

## Lecture 1 - Intro to Cognition

### Cognition - meaning "to know" (Latin representation)

Cognition is actively acquiring and organising and using information to enable adaptive, goal directed behaviour. How we learn, how we remember, and how we use this in a dynamically changing environment.

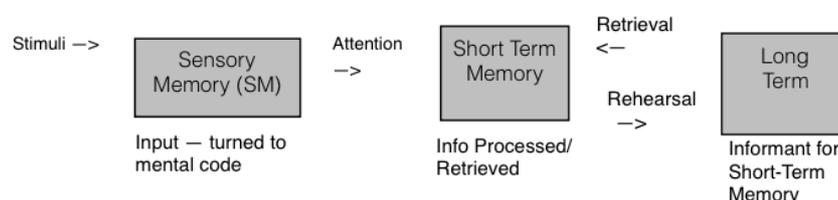
- Cognition is the study of information processing.
- Mental processes such as learning, memory, attention, language, reasoning and decision making.
- Cognitive agents: They must sense and act on their environment Detect and effect changes in the environment. gain information.
  - A cogniser constructs a mental models in response to further feedback from the environment. An actively changing dynamic system.

*The mind is a system that creates representations of the world so that we can act within it to achieve our goals - Goldstein.*

### Classical Cognition - The Computational metaphor of cognition.

- Cognition is a flow of information through processing devices that **encode, store and retrieve** symbolic representations of knowledge.
- The brain is the hardware, the mind is the software.
- *Classical cognition is based on the classical computational model of mind which states that thinking and reasoning reflect computations carried out with abstract symbols, according to symbolically represented rules. The symbols represent concepts and relations in the world - they are abstract tokens that bear no necessary resemblance to the thing they represent (e.g., 0s and 1s in a computer programme). The rules specify an input-output relation as in "If X, Then, Y".*

### The Classical Cognition Model (Atkinson & Shiffren)



1. Sensory signals provide the input to the system
2. Transduction of sensory signal to mental code for central processing
3. Further processing (computation) in short term/working memory is informed by long term memory.

### 1. Classical Cognition

- Thought processes reflect the mental manipulation of symbols according to syntactic rules for combining those symbols.

- Symbols represent our knowledge of “things” and events (concepts) - and our knowledge of the way concepts can relate to one another. (Words and numerals are examples of symbols)
- Syntactic rules are the “program” of the mind - expressed in “mentalese” - mental language.
- Classical cognition can be used to model intelligent behaviour (problem solving and reasoning).
  - Steps used to solve a problem are represented by a symbolic code.

### Symbolic Representations

**Propositional representations** - a symbolic code used to express the meaning underlying a particular relationship among concepts. “The cat is under the table”, “The table is above the cat” - relationship between elements.

Formal equation : (relationship between elements)(subject element)(object element)

- Independent of specific details of utterance/sentence/image (it abstract)
- Composed of a predicate (relationship between elements; e.g “is blue”) and number of arguments (subject-object elements; meaning - e.g. “the sky”)
- e.g. “Gave” (agent, object, recipient)
  - John gave Mary the book - > GAVE is the predicate ; the arguments are John, Book and Mary
  - Kevin gave Julia a kiss - > GAVE is the predicate; the arguments are Kevin, Julia and Kiss.
- The predicate and number of arguments combine to represent complex relationships.

Criticism : Classical cognition tends to assume knowledge rather than explain learning (which is a negative for perception, action and recognising patterns).

### Semantic Networks

Collins & Quillian (1969)

- Semantic knowledge is knowledge of the facts about the world, organised hierarchically.
- Concepts are coded in propositional form, expressing relationships (“is” “has” or “can”) - A canary is a bird, but a canary has wings
  - Hierarchical organisation of networks from superordinate (general ideas; i.e. living things) down to basic (middle level; i.e. animal) down to subordinate (Detailed; i.e. Canary)
  - We know that canary can move around because *Canary* is connected to the *animal* node, so it inherits the properties of animals via connection.

### **Analogue Representations**

- Mental imagery and mental rotations
- Refer to Shepard and Metzler experiment (1971) - mentally rotating objects in space.
- Our intuition takes the same amount of time that it would take us to physically rotate the objects. We manipulate images in our mind - mental images are analogous.
- At least some of our cognition is done with analogue representation rather than abstract symbols. The mind works with mental imagery.

## **2. Bottom- Up Cognition**

**Dynamic, embodied, situated cognition.**

*Cognition is dynamic* - it unfolds over time and space. It is inseparable from sensing, thinking, acting in real time. Example - Carrot v Carriage continual response time - example of real time cognition.

*Cognition is embodied* - our embodied interactions with the world provide the basis for higher level thought processes. Our knowledge is grounded in physical interactions with the world. i.e metaphors

- Love = warmth (love is symbolic, warmth is a physical balance)

*Cognition is situated* - we structure the physical environment to support our cognitive processes. (We lay things out in physical space to help us think about how to organise ideas - lists for example). The mind is “not just in your head”.

Building cognition from the bottom up - we need to start by “not bumping into stuff” .

### **Rodney Brooks Robotic Project:**

- The world is its best own model.
- Used robots to navigate simple environments (of where which were modelled instincts).
- Leonardo - The Social Robot.
  - Appraised objects as novel, then conditioned (through the tone of a human's voice) to believe item was scary or safe
- Understands tone, facial expressions, gaze, how to link objects - basic embodied interactions with the world.
- Change in emotional response triggers a long term memory response for object based on the socially referenced emotional information.

### **Symbol Grounding**

- Conceptual (abstract) knowledge must be grounded in our perceptions and interactions with the world.
- There is a fundamental relationship between cognition, sensation, perception and emotion.
  - I feel/sense... therefore I think.
- Our mental representations form a hierarchy independent of stimuli; Grounded in perception and emotion, accommodate for abstract symbols that are grounded in the real world.