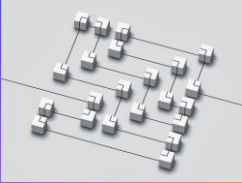


COGNITION AND EMOTION

On-campus Session: Computational Cognitive Science

1



Artificial Intelligence (AI)

- Cognitive modelling can be simple box-&-arrow diagrams derived from behaviour.
 - It can be equations and software programmes derived from a computer.
- From computational modelling, idea arises of using AI to help better understand us as humans.

2

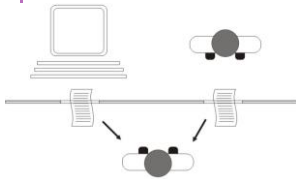
Artificial Intelligence

- AI: "intelligence" shown by machine/computer.
- Founded on idea that cognition can be precisely described due to machine simulation.
- An ideal "intelligent" machine is a flexible rational agent that perceives its environment and takes actions that maximize chance of success at a goal.
- [Cold Fusion – What is artificial intelligence exactly?](#)

3

Turing Test/Imitation Game

- The way we work something out, a computer can do in the same way by following a series of rules in a step-by-step manner and manipulate symbols according to these rules.
- To examine this Turing devised the imitation game...

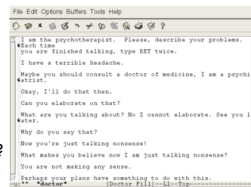


- If human and machine perform the same in the Imitation Game then the material is irrelevant; only the function matters.

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ELIZA programme:

- Natural language processing computer that would simulate a conversation by using pattern matching and substitution
 - ELIZA would process user inputs/engage in discourse following rules/directions of pre-programmed script.
- Most famous script: DOCTOR, simulated psychotherapist.
- Any major issues with this?
 - ELIZA did not have true understanding
 - Why is this an issue for therapy?



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Artificial Intelligence

- Term "artificial intelligence" is applied when a machine mimics "cognitive" functions associated with what a human mind can achieve.
- Main aims of AI research include being able to mimic problem-solving, reasoning, knowledge, planning, learning, natural language processing, and ability to move objects.
- Long-term goal of some AI researchers is to mimic "general intelligence".
 - This raises several issues, which can be divided into philosophical and practical arguments.

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Artificial Intelligence

- Philosophical arguments:**
 - Raises questions about nature of the mind + ethics of creating artificial beings endowed with human-like intelligence
 - What are your thoughts?
- Resulted in most challenging question in AI research:
 - Can a computer experience conscious awareness?

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Artificial Intelligence

- Typically, AI is divided into **strong** AI and **weak** AI.
- Strong AI: all thinking is computational, so the more carrying out of computations a machine does, the outcome will eventually evoke conscious awareness.
- Weak AI: what is simply being expressed is that we can only model our intelligent processes to create a different type of intelligence – e.g., pocket calculator.
 - [Andrew Keever – Strong and Weak AI](#)

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Artificial Intelligence



- Practical arguments:**
 - Say we created machines to mimic how our mind reasons – what are the problems with attempting to do this?.....
 - We do not know how this works in us to begin, so how could we create a machine to do it?
- What would the counterargument to this, based on the basic assumption of why we attempt cognitive modelling to begin?

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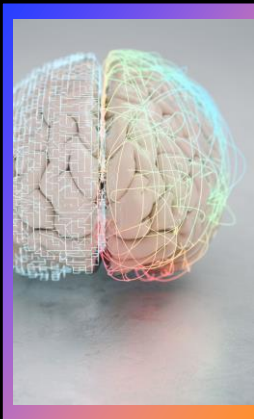
Searle (1980): 'Chinese room argument'.



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Brains vs. Computers

- Work together in Groups to Consider:
- How is the mind/brain similar to a computer?
- How does the mind/brain differ to a computer?



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Computer Metaphor

	COMPUTER	HUMAN
HARDWARE	• Circuit board • Chips	• Brain structures
SOFTWARE	• Programme and sequence of instructions. • Symbol manipulation	• Mental processes. • Abilities

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Computer Metaphor

Computer	Human
Serial vs. Parallel Processing	
Binary Coding (0s & 1s)	Neurons ("On" or "Off")
Internal and auxiliary memory	Short-term 'working' memory and Long-term memory
Independent "chips" for processing specialised tasks	Distinct processing areas performing specialised task

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Brains vs. computers

- However, we are not made of metal and cables, we are made of blood and tissue.
 - Surely the type of material that makes us and that makes computers are too different to be compared?
 - In concurrence with this argument, French proposed a list of questions that an entity could only answer if it had a body in a Turing type test – this naturally makes it impossible for a computer to pass.

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Brains vs. Computers

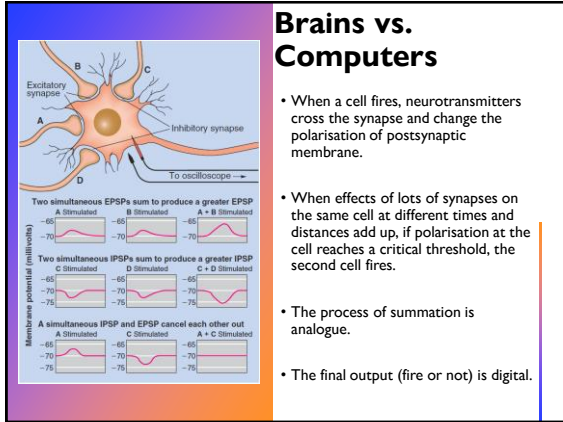
- However, what do we now know about connections in the brain?
 - Wired connections of electrical activity.

Digital vs. Analogue

- Is the human brain digital or analogue?
 - Both
 - Neurons either fire or not: essentially it is digital
 - Yet the rate of firing is a continuous variable
 - Another analogue process is spatial summation



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Brains vs. Computers

Serial vs. Parallel

- Digital computers process info quickly but serially.
- They have a single central processing unit.
 - They can work simultaneously on different tasks
 - But only by dividing tasks and switching between them.
- By doing this, a serial machine can **simulate** a parallel machine.

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Brains vs. Computers

Serial vs. Parallel

- In comparison, neurons operate slower
- However, the brain is parallel in nature with no central processor.
- Instead it has millions of simultaneously operating cells, which compensates for slower speed.
- The latest super computers are estimated to be four times as fast as the human brain.

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Brains vs. Computers



Computable vs. Non computable

- A computable procedure can be described explicitly (a procedure done by a computer).
- **Computational functionalism:** the brain is a Turing machine and its operations are computations.
- If true, it should be possible to reproduce all human abilities (making strong AI feasible).
- However, such computations would only simulate human function - There is more to consciousness than "running the right programme".

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Brains vs. Computers

Deterministic vs. Nondeterministic

- A machine that always produces same output from same input and internal state is **deterministic**.
- One that produces different outcomes is **nondeterministic**.
- Digital computers: deterministic, brains: nondeterministic.
- Neurons are living entities whose electrical properties change as their dendrites grow or move.
- Synapses form and decay and their strength changes in response to use.

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Considerations

- What about creativity?
 - Can be unexpected and sometimes unconscious in humans.
- Can machines be creative?
- If a robot draws a brilliant piece of art, can we say it's been creative?



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WHAT IS CONSCIOUSNESS?



- Moment-to moment awareness of ourselves and environment.
- Subjective/private – nobody will know what reality is for you and vice-versa
- It is dynamic – we drift in and out of different states throughout the day and the stimuli we encounter also changes.
- It is a continuous flowing stream of mental activity.
- It's self-reflective and central to our sense of self – our mind is aware of its own consciousness.
- In-between stimulus and response is us – conscious thought and awareness.
- So, we can still act on things and behave based on what happens internal to us.

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CONSCIOUSNESS



- This is where Cognitive ideas of Mental States and representations come in
 - We think of things in our mind
 - So, there needs to be a model or theory to explain consciousness and the way we represent the information we think about.
- By defining mental representations, we can infer from observable behaviour back to internal mental processing that underpinned that behaviour.

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Consciousness

- Can a machine be conscious?
- If so, can we test for consciousness?
- If we agree consciousness is subjective, then the only one who can know whether a machine is conscious is the machine itself.
- [Does the following provide evidence for machine consciousness?](#)
- [Cold Fusion: Are we approaching robot consciousness?](#)

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VISUAL IMAGERY

- What did the children in your primary school or secondary look like?
- What did you do/How did you go about answering that question?
- You had to visualise (see a picture in your head) people's faces, you had to use your memory to think about all the different people, and you had to have an awareness of what you were thinking about.

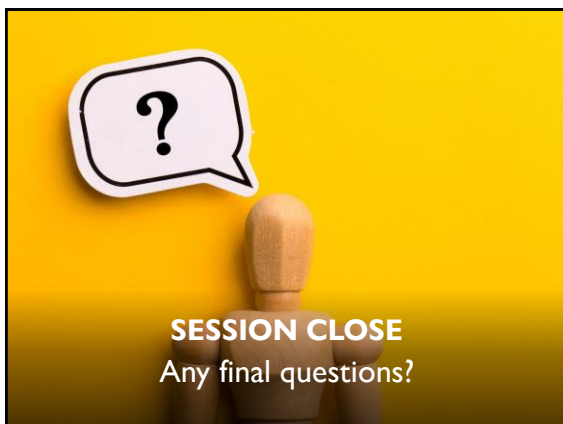
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Visual Imagery and Memory

- Hopefully from that short exercise you can see there is more going on than just seeing a picture in your mind.
- What we are going to do now is a task that is going to involve some active participation from you to look further at the link between visual imagery and memory.
- Read the instructions provided and then follow what those instructions ask you to do while I read out a list of words to you.

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SESSION CLOSE
Any final questions?

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