The Development Of Artificial Intelligence

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What Is AI?

What is AI?

- Involves emulating:
  - Thought process
  - Reasoning
  - Behavior
  - Rationality
- Can be discerned in 4 groups:
  - Thinking Humanly (Bellman 1978)
  - Thinking Rationally (Winston 1992)
  - Acting Humanly (Kurzud 1990)
  - Acting Rationally (Poole et al. 1998)
- Each group tries to theorize as to how we can reproduce *minds* using *machines.*

Acting Humanly - Birth of AI

- Essentially consists in passing the Turing Test.
- The Turing test: (Turing 1950)
  - The *Imitation Game* involves 3 participants
    - Player A: a man, authorized to lie
    - Player B: a woman, cannot lie
    - Player C: the interrogator, doesn't know which one of the other players is A or B.
  - In this game, C has the task to identify the players.
  - C can only ask descriptive questions using a text interface.
- The twist: replace A by a *Thinking Machine* and see if C will win in similar proportion.

Acting Humanly - Birth of AI

- Turing Test sets the scene for 4 basic needs (+2 for the Total Turing Test):
  - Natural Language Processing
  - Knowledge Representation
  - Automated Reasoning
  - Machine Learning
    - Total TT: Computer Vision and Robotics
- Given enough progress in them, a thinking machine could pass the Turing Test.
- Consequently, these are most of what AI covers today.

Other 'philosophies' in AI

Thinking Humanly

- Cognitive science
- Try to reproduce thought process of humans.
- Interesting but very informal.
- Thus, hard to progress.

Thinking Rationally

- Syllogism, logicist.
- Build AI from a huge sum of inference rules.
- Hard because:
  - Not all knowledge is formal.
  - Problems too big $O(2^n)$
- Can't find 99% solution.

Acting Rationally - Modern AI

- Rational **Agent**
- Based in part on **Logical Inference**.
- Not only correct inference:
  - Some things can't be proved...
    - Not enough time in the Universe
    - Not enough resources/impracticable
    - Incompleteness Theorem (computability)
  - Still need to make a decision!
  - Emulate **intuition** or **reflexes**.
- Two advantages:
  - More general than mere Logical Inference
  - More amenable to scientific approach:
    - Human behavior/thought is too subjective

A Short History Of AI

Fast-Forwarding History

- **~300 BC**: Aristotle: syllogism. Steps to infer truths.
- **1315:** Ramon Lull: mechanical artifacts can reason.
- **~1600:** Hobbes (*Leviathan*): reasoning is computations.
- **~1600:** Blaise Pascal: machine appears thinking
- **~1600:** Leibniz: rationalism, given all info = all states
- **~1600:** Descarte: only logic, then no free will? Dualism!
- **1739:** Hame: rules acquired by exposure. Induction!
- **~1800:** Boole, logic algebra. Gottlob: ++first order logic.
- **1928:** Carnap/Hempel: mind == computational process!
- **1931:** Gödel: Incomp. thrm. Limits on deduction.
- **1936:** Turing/Church: Gödel says some functions can't be computed. If function computable, Turing Machine can compute it. **Computability**.
- **1964:** Cobham/Edmunds: some problems too big to compute. **Tractability**.

Dates are shortened for formatting.

The Birth Of AI

- **1943**: First AI project; Pitts & McCullogh build a model of networking artificial neurons. Suggested that properly designed **networks could learn**.
- **1950**: Alan Turing defines the **Turing Test**.
- **1950**: Early **Neural Network** at Harvard University was composed of 40 neurons.
- **1956**: Minski et al.: Dartmouth Conference gives **birth to AI** as a discipline.

Golden Age

- Many of the first AI programs are created at IBM in the 50s, including the Geometry Theorem Prover and checkers' AI programs.
- Lisp is invented in 1958 at MIT.
- Fast progress in early AI research, but two problems:
  - Machines knew nothing of their subject matter.
  - Algorithms scale poorly to larger or difficult problems due to **perceptrons learning limits**

Winter(s) of AI

↓ **~1960:** Perceptrons will save the World:
- Not so much, in fact very limited.
- Industry is delusioned, removes funding.

↑ **~1970:** *Re*discover **Neural Networks**.
- Japan initiative makes US jump back in to maintain competitivity.

↓ **~1970:** Neural Networks will save the World:
- Not so much. Industry cuts funding massively.

↑ **~1980: Expert systems** based on inference:
- Make lot of progresses. Lot of excitement.

↓ **1987:** Expert systems show their limits.

Present - Spring of AI

- **1982:** First commercial application of AI by Digital Equipment Corp. to configure computer orders. System saves $40M per year by 1986.
- **~1990 - Present:** AI research becomes mainstream, as the core theory is well founded and it's applications are ubiquitous.
- Linear/Logistic/SVM regression.
- Neural Networks: Supervised/Unsupervised/Deep Learning.

Modern Applications of AI

- Driverless Vehicles; Google Car
- Spam fighting;
- Machine translation;
- Logistics Planning; AI planned logistics during the Gulf War in itself paid back 30 years of investments in R&D by DARPA.
- Game playing; IBM's DEEP BLUE and Watson.
- Search Engines;
- Robotics, speech recognition, Autonomous planning and scheduling and many more...