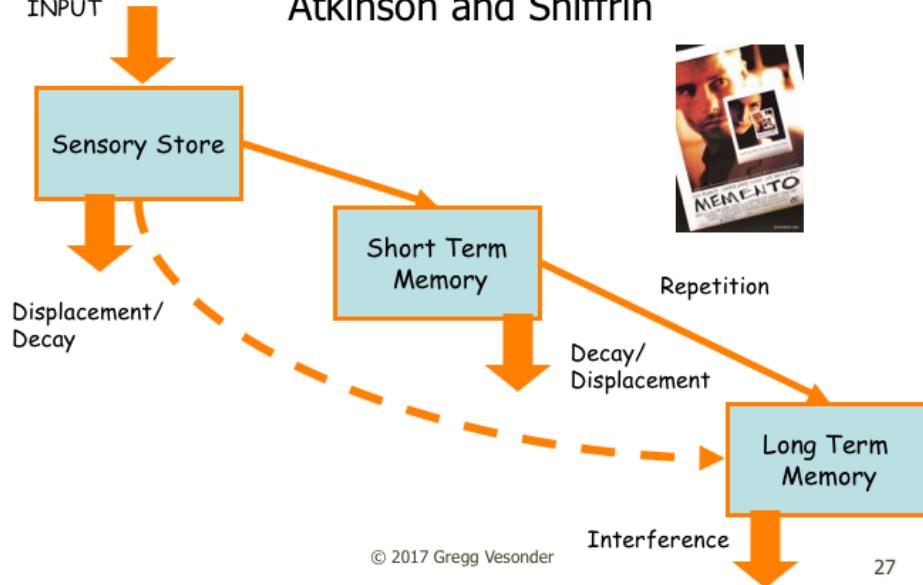


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So let's get into who we are. This is the anatomy of a software agent. In many ways our design of the software agent is based on who we are, but our understanding of who we are has greatly benefited from using an information processing metaphor.

## The Human Information Processing System - Atkinson and Shiffrin



This is a classic model of the Human Information Processing system. The Atkinson-Shiffrin model is similar to most and one that I especially like. Your sensory store could be your eyes, ears or even touch. The input decays or is displaced very rapidly. It is also placed into short term memory (memory that you would use to remember a telephone number from the phone book to dialing, for those of you that remember using a phone book). Things stay in short term memory if you repeat them and after a while, with sufficient repetition, they may be entered into long term memory (there are other ways to enter long term memory but this is sufficient for our purposes). Many aspects of this model have been verified by experimental results.

This simple model provides you with some insight into how to design interfaces. For information that you would like the user to work with, it must be present continuously, since it decays very rapidly. This suggests a visual interface rather than an auditory interface. This begins to give you a flavor of how psychologists work from their knowledge of how the mind works to a knowledge of how best to design systems -- we will discuss this more later.

A great movie that explores the link between short term and long term memory is *Memento* - worth renting sometime.

## Human Information Processing System

- Maintenance rehearsal vs. elaborative rehearsal -- depth of processing improves memorability
- Forgetting
  - Repression - Freud
  - Interference
    - Proactive - previous memories
    - Retroactive - later learning

So this elaborates on the Human Information Processing story. The more actively one works to remember, by associating the item with other cues, the stronger the memory. For example Mr. Amber has red hair, the red hair cuing his last name, Amber. There have been many theories about how things are forgotten. Freud claimed that folks repressed memories because they did not want to deal with them. Many modern information theorists feel it is an interference problem that previous memories interfere with new memories – I often call a restaurant I occasionally dine at the Magic Mushroom when its real name is the Mellow Mushroom, since as a child of the Hippie Era we discussed Magic Mushrooms a lot. Retroactive interference is the opposite, something new interferes with the old memory. In this case I would begin calling psychedelic magic mushrooms, mellow mushrooms!

## Stroop Test

<b>BLUE</b>	<b>GREEN</b>	<b>YELLOW</b>
<b>PINK</b>	<b>RED</b>	<b>ORANGE</b>
<b>GREY</b>	<b>BLACK</b>	<b>PURPLE</b>
<b>TAN</b>	<b>WHITE</b>	<b>BROWN</b>

Interference between the memory systems  
What color are the words?

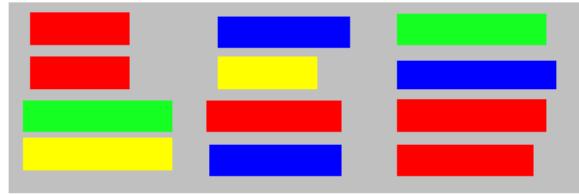
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What are the colors?      Read the words

Conflict between short term memory and long term memory .. Native English speakers can read the words faster than they can name the colors. This is interesting since recognizing colors has some very basic evolutionary value!

## Stroop Test



Interference between the memory systems  
What color are the words?

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What are the colors?      This is a much easier task and serves as a control group for the other slide

## Stroop Results

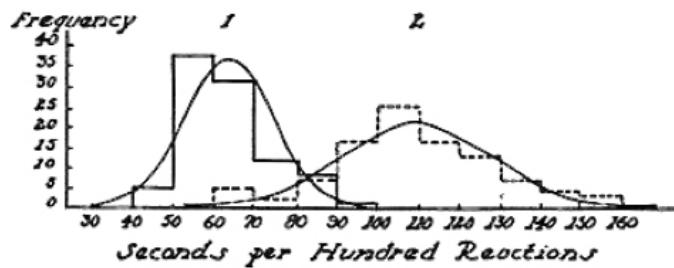
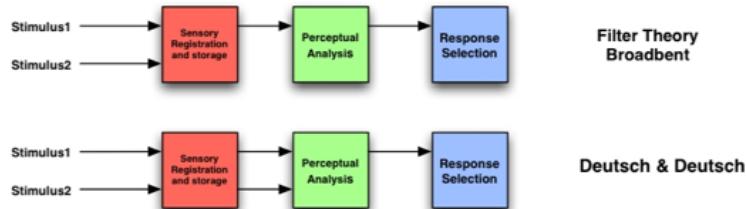


FIG. 1. Showing the effect of interference on naming colors. No interference (1); interference (2).

This was the original study, stating the color of the block (previous slide), represented as curve 1 is much easier than stating the color of the word, represented as curve 2. The word interferes with naming the color, the memory is so strong for it.

# Your Attention Please!

**Models of Selective Attention**  
Kahneman(1973)

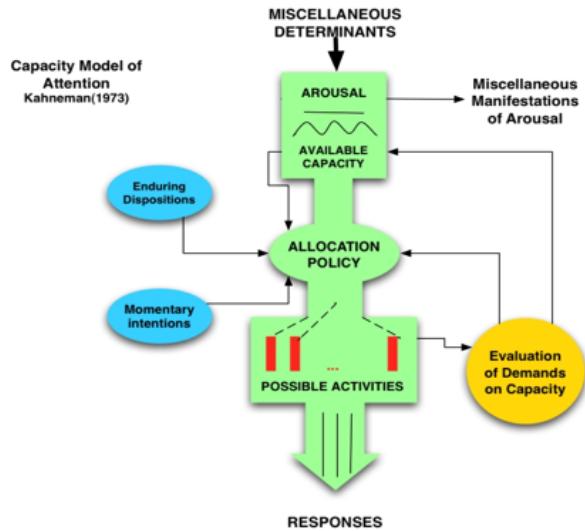


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There are many theories of attention – the key is that we may attend a lot sooner than you think. One frequent example of this is the cocktail party phenomenon – you are at a party and someone in another group nearby says your name. Although you are not listening to the conversation you instantly turn and attend when someone says your name.

## Saturated Yet?



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The beauty of this artwork is that it illustrates that attention has limited capacity. You can only attend to so many things (remember that next time you text while driving) and this is affected by your state. For example your attention is not as good when you are tired or inebriated.



## Attention and Multi-taskers

<http://www.youtube.com/watch?v=2zuDXzVYZ68>

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Check out this video exploring attention and multi-taskers. Also available in canvas in the module with this lecture



## Psychological Principles

- Working memory (STM) is only around 5 - auditory tasks depend on working memory
- Long Term Memory is slow and things may be available but not accessible - multiple coherent cues make it easier
- Attention can be overloaded and depends on the state of the individual
- Recognition is easier than recall
- Remember issues of Just Noticeable Differences, JNDs
- Expert Novice distinctions are a factor in enjoyment of the system

The next few slides provide a few items that researchers have discovered about memory, some of it summarizes what we already discussed but I thought it was great to put it in one place, so that, well you can remember. Besides repetition helps you to remember too!

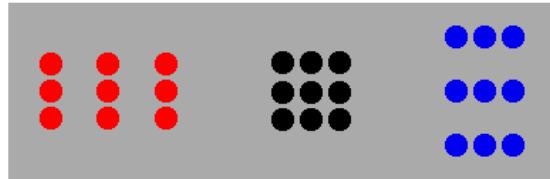


## More Principles

- Humans receive more information through visual system and store it spatially -- mental rotation studies, the more rotation, the longer to respond
- Humans tend to structure what they see to form cohesive patterns -- 5 Gestalt laws
  - **Proximity** - we tend to group things together that are close together in space
  - **Simularity** - we tend to group things together that are similar
  - **Continuation** - we tend to perceive things in good form
  - **Closure** - we tend to make our experience as complete as possible
  - **Figure and ground** - we tend to organize our perception by distinguishing between a figure and a background

Gestalt psychology studied how we perceive and complete patterns. These principles have important implications in design

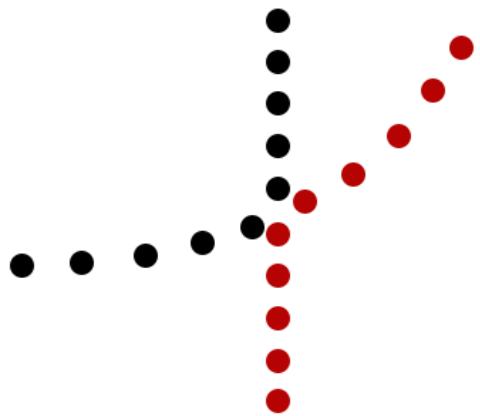
## Proximity



Thanks to Psy280 notes from Toronto!

In each instance we see groups of dots not individual dot, humans use proximity to group things. Why is this important? Take a look at your tv remote control. Do you think it is well designed? Usually well designed controls have clearly perceived groupings and the items in these groupings “belong” together because they support a specific function.

## Continuation



<http://www.vanseodesign.com/web-design/gestalt-principles-of-perception/>

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Most folks automatically see a curve and straight line even though the dots change color, we tend to continue shapes and forms, our perceptual system works to complete familiar patterns.

## Figure - Ground



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This is a true classic – what do you see in this picture, the figure, a vase or the “ground,” the background, two faces staring at each other. It is part of focusing our attention, on the whole scene or just an element. Think how we do so, when driving for instance or focusing and defocusing a camera – focusing on a particular person blurs the rest – we can allocate more attention to it.

## An example



Thanks ebay!



Thanks tivo.com!

At the very least these remote controls illustrate the presence or lack of grouping and similarity.



## Still More Principles

- **Multimodal information** is easier to use than single mode (text + image + sound) increasing the richness of memory -- similar to mnemonic tricks such as the method of loci -- depth of processing!

Another memory aid is the Method of loci (from wikipedia)

To use the method of loci bring to mind a familiar building, such as your house. Take a moment to conduct a mental walk through the rooms in your house. Pay particular attention to the details , noticing any imperfections, like scratches: anything that makes your mental images more vivid. Make sure you can move easily from one room to another.

Along your route create a list of "loci" :i.e. well defined parts of the room that you can use later to memorize things. A locus can be a door, a bed, a oven, etc. Be sure that you can easily go from locus to locus as you visit the house.

Now, when you are faced with a list of words or ideas to be memorized, you must form visual images for each of the words and place them, in order, on the loci in your route. To recall the words or ideas now you take a mental walk throughout your house, asking yourself , "What is on the living-room door? What's on the sleeping room bed. What's in the oven?" And so on.

Associating the words or ideas to remember with the loci, you should create surprising images. More striking is the created image, more easily you will remember the thing.

This is all about the method! What follows is, instead, just a short FAQ if you are curious about what is behind this method.

Who invented the Method of loci?

According to Cicero's *De Oratore*, the Greek poet, Simonides, invented it. The legend says that Simonides escaped a disaster that destroyed the building where he was having a dinner with other dignitaries. He was able to name the victims by recalling where they had been seated.

# Cognitive and Perceptual Abilities

(we just scratched the surface in our discussion and will cover more as appropriate)

- Human cognitive processes
  - Short term memory
  - Long term memory and learning
  - Problem solving
  - Decision making
  - Attention and set (scope of concerns)
  - Search and scanning
  - Time perception
- Factors affecting perceptual and motor performance:
  - Arousal and vigilance
  - Fatigue
  - Perceptual (mental) load
  - Knowledge of results
  - Boredom and monotony
  - Sensory deprivation
  - Sleep deprivation
  - Anxiety and fear
  - Isolation
  - Aging
  - Drugs and alcohol
  - Circadian rhythms

Some more useful lists, the left lists cognitive processes, the right, what affects them



# PAR

- Is your user experience up to PAR?
- Perception
- Attention
- Retention

This is one slide that will be repeated frequently. I have tried to provide an aid to evaluate the psychological aspects of your user experience and it led to this.

## Maslow's PYRAMID

Needs needed  
to be met -  
ideas for  
reinforcers and  
motivation



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Motivation is still not well understood in psychology, but what drives our behavior, focus, attention depends on what are life state is. We focus differently when we are sitting at home versus being a soldier in Afghanistan.

## Other Psychological Differences

- Personality differences, gender, cultural --  
be sensitive to names: Kill, abort, master, slave
- Myers-Briggs Type Indicator no wrong answer ([example of personality tests](#)):
  - Extroversion-introversion
  - Sensing vs Intuition
  - Perceptive vs Judging
  - Feeling vs thinking
  - Matching personality types to professions, [example of psychological scales](#), there are many of them!

Of course part of the user experience is understanding what is offensive to others. It also is good to understand your audience. How would you design a party for the Stevens soccer team versus a group of Stevens professors?

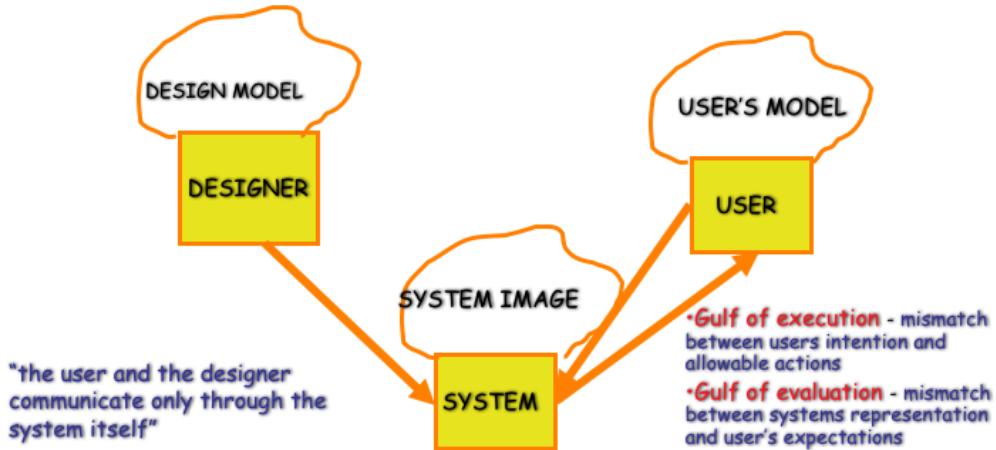


## OPD-2

- Cultural and International Diversity
  - Still largely unexplored but important in international market
  - **Respect for tradition vs novelty**
  - Japanese, Chinese may scan screen in different order
  - Sampling of other international issues:
    - Numeric (.,) and currency formats
    - Weights and measure
    - Names and titles
    - National identification
    - Etiquette, policies, tone, formality
    - Government regulations
    - Surfaces in out sourcing too
  - On to design

More psychological differences – the experience needs to be tailored to the country and this affects small things such as decimal markings to naming and also being sensitive to the laws of the country.

## Knowledge in the World and in the Head



The Design Challenge

Norman!

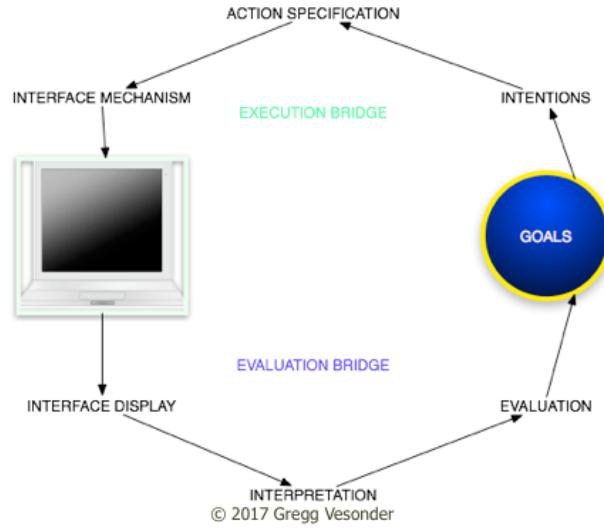
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The bottom line is that the designer has a view of how the user should interact with the system. But unfortunately the designer is not there when the user interacts with the system . So the designer has to work hard to make sure the system contributes to the formation of a User's model that is equivalent to the designer's model. The designer wants to avoid both the gulf of execution and the gulf of evaluation -- Users should understand what is the appropriate

action at any given state and the system should permit the user to do the action. When the user does the action the system should respond predictably.

## Bridge the Gulfs



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Yet another way to view the gulfs note that you form a plan of action based on your goals and the evaluation compares what occurred with the goals.



## Secret Sauce (Sharp,et.al.)

- Taking into account what people are good and bad at
- Considering what might help people with the way they are currently doing things
- Thinking through (and acting through) what might be a quality user experience
- Listening to what people want and getting them involved in the design - What a concept!
- Using "tried and tested" user based techniques during design

## Some Heuristics

## Course Aspirations

At the end of the course you should have a heightened appreciation of interfaces to the real and virtual worlds and an understanding of how to make them better for yourself and others.

We will evaluate at the end to see if these goals were met

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