

Interação Humana com o Computador

Aula III



Departamento de Informática
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The Human - Information Proc. Unit

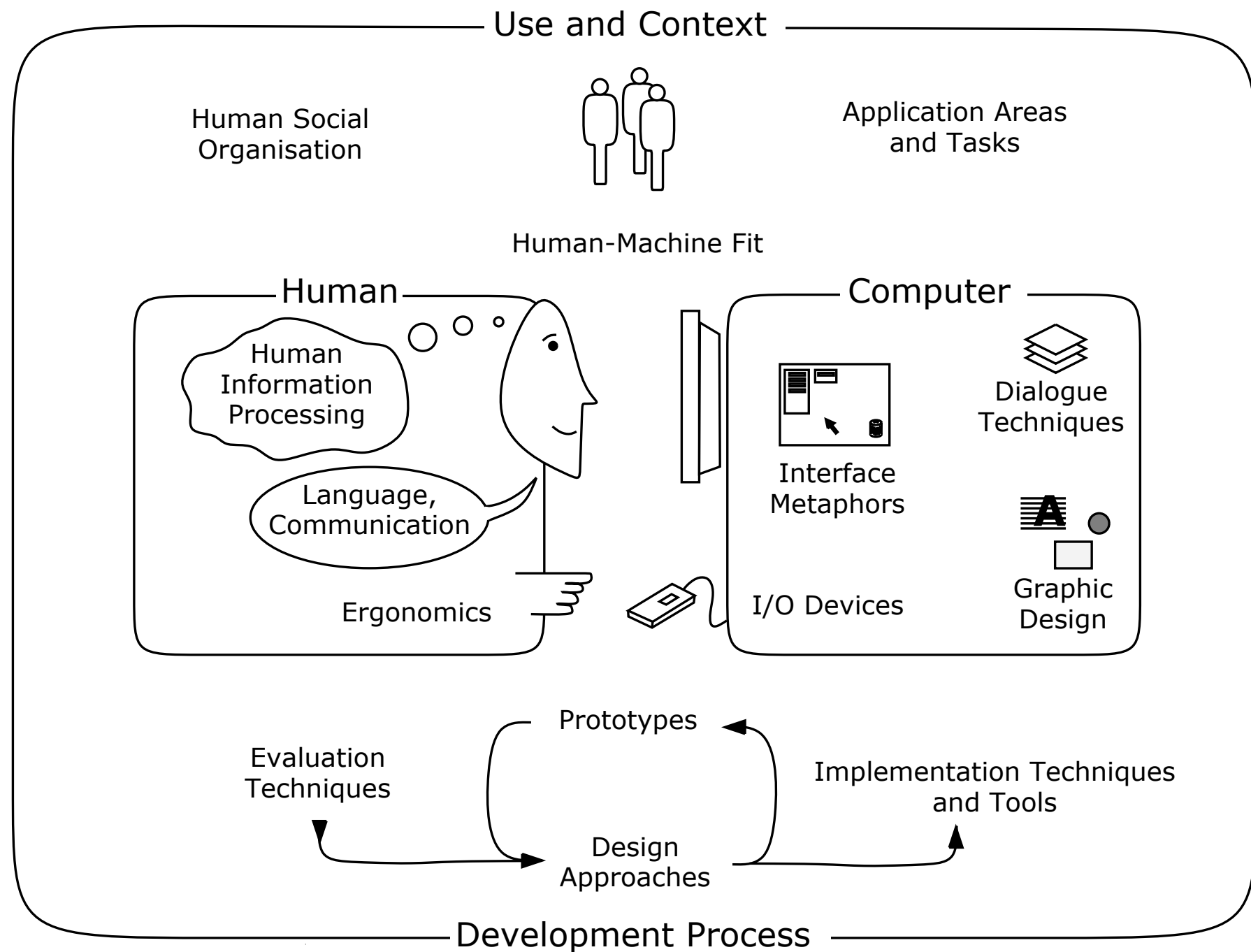


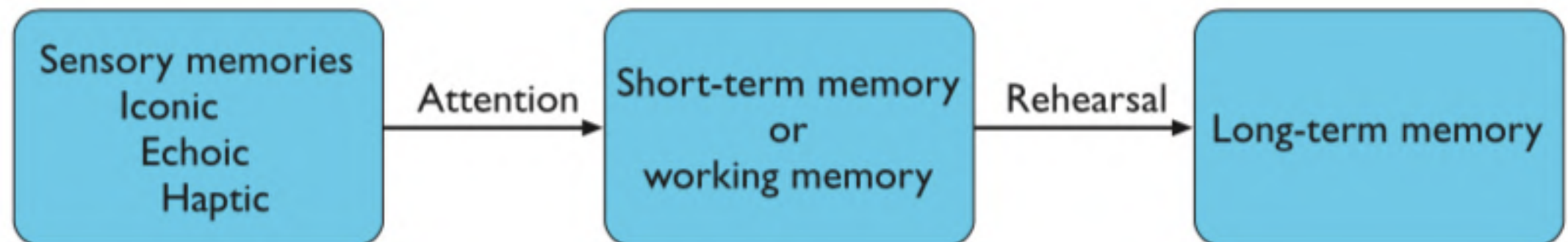
Figure 1.1: The nature of Human-Computer Interaction. Adapted from Figure 1 of the ACM SIGCHI Curricula for Human-Computer Interaction [Hewett et al., 2002]



The Human — Memory

Memory

- Stores not only facts, but also procedures and actions
- Conceptual division in three types
 - **Sensory** memory
 - **Short-term**/working memory (STM)
 - **Long-term** memory (LTM)

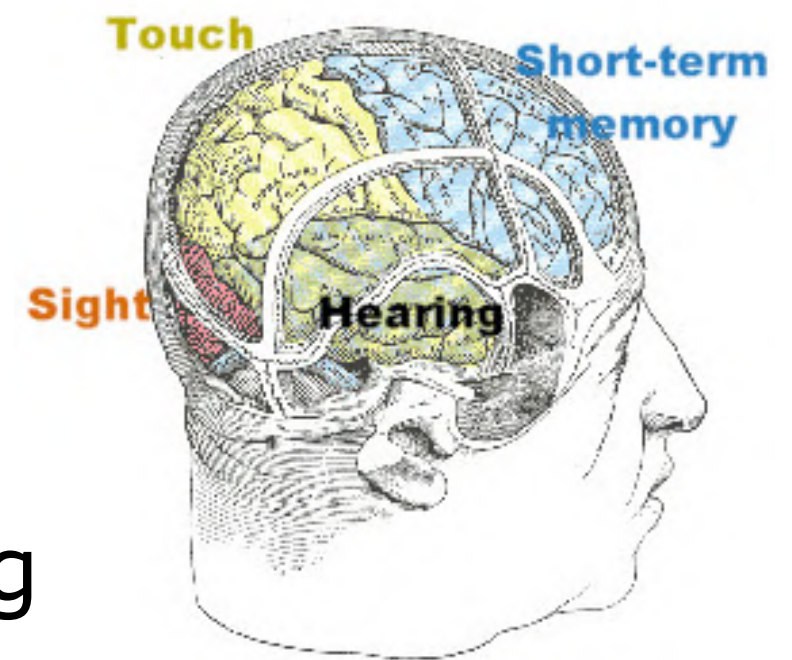




The Human — Memory

Sensory Memory

- Buffers for stimuli received through senses
 - **Iconic memory:** visual stimuli
 - **Echoic memory:** aural stimuli
 - **Haptic memory:** tactile stimuli
- These buffers are constantly being overwritten.
- Stimuli and selective attention (cocktail party)





The Human — Memory

Sensory Memory

- Stimuli and selective attention, for example: what is going on in a **cocktail party**?





The Human — Memory

Sensory Memory



- Sensory memory is **transferred** to the short-term memory, through attention;
- **Attention** is the action of **focusing** on a given item, by filtering the remaining inputs received at that time;
- Without this filtering, we will rapidly become **overwhelmed** with information.



Short-Term Memory (STM)

- Works as a scratch-pad for temporary recall
 - When we read (stores recent words)
 - In mental calculations (intermediate values)
- Temporary data storage
 - It has a rapid access **70 ms**.
 - But also a rapid decay **200 ms**.
 - Finite and very limited capacity: 7 ± 2 chunks





Short-Term Memory

Examples:

212348278493202



Short-Term Memory

Examples:

0351 961 262 619



Short-Term Memory

Examples:

HEC ATR ANU PTH ETR EET



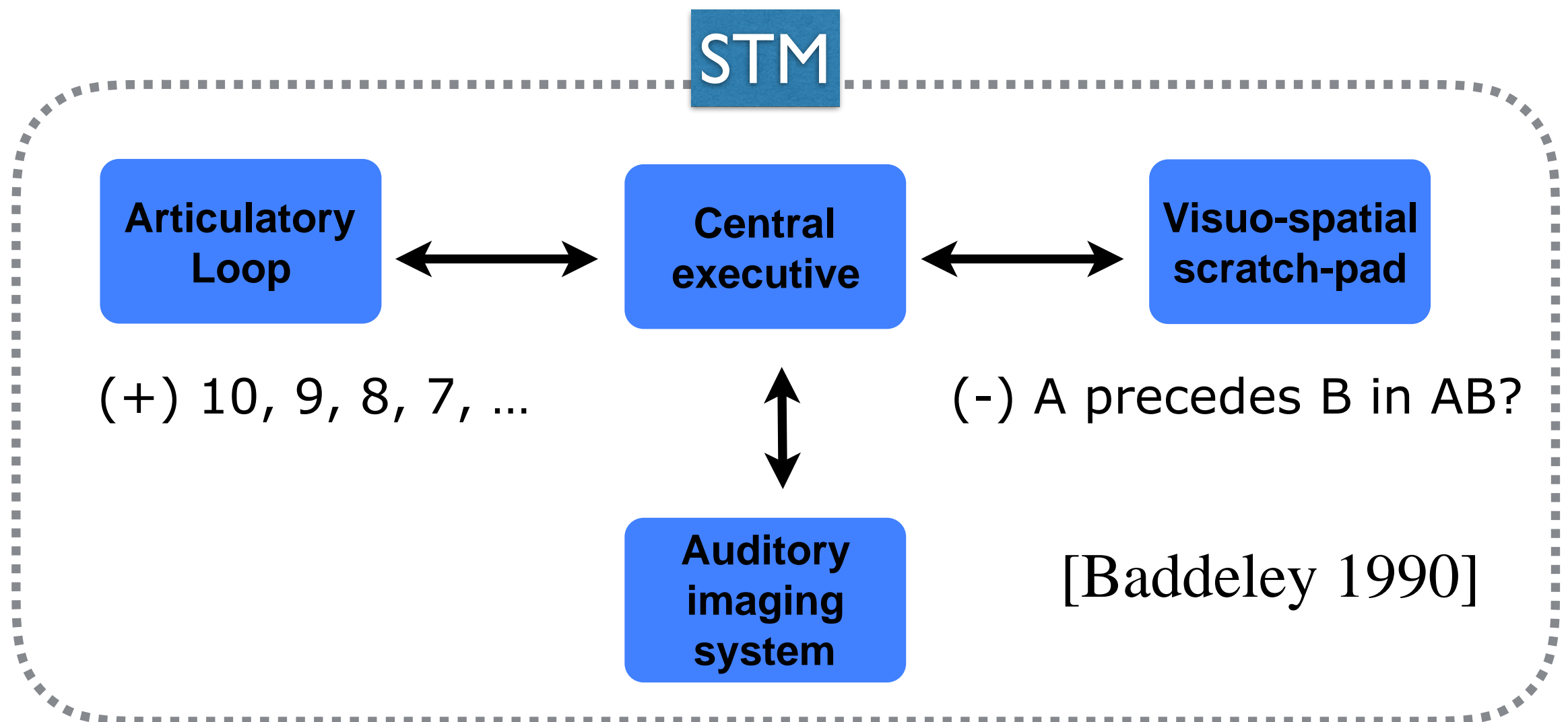
Short-Term Memory

- **Recency effect**

- e.g: remember last word & count

- **Interference:**

- not symmetric: countdown (+) \neq sentence processing (-)





Short-Term Memory

- On average, a person can remember 7 ± 2 items in his STM (**Menus, Lists, Cmds**) **but**: there are many things that can easily be remembered.
- Split data into information chunks enables 7 ± 2 chunks
- **Chunking** (division into smaller meaningful pieces) increases memory usage efficiency
- Chunking leads to **Closure**
- A failure in closure leads the user to lose mental location, causing him to make **mistakes**



Short-Term Memory

- A ***failure in closure*** leads the user to lose mental location, causing him to make mistakes (e.g ATM)





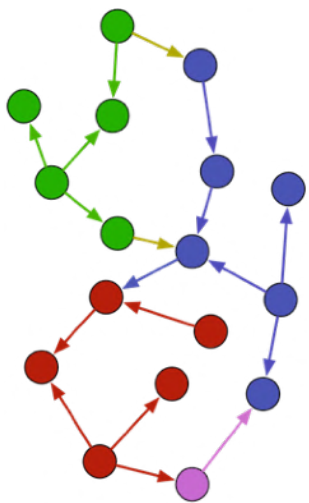
Long-Term Memory (LTM)

- **Repository for all our knowledge**

- slow access time ~ 100 ms
- slow decay, if any (after minutes = after hours)
- immense storage capacity

- **Two types**

- **Episodic** – memorize sequences of events (episodes). Like when we hear a narrative
- **Semantic** – memorize fact structures, concepts, skills, ... We can think on a graph model (connected ideas), as well as classes with attributes and connections like inheritance as in OOP.



- The Semantic LTM derives from episodic LTM



Long-Term Memory (LTM)

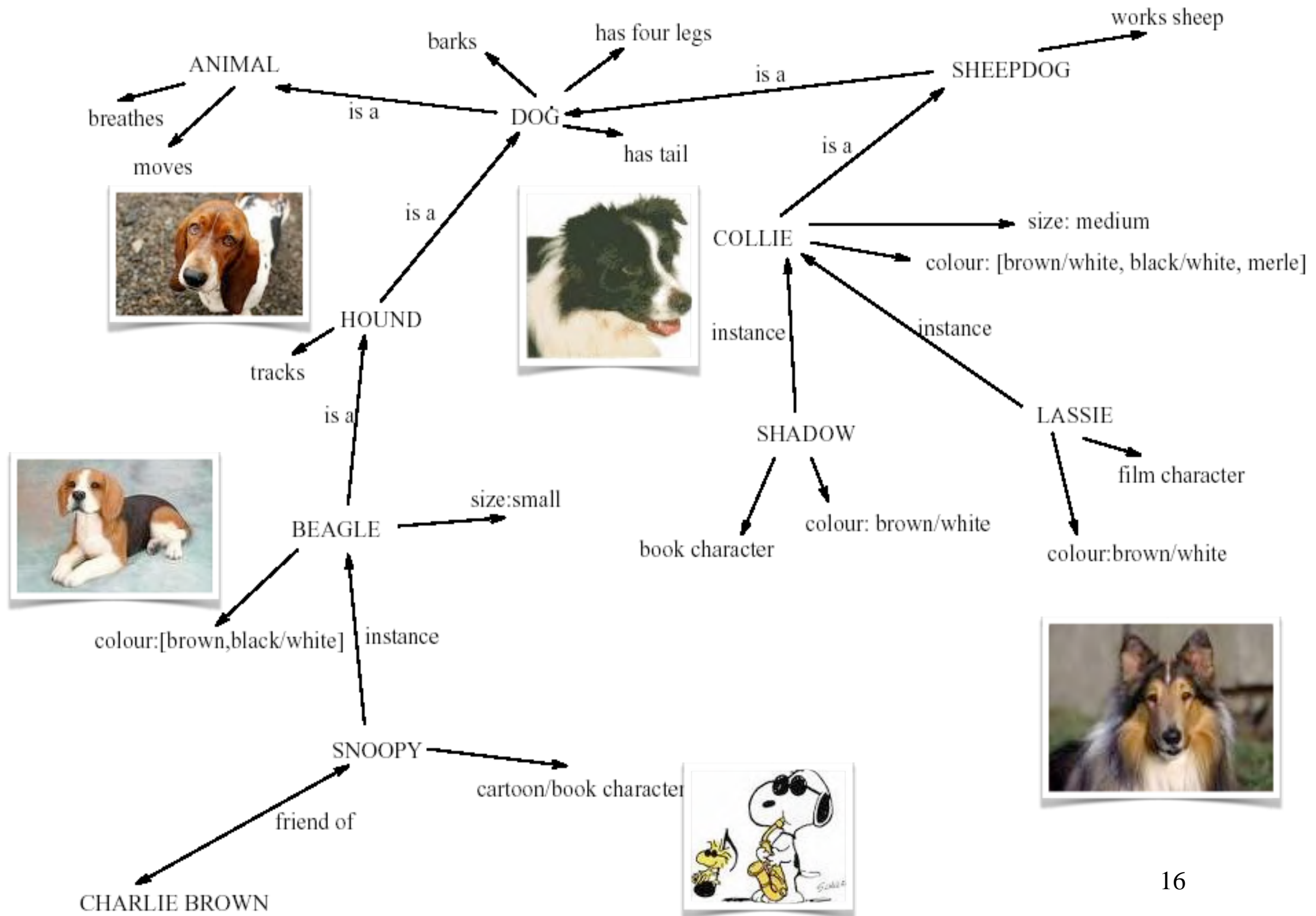
- **Structure of semantic memory** [Collins & Quinlan]

- Facilitates the retrieval of information
- Represents the relationship between two information units
- Supports inference and generalization

- **Model: semantic network**

- Inheritance: derived concepts inherit “father” properties
- Define the relationship between information units
- Allows inference through inheritance
- Knowledge associatively organized

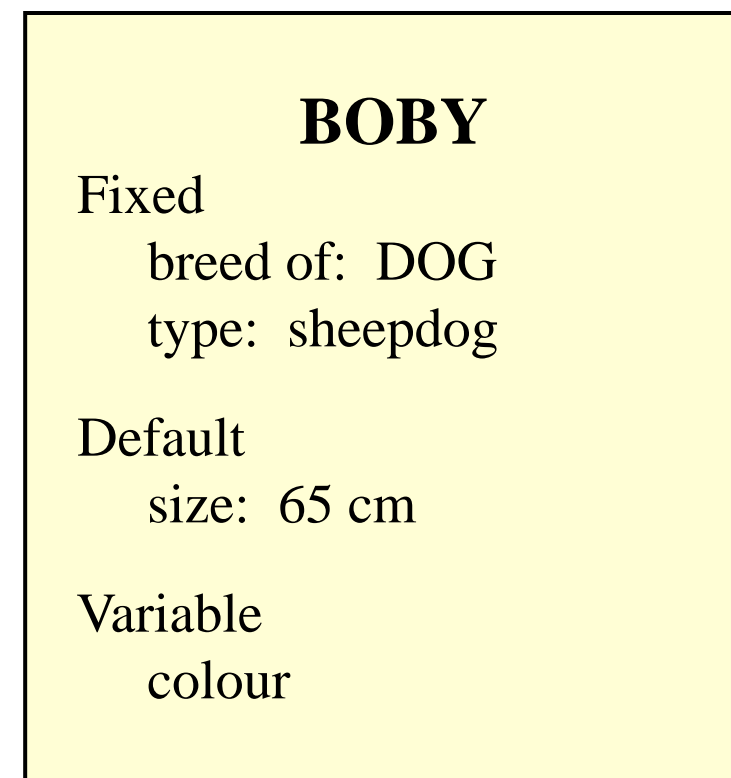
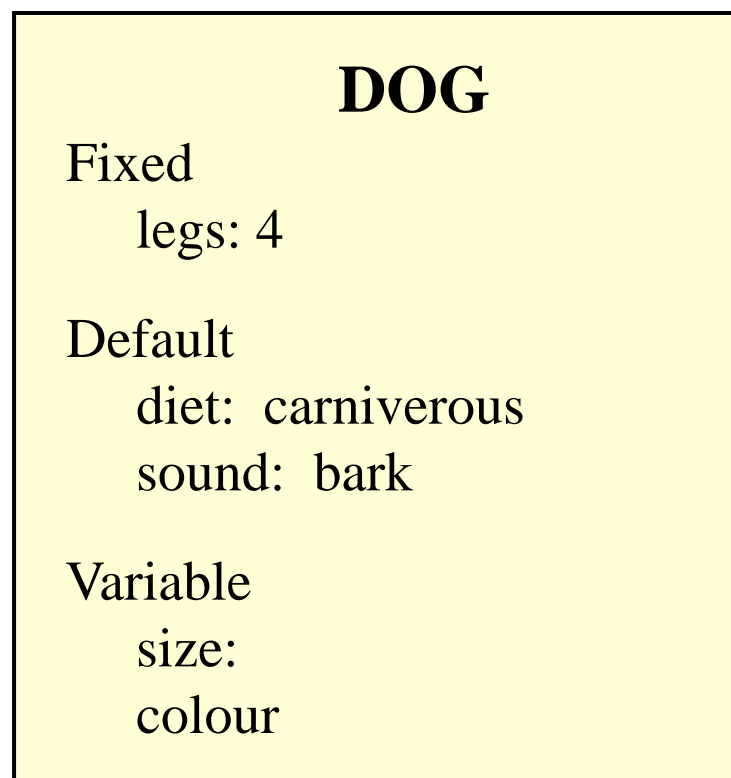
Models of LTM - Semantic Network





Models of LTM - Frames

- Information organized in data structures;
- Slots in structure instantiated with values for instance of data;
- Type-subtype relationships;
- An **extension** of a semantic network, with more informations details.





Models of LTM - Production rules

- **Representation of procedural knowledge**
- **Condition/action rules**
 - If** condition is verified:
 - Then** action rules

If dog is wagging tail
Then pat dog

If dog is growling
Then run



Memory transfers

Memory



I hear and I forget. I see and I remember. I do and I understand.

Confucius





LTM - Storage of information

- **Rehearsal**

- Information moves from STM to LTM

- **Total time hypothesis**

- Amount retained proportional to rehearsal time
[Ebbinghaus 1885]

- **Distribution of practice effect**

- Optimized by spreading learning over time
[Baddley 1978]

- **Structure, meaning and familiarity**

- Information easier to remember
 - **difficulty**(concepts) > **difficulty**(objects)



LTM - Storage of information

- **Structure, meaning and familiarity**
 - Information easier to remember
 - **difficulty**(concepts) > **difficulty**(objects)

List A:

age, warm, faith, peaceful, idea,
past, broad, bright, power.



LTM - Storage of information

- **Structure, meaning and familiarity**
 - Information easier to remember
 - **difficulty**(concepts) > **difficulty**(objects)

List B:

boat, tree, cat, black, child, flame,
city, church, police, aircraft



LTM — Retrieval

Recall

- Information reproduced from memory can be assisted by cues, e.g. categories, imagery, ...
- Concrete information is easier to remember:

Recognition

- The information provides recognizable clues
- Less complex than recall, due to certain clues
- Contextual information will assist the subject



LTM - Storage of information

- **Structure, meaning , and familiarity**

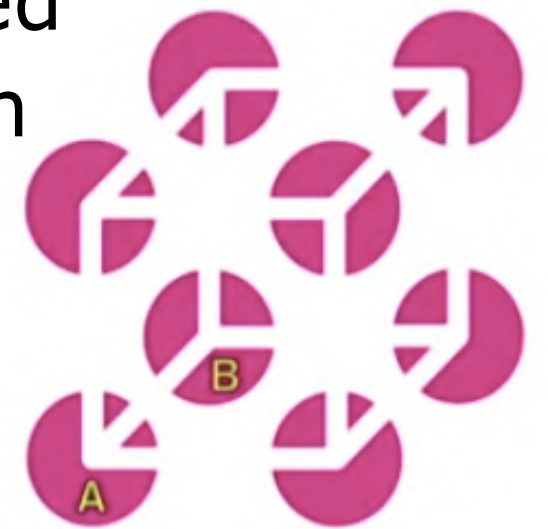
- **[Baddley 1932]**: experiments with memory, remembering meaningful information, opposed to Ebbinghaus (1885), example: subjects listen to another culture's history

- Non-familiar words are substituted

- Re-familiarize new concepts, in order to assimilate them in the existing structures

- System security challenges: lots of strange passwords

security versus memorization





LTM - Forgetting

There are two main theories:

● Decay

- Information is lost gradually but very slowly
- Ebbinghaus says it is logarithmic
- **Jost's law**: if two memories are equally strong, the oldest last longer

● Interference

- New information replaces old: **retroactive interference**
- Old may interfere with new: **proactive inhibition**, e.g: driving to our old house.
- May not forget at all. Memory is selective and biased toward positive memories: *nostalgia*

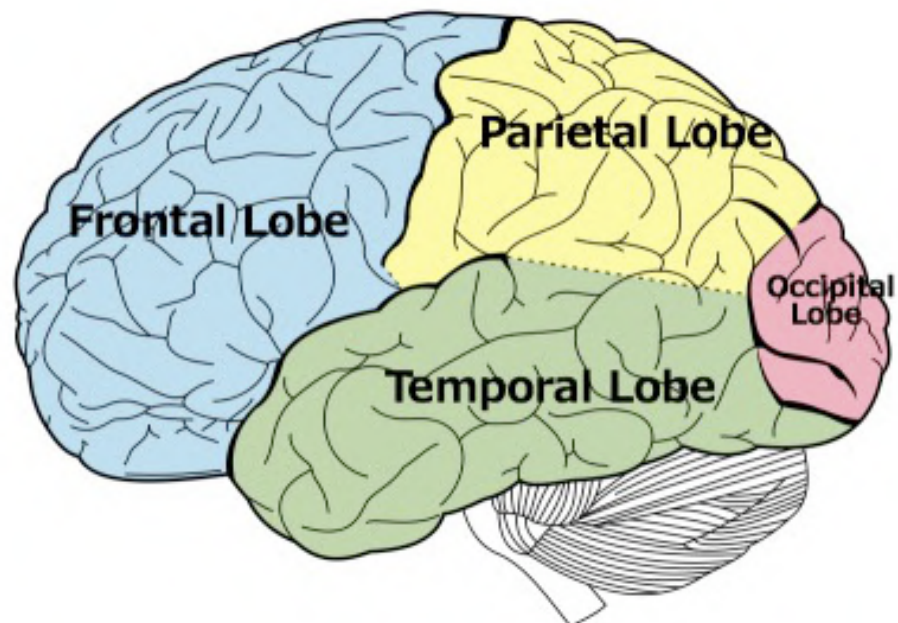
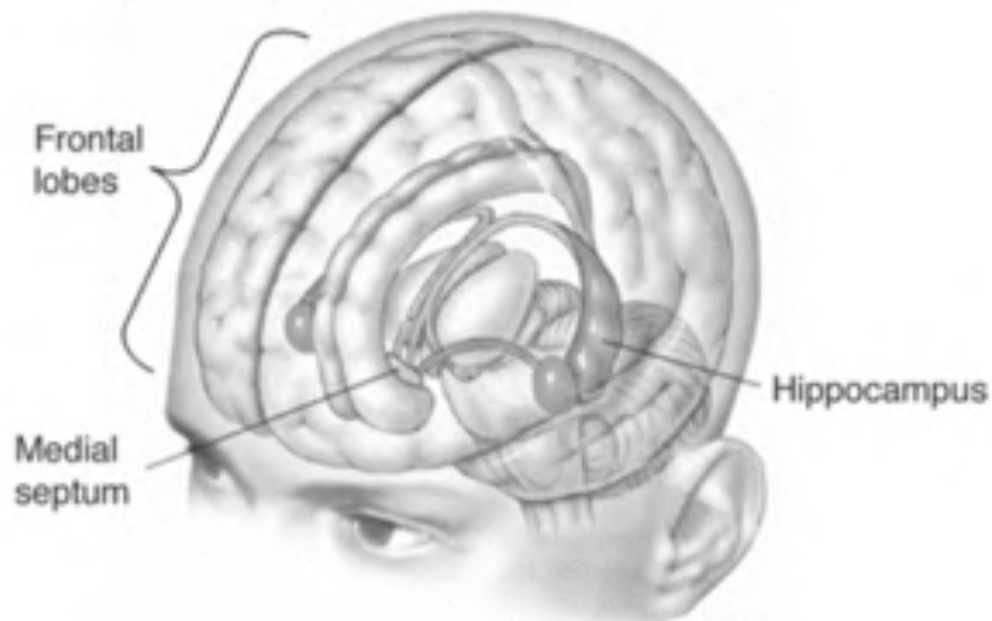
Affected by emotion <== *test with emotive words*



LTM - Forgetting

The man who cannot remember

- Henry Molaison 1958
- Hippocampus (partially removed \leq accident)





The Human - Thinking

Thinking

Different Kinds of Reasoning

Deductive, Inductive, abductive

Problem Solving

Skills, Analogy



Deductive Reasoning

- **Deduction:**

- Derive logically necessary conclusion from given premises
example:

If Friday **Then** Anne will go to work
It is Friday

Therefore: Anne will go to work

- **Logical conclusion not necessarily true:**

example:

If raining **Then** the ground is dry
It is raining

Therefore: the ground is dry



Deductive Reasoning

- **When truth and logical validity clash ...**

e.g. Some people are babies

Some babies cry

Therefore: Some people cry

Is it correct?

- **People bring world knowledge to bear**

premises, common sense, contextual
information, ...



Inductive Reasoning

- **Induction:**

- Generalize from cases seen to cases unseen

- e.g. *all elephants we have seen have trunks*
therefore all elephants have trunks

- **Unreliable**

- Can only prove false not true

- e.g. a surprise!!!

- ... but very useful!



- **Humans not good at using negative evidence**

- e.g. Wason's cards

Elefante sem tromba avistado na África do Sul

Especialistas mostram-se preocupados com a sobrevivência da cria.

13:26

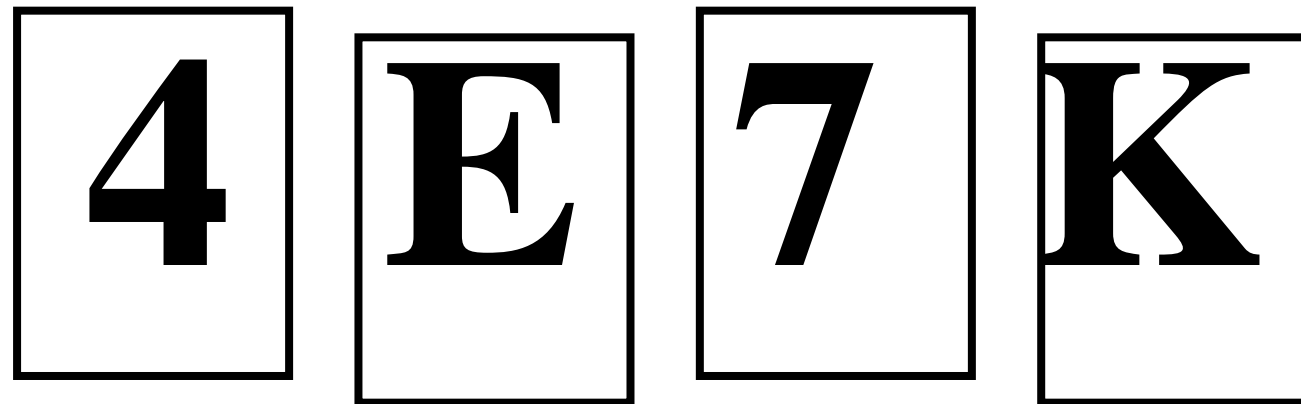


Cria de elefante foi avistada na África do Sul

Getty Images



Inductive Reasoning - Wason's cards



If a card has a vowel on one side **Then**
it has an even number on the other

Is this true?

How many cards do you need to turn over to find out?

.... and which cards?



Abductive Reasoning

- **Reasoning from event to cause**

ex: Sam drives fast when drunk
Last night I saw Sam driving fast

I assume that Sam was drunk

- **Unreliable:**

- Can lead to false explanation
- User: event => action



Abductive Reasoning

● Unreliable:

- Can lead to false explanation
- User: event \Rightarrow action

e.g. Blue Screen: “Ups! What have I done?!?”

A problem has been detected and windows has been shut down to prevent damage to your computer.

IRQL_NOT_LESS_OR_EQUAL

If this is the first time you've seen this stop error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any windows updates you might need.

If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup Options, and then select Safe Mode.

Technical information:

*** STOP: 0x0000000A (0x00000F18,0x00000002,0x00000000,0x805B39D6)

Beginning dump of physical memory





Problem Solving

- **Process of finding solution to unfamiliar task using knowledge**
- **Several theories:**
- **Behaviourism**
 - Reproductively + trial and error cycle
- **Gestalt (non behaviorists)**
 - Problem solving both **productive** and **reproductive**
 - **Productive** draws on **insight** and **restructuring** of the problem, e.g.: *Maier's Pendulum Problem* or the *Dunker's Candle*
 - Attractive but not enough evidence to explain 'insight'
 - Move away from behaviourism and led towards information processing theories.



Problem Solving

- **Gestalt** (non behaviorists)

- Problem solving both **productive** and **reproductive**
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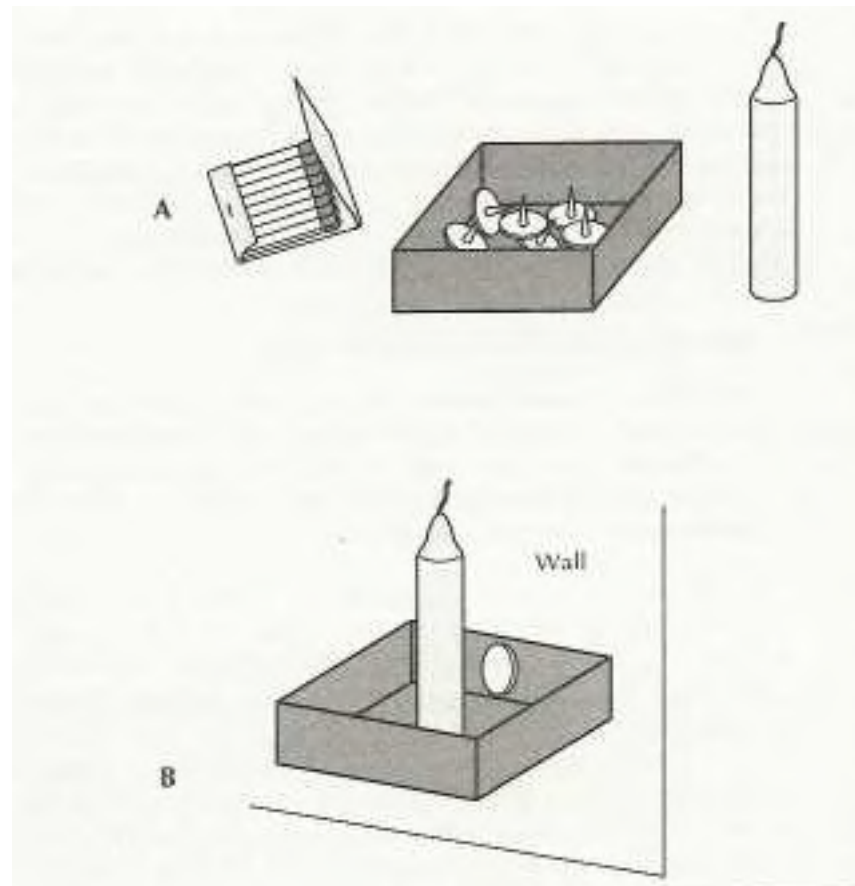




Problem Solving

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Problem Solving

- **Process of finding solution to unfamiliar task using knowledge**
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 - Reproductively or the trial and error cycle
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Problem Solving

Problem Space Theory

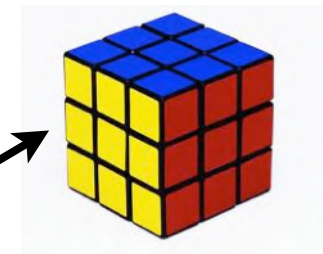
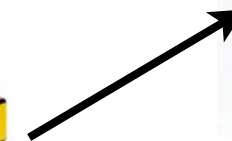
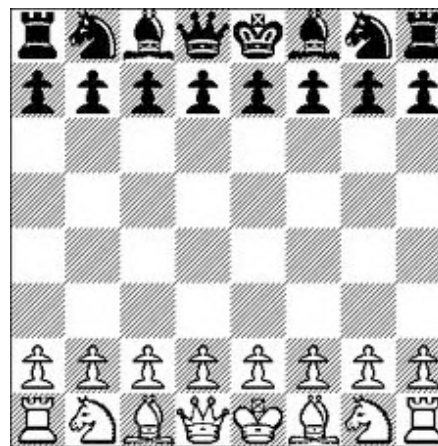
- Problem space comprises **problem states**
- Problem solving involves generating states using **legal operators**
- **Heuristics** may be employed to select operators
e.g. means-ends analysis
- Operates **within human information processing** system
e.g. STM limits etc
- **Largely applied** to problem solving in well-defined areas
e.g. puzzles rather than knowledge intensive area



Problem Solving

Problem Space Theory

- **Largely applied** to problem solving in well-defined areas
e.g. puzzles, certain games, ...



Tempo	Segunda	Sala	Terça	Sala	Quarta	Sala	Quinta	Sala	Sexta	Sala	Sábado	Sala
8-9												
9-10					6627-PL1	0625	6629-PL2	0619				
10-11					6627-PL1	0625	6629-PL2	0619				
11-12	6627-PL2	0614	6627-TE1	0603	6629-PL1	0619	6628-PL2	0613	6626-PL1	0625		
12-13	6627-PL2	0614	6627-TE1	0603	6629-PL1	0619	6628-PL2	0613	6626-PL1	0625		
13-14												
14-15	6628-TE1	0626	6630-TE1	0615			6629-TE1	0602	6626-PL2	0619		
15-16	6628-TE1	0626	6630-TE1	0615			6629-TE1	0602	6626-PL2	0619		
16-17	6628-PL1	0613	6630-PL1	0615			6626-TE1	0602				
17-18	6628-PL1	0613	6630-PL1	0615			6626-TE1	0602				
18-19												

- Economy
- Politics
- Science



Problem Solving

● Analogy

- Analogical mapping:
 - novel problems in new domain?
 - use knowledge of similar problem from similar domain
e.g. radiation-tumor vs. general-fort (10% ==> 80%)
- Analogical mapping difficult if domains are semantically different



● Skill acquisition

1. Skilled activity characterized by chunking. Information is chunked to optimize STM
2. Conceptual rather than superficial grouping of problems
3. Information is structured more effectively



Problem Solving

- **Skill acquisition** (*Procedimentalisation*)

IF cook[type, ingredients, time]

THEN

cook for: time

cook[casserole, [chicken,carrots,potatoes], 2 hours]

cook[casserole, [beef,pasta,carrots], 2 hours]

cook[cake, [flour,sugar,butter,eggs], 45 min]

IF type is casserole

AND ingredients are [chicken,carrots,potatoes]

THEN

cook for: 2 hours

IF type is cake

AND ingredients are [flour,sugar,butter,eggs]

THEN

cook for: 45 mins





Problem Solving

● **Skill acquisition** (*Procedimentalisation*)

IF cook[type, ingredients, time]

THEN

cook for: time

cook[casserole,[chicken,carrots,potatoes], 2 hours]

cook[casserole,[beef,dumplings,carrots], 2 hours]

cook[cake,[flour,sugar,butter,eggs], 45 min]

IF type is casserole

AND ingredients are [beef,pasta,carrots]

THEN

cook for: 2 hours





Problem Solving

- **Skill acquisition** (*Procedimentalisation*)

IF cook[type, ingredients, time]

THEN

 cook for: time

cook[casserole,[chicken,carrots,potatoes], 2 hours]

cook[casserole,[beef,dumplings,carrots], 2 hours]

cook[cake,[flour,sugar,butter,eggs], 45 min]

IF type is casserole

AND ingredients are **ANYTHING**

THEN

 cook for: 2 hours





Errors and Mental Models

Types of error

- **Slips** (deslizes/falhas/faltas)
 - Right intention, but failed to do it right
 - Causes: poor physical skill, inattention, ...
 - Similar aspect but different functionality

- **Mistakes** (enganos)
 - Wrong intention
 - Cause: incorrect understanding

humans create mental models to explain behavior.
if wrong (different from actual system) errors can occur

