



COMP 4752

Computational Intelligence

Lecture 1

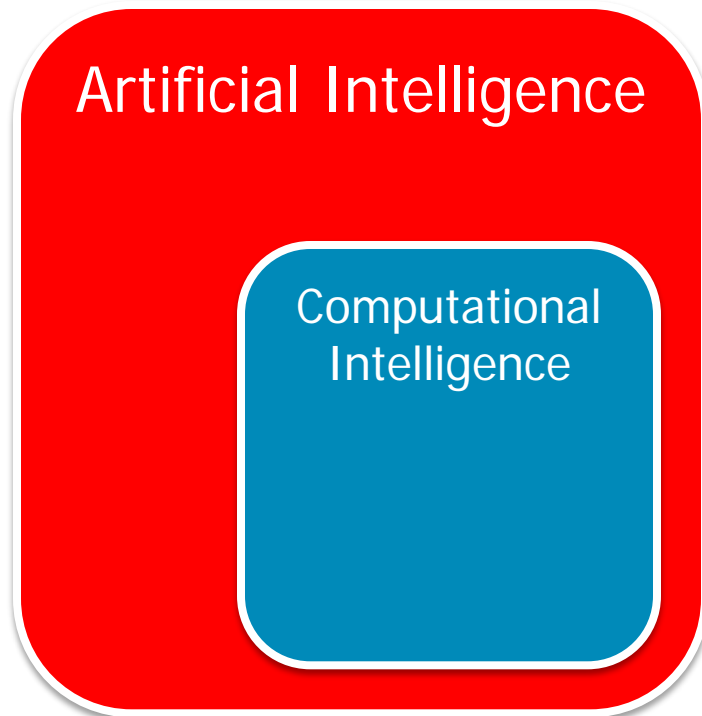
What is Computational Intelligence?

Computational Intelligence is?

- Subset of Artificial Intelligence
- Mostly biologically inspired algorithms
- Algorithms designed to obtain approximate solutions when exact / brute force cannot

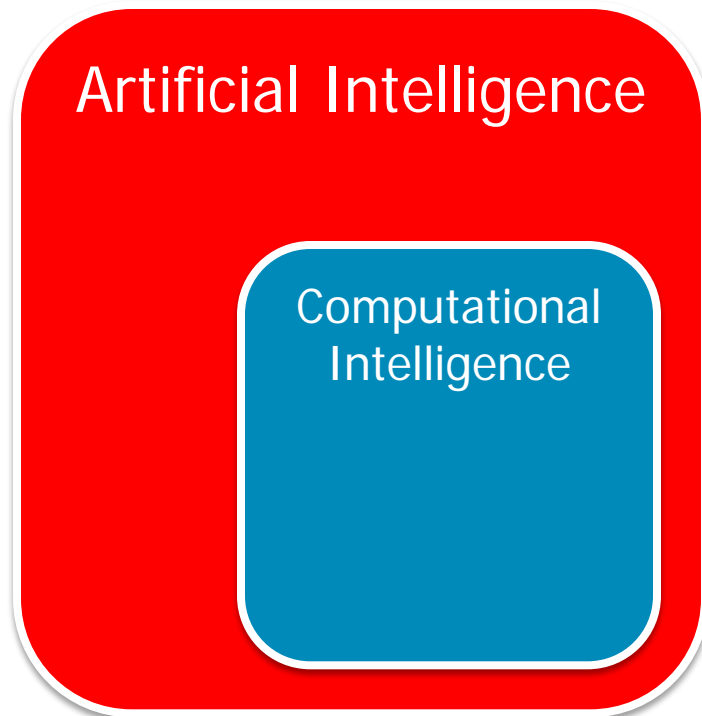
Computational Intelligence

- Methods Include:
 - Heuristic Search (?)
 - Reinforcement Learning
 - Genetic Algorithms
 - Neural Networks
 - Swarm Intelligence
 - Fuzzy Logic



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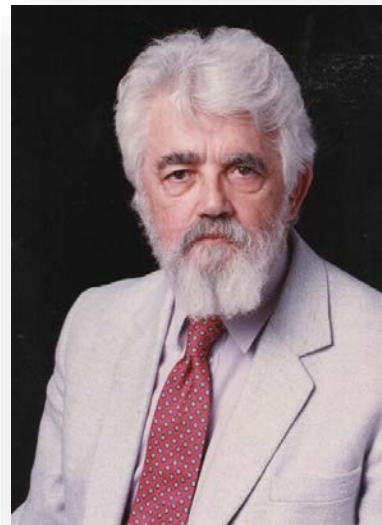


Artificial Intelligence

- “Intelligence”
 - Capacity for learning, reasoning, understanding, problem solving
- Artificial Intelligence
 - Building a program / machine that appears intelligent to the user in some domain
- Strong / General AI
 - Build a system that’s good at everything

Artificial Intelligence

- John McCarthy (1927-2011)
 - Coined the term AI
 - Developed Lisp, won Turing Award
 - "It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to **methods that are biologically observable.**"



Systems that Think Like Humans:

"The exciting new effort to make computers think... machines with minds."
(Haugheland, 1985)

"The automation of activities we associate with human thinking: decision-making, problem solving, learning..
(Bellman, 1978)

Systems that Act Like Humans

"The art of creating machines that perform functions that require intelligence when performed by people"
(Kurzweil, 1990)

"The study of how to make computers do thing that [people are currently better at]"
(Rich and Knight, 1991)

Systems that Think Rationally

"The study of mental faculties through the use of computational models"
(Charniak and McDermott, 1985)

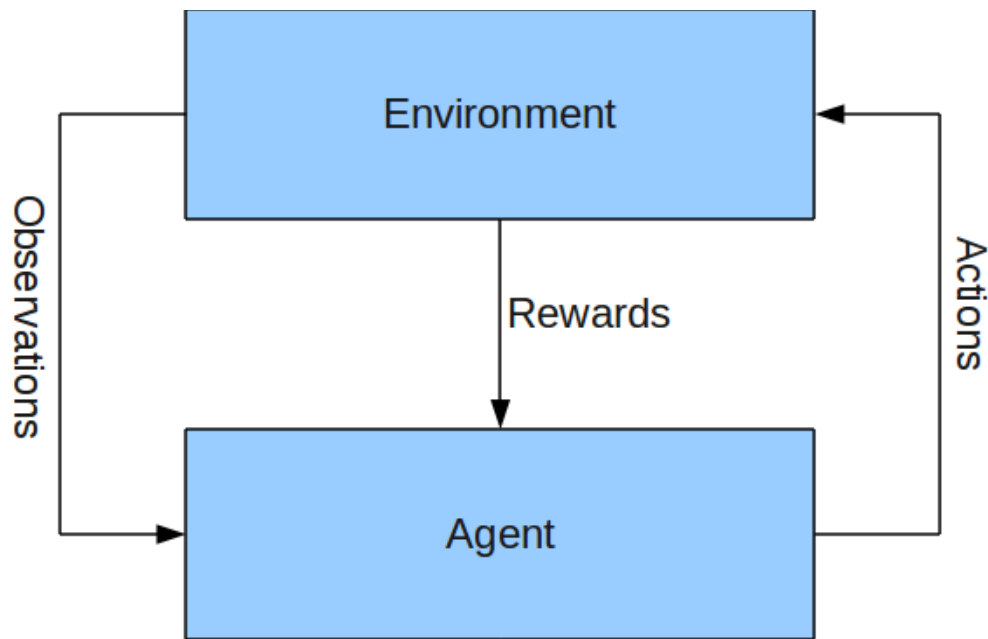
"The study of the computations that make it possible to perceive, reason, act"
(Winston, 1992)

Systems that Act Rationally

"AI... is concerned with intelligent behaviour in artifacts"
(Nilsson, 1998)

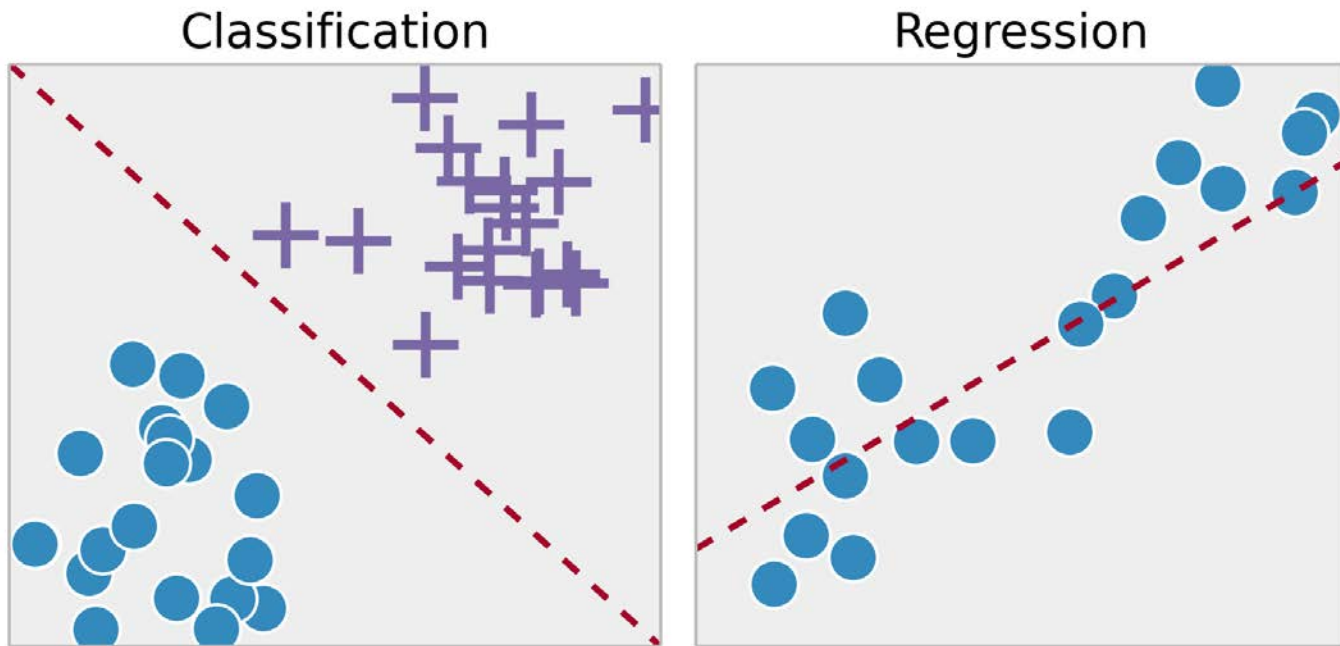
"Computational Intelligence is the study of the design of intelligent agents)
(Poole, 1998)

What is “classical” AI?



Goal of AI:
Compute the
best Action

What is Machine Learning?



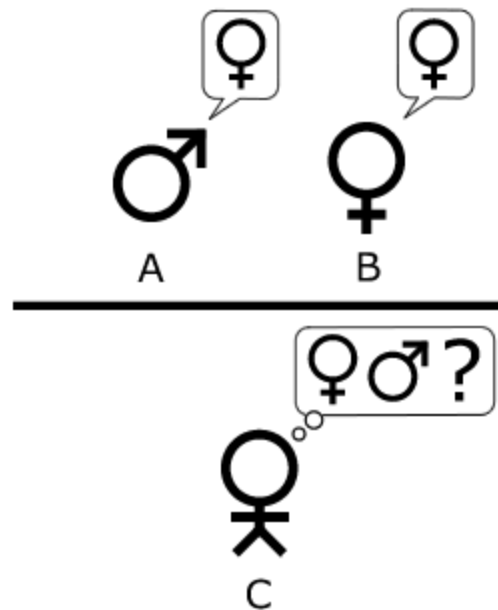
"Can Machines Think?"

- Alan Turing (1912-1954)
 - Paper: *Computing Machinery and Intelligence*
 - Definitions of 'machine' and 'think' are difficult
 - "The original question, "Can machines think?" I believe to be too meaningless to deserve discussion."
 - Instead, pose the question as a game



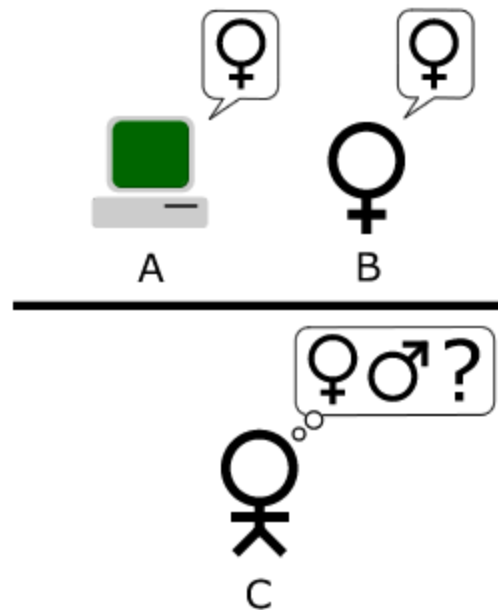
The Imitation Game (original)

- Man (A), Woman (B)
- Interrogator (C)
 - Asks questions to A,B
 - Communicate via text
 - Must decide which is man and which is woman
- A or B tries to trick C



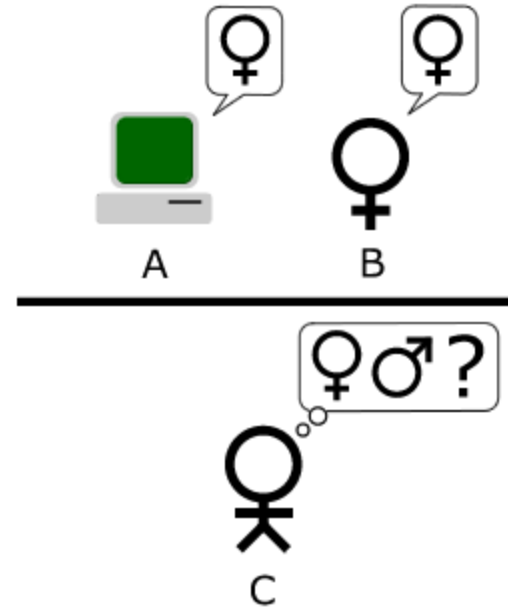
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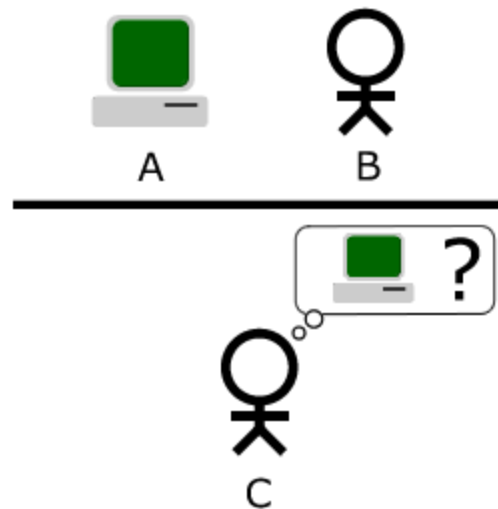
The Imitation Game (original)

- Turing stated if "the interrogator decide[s] wrongly as often when the game is played [with the computer] as he does when the game is played between a man and a woman"



The Imitation Game (standard)

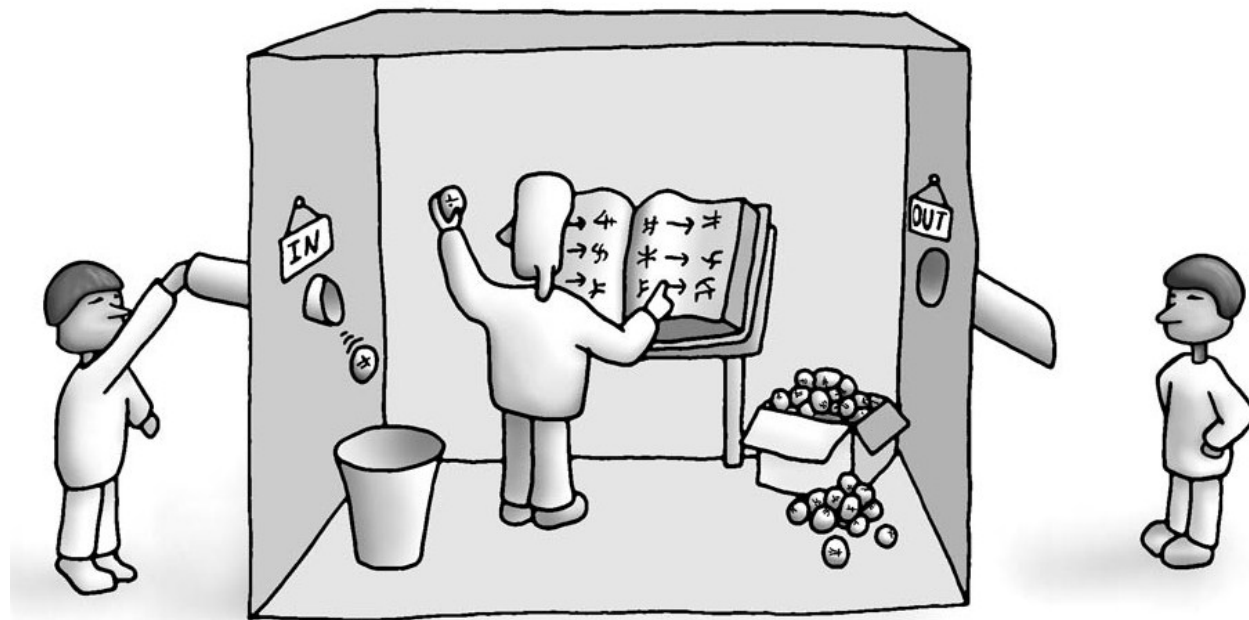
- Computer (A), Human (B)
- Human Interrogator (C)
- Can the Interrogator determine which is the human and which is the computer?



The Turing Test

- Standard interpretation of Imitation Game
- “Can computers exhibit behaviour which is indistinguishable from humans?”
- Versions have been asked for centuries:
 - 1637 Descartes (automata)
 - 1746 Diderot (parrot)
 - 1936 Ayer (consciousness of machines)

Chinese Room (Searle, 1980)



Chinese Room

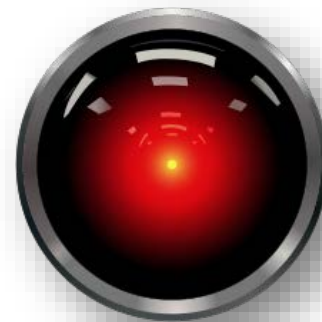
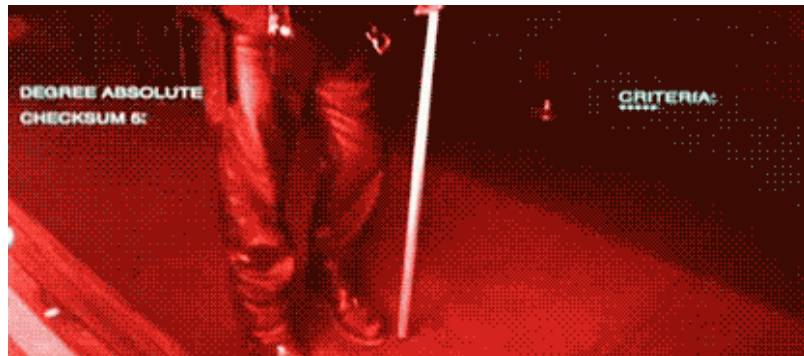
- By looking up rules and performing translation, the person appears to know the language, and appears intelligent
- John Searle argues:
 - Computers merely apply rules to data
 - There is no 'understanding' of semantics
 - The Turing Test is 'inadequate'

You may be thinking...

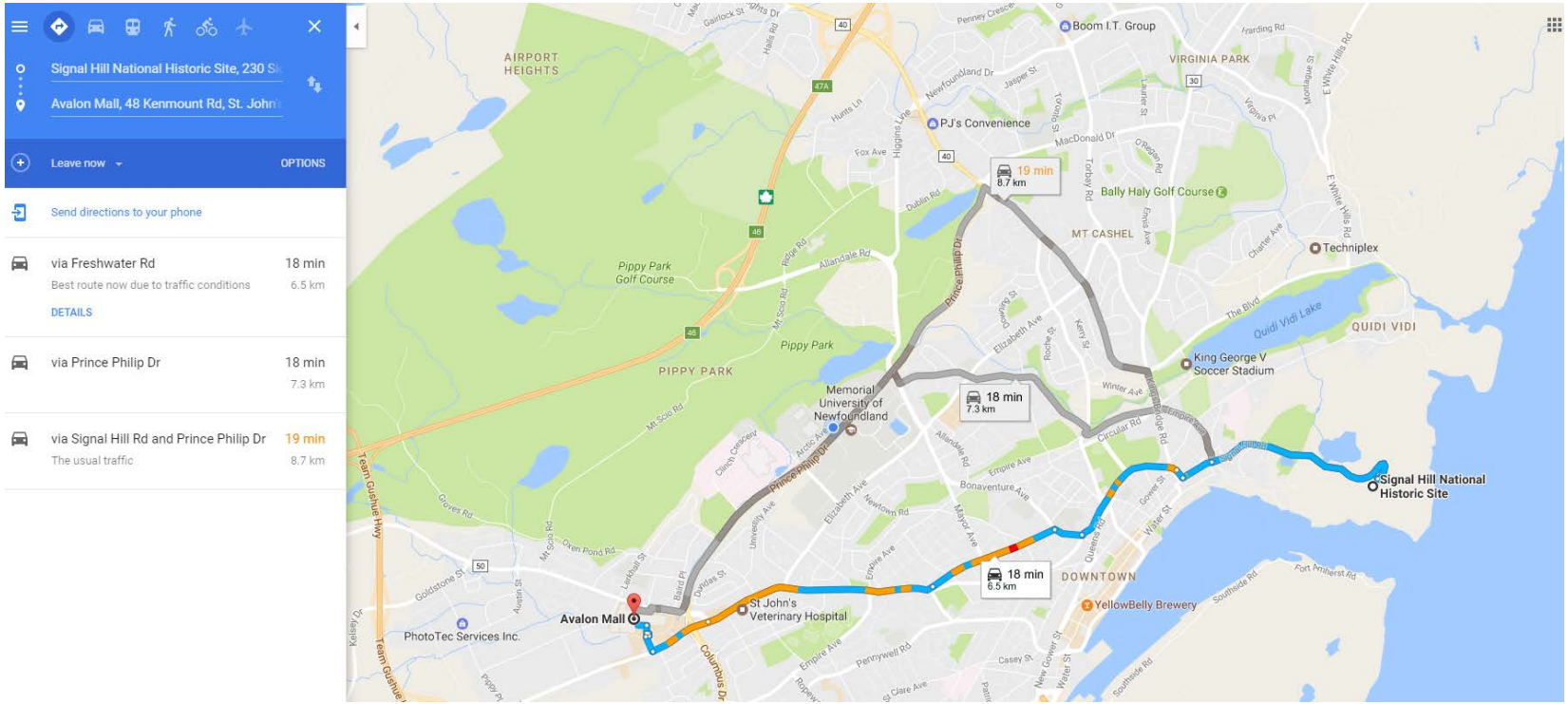


What can AI actually **do**?

Take Over the World (obviously)



Planning and Scheduling



Autonomous Control

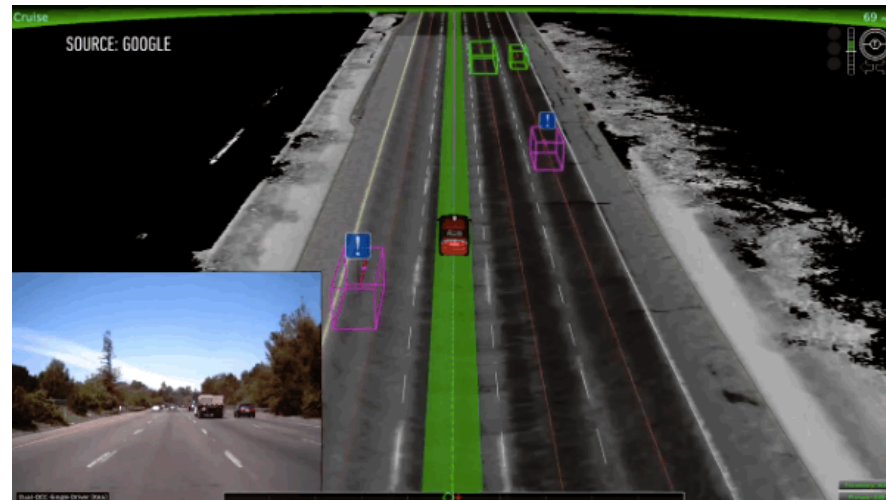
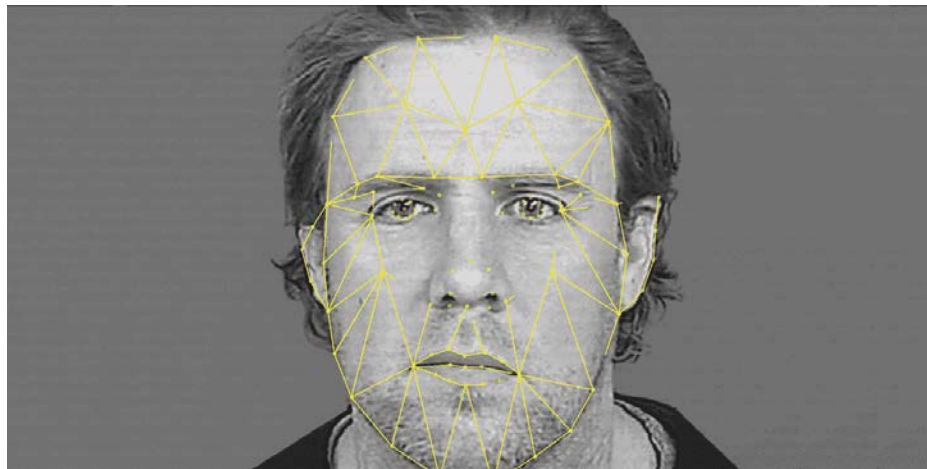
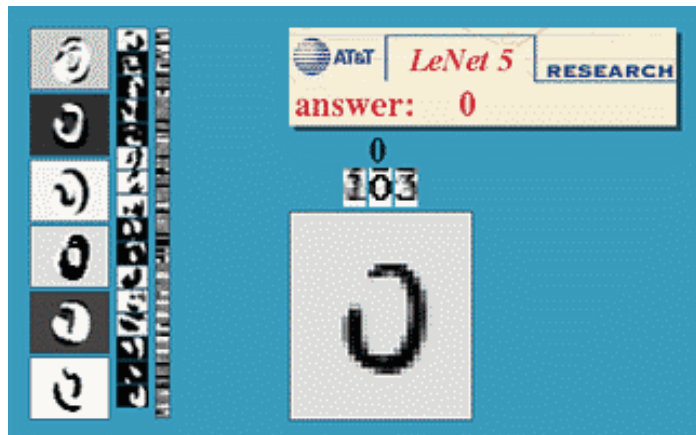
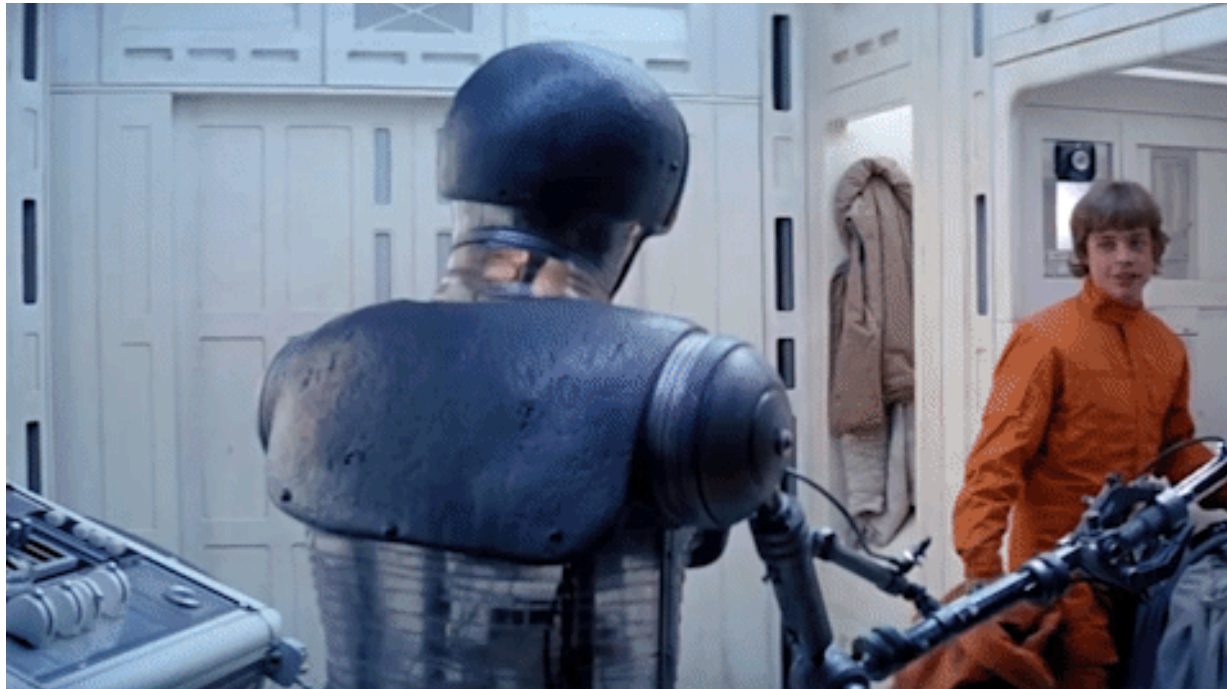


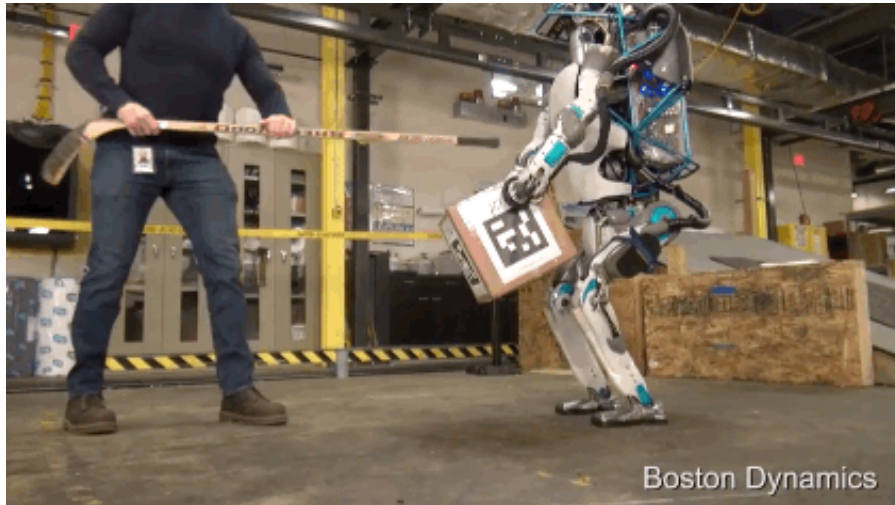
Image / Pattern Recognition



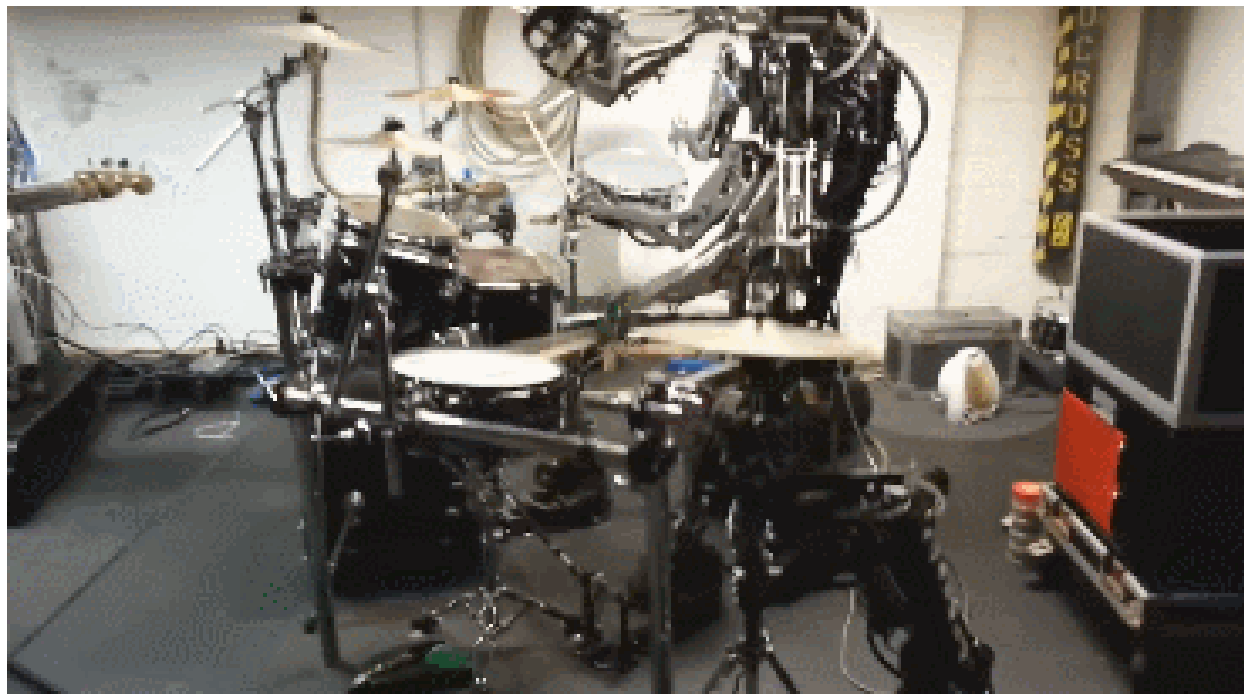
Medical Diagnosis



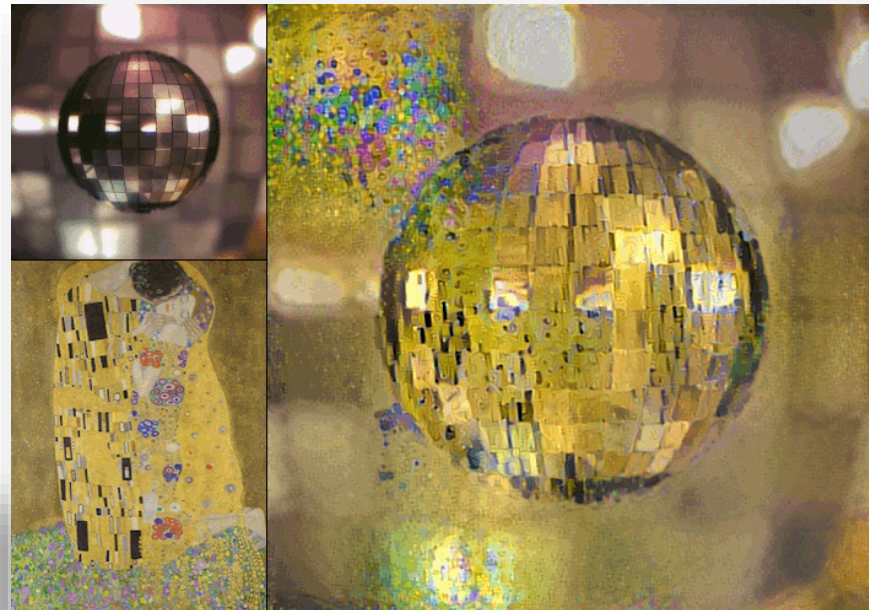
Robotics



Musical Composition



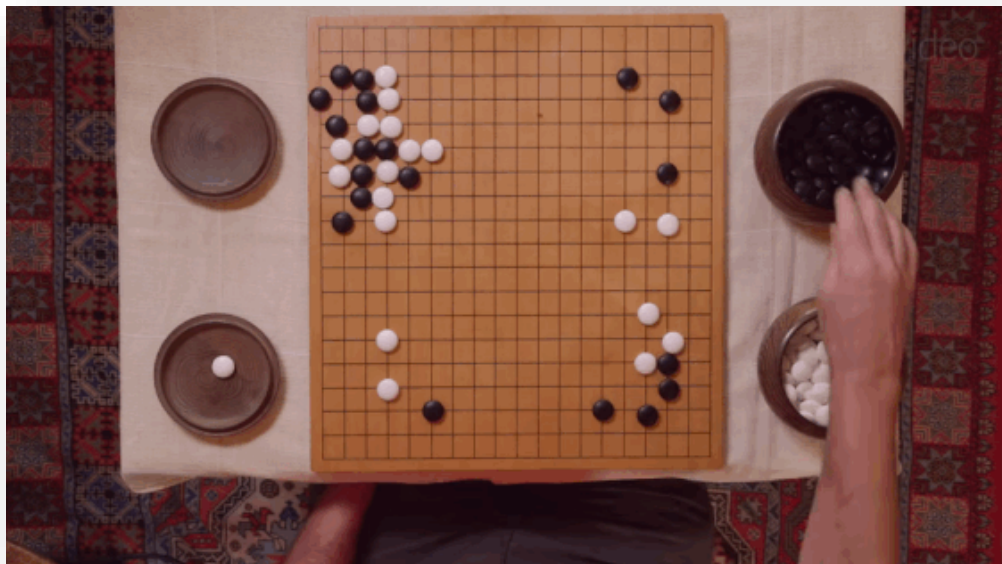
Art

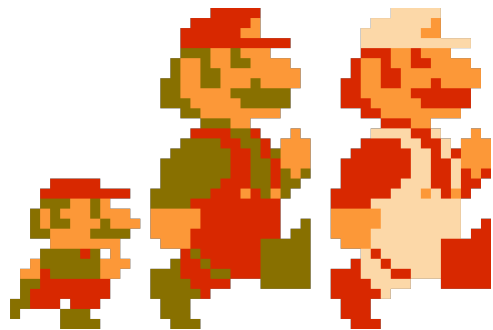


Language Processing / Translation



Game Playing



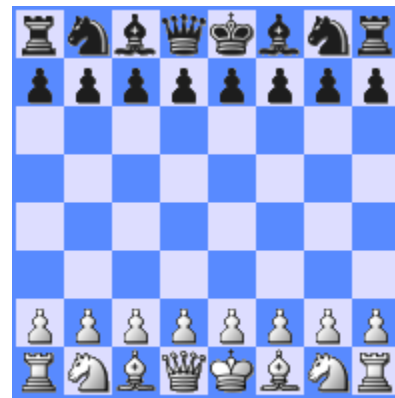


Everything is a game



What is a game?

- Agent in an environment
 - Agent can take actions
 - Actions affect the environment
- Agent has a goal
 - Defeat the opponent
 - Move to the right
 - Solve the puzzle
 - Get the most points
 - = Maximize a function



AI + Games

- Games can simulate real world
 - Game AI success translates to real world
- No ethics required for games
- Cheap (vs. robotics / real world)
- Easy to visualize / intuitive
- Fun to program and play
- Help motivate people to learn