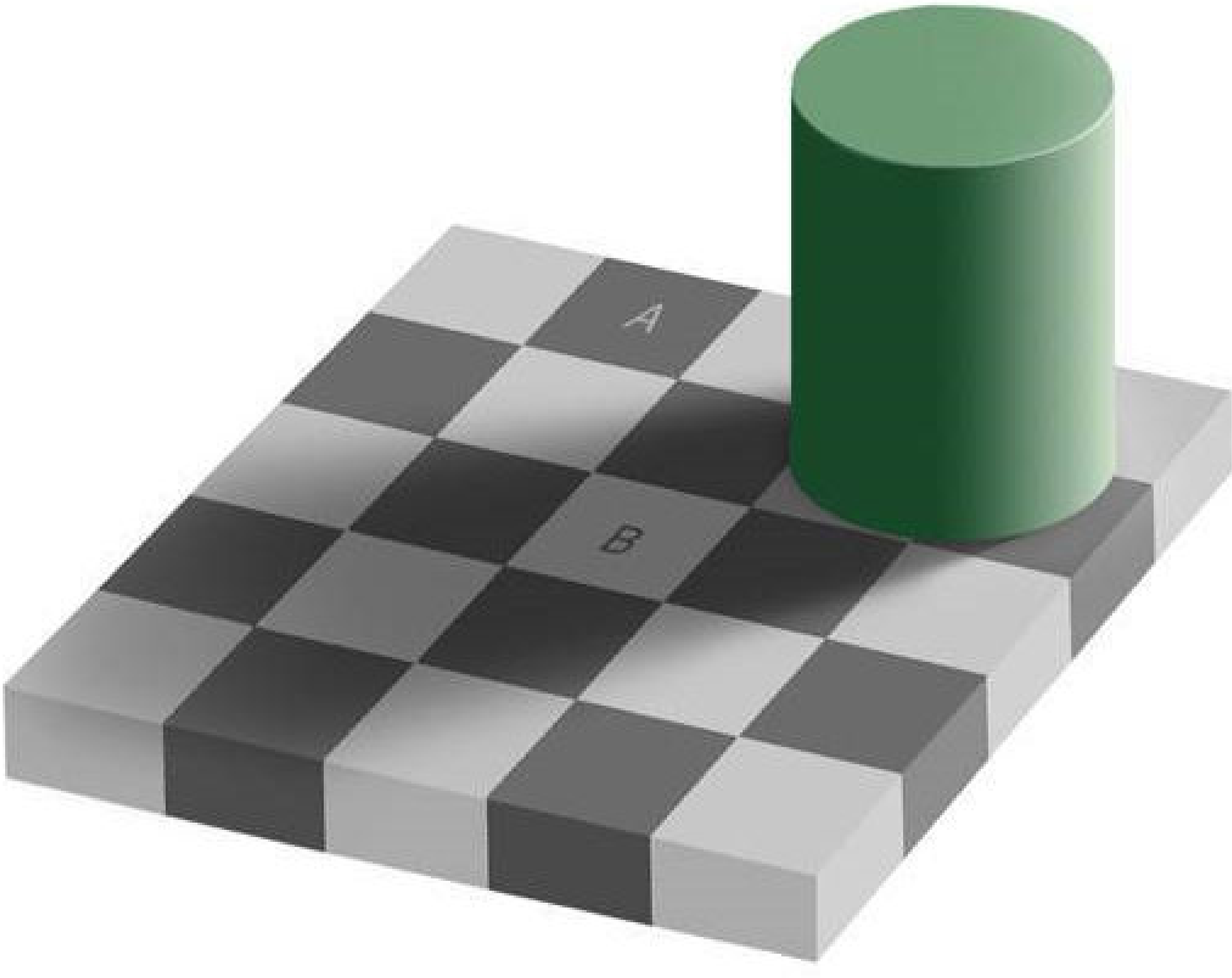
Human Computer Interaction

CSCI 4620U| SOFE 4850U | CSCI 5540G

Dr. Christopher Collins

Lecture 4: Humans

Acknowledgement: Parts of these lectures are based on material prepared by Ron Baecker, Ravin Balakrishnan, John Chattoe, Ilona Posner, Scott Klemmer, and Jeremy Bradbury.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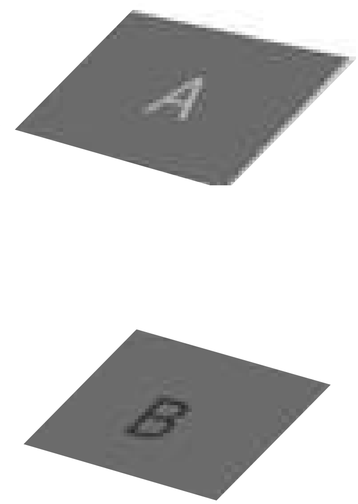
A
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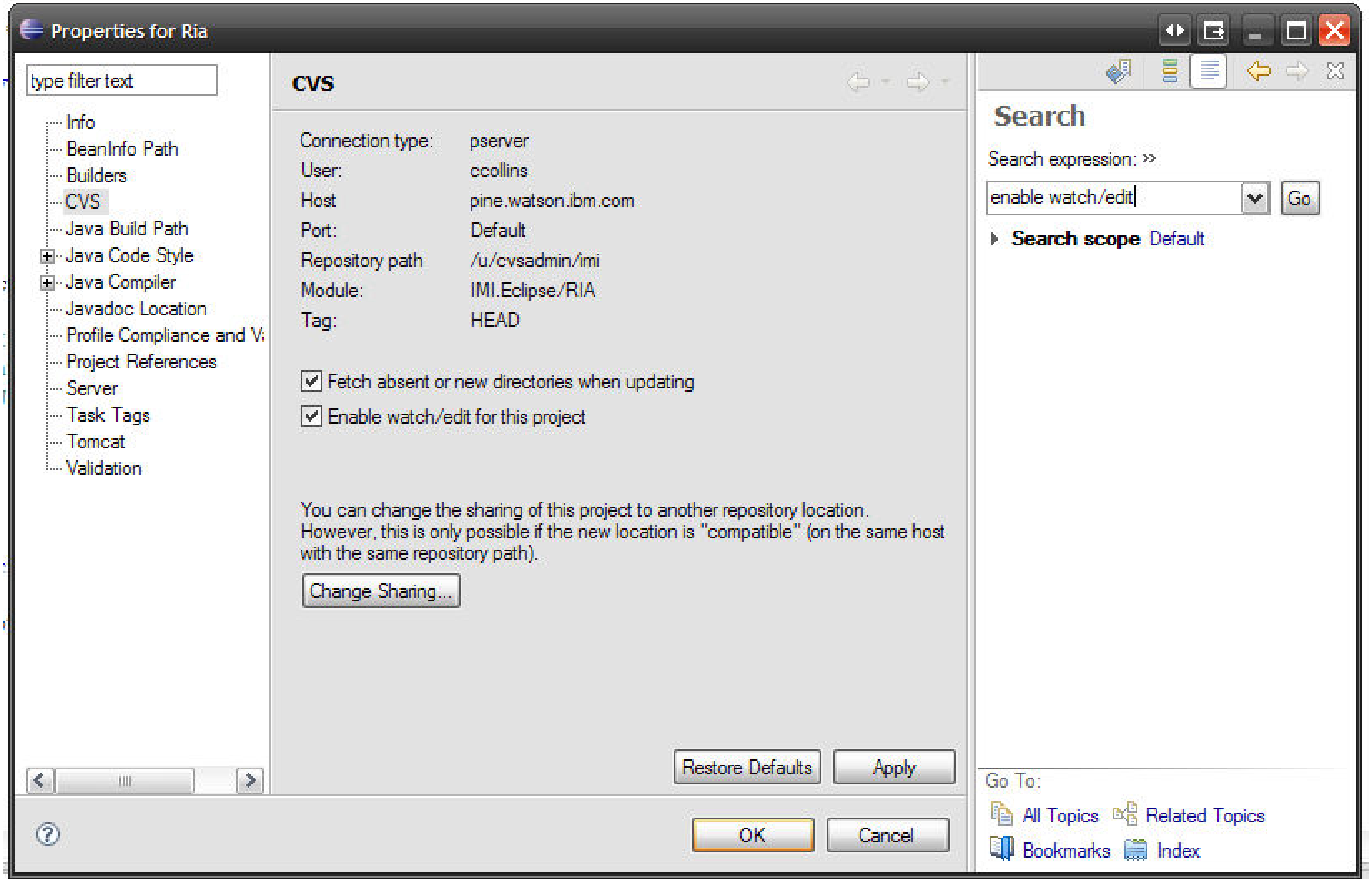
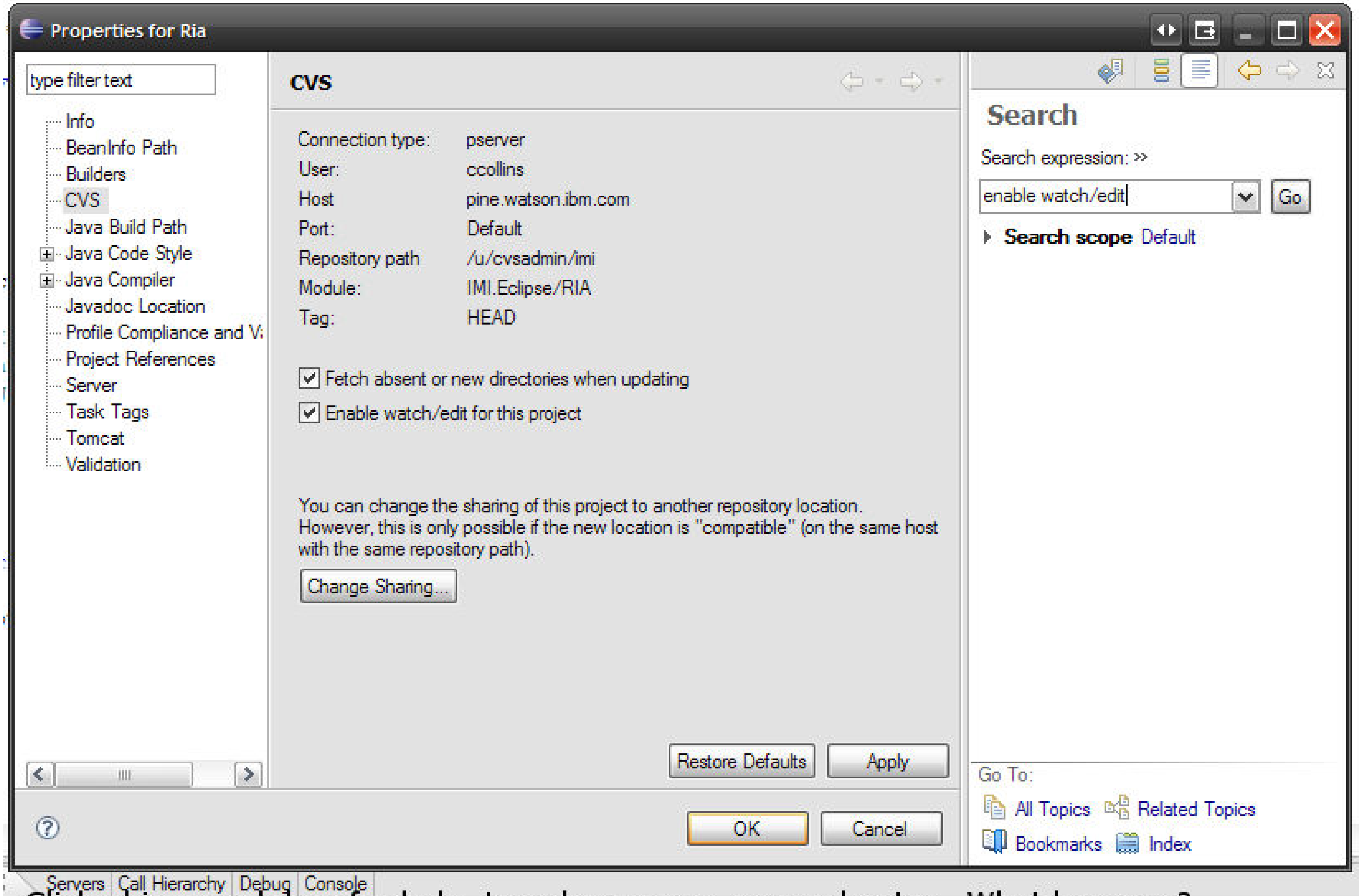
2008.

- **Munteanu, C.**, Penn, G., Baecker, R., Web-Based Language Modelling for Automatic Lecture Transcription. In *Proceedings of the Tenth European Conference on Speech Communication and Technology - EuroSpeech / Eighth INTERSPEECH*, Antwerp, Belgium, August 2007.
- **Munteanu, C.**, Penn, G., Baecker, R., Zhang, Y., Automatic Speech Recognition for Webcasts: How Good is Good Enough and What to Do When it Isn''t In *Proceedings of the Eight International Conference on Multimodal Interfaces - ICMI*, Banff, Alberta, Canada, November 2006.
- **Munteanu, C.**, Baecker, R., Penn, G., Toms, E., James, D., Measuring the Acceptable Word Error Rate of Machine-Generated Webcast Transcripts. In *Proceedings of the Ninth International Conference on Spoken Language Processing - ICSLP / Seventh INTERSPEECH*, Pittsburgh, Pennsylvania, USA, September 2006.
- **Munteanu, C.**, Baecker, R., Penn, G., Toms, E., James, D., The Effect of Speech Recognition Accuracy Rates on the Usefulness and Usability of Webcast Archives. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI*, Montreal, Canada, 2006. (**Best of CHI Nominee.**)
  (© ACM, 2006. This is the author's version of the work. It is posted here by permission of ACM for your personal use. Not for redistribution. The definitive version is published in "The Proceedings of the SIGCHI Conference on Human Factors in Computing Systems – CHI 2006")
- **Munteanu, C.**, Penn, G., Optimizing Typed Feature Structure Grammar Parsing through Non-Statistical Indexing. In *Proceedings of the 42nd Annual Meeting of the Association for Computational Linguistics - ACL*, Barcelona, Spain, 2004.



Properties for Ria
type filter text
Info
BeanInfo Path
Builders
CVS
Java Build Path
Java Code Style
Java Compiler
Javadoc Location
Profile Compliance and V
Project References
Server
Task Tags
Tomcat
Validation
CVS
Connection type: pserver
User: ccollins
Host pine.watson.ibm.com
Port: Default
Repository path /u/cvsadmin/imi
Module: IMI.Eclipse/RIA
Tag: HEAD
Fetch absent or new directories when updating
Enable watch/edit for this project
You can change the sharing of this project to another repository location. However, this is only possible if the new location is "compatible" (on the same host with the same repository path).
Change Sharing...
Restore Defaults
Apply
OK
Cancel
Search
Search expression: »
enable watch/edit
Go
Search scope Default
Go To:
All Topics
Related Topics
Bookmarks
Index



Clicked in search box for help, typed message, pressed enter. What happens?

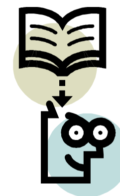
Button focus is not updated when click in text field!

Paris in the the spring	Once in a a lifetime	A bird in the the hand

Paris in the the spring	Once in a a lifetime	A bird in the the hand

- Perceptual set refers to the effect of such things as our expectations of a situation, our state of arousal and our past experiences on how we perceive others, objects and situations.
- More than 50 years ago Bruner and Postman (1949) demonstrated a link between expectation and perception.

Today



Benyon text
Chapters 21 & 25

- Characteristics of Humans
  - Senses
  - Memory
  - Reasoning
  - Emotion

The Human-Computer Complex

HUMANS

Are you Machine- or People-Centered?

Machine- and people-centred views

View	*People are*	*Machines are*
Machine-centred	Vague Disorganised Distractible Emotional Illogical	Precise Orderly Undistractible Unemotional Logical
People-centred	Creative Compliant Attentive to change Resourceful Able to make flexible decisions based on content	Dumb Rigid Insensitive to change Unimaginative Constrained to make consistent decisions

Source: Adapted from Norman (1993), p. 224

Introduction I

Overview

- Humans have characteristics and limitations that affect their ability to interact with computers
- Today, we will discuss: vision, hearing, touch.

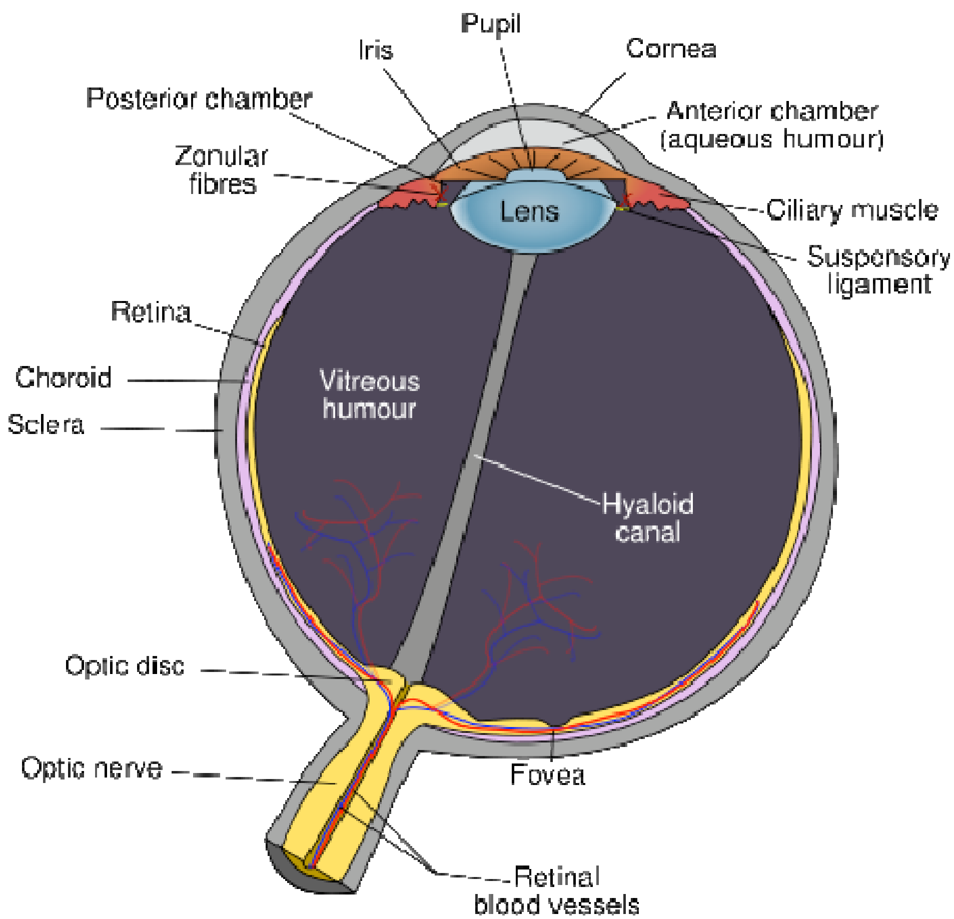
Human Input/Output Channels

- The Five Senses:
  - Sight (Vision)
  - Sound (Hearing)
  - Touch
  - Smell
  - Taste

Human I/O: Vision

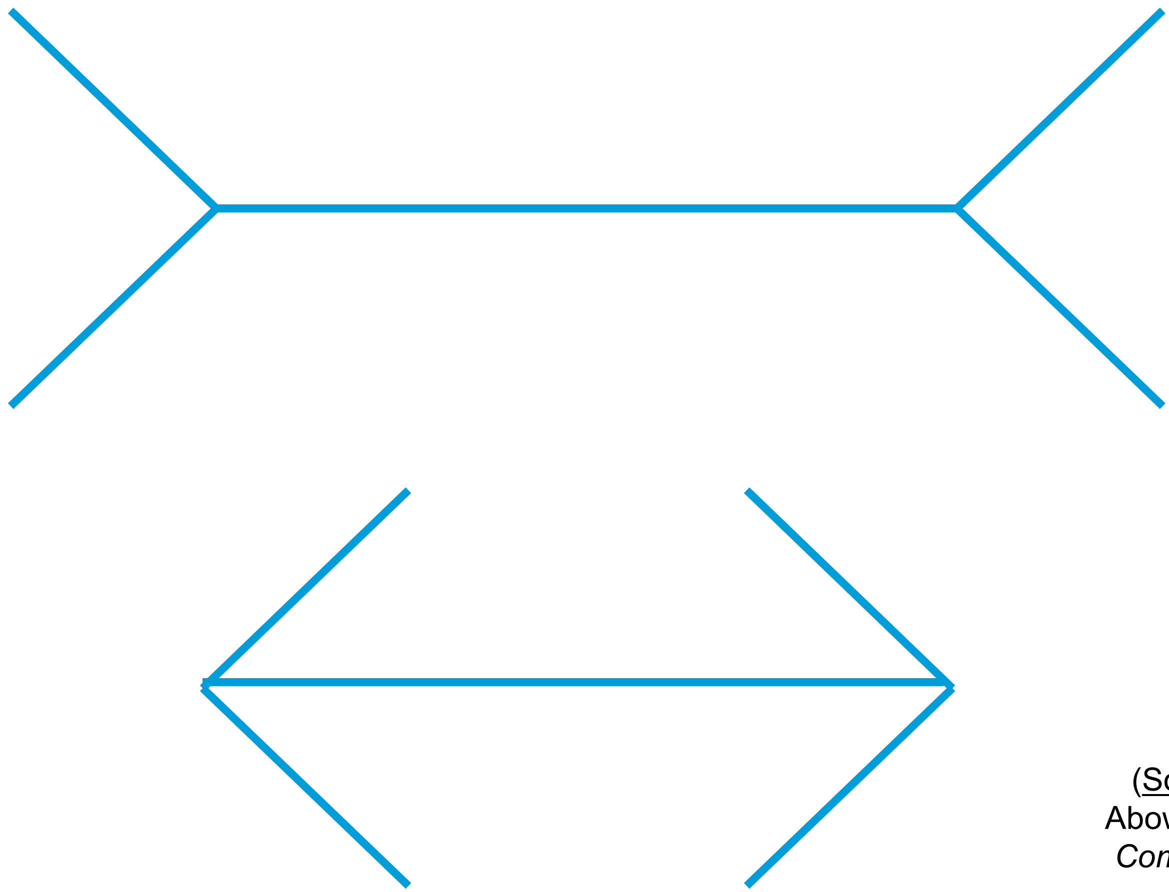
- Two stages:
  - Receiving the visual stimulus
    - The retina has two kinds of photoreceptors:
      - Rods (120 million per eye) – light sensitive and have major role in peripheral vision
      - Cones (6 million per eye) – three kinds each sensitive to a different light wavelength (color!)
  - Processing/interpreting the stimulus
  - We have the ability to perceive: depth, size, brightness and color
    - However there are limits…

Human I/O: Vision



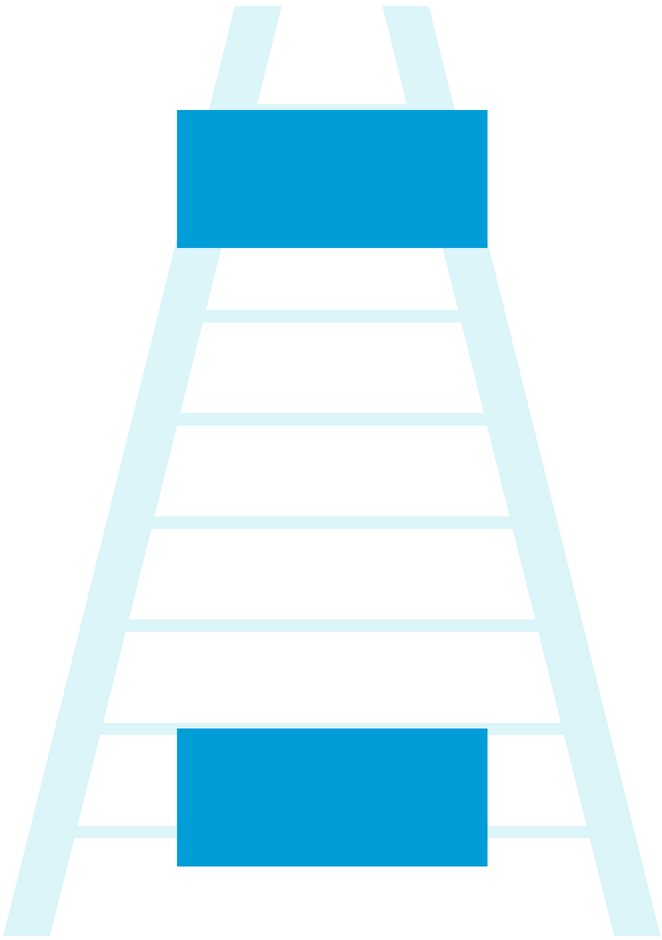
(Source: Wikipedia - http://en.wikipedia.org/wiki/Image:Schematic_diagram_of_the_human_eye_en.svg)

Human I/O: Vision



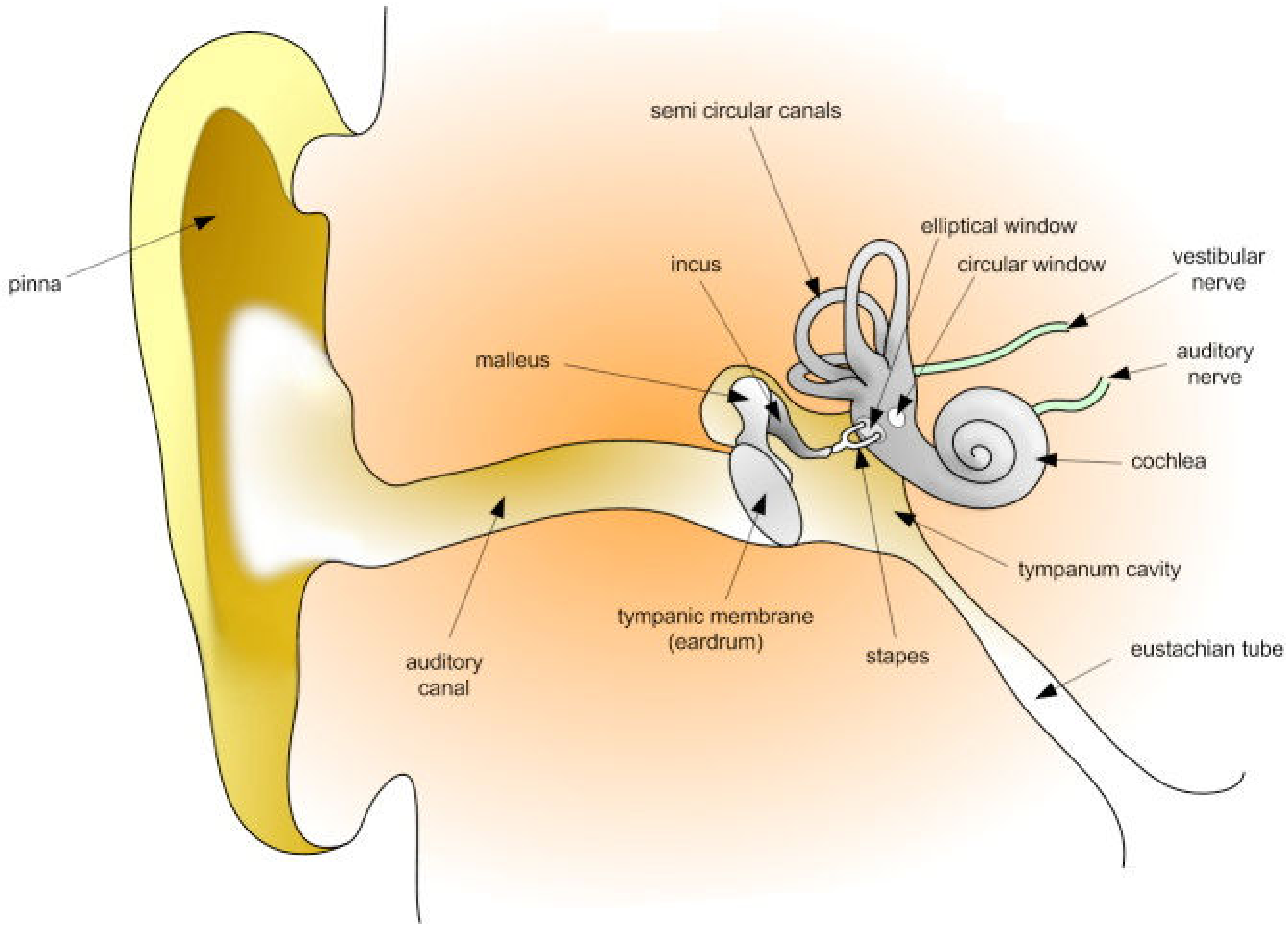
(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

Human I/O: Vision



(<u>Source</u>: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

Human I/O: Hearing



(Source: Wikipedia - http://en.wikipedia.org/wiki/Image:HumanEar.jpg)

Human I/O: Hearing

- We can differentiate:
  - Pitch (frequency)
  - Loudness
  - Kinds of sounds
- We are capable of selectively filtering out background noise (the "cocktail party effect")

Human I/O: Touch

- Touch is referred to as haptic perception
- The skin has 3 kinds of receptors:
  - Temperature (thermoreceptors)
  - Pressure/heat/pain (nociceptors)
  - Pressure (mechanoreceptors)
    - Rapidly adapting mechanoreceptors
    - Slowly adapting mechanoreceptors

Human I/O: Touch

- Can you see the difference?

(Sources: Wikipedia - http://en.wikipedia.org/wiki/Image:Several_mobile_phones.png
Apple - http://www.apple.com/iphone/features/homescreen.html)

Human I/O: Touch

- Can you see the difference?

(Sources: Wikipedia - http://en.wikipedia.org/wiki/Image:Several_mobile_phones.png
Apple - http://www.apple.com/iphone/features/homescreen.html)

Human I/O: Touch

- Kinesthesis – our bodies (and limbs) know where they are!
- Joint receptors
  - Rapidly adapting (respond to movement)
  - Slowly adapting (respond to movement and static position)
  - Positional receptors (respond to static position)

Scenarios which use kinesthesis?

Human I/O: Touch

- Movement – our ability to move has a direct impact on our interaction with computers
- We can measure our movement abilities in terms of:
  - Reaction time
  - Accuracy

Fitts' Law

- Movement
  - Calculates the time required to hit a target (with a set size) given the distance that has to be traveled to reach the target.

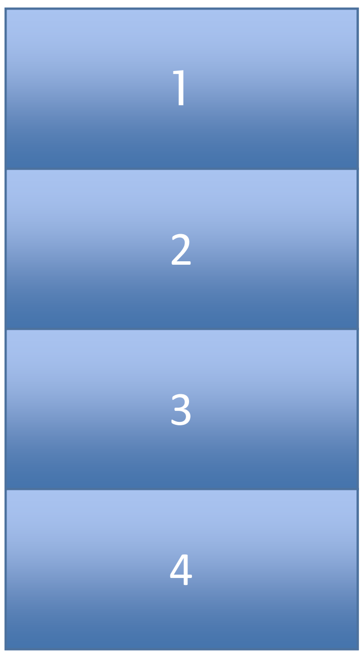
$$\text{Movement time} = a + b \log_2((\text{distance}/\text{size}) + 1)$$

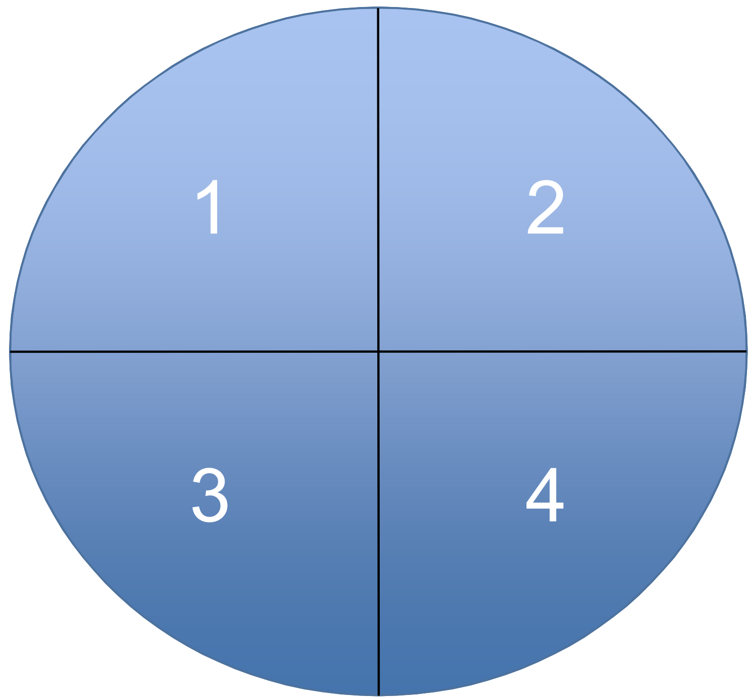
Where a and b are constants

Memorize!

Human I/O: Touch

- Which is better? Why (*<u>hint</u>:* think Fitts' Law)?





Design informed by Fitts' Law

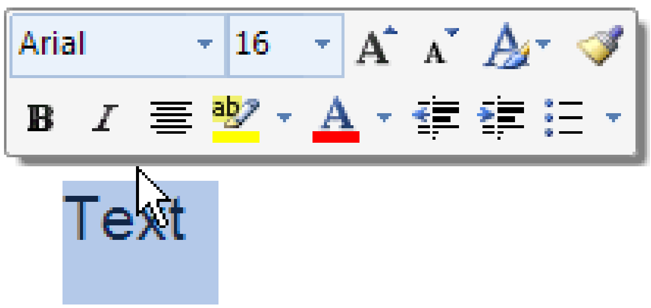
- The position of the start menu button was improved to go all the way to the corner – an improvement predicted by Fitts' Law (how?)

Windows 95: Missed by a pixel
Windows XP: Good to the last drop

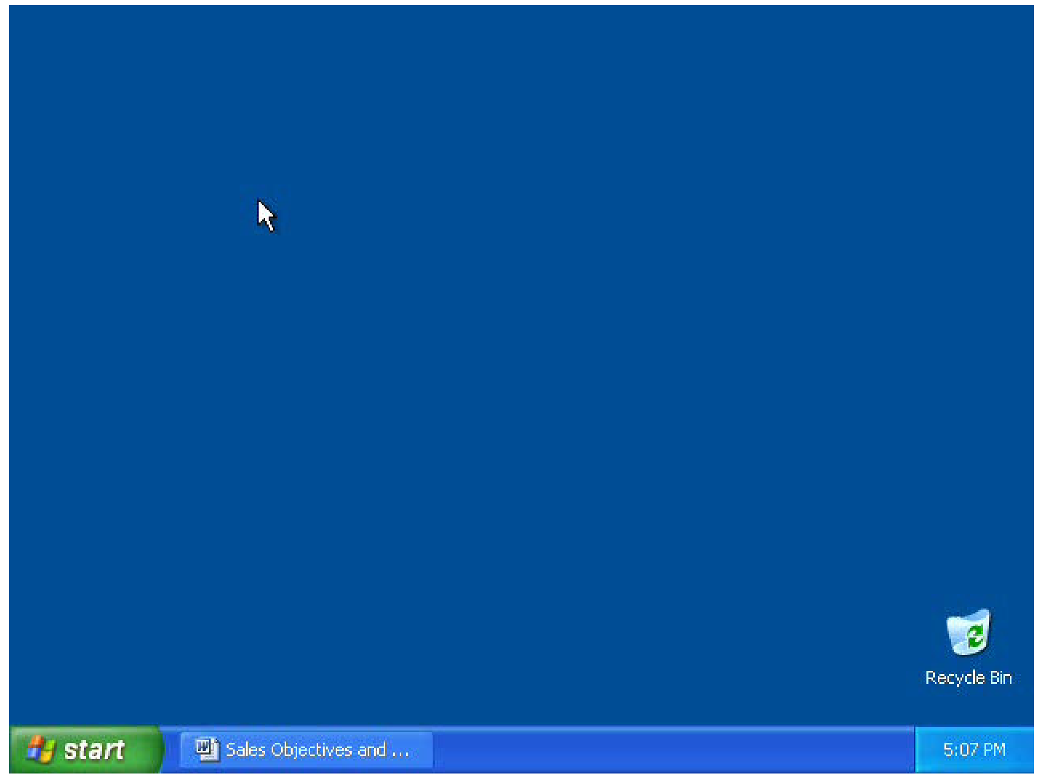
http://blogs.msdn.com/b/jensenh/archive/2006/08/22/711808.aspx

Design informed by Fitts' Law

- Popup menus in Office lower *D*



Mini Toolbar: Close to the cursor



http://blogs.msdn.com/b/jensenh/archive/2006/08/22/711808.aspx

Human Memory

Model of memory structure
(<u>Source</u>: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction")*

- We have three kinds of memory: sensory, short-term and long-term
- Information can be passed from one kind of memory to another

Table 22.1 A summary of the structure of memory

Main components	*Key processes associated with this particular store*
Sensory stores The **iconic** store (visual) and the **echoic** store (auditory) are temporary stores where information is held before it enters working memory.	The contents of these stores are transferred to working memory within a fraction of a second.
Working memory (WM) Working memory is made up from three key elements: the **central executive**, the **articulatory loop** and the **visuo-spatial sketchpad**. The central executive is involved in decision making, the articulatory loop holds auditory information and the visuo-spatial sketchpad, as the name suggests, holds visual information.	**Rehearsal** is the process of refreshing the contents of WM, such as repeating aloud a phone number. The contents of WM are said to **decay** (are lost/forgotten) if they are not rehearsed. Another way of forgetting from WM is **displacement** which is the process by which the current contents of WM are pushed out by new material.
Long-term memory (LTM) Long-term memory comprises the following: **Semantic** memory. This holds information related to meaning. **Procedural** memory. This stores our knowledge of how to do things such as typing or driving. **Episodic** and/or **autobiographical** memory. This may be one or two different forms of memory that are related to memories personal to an individual such as memories of birthdays, graduation or getting married. **Permastore**. This has been suggested by Bahrick (1984) as the name for the part of LTM which lasts for our lifetime. It stores the things you never forget.	**Encoding** is the process by which information is stored in memory. **Retrieval** is the means by which memories are recovered from long-term storage. **Forgetting** is the name of a number of different possible processes by which we fail to recover information.

Benyon p. 470

Sensory Memory

Model of memory structure
(<u>Source</u>: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

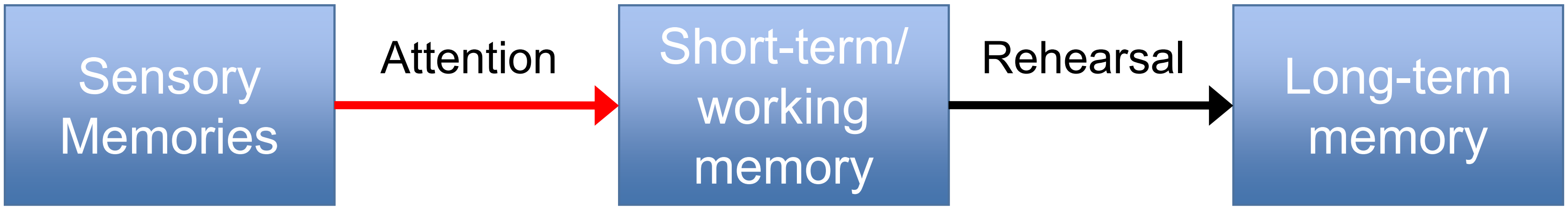
- A buffer for our senses – all of the stimuli from our senses are stored here (for a very short period of time)

Sensory Memory

Model of memory structure
(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

- Visual stimuli ➔ iconic memory
- Aural stimuli ➔ echoic memory
- Touch stimuli ➔ haptic memory

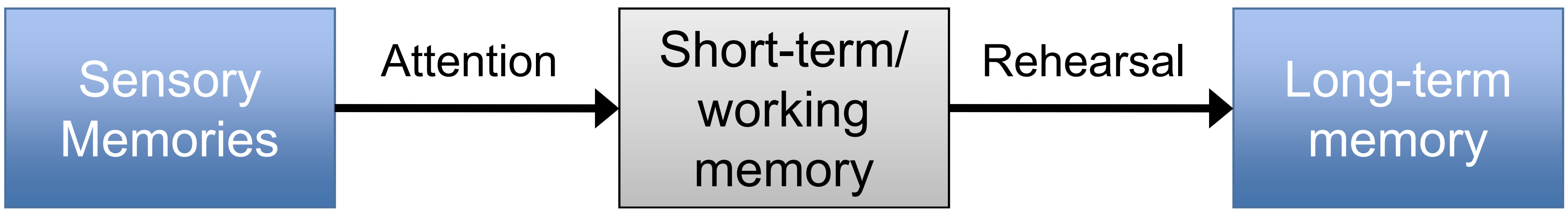
Attention



Model of memory structure
(<u>Source</u>: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction")*

- If we are interested in (pay attention to) stimuli the stimuli will be stored in short-term memory
- If we are not interest in stimuli the stimuli will be overwritten

Short Term Memory



Model of memory structure
(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

- Decays rapidly
- Has a limited capacity
  - 7+-2 chunks, which are ended by closure
  - Familiar patterns can cause seemingly separate pieces of information to chunk, increasing capacity

HEC ATR ANU PTH ETR EET

THE CAT RAN UP THE TREE

Early ATM: Closure Effects

Remember the following numbers….

10528037598204596

Short Term Memory

Model of memory structure
(<u>Source</u>: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

- Decays rapidly
- Has a limited capacity
  - limited number of pieces of information we can recall in any order – recency effect (last words recalled easier than the middle)

Rehearsal

Model of memory structure
(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction")*

- Information in short term memory decays in ~200ms
- Rehearsal allows information in short-term memory to be stored in long-term memory

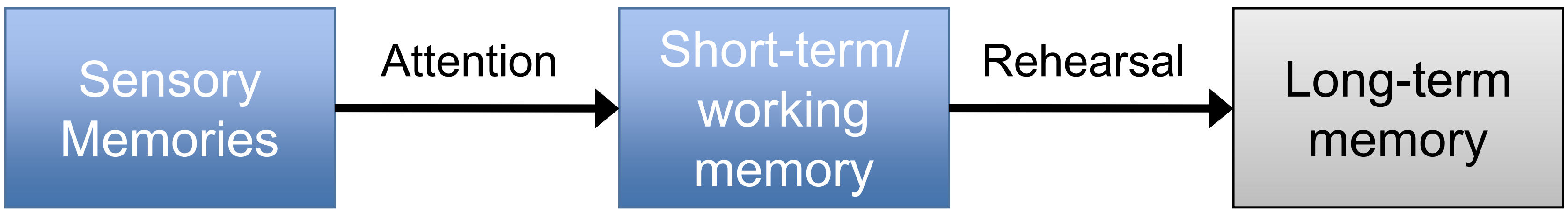
Long Term Memory

Model of memory structure
(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

Long-term Memory

- Possibly unlimited capacity
- Minimum decay of information
- Slow access time ~0.1s

Long Term Memory



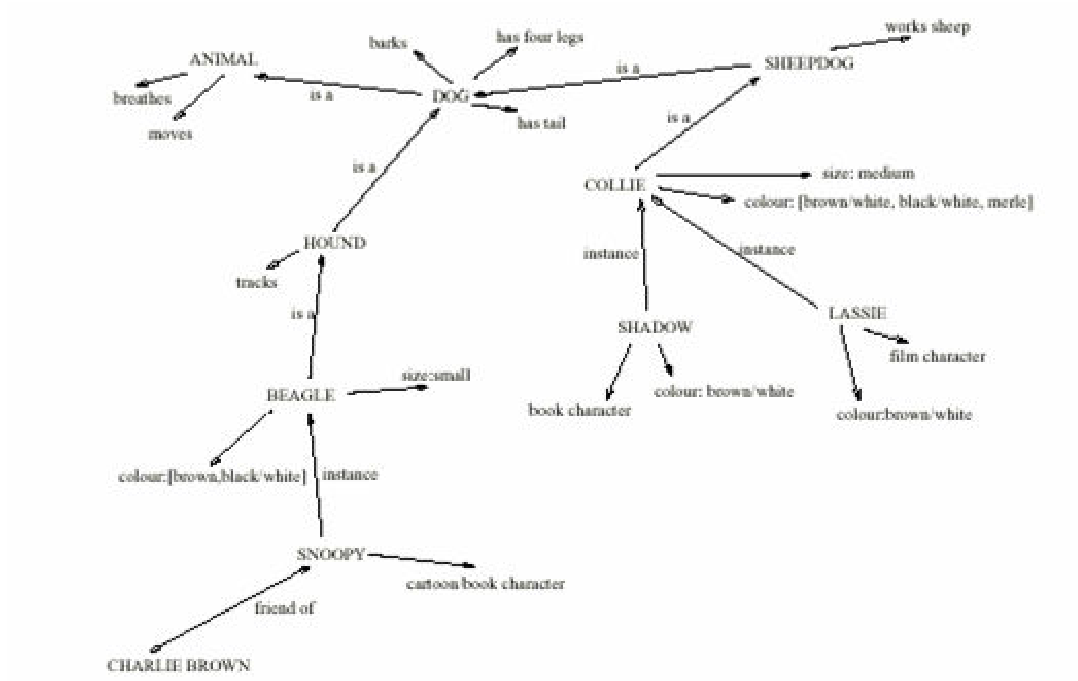
Model of memory structure
(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

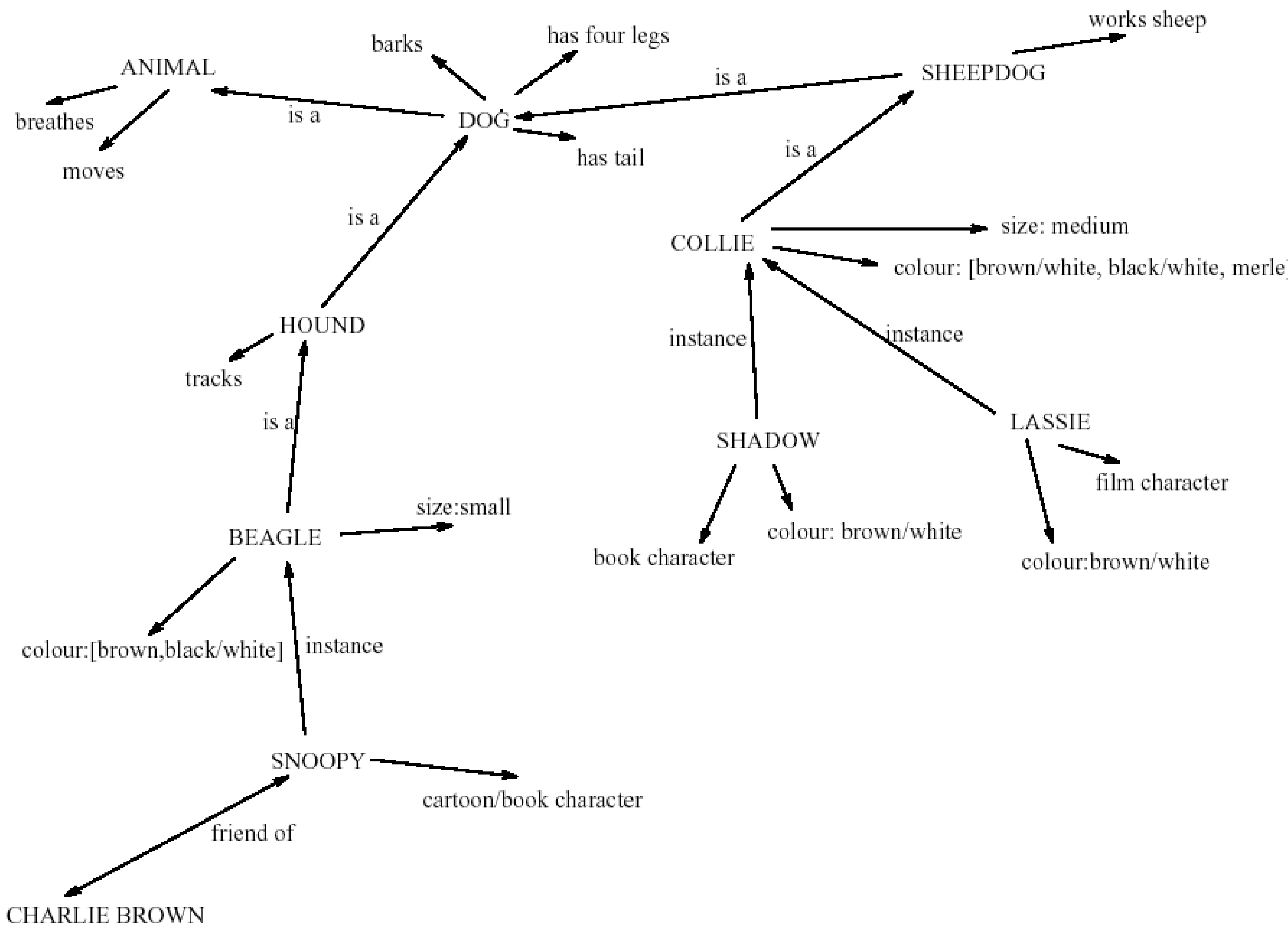
- Serial events/experiences ➔ Episodic memory
- Skills, facts, etc. ➔ Semantic memory

Derived from episodic memory

Memory Structure: Network Model

- Stores general knowledge
- Allows Inference




works sheep
barks
has four legs
ANIMAL
is a
SHEEPDOG
breathes
is a
DOG
has tail
moves
is a
is a
COLLIE
size: medium
colour: [brown/white, black/white, merle]
HOUND
instance
instance
tracks
is a
SHADOW
LASSIE
film character
size:small
BEAGLE
book character
colour: brown/white
colour:brown/white
colour:[brown,black/white]
instance
SNOOPY
cartoon/book character
friend of
CHARLIE BROWN

Memory Structure: Frames

- Stores complex concepts such as behaviours

DOG

Fixed
    legs: 4
Default
    diet: carnivorous
    sound: bark
Variable
    size:
    colour:

COLLIE

Fixed
    breed of: DOG
    type: sheepdog
Default
    size: 65 cm
Variable
    colour:

LTM - Storage of information

- rehearsal
  - information moves from STM to LTM
- total time hypothesis
  - amount retained proportional to rehearsal time
- distribution of practice effect
  - optimized by spreading learning over time
- structure, meaning and familiarity
  - information easier to remember

LTM - retrieval

recall

- information reproduced from memory can be assisted by cues, e.g. categories, imagery

recognition

- information gives knowledge that it has been seen before
- less complex than recall - information is cue

LTM - Forgetting

decay

- information is lost gradually but very slowly

interference

- new information replaces old: retroactive interference
- old may interfere with new: proactive inhibition

so may not forget at all memory is selective …

… affected by emotion – can subconsciously `choose' to forget

How can a computer assist memory?

Human Reasoning and Problem Solving

- Reasoning

"…a means of inferring new information from what is already known…"

- Dix, Finley, Abowd, Beale

- Problem Solving

"…the process of finding a solution to an unfamiliar task."

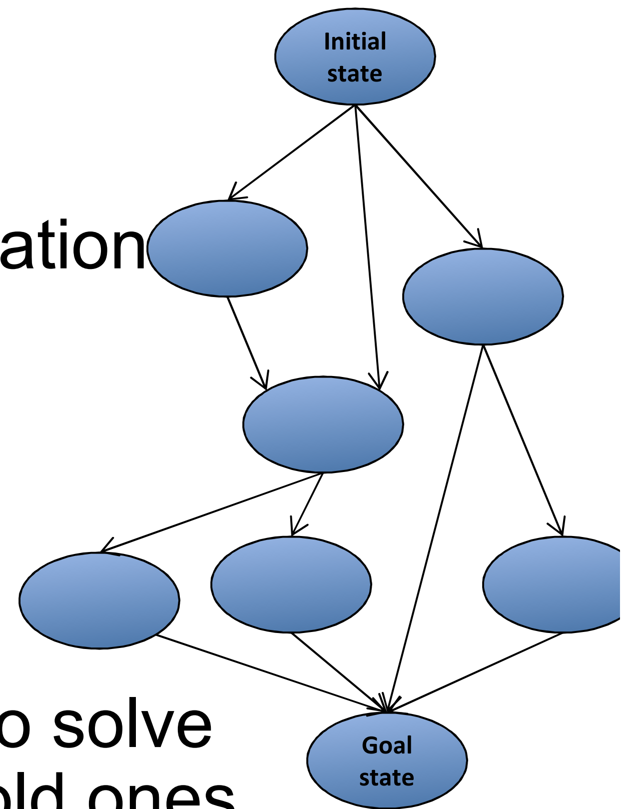
- Dix, Finley, Abowd, Beale

Human Reasoning and Problem Solving

- Reasoning
  - Deductive reasoning – give a premise what is the conclusion?
  - Inductive reasoning – given an unknown situation what can you generalize based on known information?
  - Abductive reasoning – given a fact what is the cause?

Human Reasoning and Problem Solving

- Problem Solving
  - Humans are processors of information
  - Problem space theory
    - Use state transition operators to
    - move from initial state to goal state
    - Select operators using heuristics (e.g., means-end analysis)
  - We can use analogical mapping to solve new problems that are similar to old ones
  - Solving problems that are familiar leads to skill acquisition



Human Emotion

- Humans can have a biological response (e.g., sweating, heart racing) to external situations that are observed through sight, hearing, touch, smell, taste.
  - The response can be associated with an emotion (e.g., fear, anger, sadness, happiness)
- Emotions can affect a users ability to use a program's user interface – we need to develop interfaces and software that minimize negative emotions!

Attention

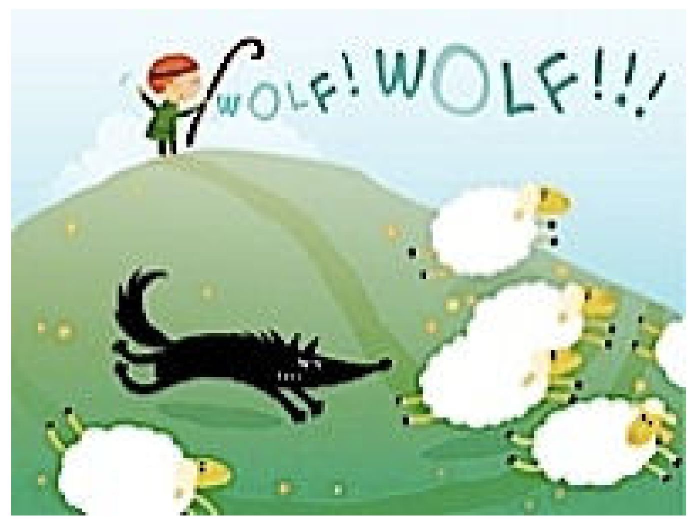
- Attention is a pivotally important human ability and is central to operating a machine, using a computer, driving to work or catching a train.

Failures in Attention

- Failures in attention are a frequently cited reason for accidents:
  - Accident while using mobile phone driving
  - aircraft have experienced ‘controlled flight into terrain’ (to use the official jargon) when the pilots have paid too much attention to the ‘wrong’ cockpit warning
  - control room operators can be overwhelmed by the range and complexity of instruments to which they must attend

Attention and “Alert Fatigue”

- Alerts are designed to command attention
- But too many alerts leads to ignoring them



Selective and Divided Attention

- Selective attention: are we aware of sensory information (cocktail party effect)? Filtering out noise.
- Divided Attention: Multi-tasking – switching focus amongst several stimuli. Generally poorer performance on both.

Stroop Effect

- Name these colours!

RED

GREEN

RED

BLUE

BLUE

RED

GREEN

RED

RED BLUE

GREEN RED

RED GREEN

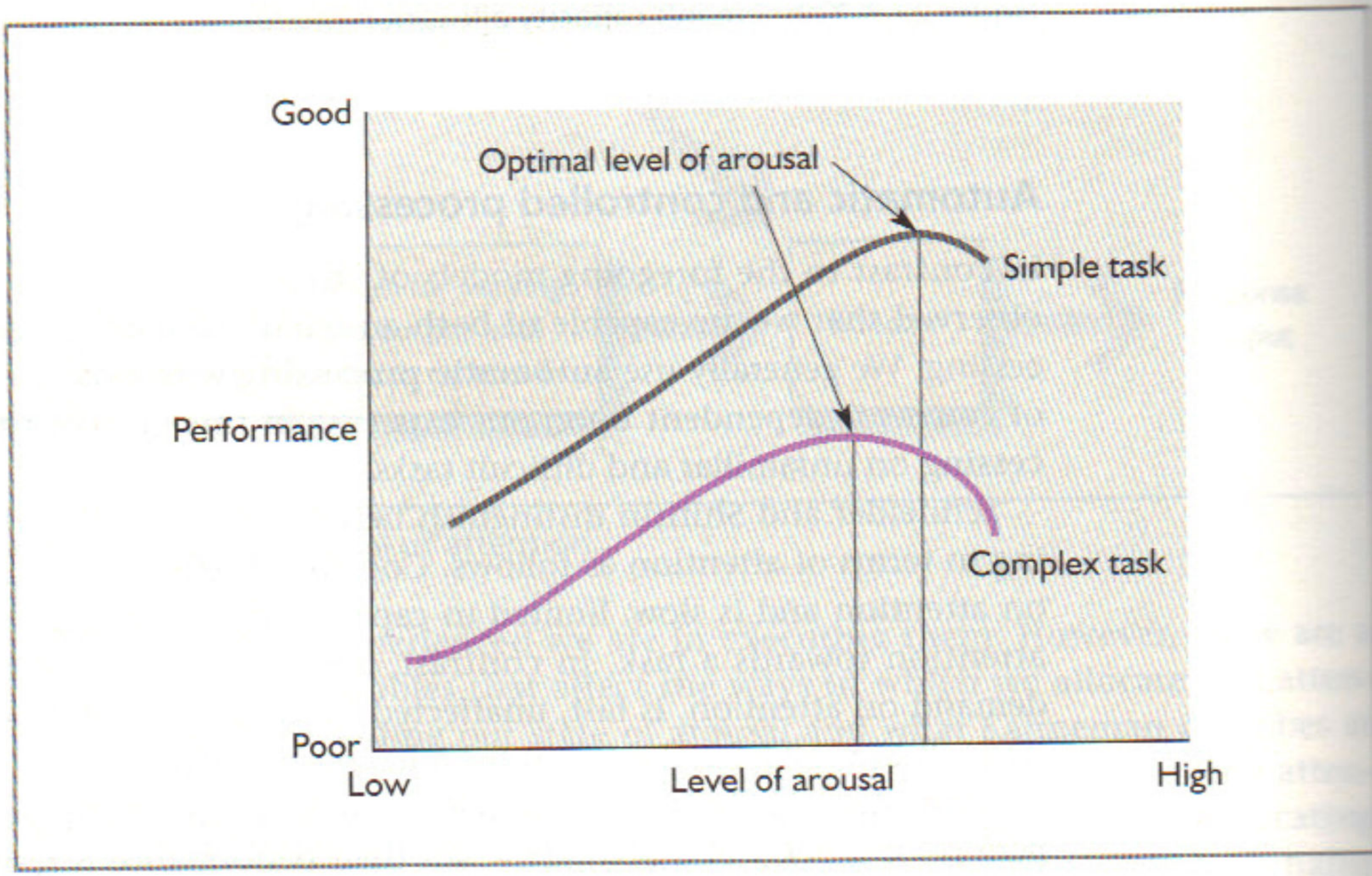
BLUE RED

Factors affecting attention

- Of the factors that affect our ability to pay attention to a task, stress is the most important.
- Stress is the effect of external and psychological stimuli on us and directly affects our level of arousal.
- Arousal is different from attention in that it refers to a general increase or decrease in perceptual and motor activity.

Stressors

- Stressors (stimuli which cause stress) include such things as noise, light, vibration (e.g. flying through turbulence) and more psychological factors such as anxiety, fatigue, anger, threat, lack of sleep and fear (e.g. think about the days before an examination).



The Yerkes-Dodson law

Benyon, p. 478

Yerkes-Dodson Law

- For both simple and complex tasks there is an optimal level of arousal.
- As our level of arousal increases, our ability to execute a task increases until we reach a point when we are too aroused and our performance falls off sharply.
- Secondly, simple tasks are more resistant to increased levels of arousal than are complex tasks.
- The other aspect of this is the skill of the individual involved.
- A simple task to a highly skilled individual is likely to be seen as complex to a less skilled or able individual.

Mihaly Csikszentmihalyi: Flow, the secret to happiness

- http://www.ted.com/talks/mihaly_csikszentmihalyi_on_flow.html

Visual search

- Visual search has been researched extensively by psychologists and ergonomists and refers to our ability to locate particular items in a visual scene.
- Participants in a visual search study, for example, may be required to locate a single letter in a block of miscellaneous characters.
- This is a good example of how perception and attention overlap and an understanding of the issues involved in visual search can help in avoiding poorly designed interactive systems

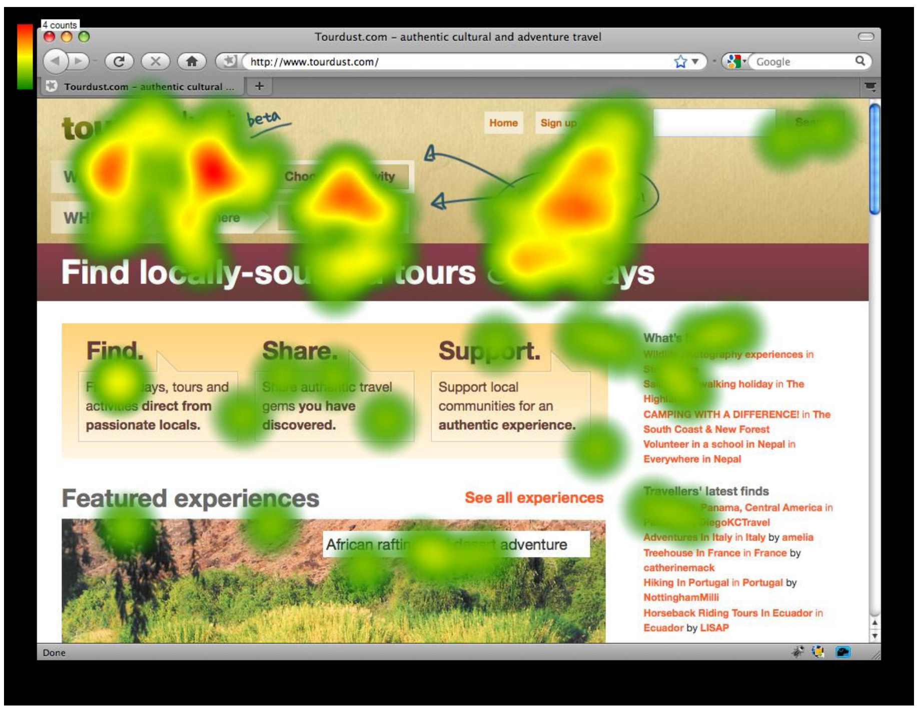

HavenWorks.com
A-Z
Search
News by Date
NewsStand
Global
US
A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-P-Q-R-S-T-U-V-W-X-Y-Z-2008 Election
HavenWorks.com
News Reference Facts Information Sources Intelligence Haven Works
Sunday, 28 June 2009
CALENDAR
Search: Google:
GO
HavenWorks Web 2008 News / Blog
TV Online Television
News
Fair. Balanced.
Bill Moyers Journal
FRONTLINE: NewsWar
NOW! Exposé
Democratic News:
2010 TV:
TV Blog
2010 Radio:
Republican News:
Atwater Politics
"Two Santa Clauses or How The Republican Party Has Conned America for Thirty Years."
HavenWorks.com+A-Z
News Topics
Hartmann/MP3s/TV
Greenwald/+/Radio/MP3s
Blogs -; ABlog/TV Blog
Weblog
20090330
OPINION
Torture - Criminal - Dick Cheney - War Crimes - NB - Military - Government - Intelligence - Terrorism - Detainee - Secret - Censored - Videotapes - Legal - Politics - History - Book
"Bush's Torture Rationale Debunked."
... "Abu Zubaida was the alpha and omega of the [Republican President] Bush administration's argument for torture." ... "That's why Sunday's front-page Washington Post story by Peter Finn and Joby Warrick is such a blow to the last remaining torture apologists." ... "Finn and Warrick reported that "not a single significant plot was foiled" as a result of Zubaida's brutal treatment -- and that, quite to the contrary, his false confessions "triggered a series of alerts and sent hundreds of CIA [Central Intelligence Agency] and FBI [Federal Bureau of Investigation] investigators scurrying in pursuit of phantoms."" ... "Zubaida was
DEM 2010 TV
OBAMA TV
WHITE HOUSE TV
'News' Media Politics
Jay Rosen
Glenn Greenwald
PBS.org/moyers
Jay Rosen and Glenn Greenwald discuss journalism and media politics on Bill Moyers Journal. Transcript. Also: Rosen, Greenwald, Moyers. #News Media Politics: Jay Rosen and Glenn Greenwald
Right-Wing TV Bias
MEDIA BIAS: 2 to 1 in
U. S. A.
20090330
Politics
John McCain - Government - Money - Accounting - Arizona
"Despite McCain's Comments, Senate GOP Not Offering Detailed Budget." ... "On Thursday, House Republicans did wind up offering the frame of an alternative budget -- but then they were widely panned for not releasing a more detailed alternative to the Democratic proposals." ... "That's what made an exchange Sunday with [Arizona Republican Senator] Sen. John McCain, R-Ariz., on NBC's "Meet the Press," intriguing."
"DAVID GREGORY: "Do you think that Republicans should provide a detailed budget alternative?""
"McCAIN: "Yes.""
"GREGORY: "With numbers?""
"McCAIN: "Yes.""
TV
WORLD
20090331
Terrorism
Pakistani - Police - Military - Political - Religious - History - Soviet - Afghanistan - India
"Insurgent Threat Shifts in Pakistan: Assault on Police Academy Indicates Risk Has Moved Beyond Tribal Areas." ... "The brazen occupation of a Pakistani police academy Monday by heavily armed gunmen near the eastern mega-city of Lahore [Pakistan] was the latest indication that Islamist terrorism, once confined to Pakistan's northwest tribal belt, now threatens political stability nationwide." ... "The precisely orchestrated assault by a squad of young men, which left at least 11 people dead and took security forces nearly eight hours to quell, was also a likely sign that Islamist militant groups in Punjab province, once tolerated and even supported by the Pakistani state to fight in India and Afghanistan, have turned openly against the government." ... "Pakistan has been an incubator for Islamist militant groups for the past several decades. Until recently, they were
INTELLIGENCE
IRAQ NEWS
War Crimes
Law/Legal
Poll - Criminal - Torture
"Poll: Most want inquiry into anti-terror tactics." ... "Even as Americans struggle with two wars and an economy in tatters, a USA TODAY/Gallup Poll finds majorities in favor of investigating some of the thorniest unfinished business from the [Republican President] Bush administration: Whether its tactics in the "war on terror" broke the law." ... "Close to two-thirds of those surveyed said there should be investigations into allegations that the Bush team used torture to interrogate terrorism suspects and its program of wiretapping [United States] U.S. citizens without getting warrants. Almost four in 10 favor criminal investigations and about a quarter want investigations without criminal charges. One-third said they want nothing to be done." ... "Even reversed, Bush policies

Visual Search 2

- Visual search cannot be presumed to be left to right, or clockwise rather than anticlockwise, except to say that searching tends to be directed towards where the target is expected to be.
- However, visual attention will be drawn towards features which are large and bright and changing (e.g. flashing, which may be used for warnings).
- These visual features can be used to direct attention, particularly if they have a sudden onset (i.e. a light being switched on, or a car horn sounding).

Eye Tracking

- Heatmaps and fixation sequences



Visual search 2

- Visual scanning reveals much about the internal expectancies that drive selective attention.
  - These insights are probably most useful in the area of diagnostics.
- Clearly those instruments which are most frequently watched are likely to be the most important to an operator's task.
- This should guide design decisions to place the instruments in prominent locations or to locate them adjacent to one another.

Summary

- Today we:
  - Reviewed the characteristics of humans

Your Action Items

- Continue posting your examples of “Usability Wins and Epic Fails” under Blackboard discussion
- Refine your idea and read the ideas of your peers
- Complete part 1b – project proposal due Sept 18 (Tuesday Lab) or 21 (Friday lab)

Required Readings

- Excerpts from “The Trouble with Computers” by Thomas K. Landauer (Sept 19)
- “What is Interaction Design?” by Preece, Rogers, Sharp (Sept 19)
- Chapter 21 & 25, Benyon Text

Ongoing Course Evaluation

- Please complete the daily feedback for **Lecture 4**