Introduction

- What is AI?
- The foundations of AI
- A brief history of AI
- The state of the art
- Introductory problems

What is AI?

What is AI?

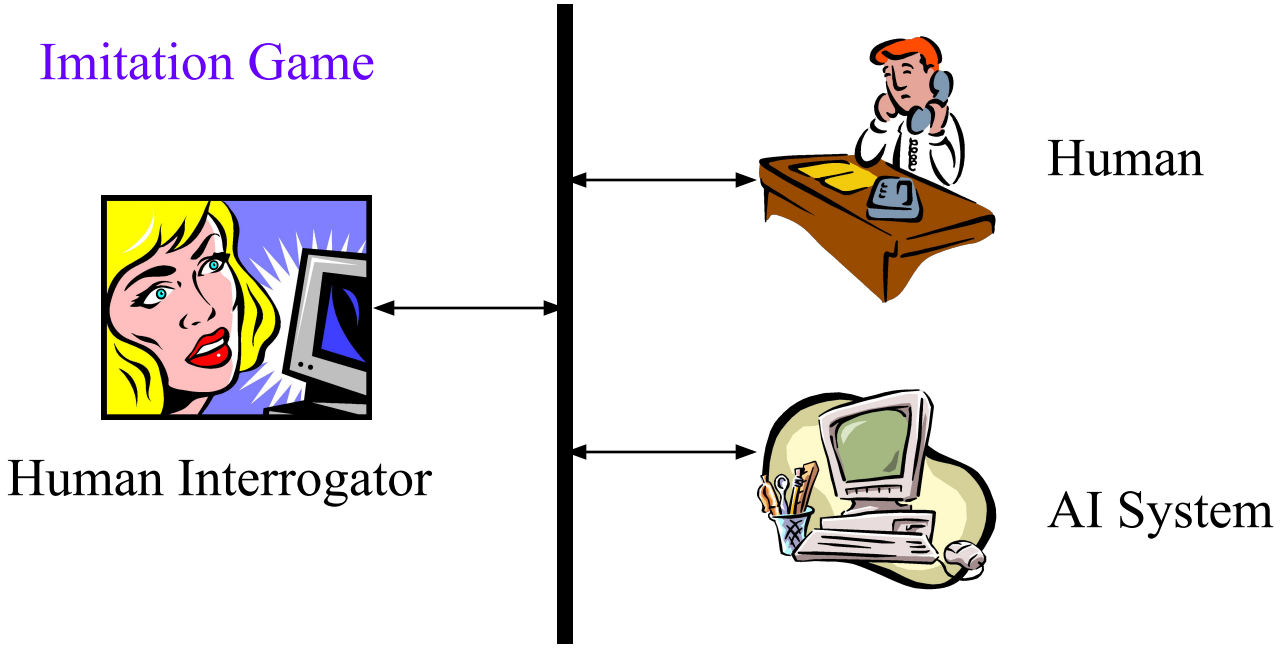
- Intelligence: “ability to learn, understand and think” (Oxford dictionary)

What is AI?

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

Acting Humanly: The Turing Test

- Alan Turing (1912-1954)
- "Computing Machinery and Intelligence" (1950)



Acting Humanly: The Turing Test

- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes.
- Anticipated all major arguments against AI in following 50 years.
- Suggested major components of AI: knowledge, reasoning, language, understanding, learning.

Thinking Humanly: Cognitive Modelling

- Not content to have a program correctly solving a problem. More concerned with comparing its reasoning steps to traces of human solving the same problem.

- Requires testable theories of the workings of the human mind: cognitive science.

Thinking Rationally: Laws of Thought

- Aristotle was one of the first to attempt to codify "right thinking", i.e., irrefutable reasoning processes.
- Formal logic provides a precise notation and rules for representing and reasoning with all kinds of things in the world.
- Obstacles:
  - Informal knowledge representation.
  - Computational complexity and resources.

Acting Rationally

- Acting so as to achieve one's goals, given one's beliefs.
- Does not necessarily involve thinking.
- Advantages:
  - More general than the "laws of thought" approach.
  - More amenable to scientific development than human-based approaches.

The Foundations of AI

- Philosophy (423 BC − present):
  - Logic, methods of reasoning.
  - Mind as a physical system.
  - Foundations of learning, language, and rationality.

- Mathematics (c.800 − present):
  - Formal representation and proof.
  - Algorithms, computation, decidability, tractability.
  - Probability.

The Foundations of AI

- Psychology (1879 − present):
  - Adaptation.
  - Phenomena of perception and motor control.
  - Experimental techniques.

- Linguistics (1957 − present):
  - Knowledge representation.
  - Grammar.

A Brief History of AI

- The gestation of AI (1943 − 1956):
  - 1943: McCulloch & Pitts: Boolean circuit model of brain.
  - 1950: Turing's "Computing Machinery and Intelligence".
  - 1956: McCarthy's name "Artificial Intelligence" adopted.

- Early enthusiasm, great expectations (1952 − 1969):
  - Early successful AI programs: Samuel's checkers, Newell & Simon's Logic Theorist, Gelernter's Geometry Theorem Prover.
  - Robinson's complete algorithm for logical reasoning.

A Brief History of AI

- A dose of reality (1966 − 1974):
  - AI discovered computational complexity.
  - Neural network research almost disappeared after Minsky & Papert's book in 1969.

- Knowledge-based systems (1969 − 1979):
  - 1969: DENDRAL by Buchanan et al..
  - 1976: MYCIN by Shortliffle.
  - 1979: PROSPECTOR by Duda et al..

A Brief History of AI

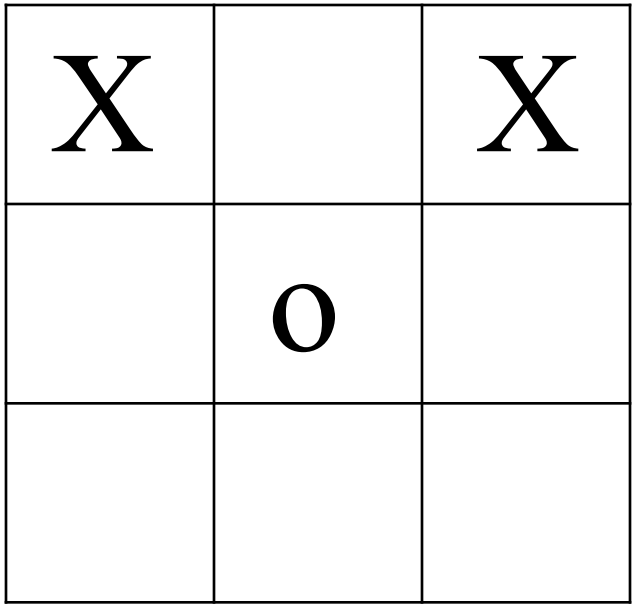
- AI becomes an industry (1980 − 1988):
  - Expert systems industry booms.
  - 1981: Japan's 10-year Fifth Generation project.

- The return of NNs and novel AI (1986 − present):
  - Mid 80's: Back-propagation learning algorithm reinvented.
  - Expert systems industry busts.
  - 1988: Resurgence of probability.
  - 1988: Novel AI (ALife, GAs, Soft Computing, …).
  - 1995: Agents everywhere.
  - 2003: Human-level AI back on the agenda.

The State of the Art

- Computer beats human in a chess game.
- Computer-human conversation using speech recognition.
- Expert system controls a spacecraft.
- Robot can walk on stairs and hold a cup of water.
- Language translation for webpages.
- Home appliances use fuzzy logic.
- .....

Introductory Problem: Tic-Tac-Toe



Introductory Problem: Tic-Tac-Toe

Program 1:

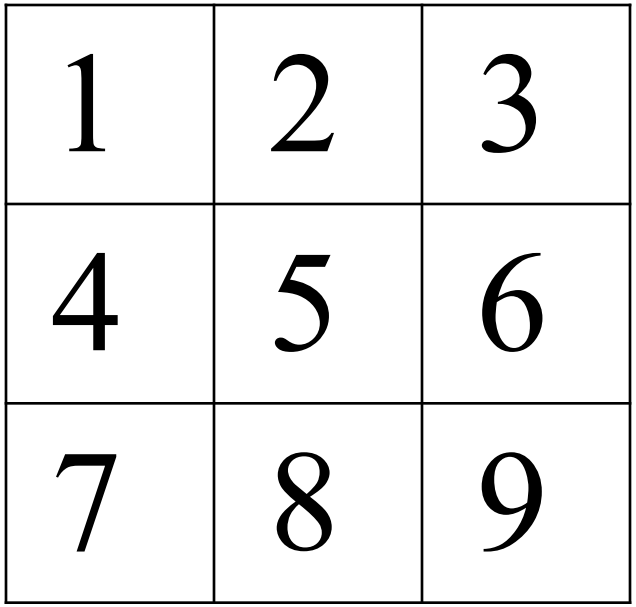
1. View the vector as a ternary number. Convert it to a decimal number.
2. Use the computed number as an index into Move-Table and access the vector stored there.
3. Set the new board to that vector.

Introductory Problem: Tic-Tac-Toe

Comments:

1. A lot of space to store the Move-Table.
2. A lot of work to specify all the entries in the Move-Table.
3. Difficult to extend.

Introductory Problem: Tic-Tac-Toe



Introductory Problem: Tic-Tac-Toe

Program 2:

Turn = 1 Go(1)

Turn = 2 If Board[5] is blank, Go(5), else Go(1)

Turn = 3 If Board[9] is blank, Go(9), else Go(3)

Turn = 4 If Posswin(X) ≠ 0, then Go(Posswin(X))

.....

Introductory Problem: Tic-Tac-Toe

Comments:

1. Not efficient in time, as it has to check several conditions before making each move.

2. Easier to understand the program's strategy.

3. Hard to generalize.

Introductory Problem: Tic-Tac-Toe

8	3	4
1	5	9
6	7	2

$15 - (8 + 5)$

Introductory Problem: Tic-Tac-Toe

Comments:

1. Checking for a possible win is quicker.

2. Human finds the row-scan approach easier, while computer finds the number-counting approach more efficient.

Introductory Problem: Tic-Tac-Toe

Program 3:

1. If it is a win, give it the highest rating.

2. Otherwise, consider all the moves the opponent could make next. Assume the opponent will make the move that is worst for us. Assign the rating of that move to the current node.

3. The best node is then the one with the highest rating.

Introductory Problem: Tic-Tac-Toe

Comments:

1. Require much more time to consider all possible moves.

2. Could be extended to handle more complicated games.

Introductory Problem: Question Answering

"Mary went shopping for a new coat. She found a red one she really liked. When she got it home, she discovered that it went perfectly with her favourite dress".

Q1: What did Mary go shopping for?

Q2: What did Mary find that she liked?

Q3: Did Mary buy anything?

Introductory Problem: Question Answering

Program 1:

1. Match predefined templates to questions to generate text patterns.
2. Match text patterns to input texts to get answers.

“What did X Y” “What did Mary go shopping for?”

“Mary go shopping for Z”

Z = a new coat

Introductory Problem: Question Answering

Program 2:

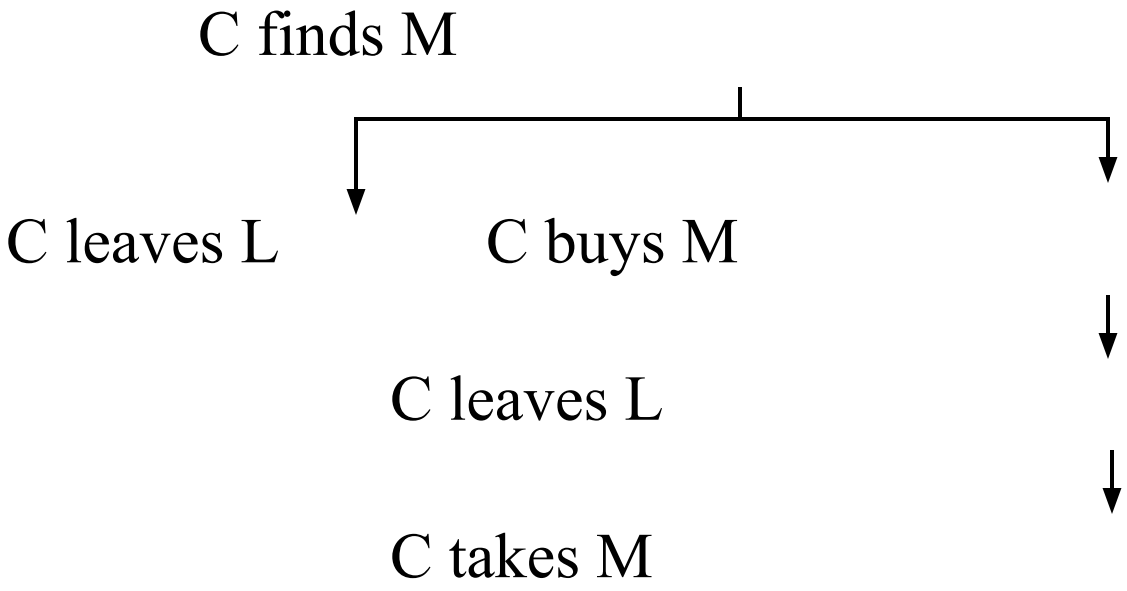
Structured representation of sentences:

Event2:		Thing1:	
instance:	Finding	instance:	Coat
tense:	Past	colour:	Red
agent:	Mary		
object:	Thing 1		

Introductory Problem: Question Answering

Program 3:

Background world knowledge:



What is AI?

Not about what human beings can do!

About how to instruct a computer to do what human beings can do!

Homework

1. Read “Computing Machinery and Intelligence” (1950).