

Artificial Intelligence

Steve James
Introduction to AI

Syllabus

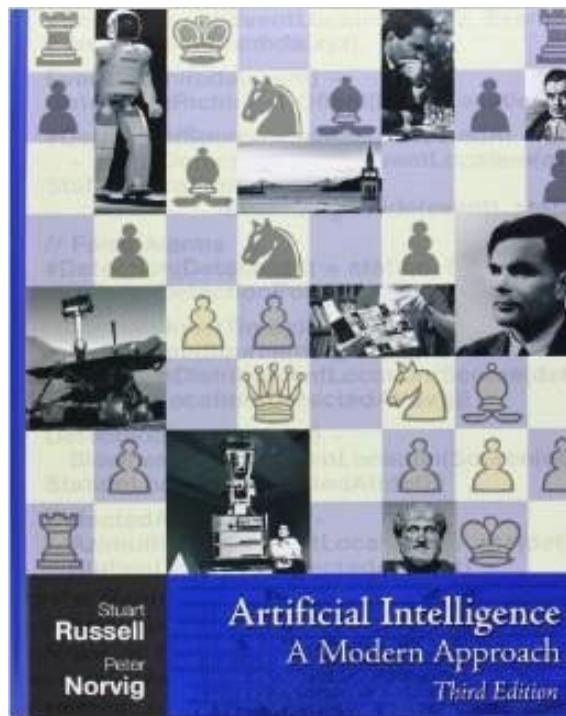
- AI, Philosophy and Agents
- Search
 - Adversarial Search and Game Theory
- Knowledge Representation and Reasoning
 - Logic and Inference
 - Uncertain Knowledge
 - Bayes' Rule
 - Probabilistic Reasoning
 - Bayes Networks
 - Hidden Markov Models
- Planning
 - Classical Planning
 - Robot Motion Planning
 - Planning under Uncertainty
- Learning
 - Reinforcement Learning
 - Supervised Learning
 - Unsupervised Learning
- Social and Ethical Issues
- Topics
 - Natural Language Processing
 - Machine Vision
 - Robot Learning

Admin

- Lecture + Lab: Wednesdays @ 09h00 – 12h00
 - MSL006
- Breakdown:
 - 1x assignment (2x for MSc)
 - Nx labs
 - 1x test
 - 1x exam
 - See course outline for weightings
- Languages: Python, C++, Prolog

Textbook

- *Artificial Intelligence: A Modern Approach*,
Russel & Norvig, 3rd Ed

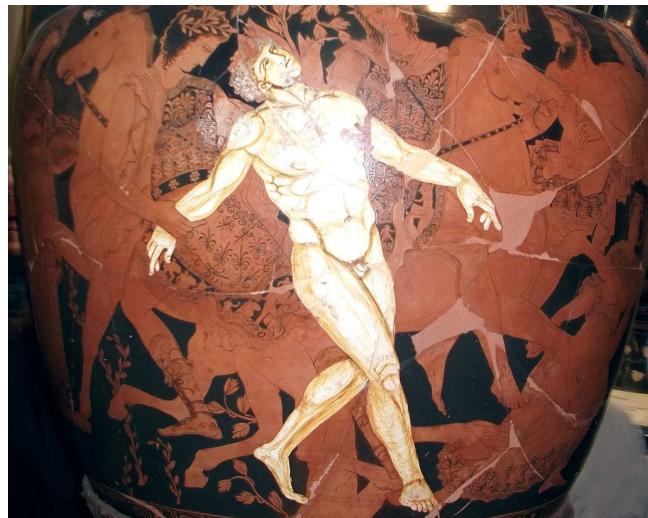


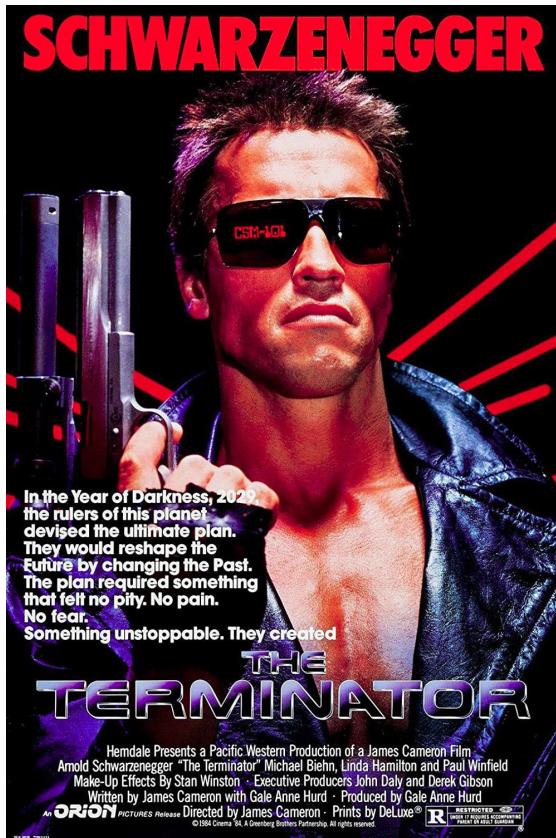
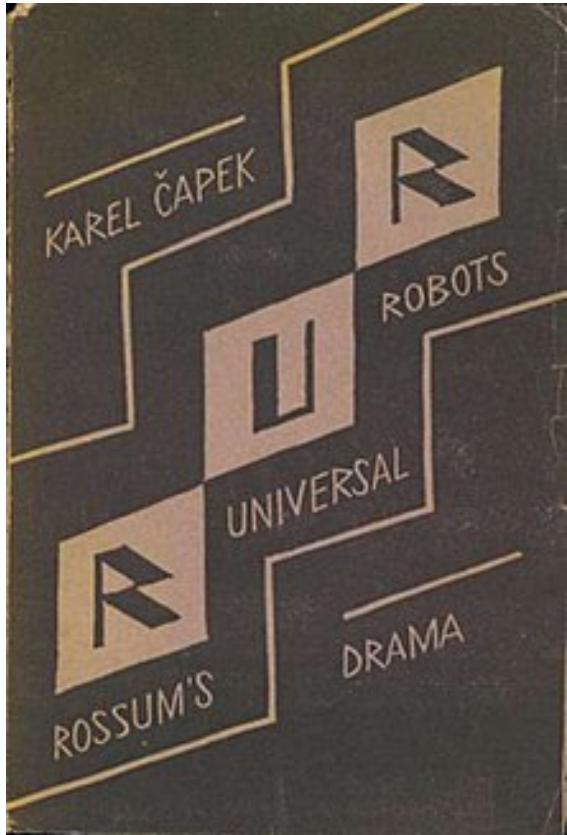
Academic Honesty

- Okay?
 - Have discussions with classmates
 - Use Google for definitions and background
- Not okay?
 - Hand in anyone else's work, in part or in whole
 - Google for solutions

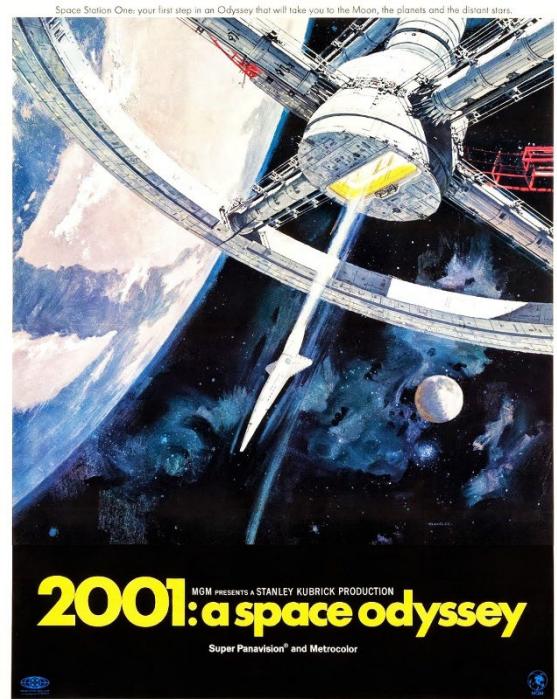
AI

- For as long as humans have made machines, we have wondered whether **machines could be made intelligent**





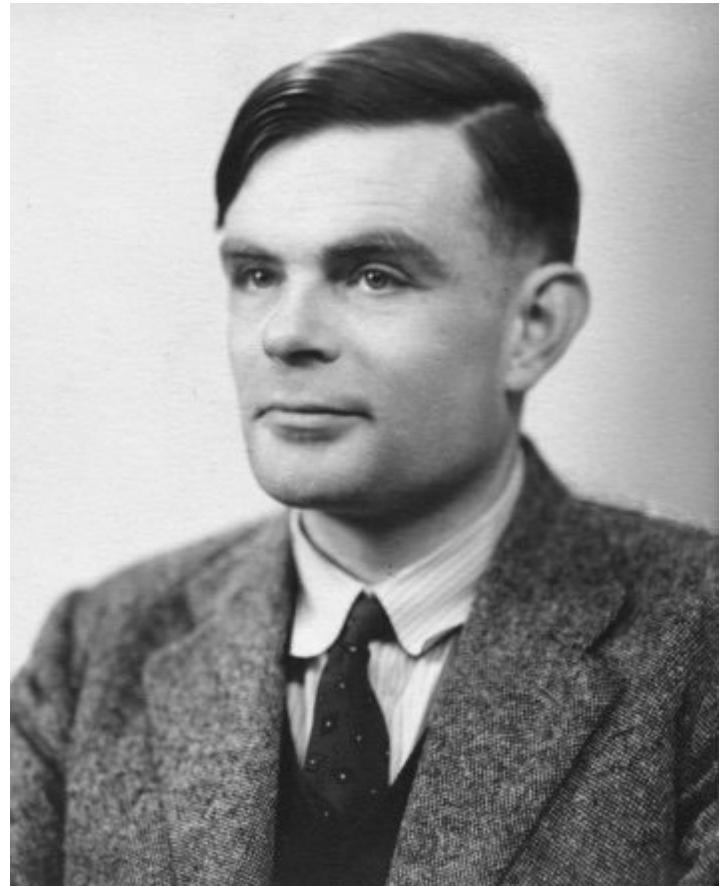
An epic drama of
adventure and exploration



Turing

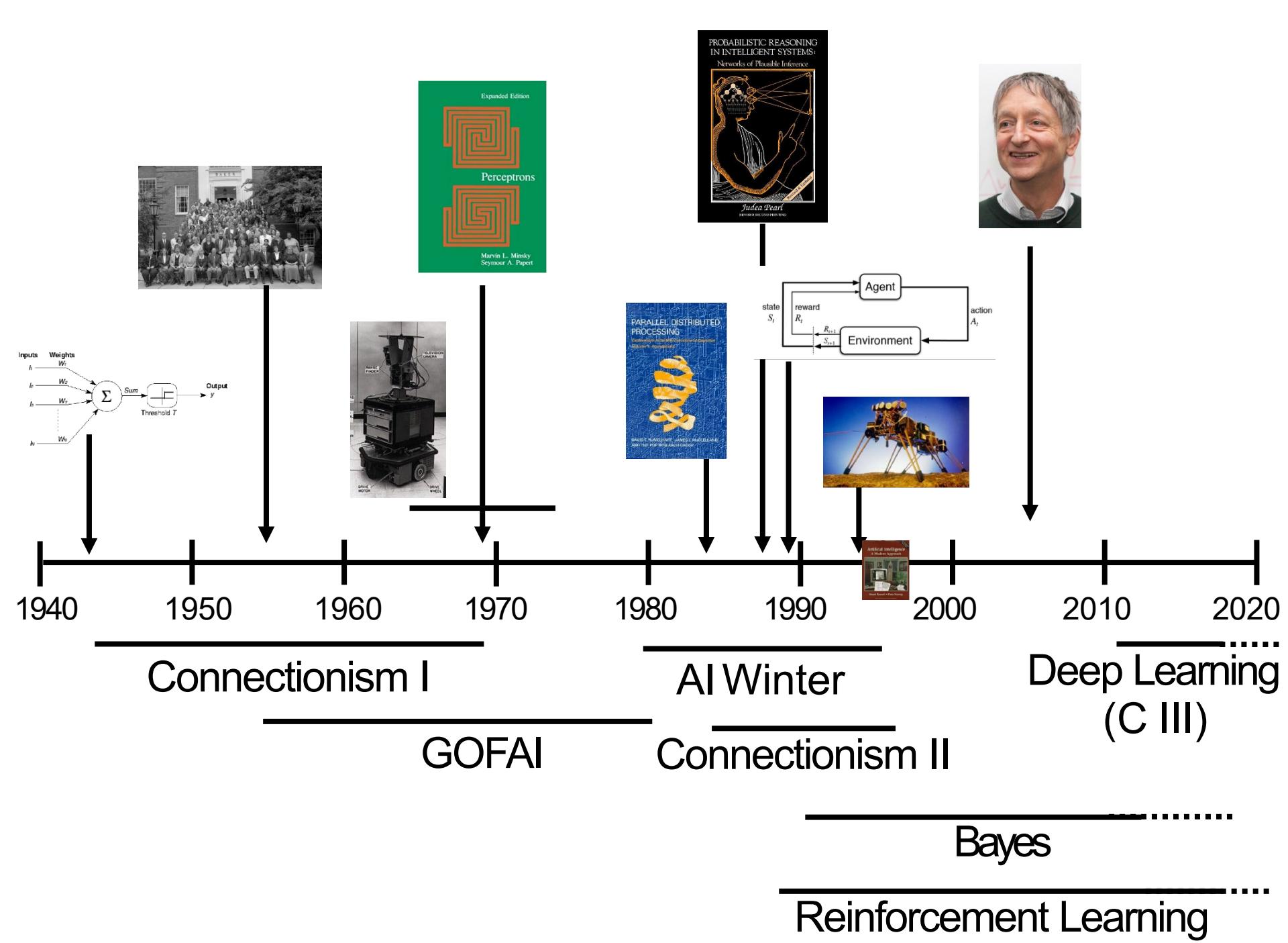
Computing machinery and
intelligence. *Mind*, October
1950.

- Turing test
- “Can machines think?”



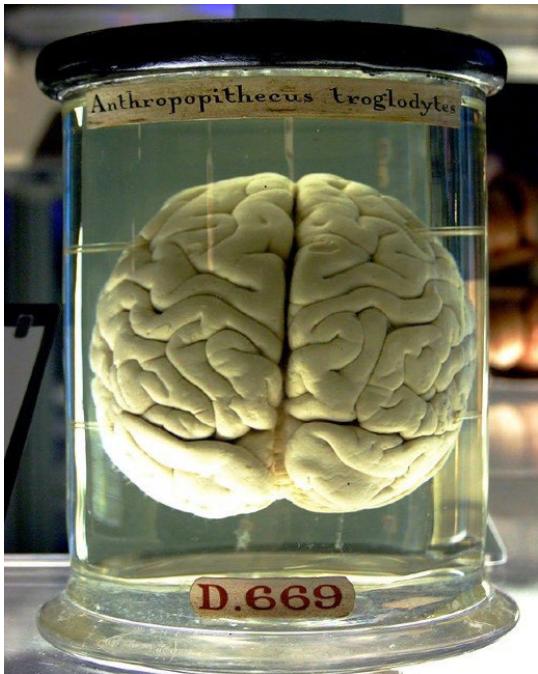
Dartmouth, 1956





Fundamental Assumption

- Brain is a computer



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What is AI?

- Unclear!
- Two dimensions
 - “Humanly” vs “Rationally”
 - “Thinking” vs “Acting”

Thinking Humanly	Thinking Rationally
Acting Humanly	Acting Rationally

What is AI?

Cognitive
Science

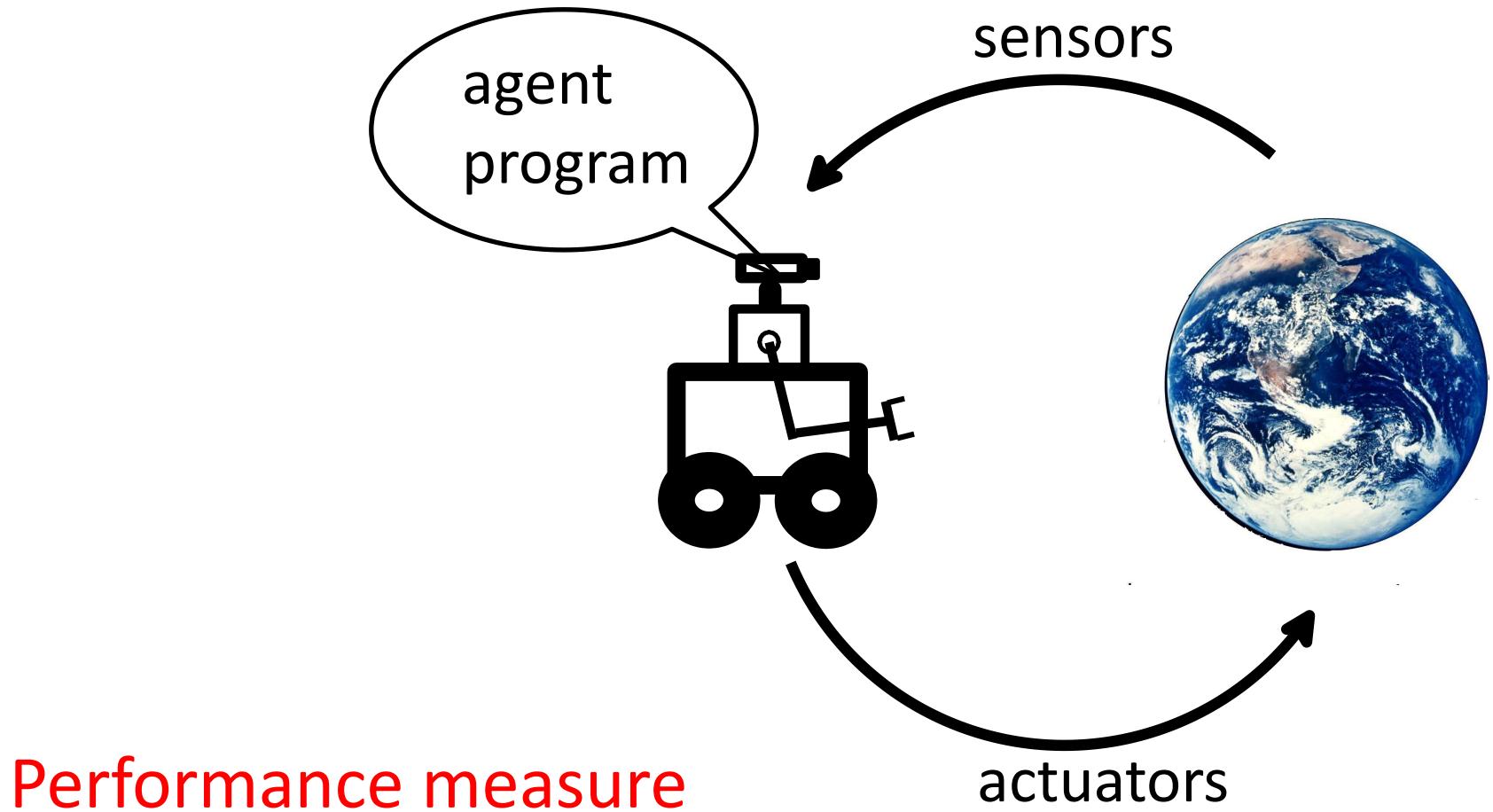
Thinking Humanly	Thinking Rationally
Acting Humanly	Acting Rationally

"Emulation"

Rational
agent

Laws of
thought

What is a rational agent?



Rational Agents

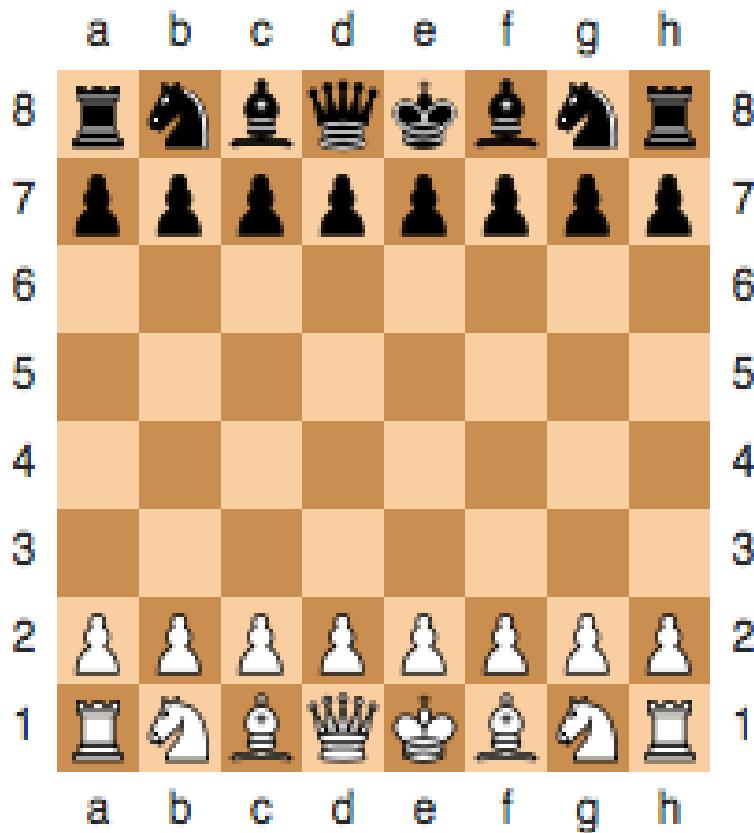
- A rational agent:
 - acts in its environment
 - according to what it has perceived
 - in order to maximise its expected performance measure
- actuators*
sensors
agent program
given

Properties of an environment

- Observable?
- Deterministic or stochastic?
- Episodic or sequential?
- Static or dynamic?
- Discrete or continuous?
- Single or multiagent?
- Known?

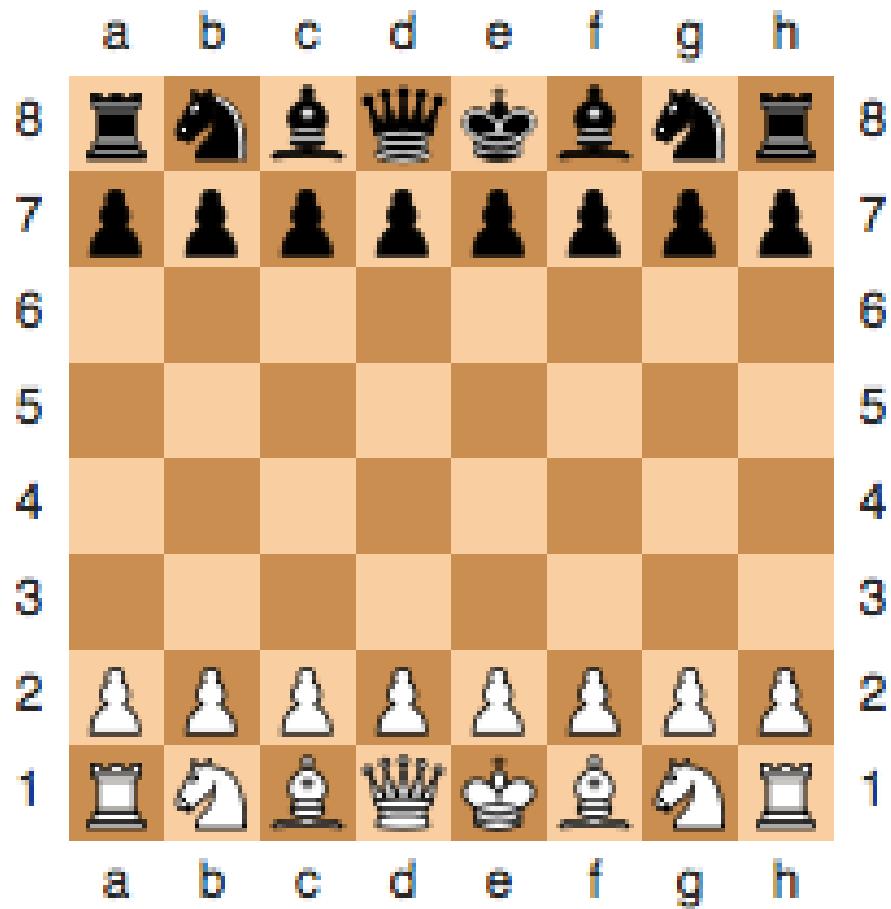
Chess Example

- Performance measure?
- Environment?
- Prior knowledge?
- Sensing?
- Actions?



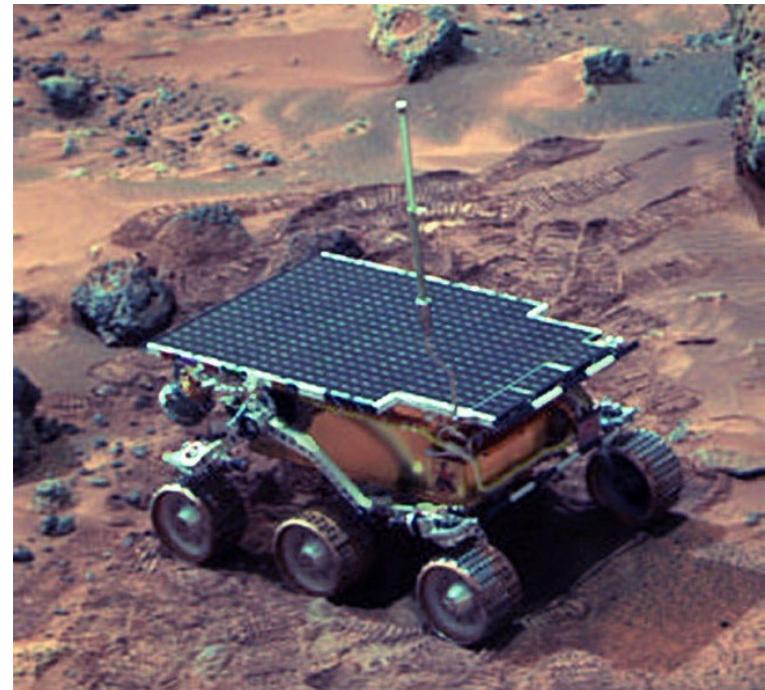
Chess Example

- Fully observable
- Deterministic
- Episodic
- Static
- Discrete
- Multiagent
- Known



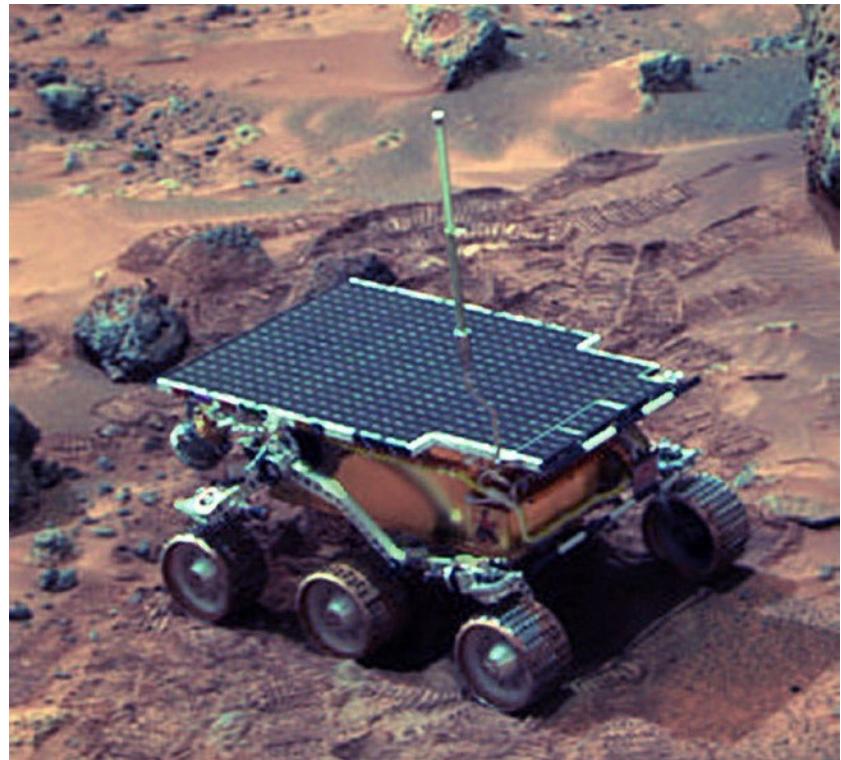
Rover Example

- Performance measure?
- Environment?
- Prior knowledge?
- Sensing?
- Actions?



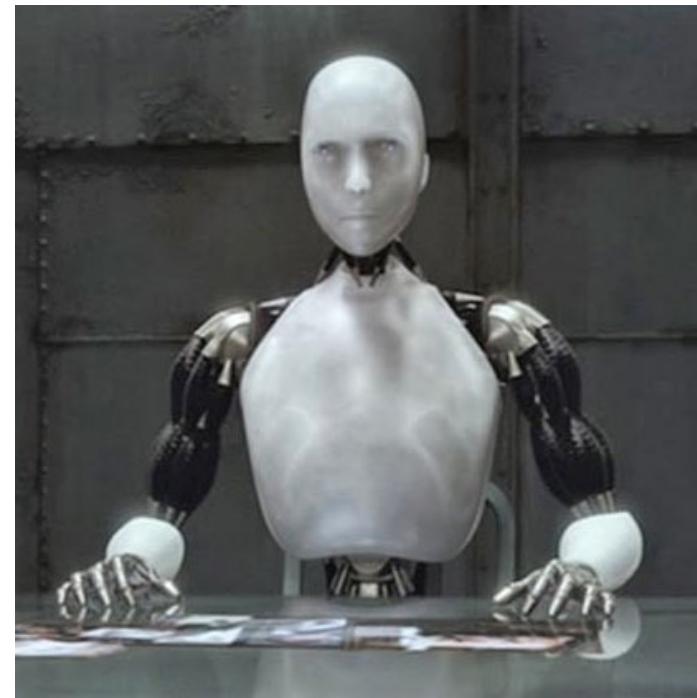
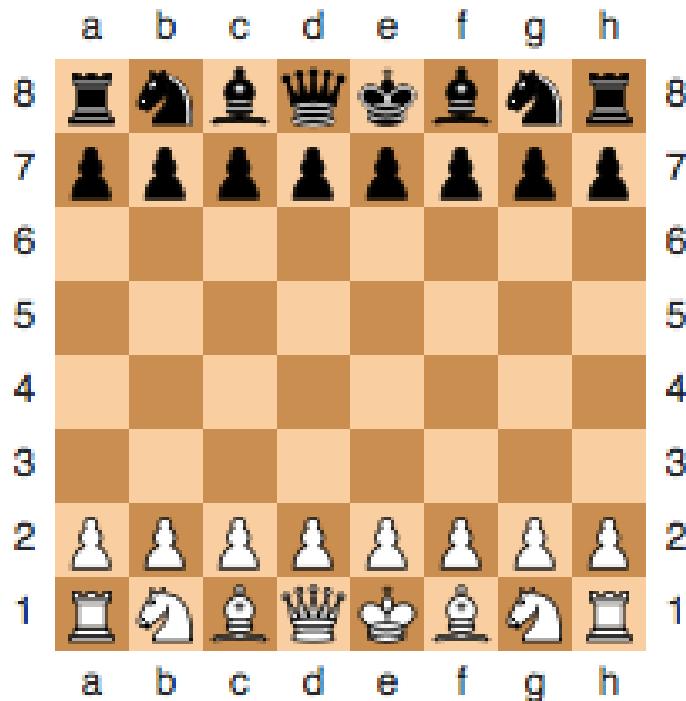
Rover Example

- Partially observable
- Stochastic
- Sequential
- Dynamic
- Continuous
- Single agent
- Partially known

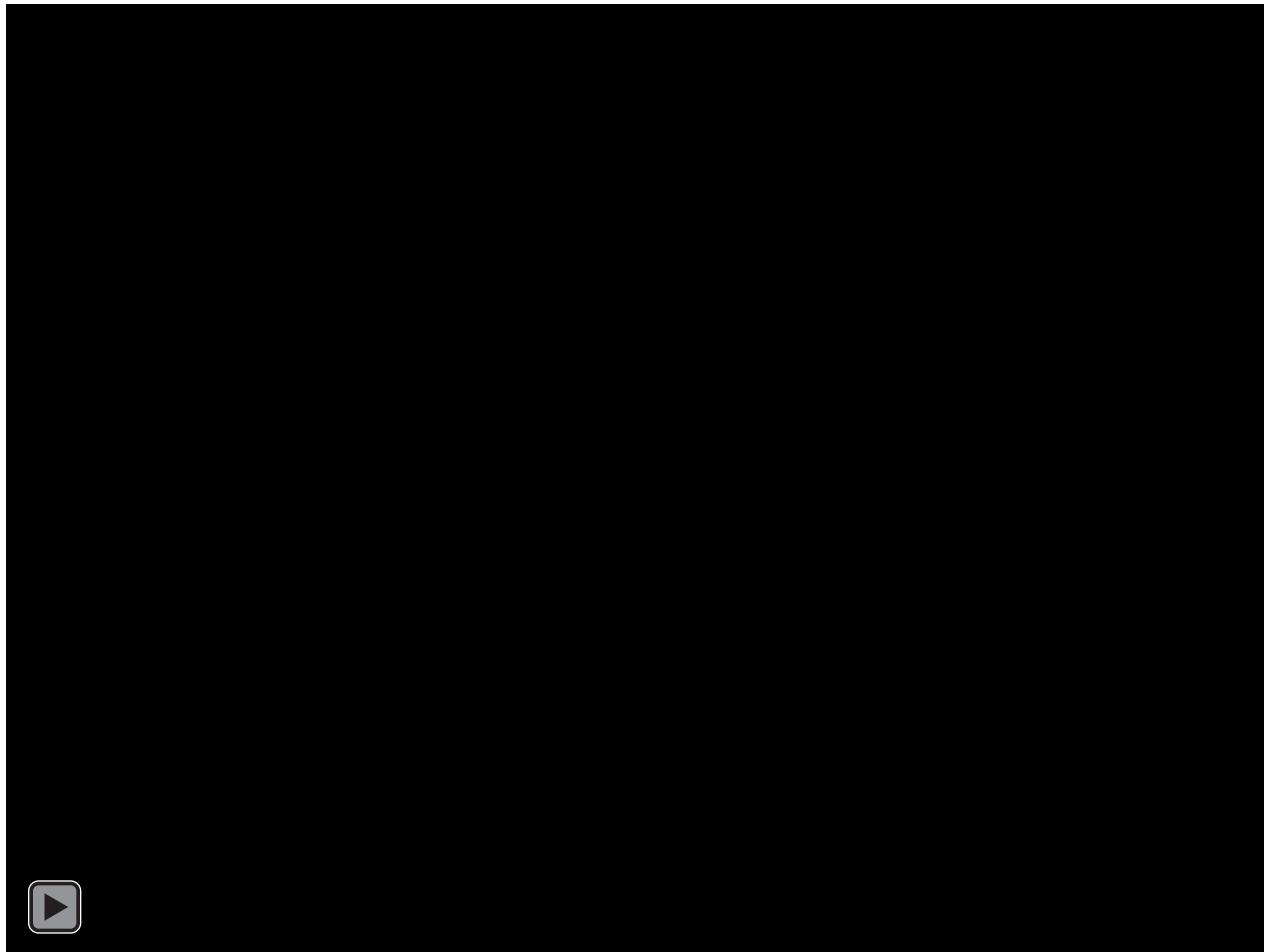


Are we making progress?

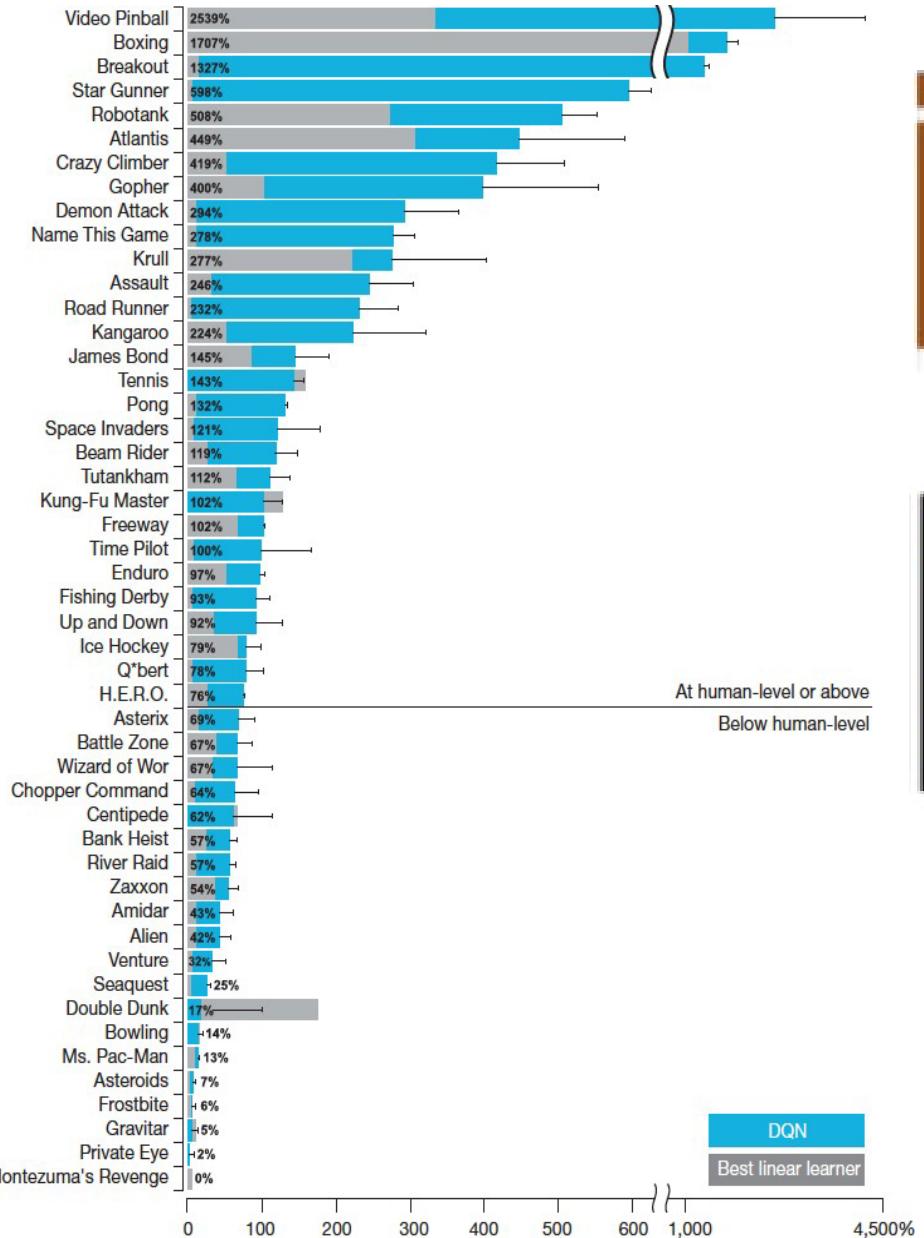
- Specific vs **general**



Progress

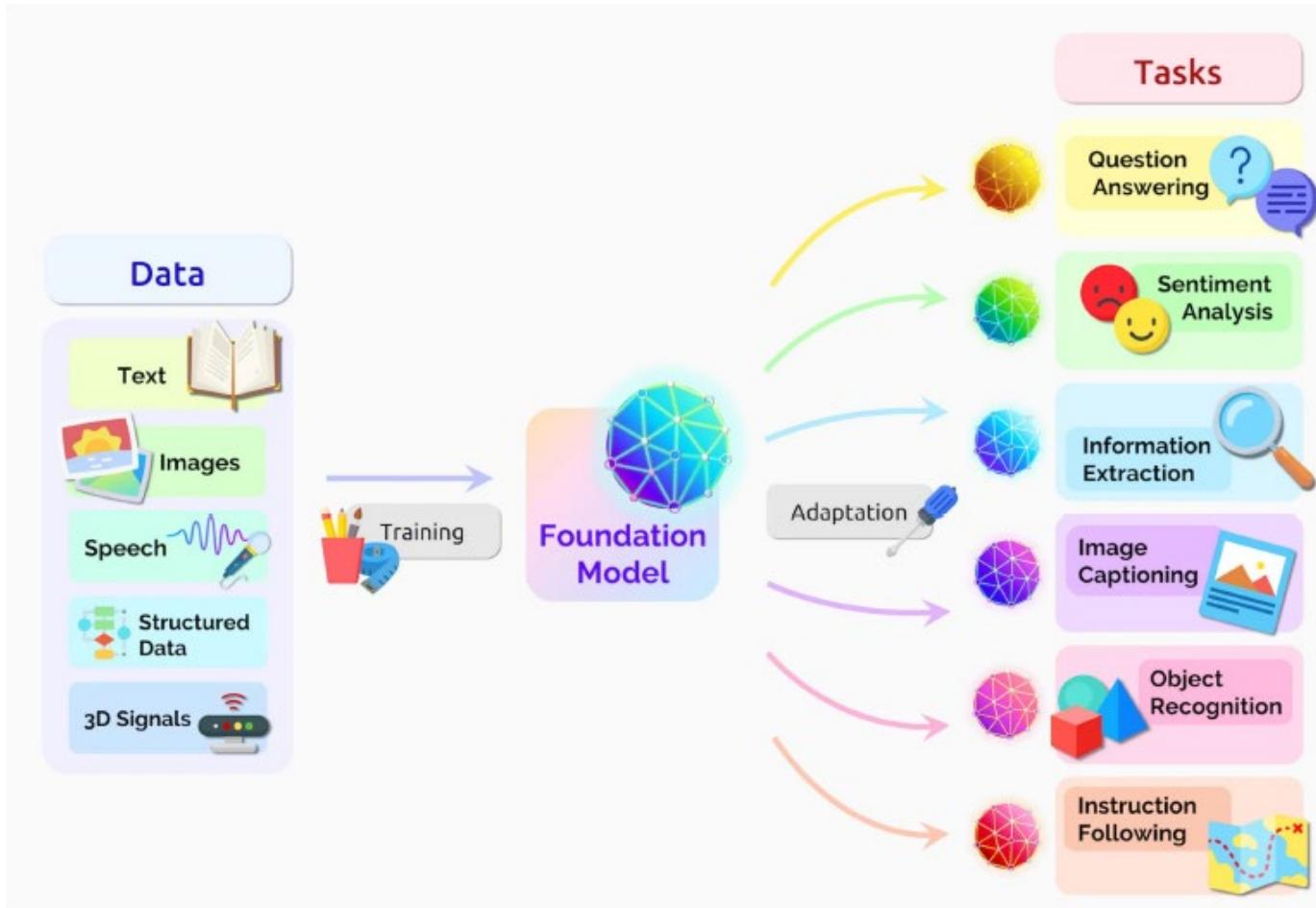


[Mnih et al., 2015]



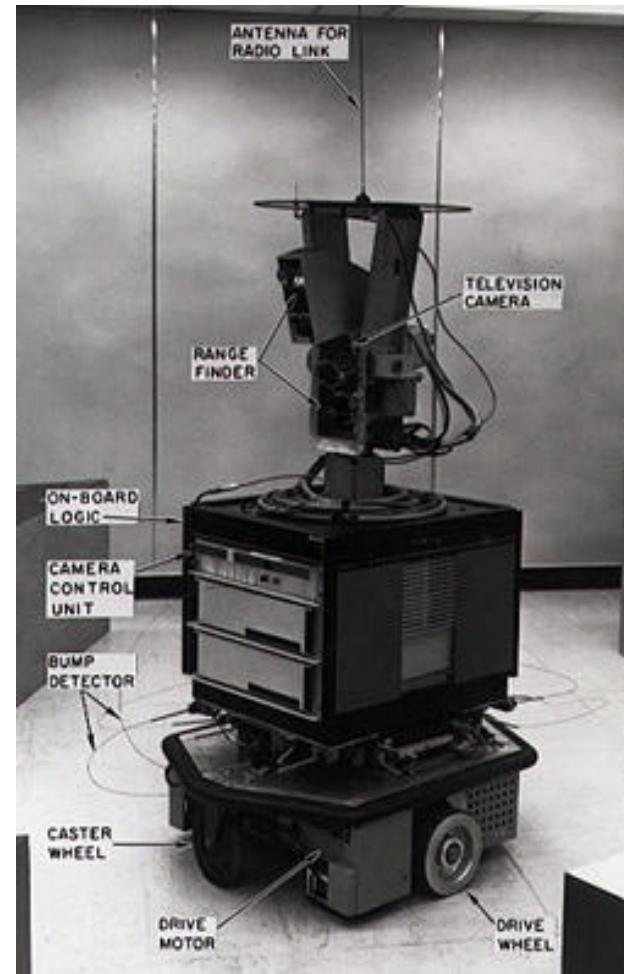
[Mnih et al., 2015]

ChatGPT



Structure of the Field

- AI is **fragmented**:
 - Learning
 - Planning
 - Vision
 - Language
 - Robotics
 - Reasoning
 - Knowledge Representation
 - Search



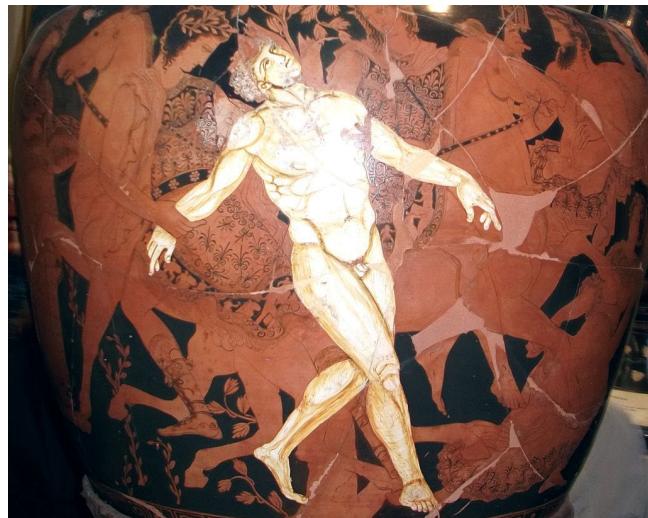
Progress in AI

- Clear, precise models of a class of problems
- Powerful, general-purpose tools
- A clear understanding of what each model and tool can and cannot do
- Occasionally: vividly **illustrative applications.**
- Arduous and slow
- Huge opportunity

PHILOSOPHY OF AI

AI

- For as long as humans have made machines, we have wondered whether machines could be made intelligent

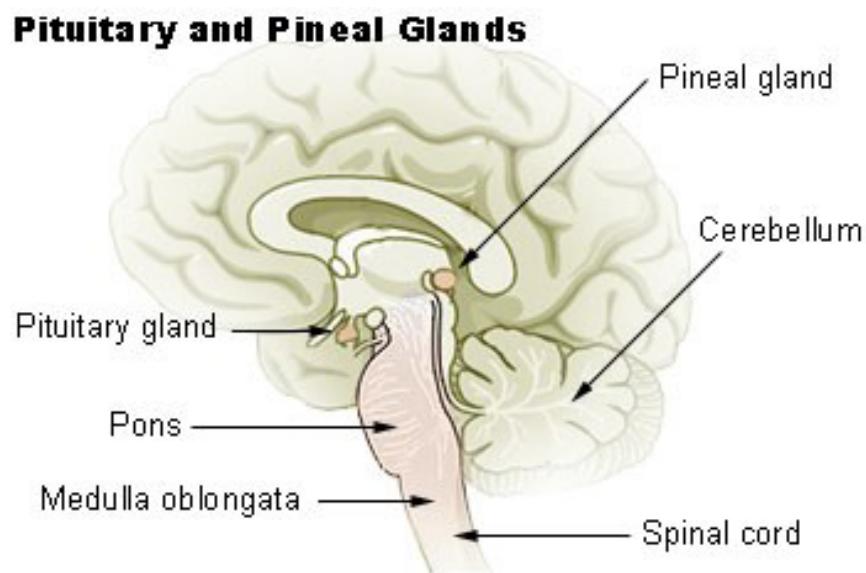


The Mind-Body Problem



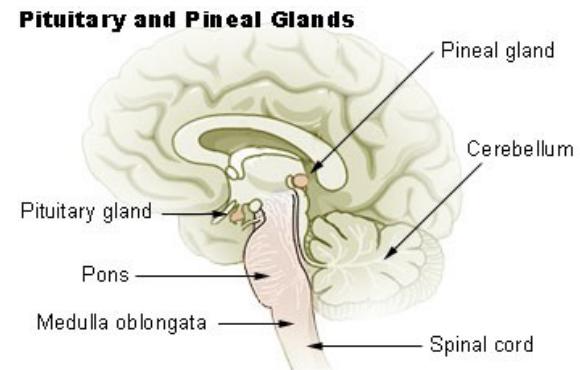
What are minds made of?

- Dualism
 - Mind and body are two different things
 - Mind is **non-physical** entity



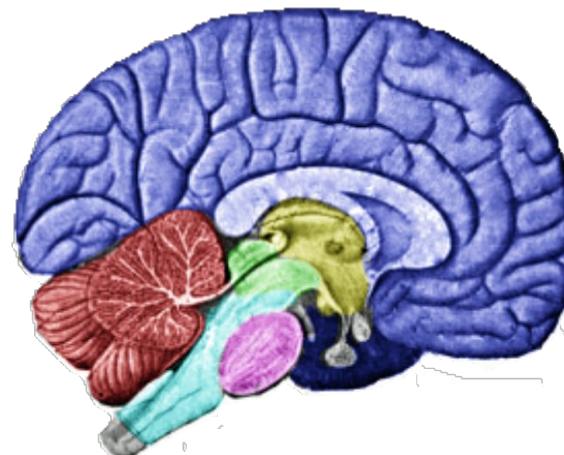
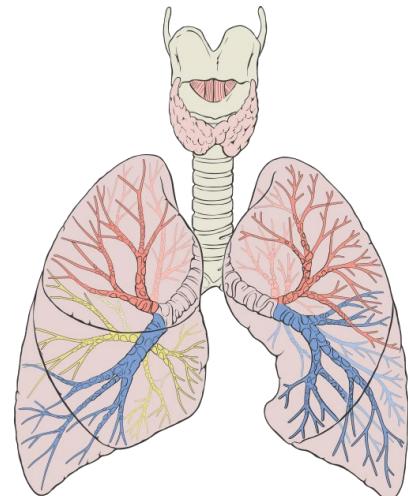
What are minds made of?

- Materialism
 - Only material objects exist
 - Mental states = physical states
- Brains cause minds
 - Because of what they are: biological naturalism
 - Because of what they do: functionalism



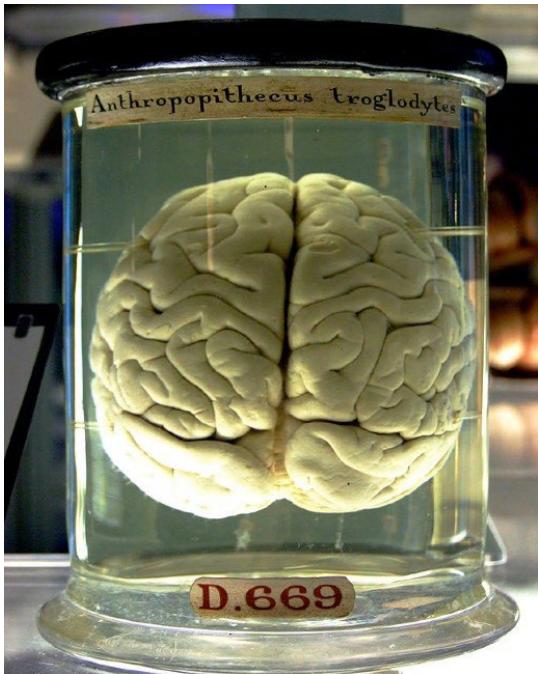
What is computation?

- Information processing
 - Symbols and rules for operating on symbols
 - Symbols and rules matter
 - Physical substrate doesn't matter



Fundamental Assumption

- Brain is a computer

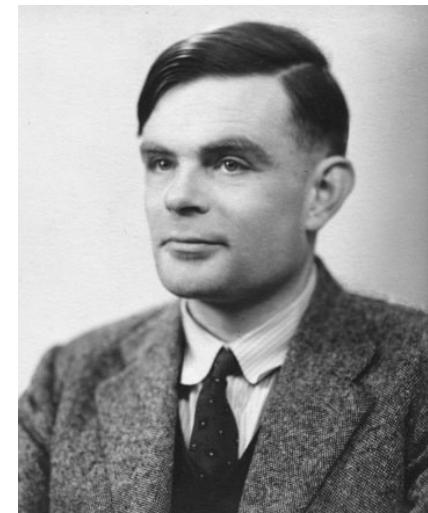


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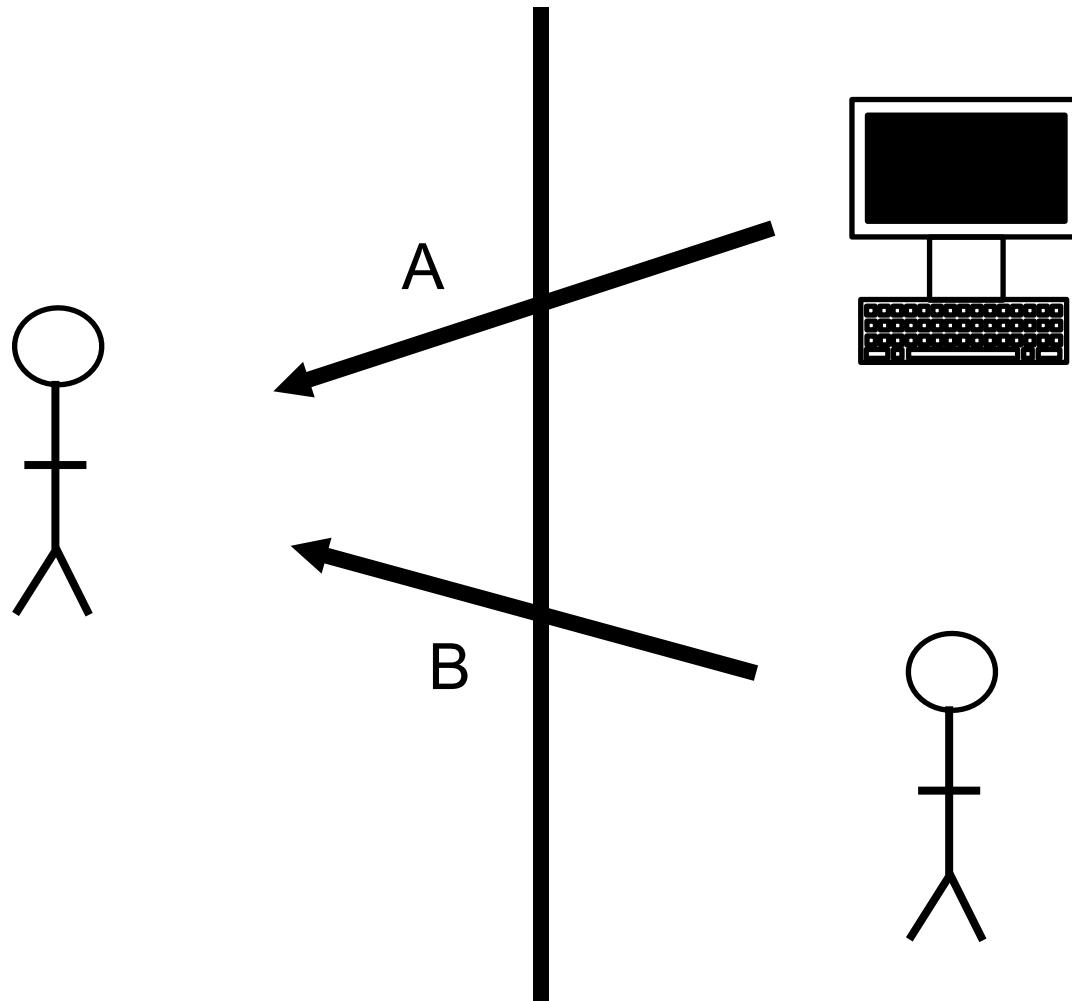


Weak AI Hypothesis

- A computer program can be built that acts as intelligently as a human.
 - This is about **behaviour**.
 - It makes **no claim about minds** or even thought.
 - Not even about practicality: asks whether it can be done in **principle**.
- **Rational agent!**



Turing Test



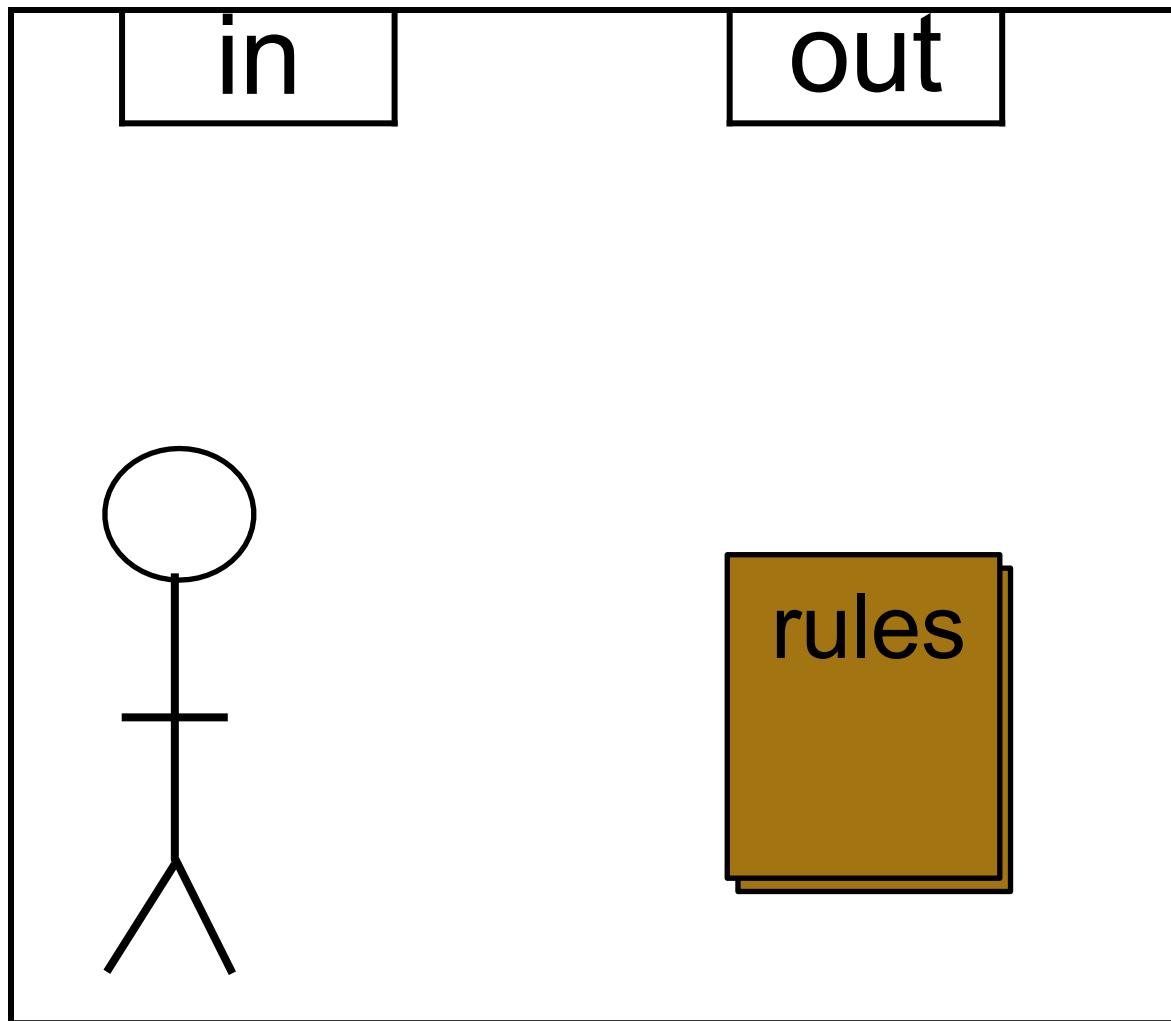
Objections

- The theological objection
- The mathematical objection
- The argument from consciousness
- The argument from various disabilities

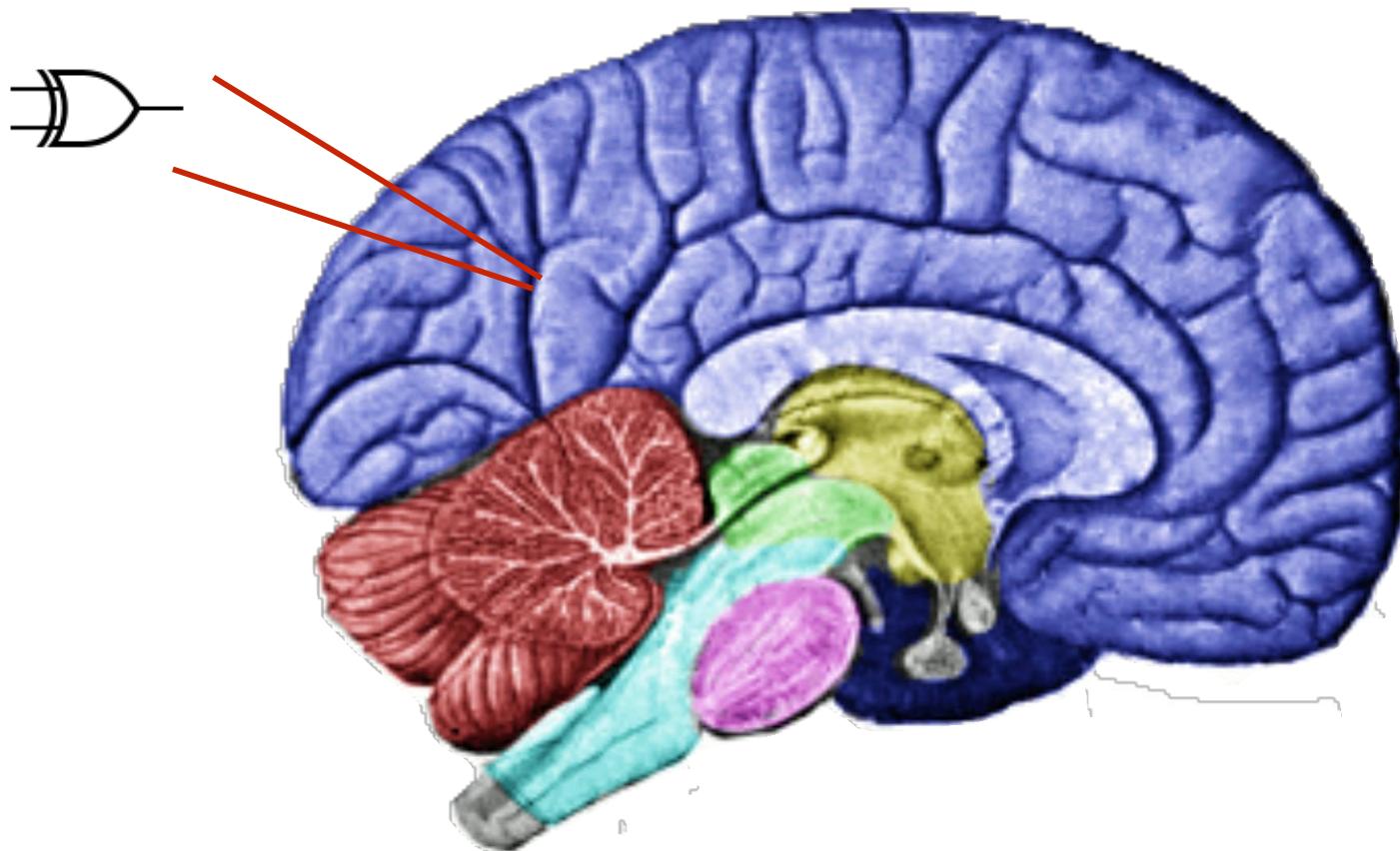
Strong AI Hypothesis

- A machine that behaves as intelligently as a human **has a mind and is thinking**
- Weak AI hypothesis is true
 - Intelligent behaviour is assumed
- Claim about minds and thought

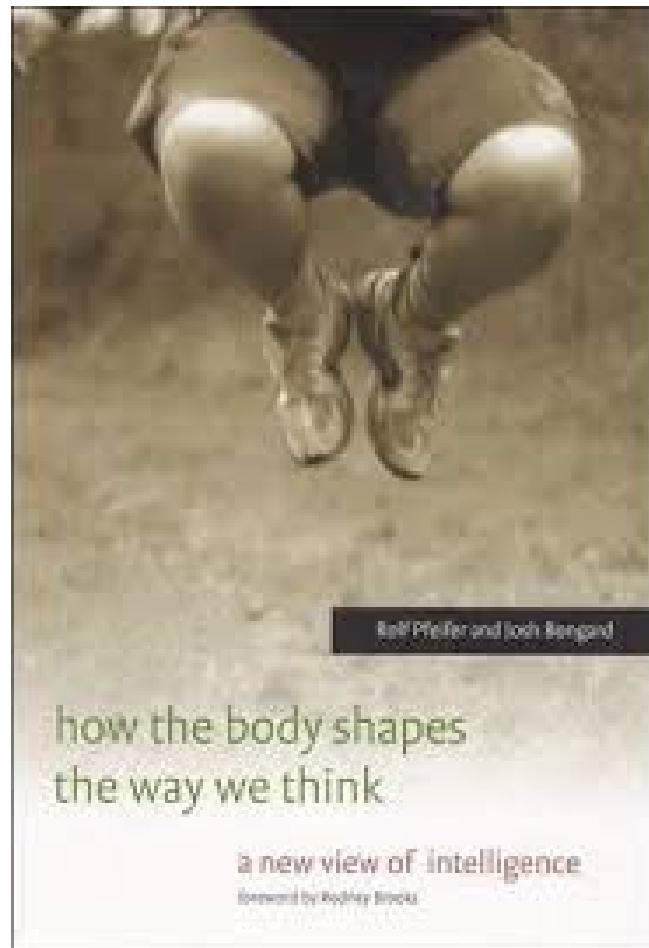
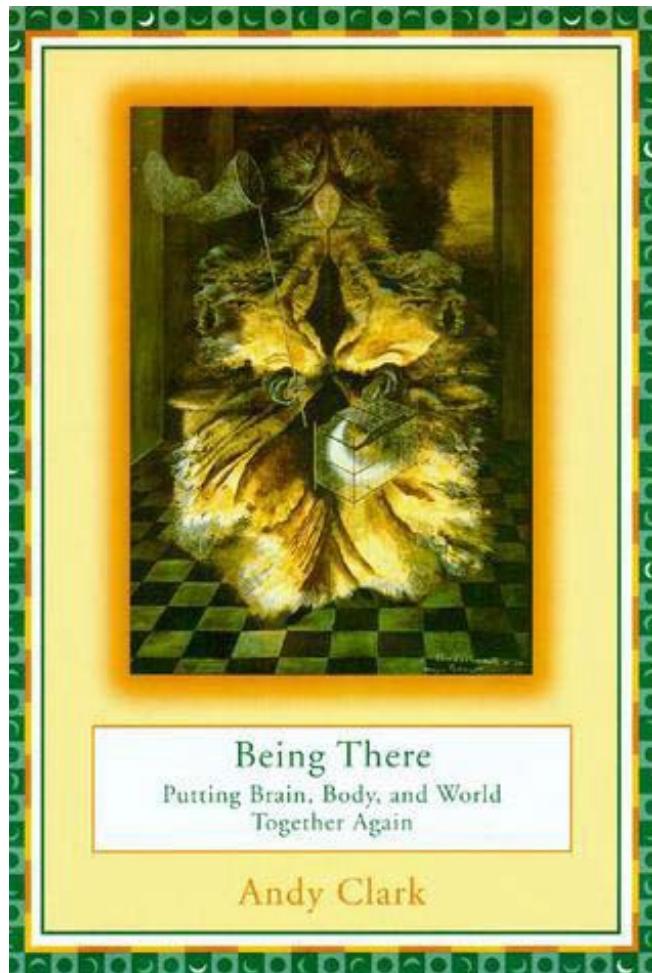
The Chinese Room



Brain Replacement Experiment



Embodied Intelligence



The Thai Library

โลกเราเป็นอะไรมหันต์ในช่วงนี้ ผู้คนนิ่งของโลกมีโอกาสอันแปรปรวนวิปริต หน่วยเห็นบอย่างไม่เคยเกิดขึ้นมาก่อน และยังเกิดแผ่นดินพิโตรกราคร้าวีวิตคนไปเป็นเรือนแสนส่วนบ้านเรานั้นในปีที่ผ่านมาแบบไม่มีดูหน้าให้ชื่นใจกันเลย อาการคลับร้อน แม้มีทั้งฝนหลวงดูในช่วงนี้อีกต่างหาก ทุกคนพูดว่า เป็นเพราภาระโลกร้อนนั้นเองที่ทำให้ทุกอย่างดูไม่เหมือนเดิม ประเทศไทยมีความสามารถกว้างสุดข้า ประเทศไทยมีความสามารถกว้างจะร้อนจนหมกใหม่ อะไรมะเกิดอีกต่อไป

Collective Intelligence



Questions

- What do we mean by:
 - Mind
 - Consciousness
 - Thought
 - Intelligence
- How can we explain or define subjective experience? Is it susceptible to objective analysis or definition?
- Can it be reproduced by a computer program?