A few historical (and pre-historical) landmarks in AI

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A few references

- Pierre Marquis, Odile Papini, Henri Prade: Some Elements for a Prehistory of Artificial Intelligence in the Last Four Centuries - ECAI 2014.
- Pierre Marquis, Odile Papini, Henri Prade: Eléments pour une histoire de l'intelligence artificielle, *in* Panorama de l'Intelligence Artificielle. Ses Bases Méthodologiques, ses Développements, Vol. I, 1-39, Cepadues, 2014.
- Jamal Atif: Intelligence Artificielle : enjeux et perspectives pour l'enseignement supérieur et la recherche - Présentation à la CPU, 2018.

From Antiquity to XVIth century

First steps...

- Greek philosophy, but also Chinese, Indian, Arabic, Persian... philosophies.
- Aristotle (-384 - -322): analysis of human reasoning, syllogisms, validity conditions.
- Opposition knowledge/opinion, necessity/possibility.
- Saint Augustine of Hippo (354-430): existence of knowledge.
- Inspiration for the philosophers of the Middle-Age.
- Distinction between logics and theologics.
- Ramon Llull (1232-1316): logical machine for argumentation.
- William of Ockham (c.1287-1347): law of parsimony (Ockham's razor: "shaving away" unnecessary assumptions).
- Imaginary artificial creatures (Galatea, Golem...).
- Machines: pulley, clepsydra...

XVIIth and XVIIIth centuries

- Slow transition towards the birth of modern logic.
- Link between symbolic manipulation of terms in logic and mathematical calculus: Thomas Hobbes (1588-1679).
- First developments of probabilities:
    - Before 1660: two independent concepts:
        - chance (randomness)
        - probability (attribute of the opinion)

      Theory of games and chances (without referring to probabilities): Dante, Cardano, Galileo, Pascal, Fermat, Huygens.
    - Towards Bayesian mathematical formulation: Arnault, Leibniz, Bernoulli, Hooper, Montmort, De Moivre, Bayes, Lambert, Laplace.
- Emergence of the first machines and automata (Vaucanson).
- Philosophical advances (Descartes, etc.)
- Votes: Condorcet, Borda.
- Towards reason and rationality,

XIXth Century

- Rise of modern logic.
- F. De Castillon: formal calculus for solving syllogisms.
- J. Gergonne: algebraic methods in mathematics, applied by G. Boole and A. De Morgan for logic, and further developed by E. Schröder, C. S. Peirce, etc.
- S. Mill: induction, qualitative inference rules for causal reasoning.
- L. Carroll: symbolic logic, voting method.

XXth Century

- Birth of computer science, calculability theory, cybernetics (Wiener).
- Early work: G. Frege (quantifiers, predicate logics), Russel, Gödel... (mathematical foundations of logics...).
- Introduction of non-classical logics (multi-valued, modal...).
- Impact in the literature and cinema.
- "Official" birth of AI in 1956.
- Alternance of enthusiasm and deception.

- 1943: McCulloch (1898-1968) and Pitts (1923-1969) - simplified model of biological neurons.
- 1945: John Von Neumann (1903-1957) - bases of computer architecture.
- 1948: EDVAC (Electronic Discrete Variable Automatic Computer), based on this architecture.
- 1948: C. Shannon (1916-1957) - "A mathematical theory of communication".
- 1948: Norbert Wiener (1894-1964) - "Cybernetics, or Control and Communication in the Animal and the Machine".
- 1950: Alan Turing (1912-1954) - "Computing Machinery and Intelligence". Can machine think? Can machine behave intelligently?

  1952-1960: Great (and sometimes unreasonable) enthusiasm

- Marvin Minsky (1927-2016) - AI: *The science of making machines do things that would require intelligence if done by men.*
- Herbert Simon (1916-2001) and Allen Newell (1927-1992): problem solver "The logic theorist".
- Arthur Samuel (1901-1990) - Chess, Machine Learning.
- John McCarthy (1927-2011) - LISP.

1956: Dartmouth Summer Research Project on Artificial Intelligence

Proposed by John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon.

We propose that a 2-month, 10-man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

1956 Dartmouth Conference: The Founding Fathers of AI
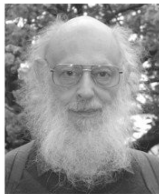

John MacCarthy

Marvin Minsky

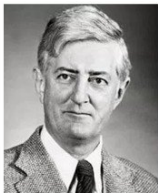Claude Shannon

Ray Solomonoff

Alan Newell

Herbert Simon

Arthur Samuel

Oliver Selfridge

Nathaniel Rochester

Trenchard More

Symbolic AI

- Representing knowledge using symbols.
- Major role of logics.
- Rules to manipulate symbols.
- Search strategies.

Perceptron and next steps

- 1958: Frank Rosenblatt (1928-1971): Perceptron (based on earlier work by Hebb), with proof of convergence.
- Used in computer vision.
- Limits demonstrated by Marvin Minsky and Seymour Papert (1928-2016) in "Perceptrons: an introduction to computational geometry" (e.g. xor can not be modeled).
- 1969-1979: less fundings, almost nothing on neural networks.
- Important works in knowledge-based systems: MYCIN (mid 1970s), PROLOG (1972) by Alain Colmerauer and Philippe Roussel...

Expert systems and next steps

- Mostly in the 1980's.
- Deception: expert systems do not meet all expectations.
- In parallel: Emergence of different communities in AI, with specific scopes, approaches, conferences... (KR, ML, Computer Vision, NLP, Robotics, Decision, Multi-Agents, Cognitive neurosciences...)

## Come-back of neural networks 1985-1995

- Re-discovery of some features (back-propagation...).
- Deep networks (many layers).
- Convolutional neural networks.
- Yann LeCun (1960-), Geoffrey Hinton (1947-), Léon Bottou (1965-), Yoshua Bengio (1964-), etc.
- 1997: IBM DeepBlue wins against Gary Kasparov.

1995-2006

- Difficulty of training.
- Other approaches are developed (SVM, optimization, statistics...).
- Vladimir Vapnik (1936-).
- Development of semantic web and ontologies.

Late 1990's - Today

- But: more data, more computing resources.
- BigData
- Amazon (94), Google (98), Alibaba (99), Baidu (2000), Facebook (2004), Twitter (2006)...
- Development of Apple, Microsoft, IBM... for data sciences.
- 2011: IBM DeepQA wins Jeopardy!
- 2016: AlphaGo (Google DeepMind). Uses deep learning, Monte-Carlo search, reinforcement learning, plays against himself.
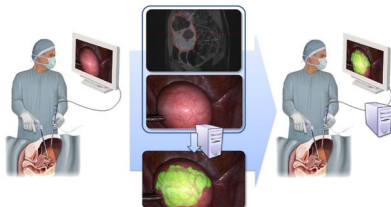- Huge applications in computer vision.
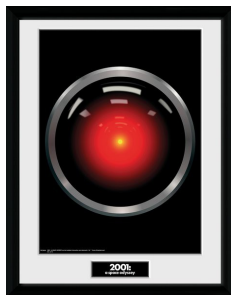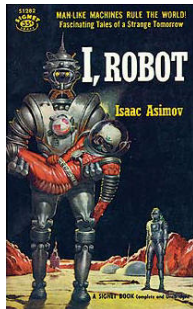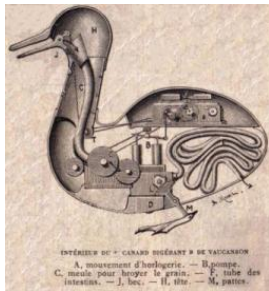
DeepMind
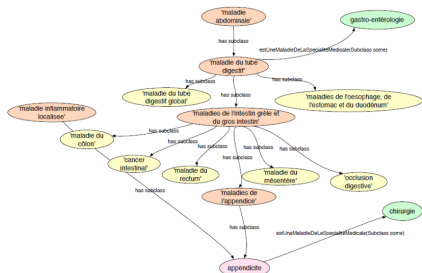
A. Esteva et al. (Stanford)

J. Charlet (LIMICS)

N. Bourdel, A. Bartoli
(Clermont-Ferrand)

Inspiration from cognitive functions

1. Receptive functions (acquisition, processing, classification, integration of information).

2. Memory and learning, storing, mining, knowledge inference.

3. Reasoning and computing.

4. Expressive functions, communication.

5. Executive functions for decision making and action.