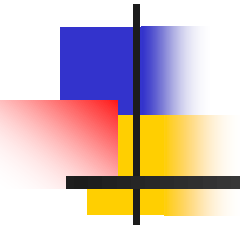
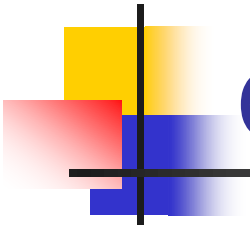


Reasoning and Logical Thinking (Part 2)



Questions to consider

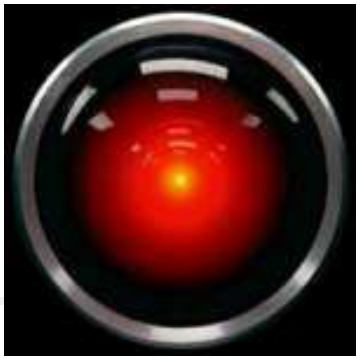
- Artificial intelligence is the attempt to artificially create cognitive beings, but:

  - What is a mind? What is consciousness? Can the mind be captured computationally?

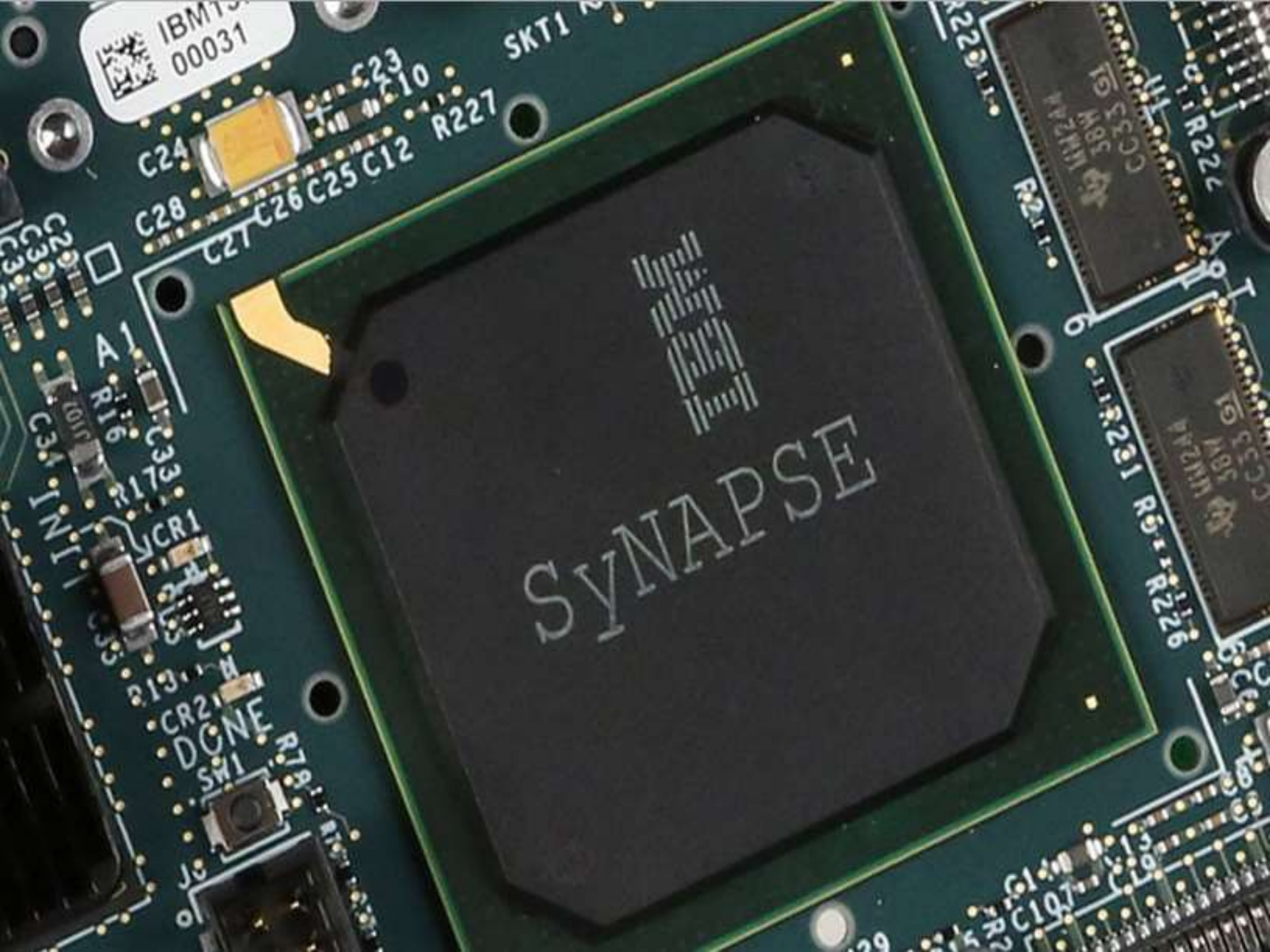
  - If mental activity is mere computation, is there free will?

  - How much human programming should support machine learning processes?

Questions to consider



- **2001: A Space Odyssey** (1969)
  - Story of an intelligent spaceship computer named HAL
  - As the "brains" of the ship, HAL is able to:
    - ✓ Speak easily with the crew and understand emotions
    - ✓ Navigate the ship automatically and diagnose on-board problems
    - ✓ Make life-and-death decisions and….. display emotion?


SyNAPSE
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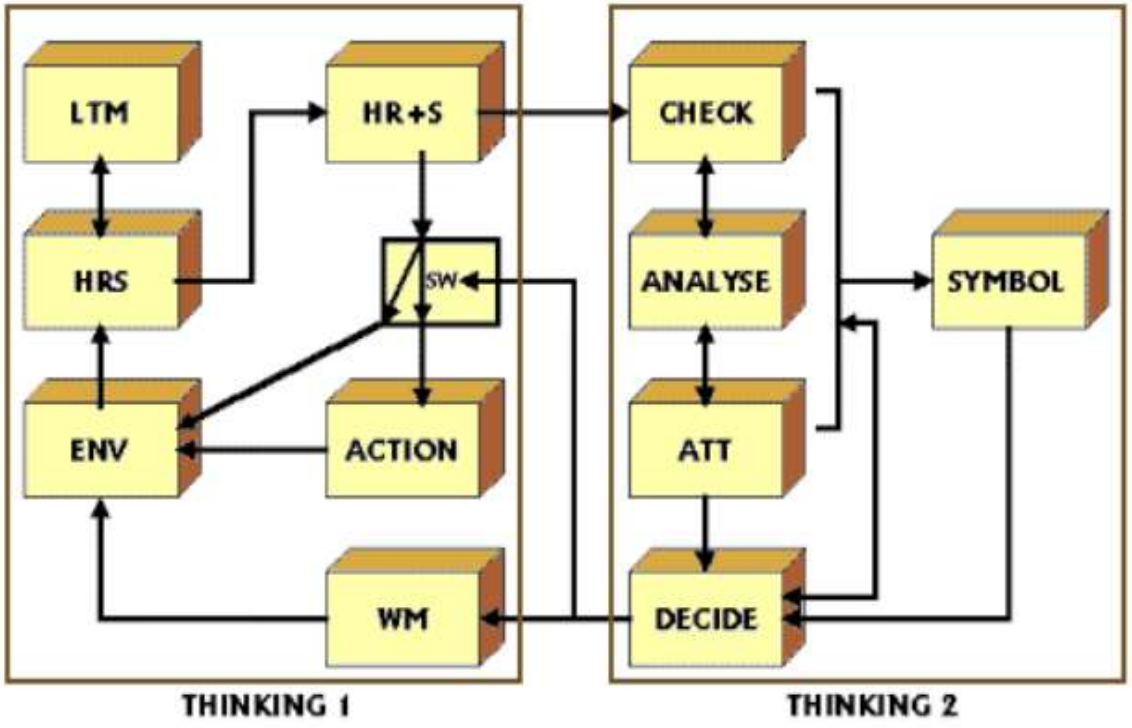
Computational Cognitive Science

Computational modelling involves recreating some aspect of human cognition in the form of computer program, flow chart or formula in order to predict behaviour in novel situations



Perspectives on AI

- **Modeling exactly how humans "should" think**
  - Cognitive models of human reasoning
  - Models of "rational" thought (e.g., formal logic).....but humans are often not rational!

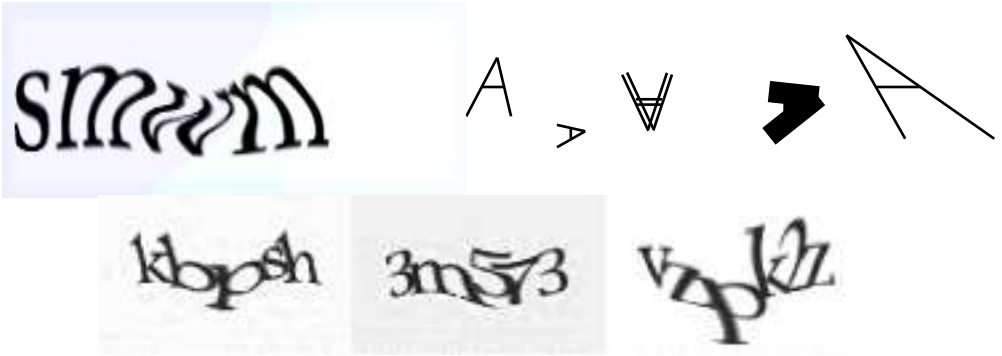
- **Modeling exactly how humans "should" act**
  - Models of human behavior (what they do, not how they think)
  - Rational actions but not necessarily formal rational reasoning
  - More of a black-box, engineering approach

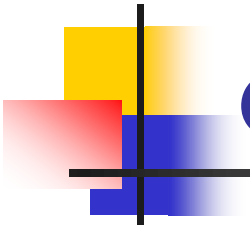
- **Modern AI focuses on:**
  - Success judged by how well the intelligent agent performs
  - Modern methods inspired by cognitive psychology and neuroscience

Can Computers "See"?

- **Recognition vs. understanding objects or stimuli?**
  - Look around this room…you effortlessly recognize objects
  - Human brain can map 2D visual image to 3D "map"

- Why is visual recognition a difficult problem for AI?





Can Computers "See"?

- **Recognition vs. understanding objects or stimuli?**
  - At present, largely NO….computers can only "see" certain types of objects and under limited circumstances
  - But….increasingly YES for constrained problems (e.g., face recognition)

Academic Influences on AI

Philosophy	Logic, methods of reasoning, mind as physical system, foundations of learning, rationality
Mathematics	Formal representation and proof, algorithms, probability
Economics	Decision theory, rational economic agents
Neuroscience	Neurons as information processing units
Psychology and Cognitive Science	How do people behave, learn, perceive, process information, mentally represent knowledge
Computer engineering	Building fast(er) computers
Linguistics	Knowledge representation, grammar, language

Computational Cognitive Science

- Computational models can vary in complexity from relatively simple flow charts to highly detailed connectionist networks
- In these latter models units or nodes are connected to many others.
- In a particular scenario units take the weighted sum of the inputs coming to it and produce a single output to another unit.
- Networks can be arranged in complex layered systems

Computational Cognitive Science

Some limitations

- There are usually many ways to model a particular cognitive phenomenon
- There is a lack of a definite method for relating computational model behavior to human behavior
- It is extremely difficult to take every cognitive factor into account when creating a model

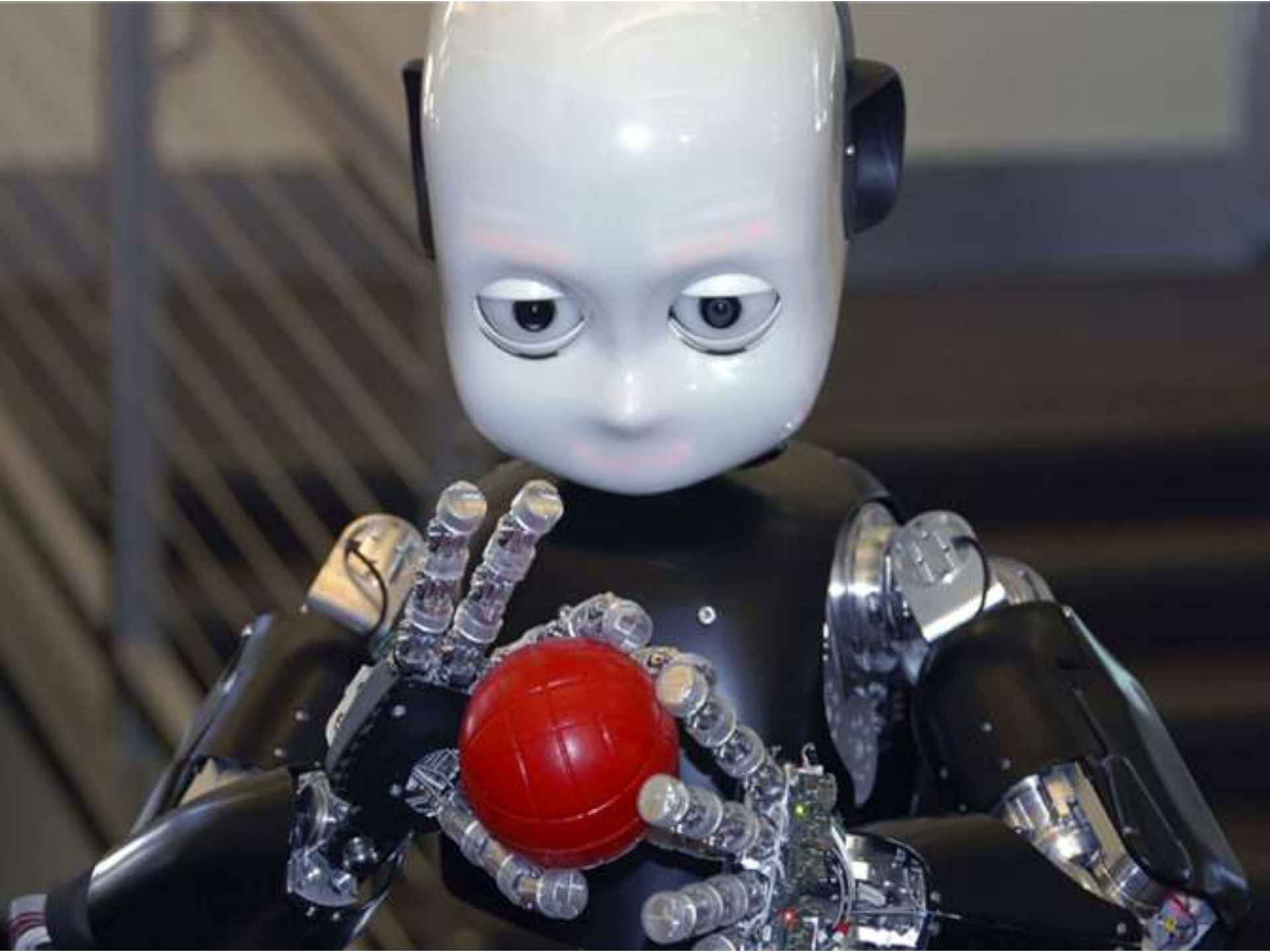
Artificial Intelligence

- **Cognitive Robotics**

  - Machines with a wide spectrum of cognitive capabilities to solve open-ended tasks and problems

  - Autonomous knowledge acquisition – agent explores and learns on its own through "curiosity algorithms"

  - Machine learning allows computers to learn to do things without explicit programming



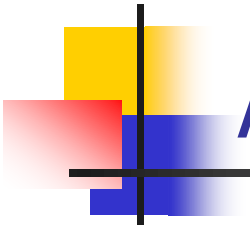
Welcome to Synthia City

Virtual world complete with pedestrians, bad weather and cyclists so AI cars can learn to drive

Watson

Deep Blue

Google's self-driving car

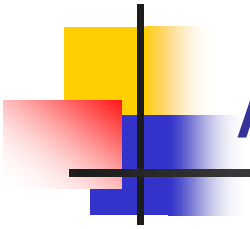


Artificial Intelligence

- **Synthetic Characters**

  - Other applications for AI will be intelligent tutoring systems

  - Also the addition of realistic VR environments used for simulation and training purposes



Artificial Intelligence

- **Synthetic Characters**

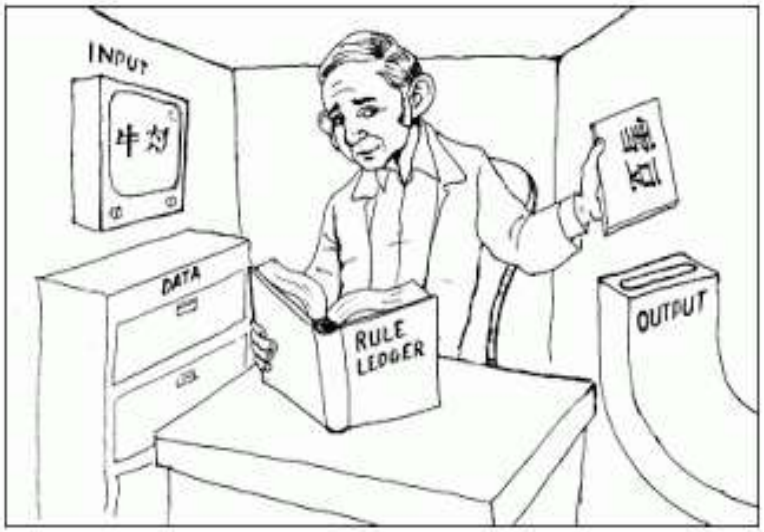
  - Agents in virtual or cybernetic environments

  - Industry is interested in game characters (AI) with more intricate cognitive models than sliding personality scales of the Sims…

Close Contact Tactical Training - Dismounted Soldier Training System (CCTT-DSTS) led by the Army's Program Executive Office for Simulation, Training, and Instrumentation (PEO-STRI)

Surgery training app Touch Surgery cuts deal with Johnson & Johnson

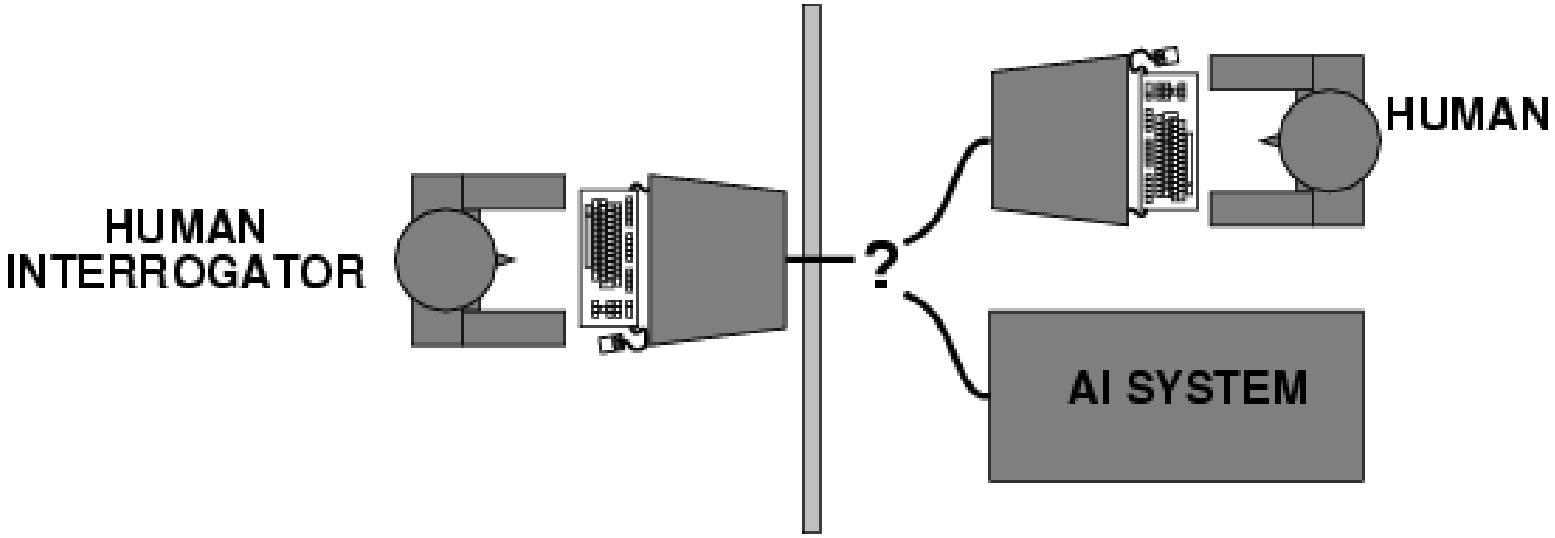
The Chinese Room Argument



The Turing Test

- Turing (1950)

  "Can machines think?"→ "Can machines behave intelligently?"



Conclusions

- AI is about building intelligent agents (robots)
- There are many interesting sub-problems to solve in machine learning, vision, speech, prediction/planning
- Strong progress has been made, but surprising lack of progress is also notable (e.g., visual object recognition)
- There is no doubt that AI has a bright future as technology becomes increasingly “smart”