Inteligencia en Redes de Comunicaciones

Tema 1
Brief History of Artificial Intelligence

Julio Villena Román, Raquel M. Crespo García,
José Jesús García Rueda
{jvillena, rcrespo, rueda}@it.uc3m.es

Universidad
Carlos III de Madrid

Fuente: http://www.aaai.org/AITopics/bbhist.html
Leyenda: Sociedad
Ciencia
Ingeniería

Brief History of Artificial Intelligence

(a subtopic of History)

A chronology of significant events in the
History of AI
initially prepared for use in
Introduction to AI classes
by
Bruce G. Buchanan
University Professor Emeritus
University of Pittsburgh
and
subsequently annotated by AI TOPICS

Bruce Buchanan and John McCarthy at the AI TOPICS booth at AAAI-02 in Edmonton, Canada (August 2002)

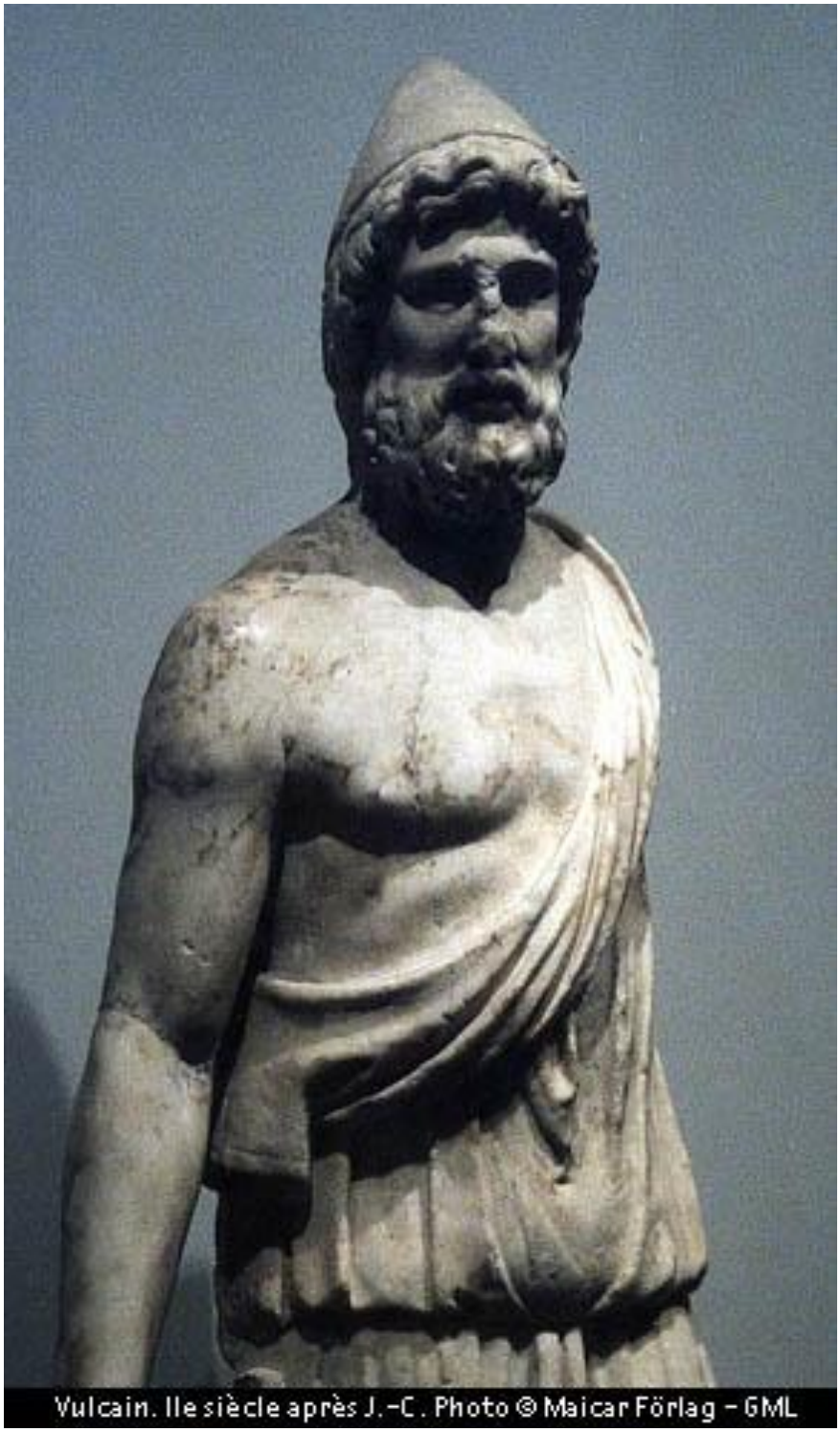
INTRODUCTION

The intellectual roots of AI, and the concept of intelligent machines, may be found in Greek mythology. Intelligent artifacts appear in literature since then, with real (and fraudulent) mechanical devices actually demonstrated to behave with some degree of intelligence. Some of these conceptual achievements are listed below under "Ancient History."

After modern computers became available, following World War II, it has become possible to create programs that perform difficult intellectual tasks. From these programs, general tools are constructed which have applications in a wide variety of everday problems. Some of these computational milestones are listed below under "Modern History."

Ancient History

Greek myths of Hephaestus and Pygmalion incorporate the idea of intelligent robots. Many other myths in antiquity involve human-like artifacts. Many mechanical toys and models were actually constructed, e.g., by Hero, Daedalus and other real persons.



Vulcain. IIe siècle après J.-C. Photo © Maicar Förlag – GML

5th century B.C.

Aristotle invented syllogistic logic, the first formal deductive reasoning system.

- Logic
    1. Categories (10 classifications of terms)
    2. On Interpretation (propositions, truth, modality)
    3. Prior Analytics (syllogistic logic)
    4. Posterior Analytics (scientific method and syllogism)
    5. Topics (rules for effective arguments and debate)
    6. On Sophistical Refutations (informal fallacies)
- Physical works
    1. Physics (explains change, motion, void, time)
    2. On the Heavens (structure of heaven, earth, elements)
    3. On Generation (through combining material constituents)
    4. Meteorologics (origin of comets, weather, disasters)
- Psychological works
    1. On the Soul (explains faculties, senses, mind, imagination)
    2. On Memory, Reminiscence, Dreams, and Prophesying
- Works on natural history
    1. History of Animals (physical/mental qualities, habits)
    2. On the parts of Animals
    3. On the Movement of Animals
    4. On the Progression of Animals
    5. On the Generation of Animals
    6. Minor treatises
    7. Problems
- Philosophical works
    1. Metaphysics (substance, cause, form, potentiality)
    2. Nicomachean Ethics (soul, happiness, virtue, friendship)
    3. Eudemain Ethics
    4. Magna Moralia
    5. Politics (best states, utopias, constitutions, revolutions)
    6. Rhetoric (elements of forensic and political debate)
    7. Poetics (tragedy, epic poetry)

13th century

Talking heads were said to have been created, Roger Bacon and Albert the Great reputedly among the owners.

(physiological / computational / cognitive models of audio-visual speech)

“That fakes were appearing in Europe in the late sixteenth and early seventeenth centuries is shown by **Miguel de Cervantes's description of a head that spoke to Don Quixote -- with the help of a tube that led to the floor below**. Like Albert the Great, this fictitious inventor also feared the judgement of religious authorities, though in his case he took it upon himslef to destroy the heresy.” [David Lindsay, "Talking Head", Invention & Technology, Summer 1997, 57-63.]

Ramon Llull, Spanish theologian, invented machines for discovering nonmathematical truths through combinatories.

“Many of the fundamental ideas in artificial intelligence have an ancient heritage. Some of the most fundamental, surely, are that thinking is a computational process, that computational processes involve combining symbols, that computation can be made mechanical, and that the mathematics of computation involves combinatorics. All of these ideas have their origin, so far as we know, in the work of an eccentric 13th century Spanish genius, Ramon Lull (1232-1316). Lull's sources were partly mystical, but the interesting part of his thought drew from - or against - an analytic tradition in logic and combinatorics." [Clark Glymour, Kenneth M. Ford and Patrick J. Hayes. (1998) AI Magazine 19(2): 136.]

15th century

Invention of printing using moveable type. Gutenberg Bible printed (1456).

Late 15th century

Clocks, the first modern measuring machines, were first produced using lathes.

16th century

Clockmakers extended their craft to creating mechanical animals and other novelties.

Rabbi Loew of Prague is said to have invented the Golem, a clay man brought to life (1580).

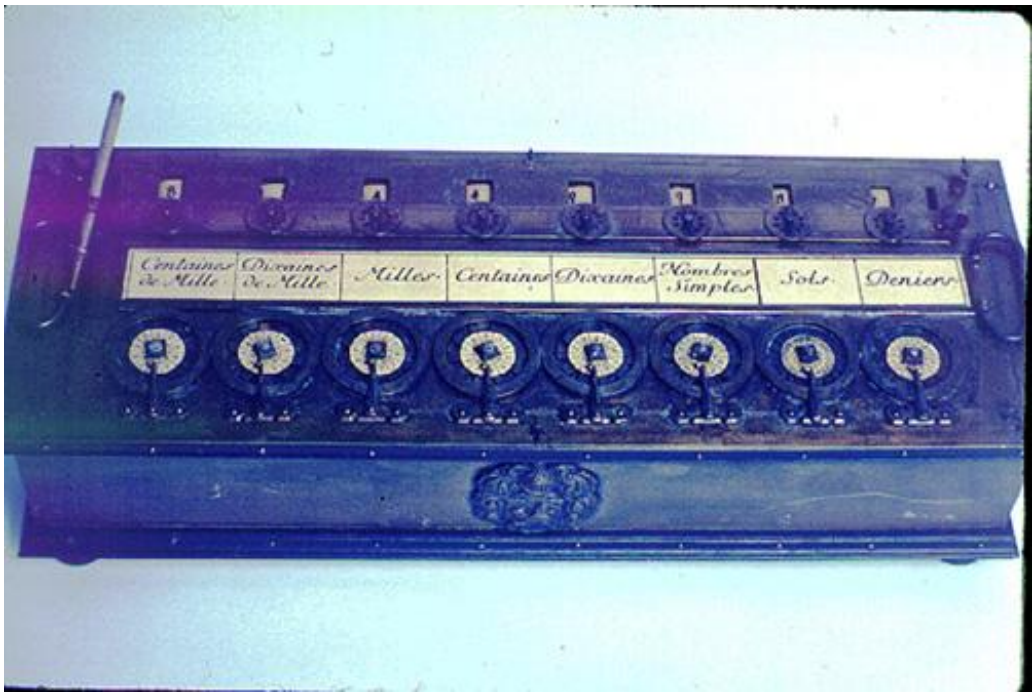
One day Great Rabbi Loew decided that he should do something to help the grownups and boys and girls. He remembered a story that his father told him when he was a little boy. His father had read one of the great books in the Synagogue, a Jewish church. The story said that a Golem, a kind of servant, could be made out of a lump of clay!
[http://www.ced.appstate.edu/projects/fifthd/legend.html]

17th century

Early in the century, Descartes proposed that bodies of animals are nothing more than complex machines. Many other 17th century thinkers offered variations and elaborations of Cartesian mechanism.

Hobbes published *The Leviathan*, containing a material and combinatorial theory of thinking.

Pascal created the first mechanical digital calculating machine (1642).



Blaise Pascal created an adding machine with automatic carries from one position to the next. The son of a tax collector, Pascal devised a machine that contained several dials that could be turned with the aid of a stylus. Addition was achieved by the underlying gears turning as each digit was dialled in, the cumulative total being displayed in a window above the "keyboard". While several models were completed, Pascal's machine (often called the "Pascalene") was more likely to be found in the living rooms of their owners as a conversation piece rather than in the work room.

Leibniz improved Pascal's machine to do multiplication & division (1673) and evisioned a universal calculus of reasoning by which arguments could be decided mechanically.

18th century

The 18th century saw a profusion of mechanical toys, including the celebrated mechanical duck of Vaucanson and von Kempelen's phony mechanical chess player, The Turk (1769).

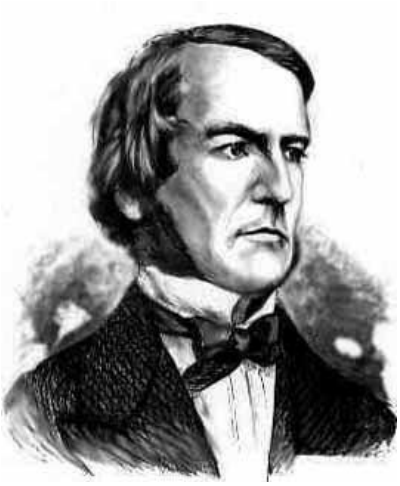
19th century

Luddites (led by Ned Ludd) destroyed machinery in England (1811-1816).

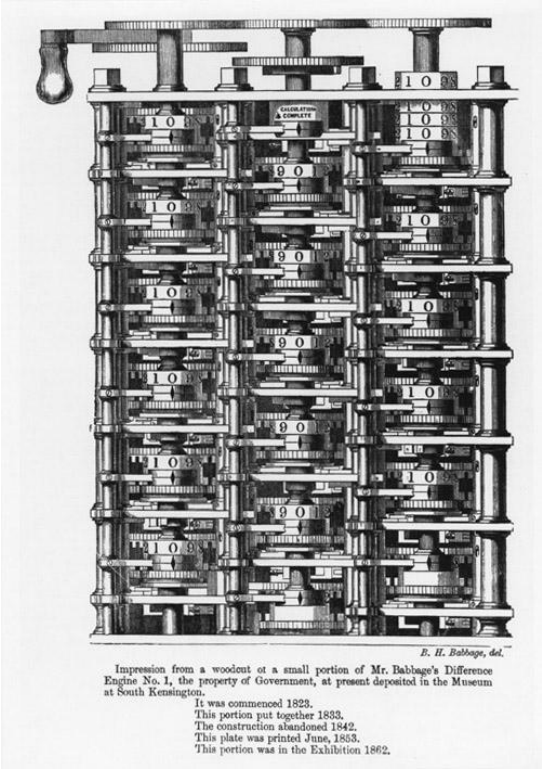
The Luddites were a group of English workers in the early 1800s who protested against the changes produced by the Industrial Revolution that they felt threatened their jobs, often by destroying machines. [Wikipedia]

Mary Shelley published the story of Frankenstein's monster (1818).

George Boole developed a binary algebra representing (some) "laws of thought."



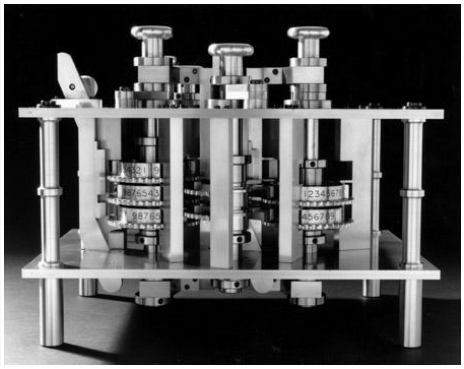
Charles Babbage & Ada Byron (Lady Lovelace) worked on programmable mechanical calculating machines.



B. H. Babbage, del.

Impression from a woodcut of a small portion of Mr. Babbage's Difference Engine No. 1, the property of Government, at present deposited in the Museum at South Kensington.

It was commenced 1823.
This portion put together 1833.
The construction abandoned 1842.
This plate was printed June, 1853.
This portion was in the Exhibition 1862.



20th century - First Half

Bertrand Russell and Alfred North Whitehead published *Principia Mathematica*, which revolutionaized formal logic. Russell, Ludwig Wittgenstein, and Rudolf Carnap lead philosophy into logical analysis of knowledge.

Karel Capek's play *"R.U.R."(Rossum's Universal Robots)* opens in London (1923). - First use of the word 'robot' in English.

Robot, which is derived from a Czech word meaning "menial labor," got its modern meaning from a 1920 play, R.U.R. (Rossum's Universal Robots), by Czech playwright Karel Capek (1890-1938). The robots in Capek's play develop emotions and overthrow their human masters. A sinister "power struggle" with robots has long been a popular theme in science fiction --- for a change of pace, try Isaac Asimov's "I Robot" stories in which he consciously strove to depict robots as a benefit to society.

Warren McCulloch & Walter Pitts publish "A Logical Calculus of the Ideas Immanent in Nervous Activity" (1943), laying foundations for neural networks.

Arturo Rosenblueth, Norbert Wiener & Julian Bigelow coin the term "cybernetics" in a 1943 paper. Wiener's popular book by that name published in 1948.

Vannevar Bush published As We May Think (Atlantic Monthly, July 1945) a prescient vision of the future in which computers assist humans in many activities.

A.M. Turing published "Computing Machinery and Intelligence" (1950). - Introduction of Turing's Test as a way of operationalizing a test of intelligent behavior.

I propose to consider the question, "Can Machines Think?"
-Alan Mathison Turing

Claude Shannon published detailed analysis of chess playing as search (1950).

Isaac Asimov published his three laws of robotics (1950).

Asimov also proposed his three "Laws of Robotics", and he later added a 'zeroth law':
Law Zero: A robot may not injure humanity, or, through inaction, allow humanity to come to harm.
Law One: A robot may not injure a human being, or, through inaction, allow a human being to come to harm, unless this would violate a higher order law.
Law Two: A robot must obey orders given it by human beings, except where such orders would conflict with a higher order law.
Law Three: A robot must protect its own existence as long as such protection does not conflict with a higher order law.

Modern History

1956 John McCarthy coined the term "artificial intelligence" as the topic of the Dartmouth Conference, the first conference devoted to the subject.

En 1956, con la ahora famosa conferencia de Dartmouth, organizada por John McCarthy y en la cual se utilizó el nombre de inteligencia artificial para este nuevo campo, se separó la Inteligencia Artificial de la ciencia del computador, como tal. Se estableció como conclusión fundamental la posibilidad de simular inteligencia humana en una máquina.

Demonstration of the first running AI program, the Logic Theorist (LT) written by Allen Newell, J.C. Shaw and Herbert Simon (Carnegie Institute of Technology, now Carnegie Mellon University).

1957 The General Problem Solver (GPS) demonstrated by Newell, Shaw & Simon.

1952-62 Arthur Samuel (IBM) wrote the first game-playing program, for checkers, to achieve sufficient skill to challenge a world champion. Samuel's machine learning programs were responsible for the high performance of the checkers player.

1958 John McCarthy (MIT) invented the Lisp language.

Herb Gelernter & Nathan Rochester (IBM) described a theorem prover in geometry that exploits a semantic model of the domain in the form of diagrams of "typical" cases.

Teddington Conference on the Mechanization of Thought Processes was held in the UK and among the papers presented were John McCarthy's "Programs with Common Sense," Oliver Selfridge's "Pandemonium," and Marvin Minsky's "Some Methods of Heuristic Programming and Artificial Intelligence."

Late 50's & Early 60's Margaret Masterman & colleagues at Cambridge design semantic nets for machine translation.

1961 James Slagle (PhD dissertation, MIT) wrote (in Lisp) the first symbolic integration program, SAINT, which solved calculus problems at the college freshman level.

1962 First industrial robot company, Unimation, founded.

1963 Thomas Evans' program, ANALOGY, written as part of his PhD work at MIT, demonstrated that computers can solve the same analogy problems as are given on IQ tests.

Ivan Sutherland's MIT dissertation on Sketchpad introduced the idea of interactive graphics into computing.

Edward A. Feigenbaum & Julian Feldman published ***Computers and Thought***, the first collection of articles about artificial intelligence.

1964 Danny Bobrow's dissertation at MIT (tech.report #1 from MIT's AI group, Project MAC), shows that computers can understand natural language well enough to solve algebra word problems correctly.

Bert Raphael's MIT dissertation on the SIR program demonstrates the power of a logical representation of knowledge for question-answering systems

1965 J. Allen Robinson invented a mechanical proof procedure, the Resolution Method, which allowed programs to work efficiently with formal logic as a representation language.

Joseph Weizenbaum (MIT) built ELIZA, an interactive program that carries on a dialogue in English on any topic. It was a popular toy at AI centers on the ARPA-net when a version that "simulated" the dialogue of a psychotherapist was programmed.

1966 Ross Quillian (PhD dissertation, Carnegie Inst. of Technology, now CMU) demonstrated semantic nets.

First Machine Intelligence workshop at Edinburgh - the first of an influential annual series organized by Donald Michie and others.

Negative report on machine translation kills much work in Natural Language Processing (NLP) for many years.

1967 Dendral program (Edward Feigenbaum, Joshua Lederberg, Bruce Buchanan, Georgia Sutherland at Stanford) demonstrated to interpret mass spectra on organic chemical compounds. First successful knowledge-based program for scientific reasoning.

Joel Moses (PhD work at MIT) demonstrated the power of symbolic reasoning for integration problems in the Macsyma program. First successful knowledge-based program in mathematics.

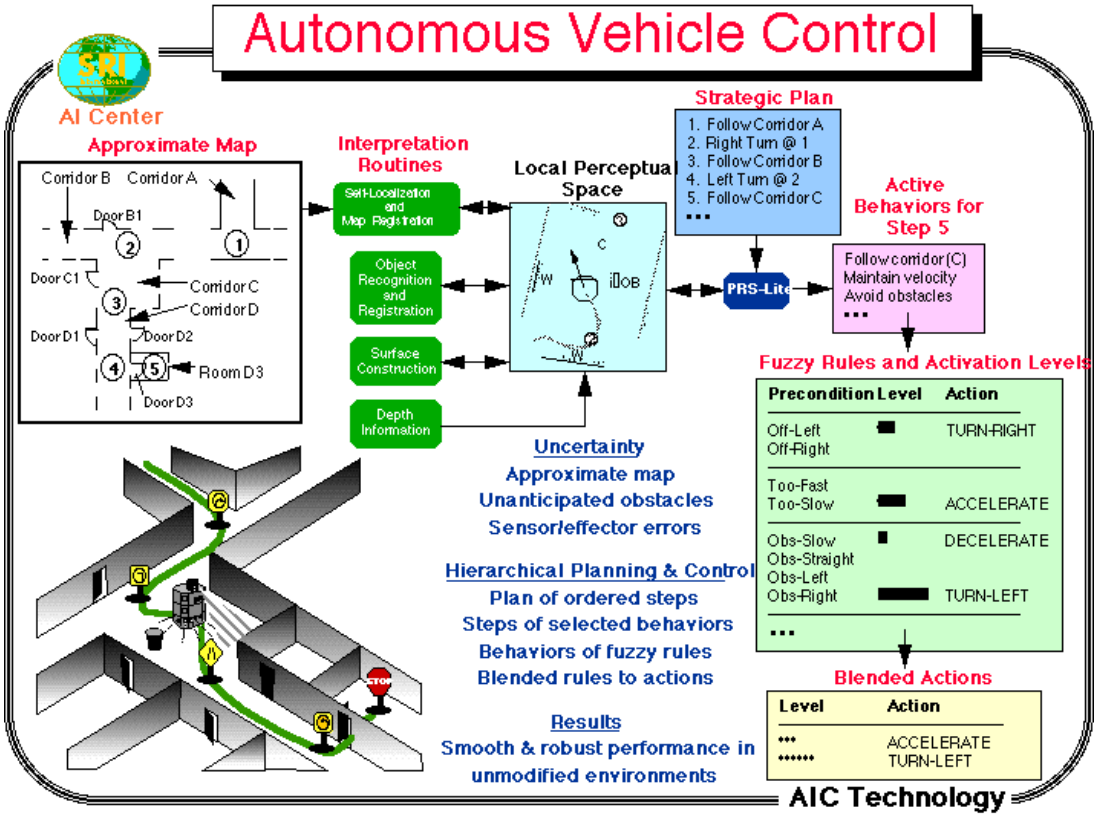
Richard Greenblatt at MIT built a knowledge-based chess-playing program, MacHack, that was good enough to achieve a class-C rating in tournament play.

Late 60s Doug Engelbart invented the mouse at SRI.

Stanford Research Institute: SRI International, an independent, nonprofit research institute, provides innovative, high-value solutions to a wide range of government, business, and foundation clients.

1968 Marvin Minsky & Seymour Papert publish Perceptrons, demonstrating limits of simple neural nets.

1969 SRI robot, Shakey, demonstrated combining locomotion, perception and problem solving.



Roger Schank (Stanford) defined conceptual dependency model for natural language understanding. Later developed (in PhD dissertations at Yale) for use in story understanding by Robert Wilensky and Wendy Lehnert, and for use in understanding memory by Janet Kolodner.

First International Joint Conference on Artificial Intelligence (IJCAI) held at Stanford.

1970 Jaime Carbonell (Sr.) developed SCHOLAR, an interactive program for computer-aided instruction based on semantic nets as the representation of knowledge.

Bill Woods described Augmented Transition Networks (ATN's) as a representation for natural language understanding.

Patrick Winston's PhD program, ARCH, at MIT learned concepts from examples in the world of children's blocks.

Early 70's Jane Robinson & Don Walker established influential Natural Language Processing group at SRI.

1971 Terry Winograd's PhD thesis (MIT) demonstrated the ability of computers to understand English sentences in a restricted world of children's blocks, in a coupling of his language understanding program, SHRDLU, with a robot arm that carried out instructions typed in English.

1972 Prolog developed by Alain Colmerauer.

1973 The Assembly Robotics group at Edinburgh University builds Freddy, the Famous Scottish Robot, capable of using vision to locate and assemble models.

1974 Ted Shortliffe's PhD dissertation on MYCIN (Stanford) demonstrated the power of rule-based systems for knowledge representation and inference in the domain of medical diagnosis and therapy. Sometimes called the first expert system.

Earl Sacerdoti developed one of the first planning programs, ABSTRIPS, and developed techniques of hierarchical planning.

1975 Marvin Minsky published his widely-read and influential article on Frames as a representation of knowledge, in which many ideas about schemas and semantic links are brought together.

The Meta-Dendral learning program produced new results in chemistry (some rules of mass spectrometry) the first scientific discoveries by a computer to be published in a refereed journal.

Mid 70's Barbara Grosz (SRI) established limits to traditional AI approaches to discourse modeling. Subsequent work by Grosz, Bonnie Webber and Candace Sidner developed the notion of "centering", used in establishing focus of discourse and anaphoric references in NLP.

Alan Kay and Adele Goldberg (Xerox PARC) developed the Smalltalk language, establishing the power of object-oriented programming and of icon-oriented interfaces.

David Marr and MIT colleagues describe the "primal sketch" and its role in visual perception.

1976 Doug Lenat's AM program (Stanford PhD dissertation) demonstrated the discovery model (loosely-guided search for interesting conjectures).

Randall Davis demonstrated the power of meta-level reasoning in his PhD dissertation at Stanford.

Late 70's Stanford's SUMEX-AIM resource, headed by Ed Feigenbaum and Joshua Lederberg, demonstrates the power of the ARPAnet for scientific collaboration.

1978 Tom Mitchell, at Stanford, invented the concept of Version Spaces for describing the search space of a concept formation program.

Herb Simon wins the Nobel Prize in Economics for his theory of bounded rationality, one of the cornerstones of AI known as "satisficing".

The MOLGEN program, written at Stanford by Mark Stefik and Peter Friedland, demonstrated that an object-oriented representation of knowledge can be used to plan gene-cloning experiments.

1979 Bill VanMelle's PhD dissertation at Stanford demonstrated the generality of MYCIN's representation of knowledge and style of reasoning in his EMYCIN program, the model for many commercial expert system "shells".

Jack Myers and Harry Pople at University of Pittsburgh developed INTERNIST, a knowledge-based medical diagnosis program based on Dr.Myers' clinical knowledge.

Cordell Green, David Barstow, Elaine Kant and others at Stanford demonstrated the CHI system for automatic programming.

The Stanford Cart, built by Hans Moravec, becomes the first computer-controlled, autonomous vehicle when it successfully traverses a chair-filled room and circumnavigates the Stanford AI Lab.

Drew McDermott & Jon Doyle at MIT, and John McCarthy at Stanford begin publishing work on non-monotonic logics and formal aspects of truth maintenance.

1980's Lisp Machines developed and marketed.

First expert system shells and commercial applications.

1980 Lee Erman, Rick Hayes-Roth, Victor Lesser and Raj Reddy published the first description of the blackboard model, as the framework for the HEARSAY-II speech understanding system.

First National Conference of the American Association of Artificial Intelligence (AAAI) held at Stanford.

1981 Danny Hillis designs the connection machine, a massively parallel architecture that brings new power to AI, and to computation in general. (Later founds Thinking Machines, Inc.)

1983 John Laird & Paul Rosenbloom, working with Allen Newell, complete CMU dissertations on SOAR.

1. A theory of cognition.
2. A set of principles and constraints on (cognitive) processing.
3. An AI programming language.

James Allen invents the Interval Calculus, the first widely used formalization of temporal events.

Mid 80's Neural Networks become widely used with the Backpropagation algorithm (first described by Werbos in 1974).

1985 The autonomous drawing program, Aaron, created by Harold Cohen, is demonstrated at the AAAI National Conference (based on more than a decade of work, and with subsequent work showing major developments).

1987 Marvin Minsky publishes *The Society of Mind*, a theoretical description of the mind as a collection of cooperating agents.

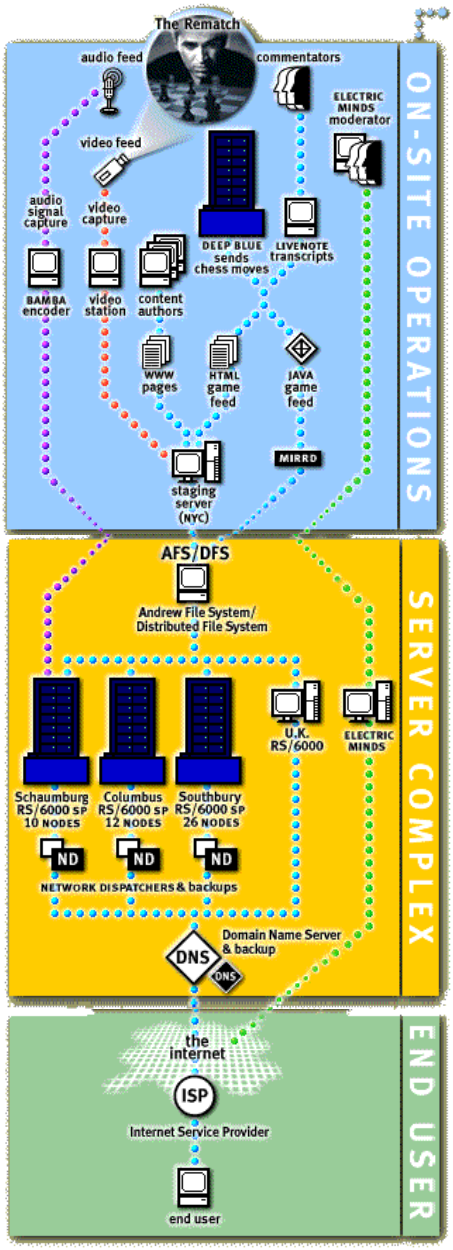
1989 Dean Pomerleau at CMU creates ALVINN (An Autonomous Land Vehicle in a Neural Network), which grew into the system that drove a car coast-to-coast under computer control for all but about 50 of the 2850 miles.

1990's Major advances in all areas of AI, with significant demonstrations in machine learning, intelligent tutoring, case-based reasoning, multi-agent planning, scheduling, uncertain reasoning, data mining, natural language understanding and translation, vision, virtual reality, games, and other topics.

Rod Brooks' COG Project at MIT, with numerous collaborators, makes significant progress in building a humanoid robot

Early 90's TD-Gammon, a backgammon program written by Gerry Tesauro, demonstrates that reinforcement learning is powerful enough to create a championship-level game-playing program by competing favorably with world-class players.

1997 The Deep Blue chess program beats the current world chess champion, Garry Kasparov, in a widely followed match.



First official Robo-Cup soccer match featuring table-top matches with 40 teams of interacting robots and over 5000 spectators.

Late 90's Web crawlers and other AI-based information extraction programs become essential in widespread use of the world-wide-web.

Demonstration of an Intelligent Room and Emotional Agents at MIT's AI Lab. Initiation of work on the Oxygen Architecture, which connects mobile and stationary computers in an adaptive network.

2000 Interactive robot pets (a.k.a. "smart toys") become commercially available, realizing the vision of the 18th cen. novelty toy makers.

Cynthia Breazeal at MIT publishes her dissertation on Sociable Machines, describing KISMET, a robot with a face that expresses emotions.

The Nomad robot explores remote regions of Antarctica looking for meteorite samples.

Today ...