BONUS: INTRO TO AI

BME 121 2016

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i solvz dis in 2 secndz if i hadz colorz vizon

Introduction to Artificial Intelligence

- Definition: AI is the intelligence exhibited by machines or software (in contrast with Human Intelligence)

- It is the science and engineering of how to create computers and software that are capable of intelligent behavior

- At the intersection of many academic fields, but most notably: computer science, software engineering, psychology, biology (neurology, cybernetics), and philosophy
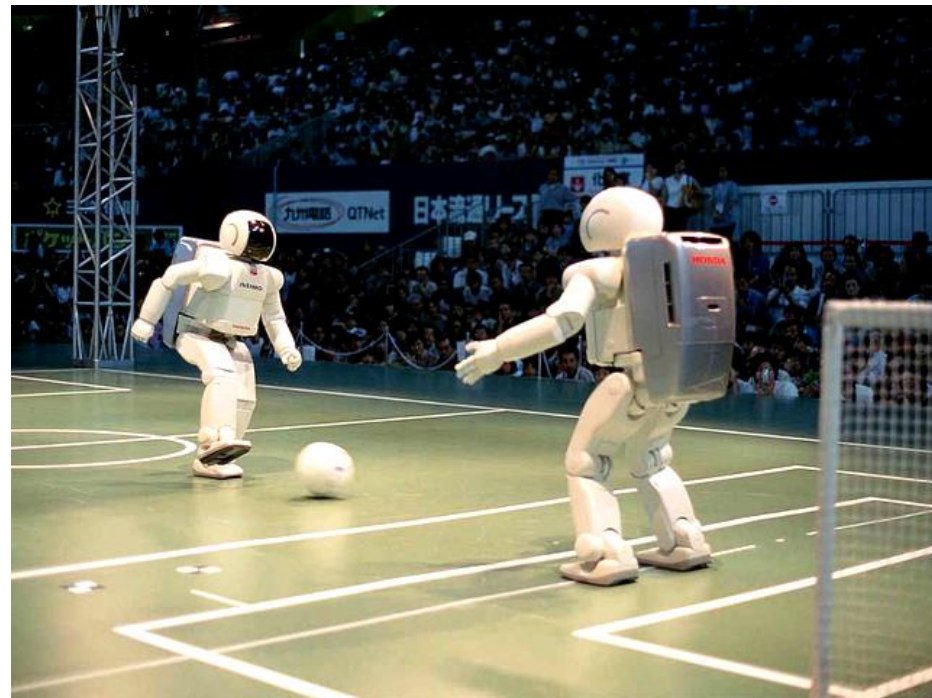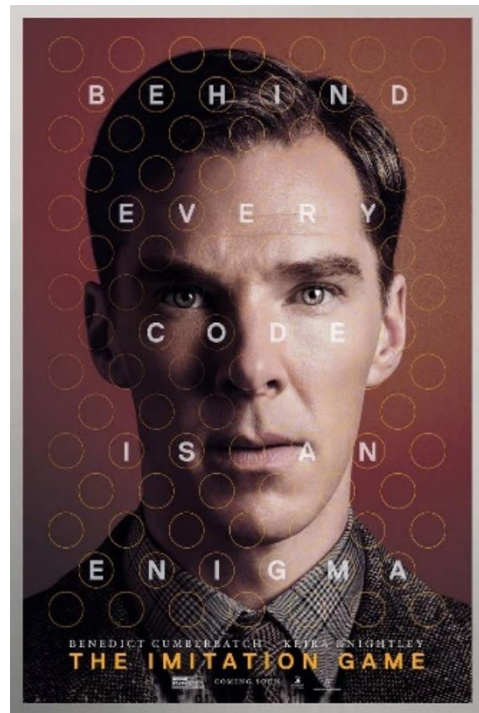
Alan Turing

- Alan Mathison Turing (1912 – 1954)
  - Officer of the Order of the British Empire
  - Fellow of the Royal Society

- Father of Computer Science, also
  - Mathematician
  - Logician
  - Cryptanalyst
  - Theoretical Biologist

- Gay (when it was illegal in Brittan)
 - Persecuted by the government despite his war time achievements in WWII
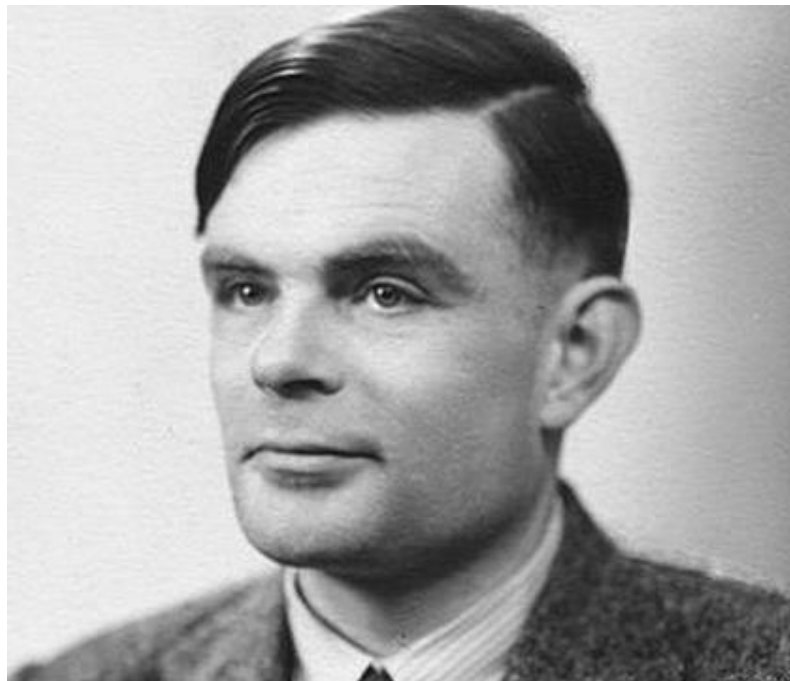
Alan Turing

- Three most endearing achievements:
  - Universal Computer
    - First theoretical model of a machine that wasn't purpose built for some task, but could be instructed to perform any task
  - WWII Code Breaking
    - Broke the ultra secret and difficult to crack encryption code used by Germany in WWII
    - Estimated to have shorted the war by more than 2 years and saved over 14 million lives.
  - Turing Test
- Life Story popularized in the movie The Imitation Game

Introduction to Artificial Intelligence

- Alan Turing defined this field, and the Turing Test:
  - A test of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, a human
  - A human evaluator would judge conversations between a human and a machine that's designed to generate human-like responses
  - The evaluator knows that one of the two conversation partners is a machine, but not which one
  - If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test
  - Not actually easy to pass…
- Modern (but imperfect) solutions:
 www.apple.com/ca/ios/siri allo.google.com www.cleverbot.com
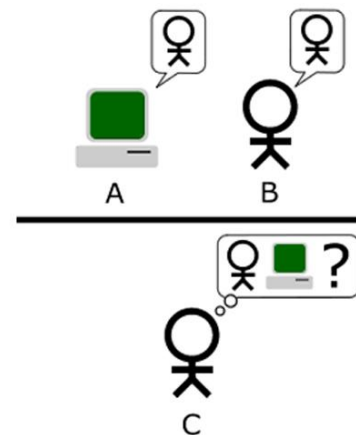
Introduction to Artificial Intelligence

- Modern AI Research began in 1956 at a conference at Dartmouth College, USA. Attendees, and the leaders of AI research include: John McCarthy, Marvin Minsky, Allen Newell, Arthur Samuel, and Herbert Simon

- Early focus on imitating & replicating human intelligence, but with experiments solving a wide range of fun and challenging problems:
  - Winning at checkers, solving word problems in algebra, proving logical theorem,s and speaking English, and eventually winning chess, Jeopardy, and GO

- AI Science still focuses on replicating human intelligence, but AI Engineering focuses on building smart software and systems
  - Google, Siri, Cortana, self-driving cars, Kinect / PS Eye … and Game AIs!

Tic-Tac-Toe AI

- Like magic tricks, AI seems powerful and mysterious until you know the trick (AI algorithm). Once you learn what the trick is, the illusion of magic is gone but you're left with a solid understanding of how to create these illusions (smart software).

- Tic-Tac-Toe: how would a smart game AI play this game?

  - Randomly picking a spot simulates a 3 year old intelligence level, not bad but not too smart.
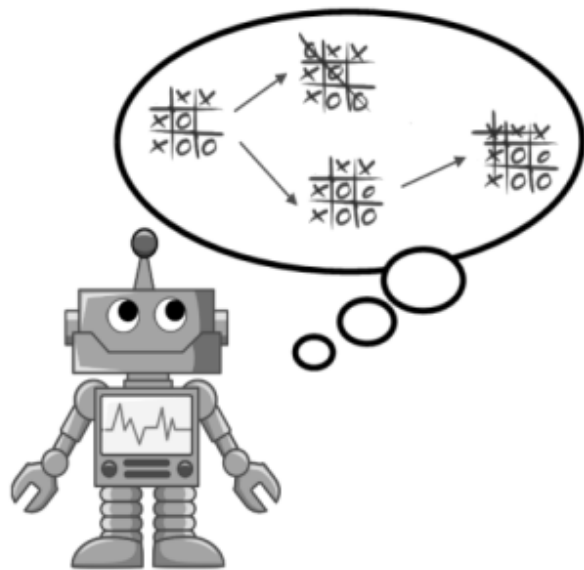
Tic-Tac-Toe AI

- Each position in on the board can be associated with a number that represents it's value

- Eg: the number of ways you can win by placing a piece at that position

3	2	3
2	4	2
3	2	3

Tic-Tac-Toe AI

- As the game progresses, the values diminish, but there's still value in each position.

- If the AI player can make a single move to win, it will.

- If the opponent can make a move and win the next turn, the AI will block it.

O	X	1/1
X	3/W	1/1
1/1	1/1	O

value:
X/O

Tic-Tac-Toe AI

- If it's none of these cases though, what should it choose?

X	2/0	2/1
O	2/1	0/2
X	X	O

value:
X/O

Tic-Tac-Toe AI

- In games such as Tic-Tac-Toe, which are known as zero sum games (if I gain 5 points, you lose 5 points), the AI runs on what's called a Min-Max algorithm:

- Minimize the Maximum gain of points by the opponent
  - Assumes the opponent is smart and will always try to maximize their gain!

X	2/0	2/1
O	2/1	0/2
X	X	O

value: X/O

Tic-Tac-Toe AI

- We would have to consider all possible moves by the AI, and the total points the opponent can gain for each move the AI makes. Then pick the one where the gain by the opponent is the lowest.

X	O	1/1
O	1/1	0/2
X	X	O

Max X = 1

X	1/0	O
O	1/1	0/W
X	X	O

Max X = 1

X	1/0	1/1
O	O	0/W
X	X	O

Max X = 1

X	2/0	1/W
O	1/W	O
X	X	O

Max X = 2

Tic-Tac-Toe AI

- A Mix-Max algorithm for Tic-Tac-Toe guarantees that the AI player will get a draw. But it doesn't guarantee that it will win:

- Under Min-Max, the AI player (O) would choose the left side move (leading to a draw) even though the right side would set it up for a win, as the left side move is the min of the max(s)

X	1/0	1/1
O	O	0/W
X	X	O

X	2/0	1/W
O	1/W	O
X	X	O

Max X = 1   Max X = 2

Tic-Tac-Toe AI

- ## Min-Max algorithm:
  - For every move we can make, calculate the scores of the board. Then,
  - If we can make a single move to win, make that move.
  - Else if opponent can make a single move to win, block that move.
  - Else make the move which ensures the opponent gains the least number of points (ie the min of the max(s)), randomly picking something among tied moves.

Download SmartAITicTacToe.cs from OneDrive and have fun!

Game Complexity

Game	Board Size (Positions)	Average Game Length (Moves)	Board Configurations	Legal Board Configurations
Tic Tac Toe	9	9	$9! = 362880$	26,830
Connect 4	42	36	$42! \sim= 1.405 \times 10^{51}$	4,531,985,219,092
9 x 9 Go	81	45	$3^{81} \sim= 4.434 \times 10^{38}$	1.039×10^{38}
19 x 19 Go	361	150	$3^{361} \sim= 1.741 \times 10^{172}$	2.082×10^{170}

Number of atoms in the observable Universe = 10^{78} to 10^{82}
http://www.universetoday.com/36302/atoms-in-the-universe/

If we can build a computer where 1 atom can store the information of a board…
we still can't exhaustively solve 19 x 19 Go. The real Go game is 21 x 21.