

Artificial Intelligence

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Overview

- ▶ Course information
- ▶ Introduction
 - Definition of AI
 - Four approaches to AI
 - Foundations and history of AI
 - AI achievements
 - Caution

Course Information

- ▶ Canvas (canvas.wsu.edu)
- ▶ Email (holder@wsu.edu)

Introduction

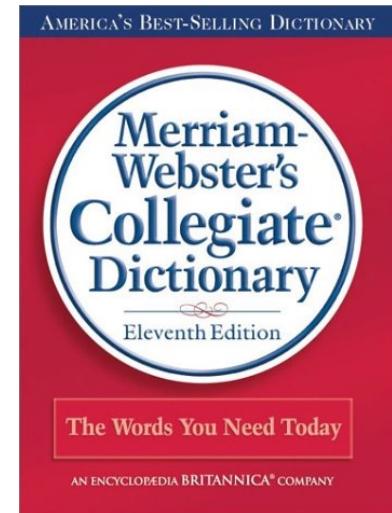
» Readings: R&N Chapter 1

What Is AI?

- ▶ John McCarthy, Dartmouth (1956)
 - “The science and engineering of making intelligent machines.”
- ▶ Intelligent?
- ▶ What makes humans intelligent?

Intelligence

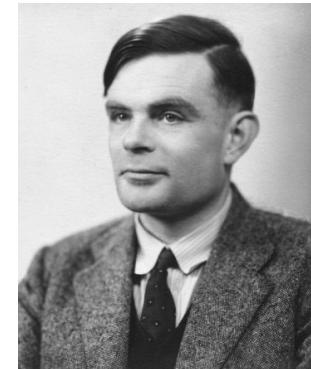
- ▶ Ability to learn or understand or to deal with new or trying situations
- ▶ Ability to apply knowledge to manipulate one's environment
- ▶ Ability to think abstractly as measured by objective criteria (e.g., tests)



Four Approaches to AI

- ▶ Acting humanly
- ▶ Thinking humanly
- ▶ Thinking rationally
- ▶ Acting rationally

AI = Acting Humanly



Alan Turing
(1912–1954)

- ▶ Turing Test
 - Can the machine convince a human that it is human via written English
- ▶ Machine abilities?

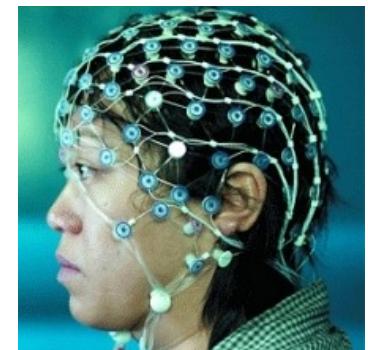
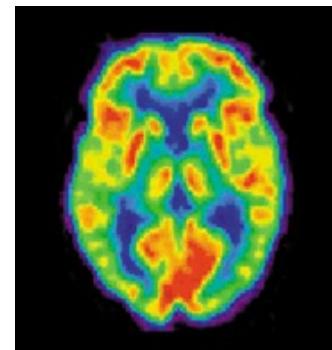
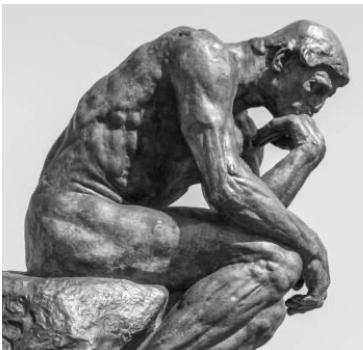


The Singularity Is Near (2012)

- ▶ Loebner Prize
 - [wikipedia.org/wiki/Loebner_Prize](https://en.wikipedia.org/wiki/Loebner_Prize)

AI = Thinking Humanly

- ▶ Building machines that mimic human cognition
- ▶ “Cognitive Science”
- ▶ How to capture human thought?

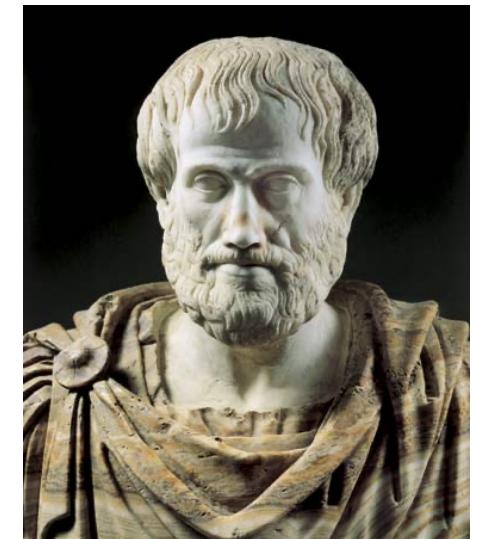


AI = Thinking Rationally

- ▶ Laws of thought
- ▶ Logic
- ▶ Difficulties
 - Expressing knowledge as logical formulae
 - Define “chair”?



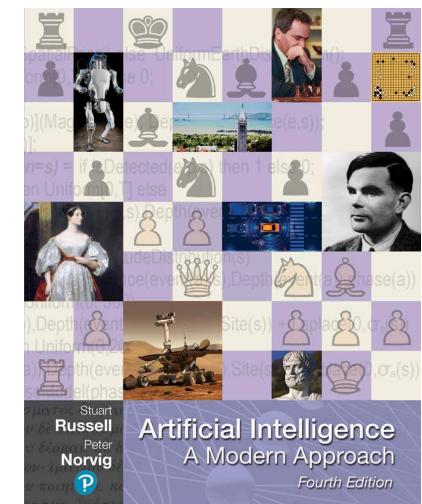
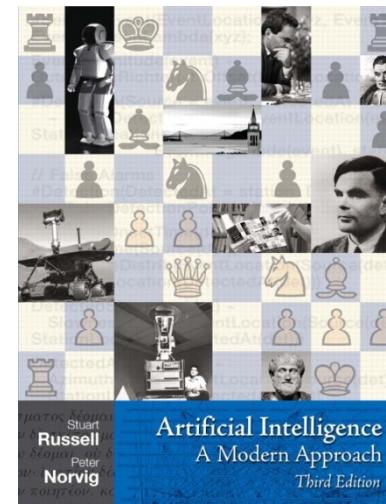
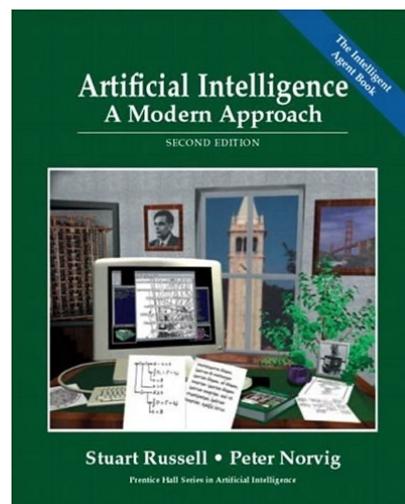
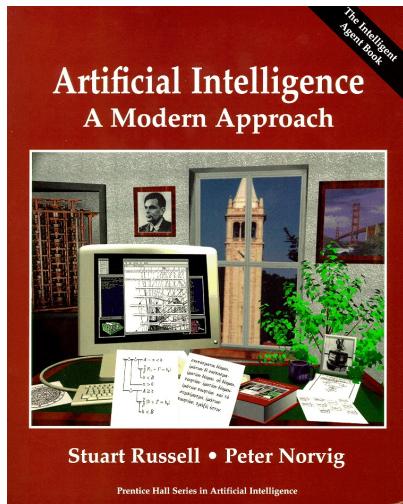
- Logical reasoning is hard (NP-Hard)
 - If A is true, and $A \rightarrow B$, then is B true?



Aristotle
384–322 BC

AI = Acting Rationally

- ▶ Rational agent
 - Acts to achieve the best outcome
 - Encompasses other approaches
- ▶ Focus of textbook (“a modern approach”)



Computer Wins Jeopardy!

- ▶ IBM's Watson competes against humans in Jeopardy! Game (2011)
- ▶ Is Watson
 - Acting humanly?
 - Thinking humanly?
 - Thinking rationally?
 - Acting rationally?



Computer Learns to Play Breakout

- ▶ Is DQN Breakout
 - Acting humanly?
 - Thinking humanly?
 - Thinking rationally?
 - Acting rationally?



Foundations of AI

- ▶ Philosophy
 - Logic, knowledge and rationality
- ▶ Mathematics
 - Algorithms, computability, probability
- ▶ Economics
 - Utility and decision theory, games
- ▶ Linguistics
- ▶ Neuroscience
 - Neuron, connectome
- ▶ Psychology
 - Human cognition
- ▶ Control Theory
- ▶ Computer Engineering
- ▶ Computer Science

History of AI

▶ Gestation of AI (1943–1955)

- Turing's “Computing Machinery and Intelligence”
- Artificial neuron



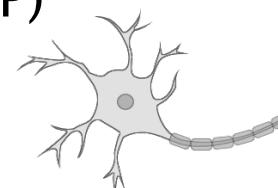
▶ Birth of AI (1956)

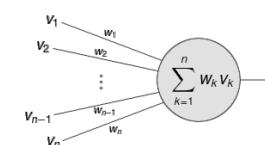
- John McCarthy
- Dartmouth Summer Workshop
- Newell and Simon's “Logic Theorist”



▶ Early enthusiasm, great expectations (1952–1969)

- Newell and Simon's “General Problem Solver”
- Symbolic programming languages (LISP)
- Perceptron



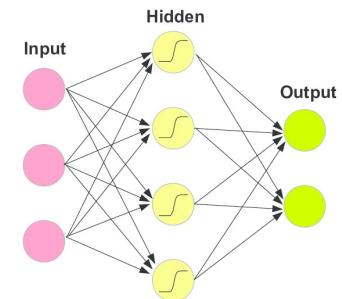
$$\sum_{k=1}^n w_k v_k$$
A schematic diagram of a perceptron. On the left, there are input nodes labeled $v_1, v_2, \dots, v_{n-1}, v_n$, each connected by a line to a central circle representing the neuron cell body. Above each input node is a weight value: w_1 above v_1 , w_2 above v_2 , and so on, with w_{n-1} above v_{n-1} and w_n above v_n . The central circle contains the mathematical expression $\sum_{k=1}^n w_k v_k$, representing the weighted sum of the inputs.

History of AI (cont.)

- ▶ “AI Winter” (1966–1973)
 - Systems lacked commonsense knowledge, made simple mistakes
 - Most AI problems found to be intractable
- ▶ Knowledge-based systems (1969–1979)
 - Knowledge and uncertainty representation
 - Expert systems (Ed Feigenbaum)
- ▶ AI industry (1980–present)
- ▶ Return of neural networks (1986–present)
 - Multi-layer perceptron, back-propagation

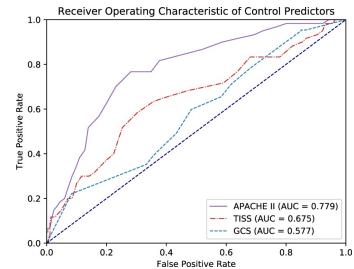


Computer translation demo for US VP Ford in 1973.

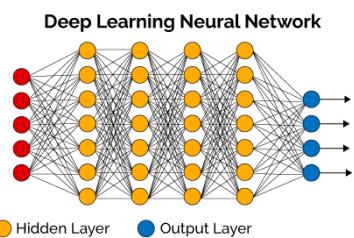
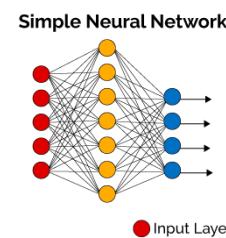
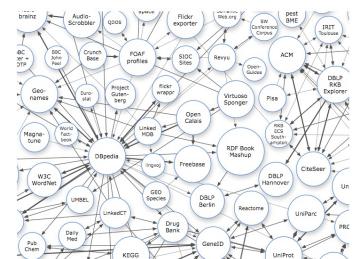
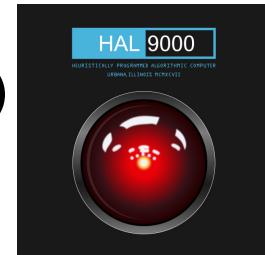


History of AI (cont.)

- ▶ AI adopts scientific method (1987–present)
 - Empirical validation and theory

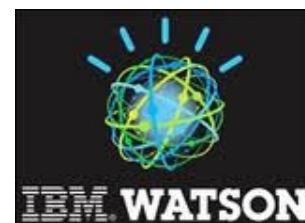
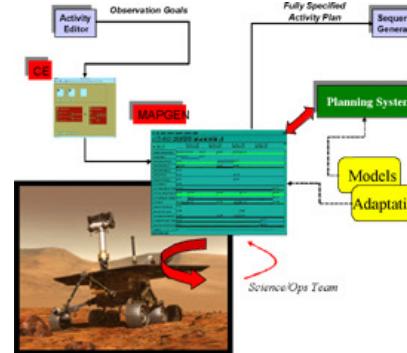
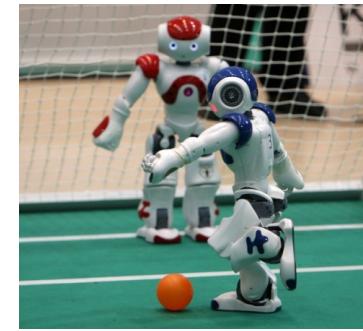


- ▶ Emergence of intelligent agents (1995–present)
 - Human-level AI
 - Artificial general intelligence
 - ▶ Availability of “big data” (2001–present)
 - ▶ Deep learning (2010–present)



Achievements

- ▶ Game playing
- ▶ Robotics
- ▶ Planning and scheduling
- ▶ Language understanding
- ▶ Speech recognition
- ▶ Big data
- ▶ Deep learning
- ▶ Vision



Caution

- ▶ “AI is a fundamental risk to the existence of human civilisation.”
 - Elon Musk, July 2017

- ▶ “... whose culmination is a world relying on machines ungoverned by ethical or philosophical norms.”
 - Henry Kissinger, June 2018



Summary

- ▶ AI is the science and engineering of building intelligent machines
 - I.e., machines that act rationally
- ▶ Impressive achievements
- ▶ Promising, challenging future

