

CS 309: Autonomous Intelligent Robotics

FRI I

Lecture 2: Introduction to AI

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Today

- What is Artificial Intelligence? – Part 1

What is (Artificial) Intelligence?

- What is intelligence?
 - The definition of intelligence itself is controversial.

What is (Artificial) Intelligence?

A very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings —"catching on," "making sense" of things, or "figuring out" what to do.

- “Mainstream Science on Intelligence”

What is (Artificial) Intelligence?

Concepts of "intelligence" are attempts to clarify and organize this complex set of phenomena. Although considerable clarity has been achieved in some areas, no such conceptualization has yet answered all the important questions, and none commands universal assent. Indeed, when two dozen prominent theorists were recently asked to define intelligence, they gave two dozen, somewhat different, definitions.

- “Intelligence: Knowns and Unknowns”

What is (Artificial) Intelligence?

- “Goal-directed adaptive behavior.”
 - Sternberg & Salter
- “The ability to deal with cognitive complexity.”
 - Linda Gottfredson
- “A synthesis of 70+ definitions from psychology, philosophy, and AI researchers: 'Intelligence measures an agent's ability to achieve goals in a wide range of environments,' which has been mathematically formalized.
 - Legg & Hutter
- “Judgement, otherwise called 'good sense,' 'practical sense,' 'initiative,' the faculty of adapting one's self to circumstances .. auto-critique.
 - Alfred Binet

AI is a moving target

- 1951 – Strachey & Prinz write programs for checkers and chess
- 1965 – Dartmouth conference
 - Chess programs a major feature
- 1968 – 2001: A Space Odyssey



AI is a moving target

- 1990 – Ray Kurzweil predicts that a computer will beat a world champion by 1998
- 1997 – Deep Blue beats Garry Kasparov
- 2017 – AlphaGo Zero beats Stockfish 8 after 4 hours of teaching itself to play



AI is a moving target

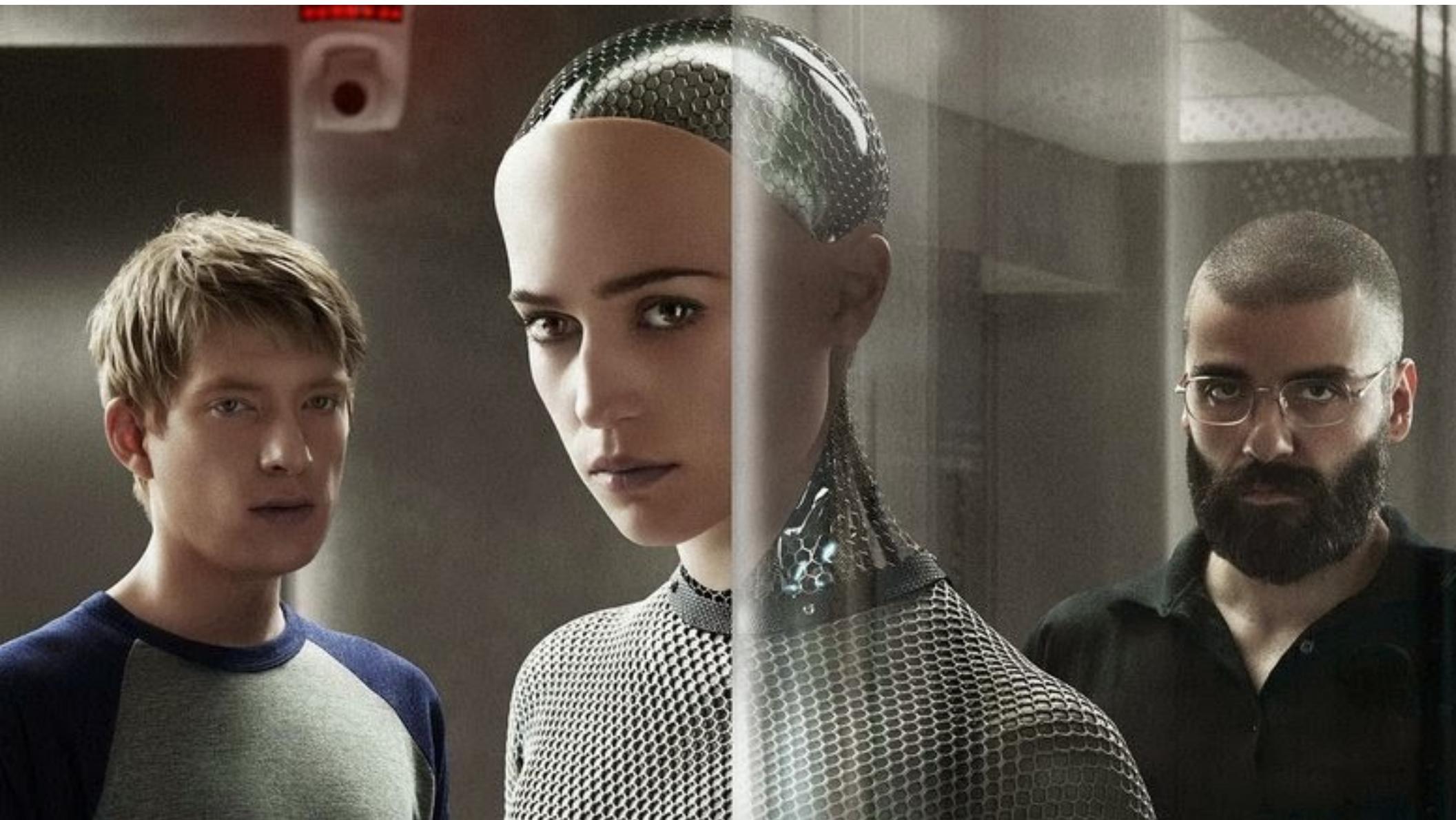
So.. have we cracked AI yet?

AI is a moving target

Often, it seems as though people feel the need to protect humans as being cognitively on top

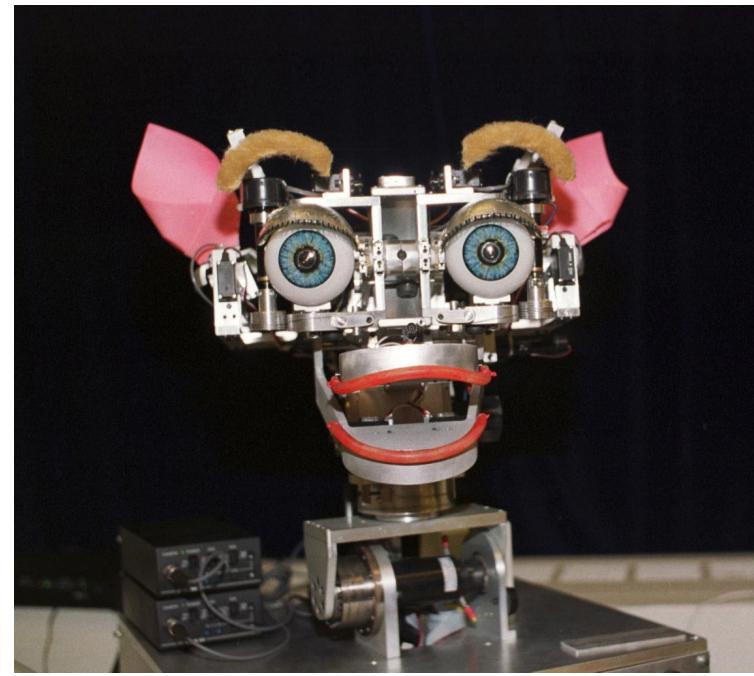
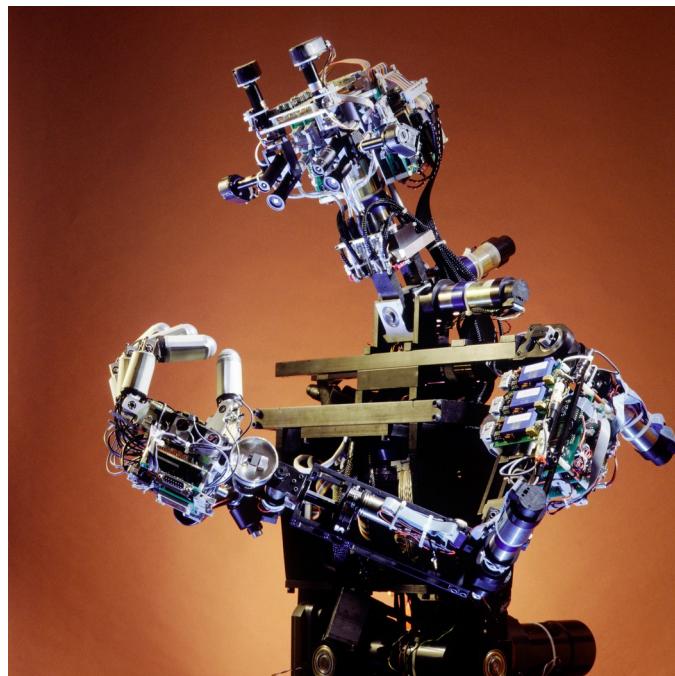
Humans vs Robots





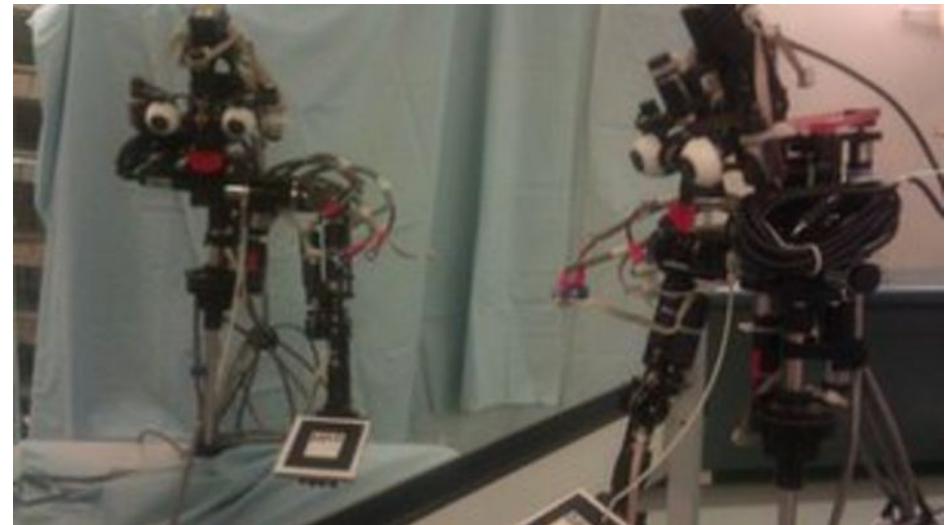
Ex Machina - 2014

Developmental Robotics and HRI



Developmental Robotics

- Take a human cognitive process
 - Attempt to emulate it and understand it by building a robot that does it
- Eventual goal: Build robots which learn as people do and develop human-like intelligence



Human-Robot Interaction

- Two different takes
 - HRI as understanding human behavior and implementing it on robots
 - HRI as design
- Applications
 - Product design
 - Collaborative manufacturing
 - Teaching
 - Diagnosis and treatment of autism



Contrasted with mainstream AI



IJCAI



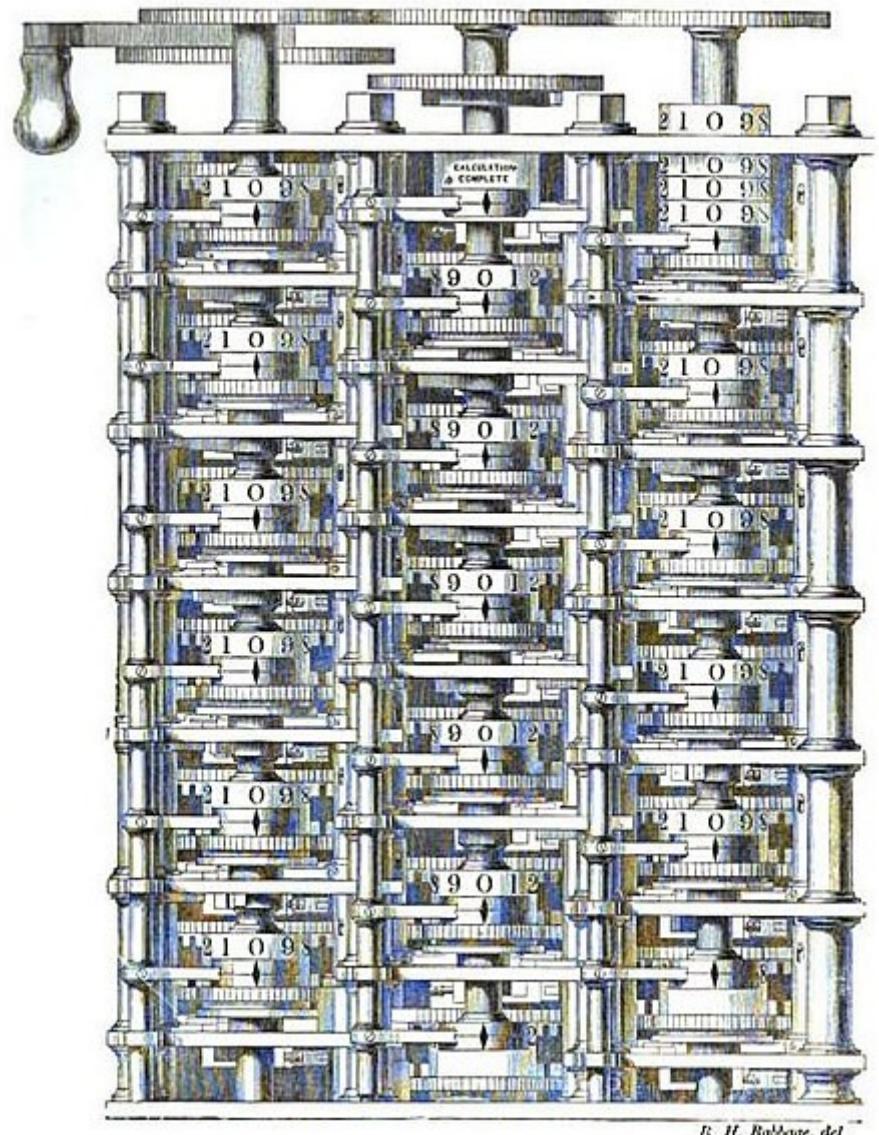
Computing gets its start

- 1936 – Church & Turing
 - Alonzo Church
 - Lambda Calculus
 - Alan Turing
 - Universal Turing Machines
 - A practical model of a workable computer
 - Based on physical concepts
 - Head
 - Tape
 - Writing symbols on tape



Computing gets its start

- A goal that had been chased for literally thousands of years.
 - Abbacus
 - Mechanical computing mechanisms
 - Charles Babbage
 - Difference Engine – 1833
 - Ada Lovelace
 - First programmer, programs for the difference engine
 - Algorithms
 - Ancient Greece
 - Sieve of Erastosthenes
 - Prime numbers
 - Name comes from Al-Khwarizmi – 9th century Islamic Mathematician



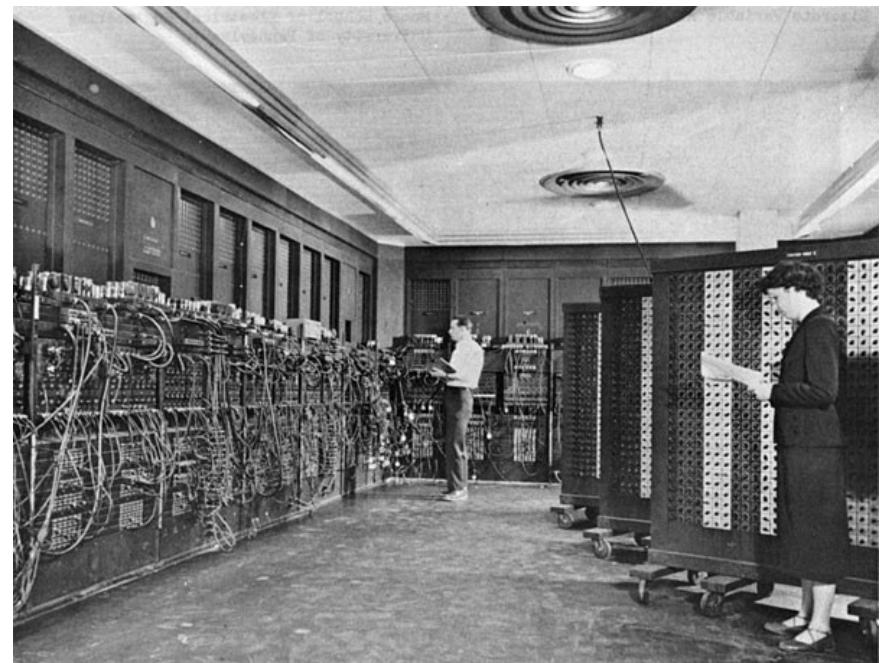
Computing gets its start

- 1939 – WWII starts
- 1941 – Bombe in Bletchley Park
 - Faster method for breaking Enigma
 - **Not** like “The Imitation Game”
 - Turing was hired to build this machine
 - “I'm talking about digital computers!!”
 - Based on an earlier Polish Machine



Computing gets its start

- 1936 – Konrad Zuse
 - First programmable computer
 - Electro-mechanical
- 1936 – Turing, UTM
- 1943 – Colossus
 - First electric programmable computer, also for codebreaking
- 1946 – ENIAC
 - U Penn – First digital computer
 - 18,000 vacuum tubes



Computing gets its start

- 1956 – TX-O
 - First transistor computer
- 1960 – PDP-1
 - First “minicomputer”
- 1971 – Intel 4040
 - First microchip
- 1981 – IBM PC

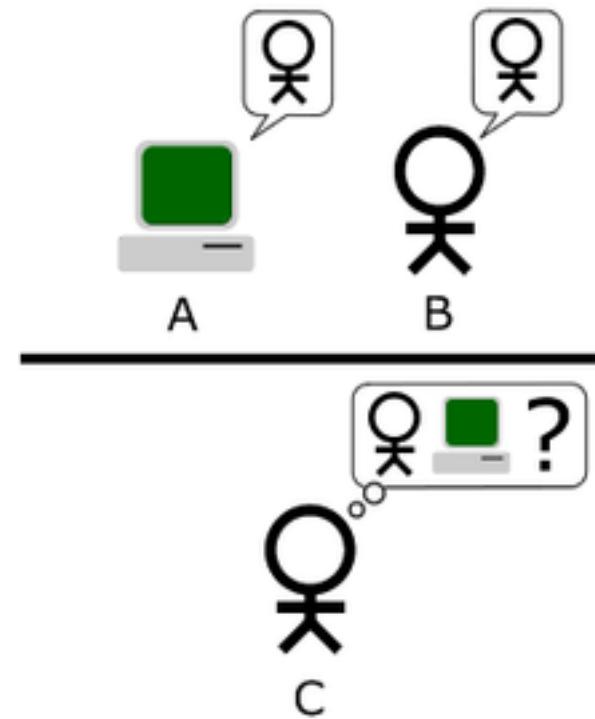


AI gets its start

- 1950 – Computing Machinery and Intelligence
 - Alan Turing
 - What it means to “think” is controversial
 - Therefore, let's “replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.”
 - “Imitation Game”
 - Players
 - Player A – a man
 - Player B – a woman
 - Player C – interrogator
 - Can the interrogator determine the sex of the players by asking questions?
 - Both players try to convince the interrogator that they are a woman
 - What happens if a machine replaces Player A?
 - If the interrogator cannot consistently tell which is the machine, the machine wins

AI gets its start

- Modern Turing Test
 - Assumes only a jury of people and computers
- Loebner Prize
 - Ranks chatbots as most convincing
 - Generally scorned by AI experts, based on very old chat programs
 - Cash prize
 - \$3000 – Best program
 - \$25,000 – Convinces the judges that the human is a program
 - \$100,000 – Adds understanding text, auditory, and visual input



AI gets its start

- 1950s – Lots of researchers were thinking about intelligent machines
- 1956 – Dartmouth Conference
 - Organized as a 6-week conference to clarify and develop these ideas
 - Largely considered to be the meeting that started the field
- At this point, both computing and AI exploded, and there was really unbounded optimism for what could be accomplished

AI gets its start

- Both AI and computing moved quickly, leading to extreme optimism
 - 1958 - Simon & Newell
 - “Within ten years, a digital computer will be the world's chess champion”
 - 1997 – Deep Blue vs Garry Kasparov
 - “Within ten years, a digital computer will discover and prove an important new mathematical theorem”
 - So far, only computer-assisted proofs have been generated
 - But some have been hundreds of gigabytes in size!
 - 1970 – Marvin Minsky
 - “In three to eight years we will have a machine with the general intelligence of an average human being.”
 - Famously assigned the entire field of computer vision as a summer project to a PhD student
 - Modern predictions such as Ray Kurzweil's may seem comparable
 - 2019 – A computer has as much compute power as the human brain
 - 2045 – The Singularity – The first ultra-intelligent machine