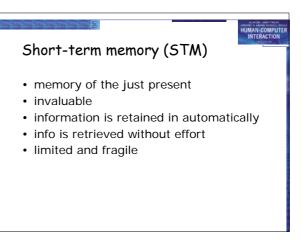
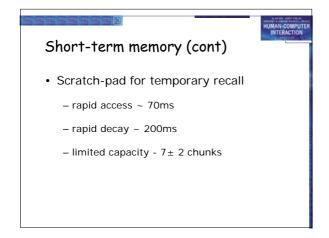


# Sensory memory • Buffers for stimuli received through senses – iconic memory: visual stimuli – echoic memory: aural stimuli – haptic memory: tactile stimuli • Examples – "sparkler" trail – stereo sound • Continuously overwritten







# Long-term memory (LTM)

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- · memory for the past
- invaluable
- information is retained through rehearsal
- · information is retrieved with effort
- · interpretation, organisation
- unlimited

# Long-term memory (cont)

- · memory for arbitrary things
  - rote learning, e.g. alphabet, the multiplication table
- memory for meaningful relationships
  - meaningful structure can organise what may seem arbitrary
- · memory through explanation
  - understanding
  - mental models

# Long-term memory (cont)

- · Declarative memory
  - stores facts and events
  - standard textbook learning
  - pair: stimulus response
  - can be put into words
- · Procedural memory
  - skills and procedures
  - "how to" knowledge difficult to verbalise
  - very durable

# Long-term memory (cont)

- Repository for all our knowledge
  - slow access ~ 1/10 second
  - slow decay, if any
  - huge or unlimited capacity
- Two types
  - episodic serial memory of events
  - semantic structured memory of facts, concepts, skills

semantic LTM derived from episodic LTM

# Long-term memory (cont)

### Semantic memory

- facts and concepts, meanings and understandings
- · storage requires rehearsal

### Episodic memory

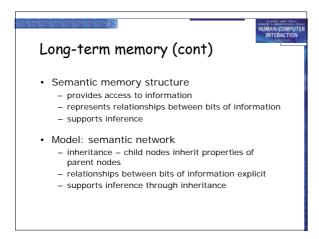
- autobiographical memories
- explicit memory of events
- narratives, includes time, space and emotions
- easy to store

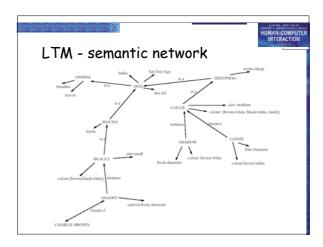
# Long-term memory structures

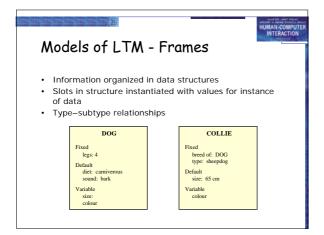
- Semantic networks
- Slots
- Frames
- Scripts

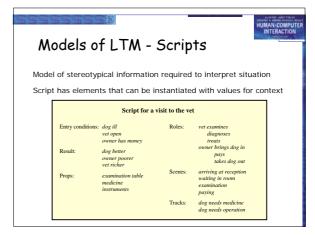


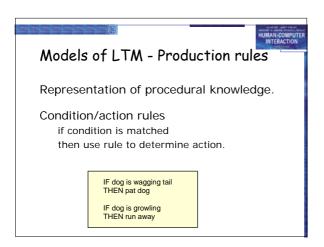
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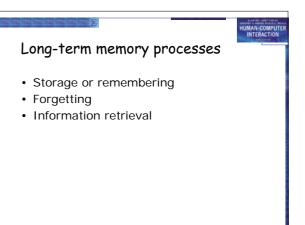












# LTM - Storage of information

- · 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 - Forgetting

decay

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- 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

### 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

# \_

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# **Thinking**

Reasoning

deduction, induction, abduction Problem solving

# Deductive Reasoning

- Deduction:
  - derive logically necessary conclusion from given premises.
    - e.g. If it is Friday then she will go to work
      It is Friday
      Therefore she will go to work.
- · Logical conclusion not necessarily true:
  - e.g. If it is raining then the ground is dry It is raining
    Therefore the ground is dry

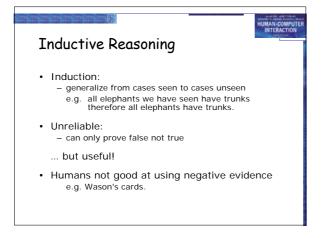
# Deduction (cont.)

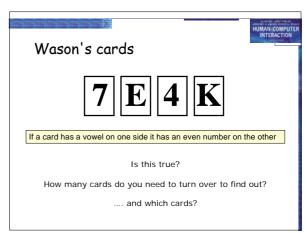
- When truth and logical validity clash ...
  - e.g. Some people are babies Some babies cry

Inference - Some people cry

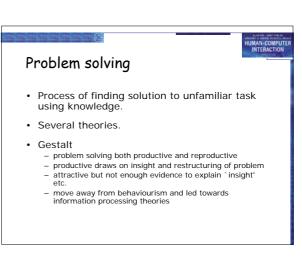
Correct?

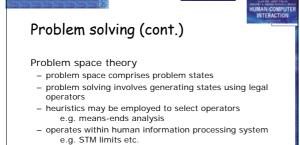
· People bring world knowledge to bear





# Abductive reasoning • reasoning from event to cause e.g. Sam drives fast when drunk. If I see Sam driving fast, assume drunk. • Unreliable: - can lead to false explanations





- largely applied to problem solving in well-defined areas

e.g. puzzles rather than knowledge intensive areas

# Errors and mental models

### Types of error

- slips
  - right intention, but failed to do it right
  - causes: poor physical skill,inattention etc.
  - change to aspect of skilled behaviour can cause slip
- - wrong intention
  - cause: incorrect understanding humans create mental models to explain behaviour. if wrong (different from actual system) errors can occur

### **Emotion**

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- · Various theories of how emotion works
  - James-Lange: emotion is our interpretation of a physiological response to a stimuli
  - Cannon: emotion is a psychological response to a stimuli
  - Schacter-Singer: emotion is the result of our evaluation of our physiological responses, in the light of the whole situation we are in
- · Emotion clearly involves both cognitive and physical responses to stimuli

# Emotion (cont.)

- · The biological response to physical stimuli is called affect
- · Affect influences how we respond to situations
  - positive → creative problem solving
  - negative → narrow thinking
  - "Negative affect can make it harder to do even easy tasks; positive affect can make it easier to do difficult tasks"

(Donald Norman)

# Emotion (cont.)

- · Implications for interface design
  - stress will increase the difficulty of problem
  - relaxed users will be more forgiving of shortcomings in design
  - aesthetically pleasing and rewarding interfaces will increase positive affect

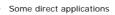
# Individual differences

- long term
  - sex, physical and intellectual abilities
- · short term
  - effect of stress or fatigue
- changing
  - age

### Ask yourself:

will design decision exclude section of user population?

# Psychology and the Design of Interactive System



e.g. blue acuity is poor
 ⇒ blue should not be used for important detail

- However, correct application generally requires understanding of context in psychology, and an understanding of particular experimental conditions
- · A lot of knowledge has been distilled in
  - guidelines (chap 7)
  - cognitive models (chap 12)
  - experimental and analytic evaluation techniques (chap 9)



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