Cognitive Psychology

Lecture Notes

Week 1

Introduction

What is cognition? What does it mean to think?

Alan Turing (1950) compared us to modern computing. Is a machine a thinking machine? Turing test.

Learning objectives:

1. Define cognition
2. Understand the computational metaphor of cognition
3. Compare and contrast classical computational models of cognition and alternative models.
4. Define mental representation.
    a. Explore examples of different forms of mental representation
        i. Symbolic and analogue representations
        ii. Propositional representations and mental imagery
5. Dynamic, embodied, situated cognition. – examples
6. Understand the argument for grounding symbolic representations in embodies representations.

Defining cognition: Latin – "to know"

- Cognition = the activity of acquiring, organising and using information to enable adaptive, goal-directed behaviour.
- The study of information processing = includes mental processes such as learning, memory, attention, language, reasoning, decision making.
- Goldstein's definition: the mind is a system that creates **representations** of the world so that we can act within it to achieve our goals.
- We store memories and we are able to draw on them to influence further behaviours.
- Mind stores data for later use. The fact we can bring things to mind that are not physically present means our mind creates a mental representation for us.
- Cognitive abilities = intelligence

What can cognitive agents do?

- Sense and act on the environment
    - Detect and effect changes in the environment to gain information.
- Construct mental models to represent the causal structure of their environment.
- Adapt their mental models in response to feedback from their behaviour.

- Use mental models to guide future behaviour.

Classical cognition: the computational metaphor of cognition

Cognition as 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 (programme)

Cognition analogous to the operations of a digital computer

Computers are based on symbolic representations because they work in code (they follow how they are programmed. They read codes and perform actions based on them).

Computational metaphor – we think in the language of the mind, not our native language or images, like a computer code.

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: Concepts <dog>, properties and relationships <in>, <has a...> <and> <or>, 1, 2, 3.

Syntactic rules are the program of the mind expressed in "mentalese" – the language of thought.

Classical cognition can be used to model intelligent behaviour

- Problem solving, reasoning.

The steps we go through to solve a problem can be represented in an explicit symbolic code.

- A series of "if...then..." commands

Good for formal problems and logical reasoning

Bad for perception, action, recognising patterns

Propositional representations: a symbolic code to express the meaning of a particular relationship among concepts.

- E.g. the cat is under the table (relationship between elements, subject element, object element).
- Although you've never seen that particular cat before and the particular table, you still understand that there is a cat and it is under a table.

- Way to write this in the language of the mind:
    - UNDER (CAT, TABLE)
    - [relationship between elements], ([subject element], [object element])
- The table is above the cat. ABOVE (TABLE, CAT).

Propositions:

- Derived from propositional logic
- Express underlying meaning, independent of the specific surface details of an utterance, written sentence, image or witnessed object/event.
- Abstract, symbolic code, like a mathematical formula.
    - Neither words nor images, that reflects our understanding
- Composed of the predicate and number of arguments (semantic elements)
    - Predicate expresses the relationship between elements
    - Argument expresses the subject and object elements
- Propositions take the form of a predicate-argument schema:
    - Predicate (argument, argument, argument)
    - Relationship/Property (Subject, Object, etc)
    - UNDER (CAT, TABLE)
    - P (x, y) → value of x and y can take on anything.

Classical Cognition: Symbolic Representations

The same abstract propositional frame/schema can express many different surface forms

Gave (agent, object, recipient)

- John gave Mary the book
    - Gave (John, book, Mary)
- The book was given to Mary by John
    - Gave (John, book, Mary)
- Kevin gave Julia a kiss
    - Gave (Kevin, kiss, Julia)

Propositions can be combined to represent more complex relationships.

You can extract basic elements of concepts and express them in more complex ways. Underlying mental language extracting meanings of verbal language and experiences.

Another symbolic representation: Semantic Networks

Analogue representations – Mental imagery and mental rotation. (Shepard and Metzler, 1971)

- Not abstract symbols, mental representations.
- The time taken to decide if two object are the same, just rotated is the same time as it would take to physically rotate the object in space.