INTRODUCTION: ARTIFICIAL INTELLIGENCE(AI)

Artificial intelligence (AI) is technology and a branch of computer science that studies and develops intelligent machines and software. Major AI researchers and textbooks define the field as "the study and design of intelligent agents", where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who coined the term in 1955, defines it as "the science and engineering of making intelligent machines".

AI research is highly technical and specialised, deeply divided into subfields that often fail to communicate with each other. Some of the division is due to social and cultural factors: subfields have grown up around particular institutions and the work of individual researchers. AI research is also divided by several technical issues. There are subfields which are focused on the solution of specific problems, on one of several possible approaches, on the use of widely differing tools and towards the accomplishment of particular applications.

The central problems (or goals) of AI research include reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. General intelligence (or "strong AI") is still among the field's long term goals. Currently popular approaches include statistical methods, computational intelligence and traditional symbolic AI. There are an enormous number of tools used in AI, including versions of search and mathematical optimization, logic, methods based on probability and economics, and many others.

The field was founded on the claim that a central property of humans, intelligence—the sapience of Homo sapiens—can be so precisely described that it can be simulated by a machine. This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings, issues which have been addressed by myth, fiction and philosophy since antiquity. Artificial intelligence has been the subject of tremendous optimism but has also suffered stunning setbacks. Today it has become an essential part of the technology industry and many of the most difficult problems in computer science.

Artificial intelligence includes:

**Games playing**: programming computers to play games such as chess and checkers

**Expert systems** : programming computers to make decisions in real-life situations (for example, some expert systems help doctors diagnose diseases based on symptoms)

**Natural language** : programming computers to understand natural human languages

**Neural networks** : Systems that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains

**Robotics** : programming computers to see and hear and react to other sensory stimuli

Currently, no computers exhibit full artificial intelligence (that is, are able to simulate human behaviour). The greatest advances have occurred in the field of games playing. The best computer chess programs are now capable of beating humans.

In the early 1980s, expert systems were believed to represent the future of artificial intelligence and of computers in general. To date, however, they have not lived up to expectations. Many expert systems help human experts in such fields as medicine and engineering, but they are very expensive to produce and are helpful only in special situations. Today, the hottest area of artificial intelligence is neural networks, which are proving successful in a number of disciplines such as voice recognition and natural-language processing.There are several programming languages that are known as AI languages because they are used almost exclusively for AI applications. The two most common are LISPand Prolog**.**

The ability of a computer or other machine to perform actions thought to require intelligence. Among these actions are logical deduction and inference, creativity, the ability to make decisions based on past experience or insufficient or conflicting information, and the ability to understand spoken language.

Artificial intelligence is the search for a way to map intelligence into mechanical hardware and enable a structure into that system to formalize thought. No formal definition, as yet, is available for as to what artificial intelligence actually is. Over the course of this section, we will try to formulate a working definition, reasoning and articulating facts and preferences of various other authors and practitioners of the field. To start with, we would think of the word *artificial* and *intelligence* as main sources of inspiration and come up with a brief description of the same as follows:

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| --- | --- | --- |
| **“** | Artificial Intelligence is the study of human intelligence such that it can be replicated artificially. | **”** |

With our first set of formal declaration of the concept, we tread gradually through different semantics of it and try to explore a much broader definition for AI. In their book Artificial Intelligence: A Modern Approach, authors Russell and Norvig tried to establish a clear classification of the definition of the field into distinct categories based on working definitions from other authors commenting on AI. The demarcation of concepts holds true to these clauses for systems that:

* Think and act like humans
* Think and act rationally

So, one would be tempted to improve upon the definition given above to include these facts into perspective such that the definition that we end up with says that:

|  |  |  |
| --- | --- | --- |
| **“** | Artificial Intelligence is the study of human intelligence and actions replicated artificially, such that the resultant bears to its design a reasonable level of rationality. | **”** |

There are numerous definitions of what artificial intelligence is.

We end up with four possible goals:

* Systems that think like humans (focus on reasoning and human framework)
* Systems that think rationally (focus on reasoning and a general concept of intelligence)
* Systems that act like humans (focus on behaviour and human framework)
* Systems that act rationally (focus on behaviour and a general concept of intelligence)

AI or artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning, reasoning, and self-correction. Particular applications of AI include expert systems, speech recognition, and machine vision.

Nearly all video games include some level of artificial intelligence. The most basic type of AI produces characters that move in standard formations and perform predictable actions. More advanced artificial intelligence enables computer characters to act unpredictably and make different decisions based on a player's actions. Artificial intelligence is used in a wide range of video games, including board games, side-scrollers, and 3D action games. AI also plays a large role in sports games, such as football, soccer, and basketball games. Since the competition is only as good as the computer's artificial intelligence, the AI is a crucial aspect of a game's playability. Games that lack a sophisticated and dynamic AI are easy to beat and therefore are less fun to play. If the artificial intelligence is too good, a game might be impossible to beat, which would be discouraging for players. Therefore, video game developers often spend a long time creating the perfect balance of artificial intelligence to make the games both challenging and fun to play. Most games also include different difficulty levels, such as Easy, Medium, and Hard, which allows players to select an appropriate level of artificial intelligence to play against.

**HISTORY OF ARTIFICAL INTELLEGENCE**

Thinking machines and artificial beings appear in Greek myths, such as Talos of Crete, the bronze robot of Hephaestus, and Pygmalion's Galatea. Human likenesses believed to have intelligence were built in every major civilization: animated cult images were worshiped in Egypt and Greece and humanoid automatons were built by Yan Shi, Hero of Alexandria and Al-Jazari. By the 19th and 20th centuries, artificial beings had become a common feature in fiction, as in Mary Shelley's Frankenstein or Karel Čapek's R.U.R. (Rossum's Universal Robots). Mechanical or "formal" reasoning has been developed by philosophers and mathematicians since antiquity. The study of logic led directly to the invention of the programmable digital electronic computer, based on the work of mathematician Alan Turing and others. Turing's theory of computation suggested that a machine, by shuffling symbols as simple as "0" and "1", could simulate any conceivable act of mathematical deduction.

The field of AI research was founded at a conference on the campus of Dartmouth College in the summer of 1956. The attendees, including John McCarthy, Marvin Minsky, Allen Newell and Herbert Simon, became the leaders of AI research for many decades. They and their students wrote programs that were, to most people, simply astonishing: Computers were solving word problems in algebra, proving logical theorems and speaking English. By the middle of the 1960s, research in the U.S. was heavily funded by the Department of Defense and laboratories had been established around the world. AI's founders were profoundly optimistic about the future of the new field: Herbert Simon predicted that "machines will be capable, within twenty years, of doing any work a man can do" and Marvin Minsky agreed, writing that "within a generation ... the problem of creating 'artificial intelligence' will substantially be solved".

They had failed to recognize the difficulty of some of the problems they faced. In 1974, in response to the criticism of Sir James Lighthill and ongoing pressure from the US Congress to fund more productive projects, both the U.S. and British governments cut off all undirected exploratory research in AI. The next few years would later be called an "AI winter", a period when funding for AI projects was hard to find.

In the early 1980s, AI research was revived by the commercial success of expert systems, a form of AI program that simulated the knowledge and analytical skills of one or more human experts. By 1985 the market for AI had reached over a billion dollars. At the same time, Japan's fifth generation computer project inspired the U.S and British governments to restore funding for academic research in the field. However, beginning with the collapse of the Lisp Machine market in 1987, AI once again fell into disrepute, and a second, longer lasting AI winter began.

In the 1990s and early 21st century, AI achieved its greatest successes, albeit somewhat behind the scenes. Artificial intelligence is used for logistics, data mining, medical diagnosis and many other areas throughout the technology industry. The success was due to several factors: the increasing computational power of computers (see Moore's law), a greater emphasis on solving specific subproblems, the creation of new ties between AI and other fields working on similar problems, and a new commitment by researchers to solid mathematical methods and rigorous scientific standards.

**THE BEGINNING OF AI:**

Although the computer provided the technology necessary for AI, it was not until the early 1950's that the link between human intelligence and machines was really observed. [Norbert Wiener](http://www-groups.dcs.st-andrews.ac.uk/~history/Mathematicians/Wiener_Norbert.html) was one of the first Americans to make observations on the principle of feedback theory feedback theory. The most familiar example of feedback theory is the thermostat: It controls the temperature of an environment by gathering the actual temperature of the house, comparing it to the desired temperature, and responding by turning the heat up or down. What was so important about his research into feedback loops was that Wiener theorized that all intelligent behavior was the result of feedback mechanisms. Mechanisms that could possibly be simulated by machines. This discovery influenced much of early development of AI.

In late 1955, Newell and Simon developed The Logic Theorist, considered by many to be the first AI program. The program, representing each problem as a tree model, would attempt to solve it by selecting the branch that would most likely result in the correct conclusion. The impact that the logic theorist made on both the public and the field of AI has made it a crucial stepping stone in developing the AI field.

In 1956 [John McCarthy](http://library.thinkquest.org/2705/people.html) regarded as the father of AI, organized a conference to draw the talent and expertise of others interested in machine intelligence for a month of brainstorming. He invited them to Vermont for "The Dartmouth summer research project on artificial intelligence." From that point on, because of McCarthy, the field would be known as Artificial intelligence. Although not a huge success, (explain) the Dartmouth conference did bring together the founders in AI, and served to lay the groundwork for the future of AI research.

History of Artificial Intelligence began when McCulloch and Walter Pitts proposed a model of artificial neurons in 1943. Significance of this work is that each neuron is characterised as being “on” or “off”. Switching to “on” occurred when significant number of neighbouring neurons stimulated. McCulloth and Pits showed that any computable function could be computed by network of connected neurons. In 1949, Donald Hebb modified the connection strength between neurons using a simple updating rule what is known as Hebbian learning even today. Marvin Minsky and Dean Edmonds built the first neural network computer called SNARC in 1951. This computer used 3000 vacuum tubes and a network of 40 neurons. Alan Turing introduced the infamous Turing test, machine learning, genetic algorithms, and reinforcement learning.

**THE TURING TEST**

The Turing test is a central, long term goal for AI research – will we ever be able to build a computer that can sufficiently imitate a human to the point where a suspicious judge cannot tell the difference between human and machine. From its inception it has followed a path similar to much of the AI research. Initially it looked to be difficult but possible, only to reveal itself to be far more complicated than initially thought with progress slowing to the point that some wonder if it will ever be reached. Despite decades of research and great technological advances the Turing test still sets a goal that AI researchers strive toward while finding along the way how much further we are from realizing it.

In 1950 English Mathematician Alan Turing published a paper entitled “Computing Machinery and Intelligence” which opened the doors to the field that would be called AI. This was years before the community adopted the term Artificial Intelligence as coined by John McCarthy.

Without a vision of what AI could achieve, the field itself might never have formed or simply remained a branch of math or philosophy. The fact that the Turing test is still discussed and researchers attempt to produce software capable of passing it are indications that Alan Turing and the proposed test provided a strong and useful vision to the field of AI. It’s relevance to this day seems to indicate that it will be a goal for the field for many years to come

and a necessary marker in tracking the progress of the AI field as a whole. This section will explore the history of the Turing test, evaluate its validity, describe the current attempts at passing it and conclude with the possible future directions the Turing test solution may take.

**ALAN TURING**

Alan Turing was an English mathematician who is often referred to as the father of modern computer science.

Born in 1911, he showed great skill with mathematics and after graduating from college he published a paper “On Computable Numbers, with an Application to the Entscheidungs problem” in which he proposed what would later be known as a Turing Machine – a computer capable of computing any computable function.

While Alan Turing focused primarily on mathematics and the theory of what would become computer science during and immediately after college, soon World War 2 came and he became interested in more practical matters. The use of cryptography by the Axis gave him reason to focus on building a machine capable of breaking ciphers. Before this potential use presented itself, Alan Turing likely hadn’t been too concerned that the Turing machine he’d proposed in his earlier work was not feasible to build.

In 1939 he was invited to join the Government Code and Cipher school as a cryptanalyst and it became clear that he needed to build a machine capable of breaking codes like Enigma which was used by the Germans. He designed in a few weeks and received funding for the construction electromechanical machines called ‘bombes’ which would be used to break Enigma codes and read German messages by automating the processing of 12 electrically linked Enigma scramblers. It wasn’t the Turing machine, but the concepts of generating cypher text

from plaintext via a defined algorithm clearly fit with the Turing machine notion.

After the war Turing returned to academia and became interested in the more philosophical problem of what it meant to be sentient, which lead him down the path to the Turing test.

**PROBLEM WITH TURING TEST**

A large portion of Turing’s original paper deals with addressing counter arguments concerning how the test he proposes may not be valid. In the introduction to that section he states that he believes there will be computers with enough storage capacity to make them capable of passing the Turing test “in about fifty years”. The statement is interesting because it seems to imply that the AI software required to pass the Turing Test would be rather straightforward and that the limiting factor would only be memory. Perhaps this limitation was at the front of his mind because he was routinely running into problems that he could have solved if only there were enough storage available. The same type of reasoning is similar to what happens today when we believe that Moore’s law will let us solve the hard problems.

Beyond the storage limitations, he also raises other objections, including those based in theology (the god granted immortal soul is necessary for sentience), mathematical arguments based on Godel’s work, the ability for humans to create original works and experience emotion, and others. One of the more interesting contradictions to the test is what he terms ‘The Argument from Consciousness.’ The argument goes that just imitating a human would not be enough because it doesn’t invoke the full range of what it is that we consider to be human. Specifically, the Turing Test could be passed by a machine unable to do things such as write a poem or piece of music wrapped up as part of an emotional response. A machine passing the

Turing test would not really have to experience or interpret art either. Turing argues that it is impossible to tell if the machine is feeling unless you are the machine, so there is no way to contradict the claim or to prove it. Using that method to dismiss the argument, he points out that the Turing test could include the machine convincing the interrogator that it is feeling something, even if there is truly no way to know that the emotions are actually being

felt the way they would in a human. This would be similar to how humans communicate to convince each other of what they are feeling, though there is no guarantee that it is really true.

Another interesting counter argument against the test that Turing describes is ‘Lady Lovelace’s Objection.” She posited that because machines can only do what we tell them, they cannot originate anything, while it is clear that humans do originate new concepts and ideas all of the time. At the time this was written it may not have been possible to model the learning process, but much of the progress that has been made in teaching machines to learn and infer seems to have shown that this issue can be overcome. There have been specific implementations

where voice or character recognition is reached by software training itself to recognize the variances in human writing or dialect. At least in these specific cases a machine can recognize something new so perhaps they will be able to in the general case as well.

**ALTERNATIVES TO TURING TEST**

Many people have proposed their own version of the Turing test to help contend with the perceived or possible shortcomings of the test as proposed by Alan Turing. Most of the alternatives either narrow the scope of the test to make it easier to pass (a more reachable goal), or shift the scope to an area where researchers might make better progress. One alternative, called the Feigenbaum Test, avoids the issues that make it difficult for a computer to communicate in a causal manner as is done in the Turing test. The Feigenbaum test asks the

computer to be able to pass as an expert in a particular field, essentially setting a mark for when technology like that in Expert systems has matured. This test definition does a couple of things – while eliminating the casual, anything goes, nature of the Turing interrogator, the test now requires that the computer be able to solve problems that another expert would be able to solve. In some ways the test is harder, given the expert problem solving portion, while being easier in others where the casual conversation isn’t needed.

**CONCLUSION OF TURING TEST**

Alan Turing’s original hope that the test would be passed by a computer by the year 2000 has not been realized. Despite all the effort expended by the research community, advances in processor technology, and cheap memory, no computer has yet been able to approach passing the Turing test. It is clear that the Moore’s law increase in computation power hasn’t been the driving force in improvement in Turing Test focused AI, instead it is a software problem. Software architectures, such as the Expert Systems (discussed later) offer possible solutions as their designs are refined and applied to various problems, perhaps including the Turing test or one of its derivatives.

**AI APPLIED TO CHESS**

Chess has long been considered a game of intellect, and many pioneers of computing felt that a chess-playing machine would be the hallmark of true artificial intelligence. While the Turing Test is a grand challenge to ascertain machine intelligence, chess too is a good pursuit, one which fortunately has been ‘solved’ by AI researchers; producing programs which can rival if not best the world’s best chess players. However, even the best game playing machines still do not understand concepts of the game and merely rely on brute force approaches to play.

Chess and intelligence have always been linked; the ability to play chess was even used as a valid question to ask during a Turning Test in Turing’s original paper. Many people envisioned machines one day being capable of playing Chess, but it was Claude Shannon who first wrote a paper about developing a chess playing program [Shannon50].

Shannon’s paper described two approaches to computer chess: Type-A programs, which would use pure brute force, examining thousands of moves and using a min-max search algorithm. Or, Type-B, programs which would use specialized heuristics and ‘strategic’ AI, examining only a few, key candidate moves. Initially Type-B (strategic) programs were favored over Type-A (brute force) because during the 50s and 60s computers were so limited. However, in 1973 the developers of the ‘Chess’ series of programs (which won the ACM computer chess championship 1970-72) switched their program over to Type-A The new program, dubbed

‘Chess 4.0’ went on to win a number of future ACM computer chess titles. \*WikiChess+. This change was an unfortunate blow to those hoping of finding a better understanding of the game of chess through the development of Type-B programs.

There were several important factors in moving away from the arguably more intelligent design of a Type-B program to a dumber Type-A. The first was simplicity. The speed of a machine has a direct correlation to a Type-Aprogram’s skill, so with the trend being machines getting faster every year it is easier to write a strong Type-A program and ‘improve’ a program by giving it more power through parallelization or specialized hardware. Whereas a Type-B program would need to be taught new rules of thumb and strategies – regardless of how much new power was being fed to it. Also, there was the notion of predictability. The authors of ‘Chess’ have

commented on the stress they felt during tournaments where their Type-B program would behave erratically in accordance to different hard-coded rules.

To this day Type-A (brute force) programs are the strongest applications available. Intelligent Type-B programs exist, but it is simply too easy to write Type-A programs and get exceptional play just off of computer speed. Grandmaster-level Type-B programs have yet to materialize since more research must be done in understanding and abstracting the game of chess into (even more) rules and heuristics.

**EXPERT SYSTEM**

Expert systems are computer programs aiming to model human expertise in one or more specific knowledge areas. They usually consist of three basic components: a knowledge database with facts and rules representing human knowledge and experience; an inference engine processing consultation and determining how inferences are being made; and an input/output interface for interactions with the user.

According to K. S. Metaxiotis et al, expert systems can be characterized by:

* using symbolic logic rather than only numerical calculations;
* the processing is data-driven;
* a knowledge database containing explicit contents of certain area of knowledge; and
* the ability to interpret its conclusions in the way that is understandable to the user.

Expert systems, as a subset of AI, first emerged in the early 1950s when the Rand-Carnegie team developed the general problem solver to deal with theorems proof, geometric problems and chess playing . About the same time, LISP, the later dominant programming language in AI and expert systems, was invented by John McCarthy in MIT.

During the 1960s and1970s, expert systems were increasingly used in industrial applications. Some of the famous applications during this period were DENDRAL (a chemical structure analyzer), XCON (a computer hardware configuration system), MYCIN (a medical diagnosis system), and ACE (AT&T's cable maintenance system). PROLOG, as an alternative to LISP in logic programming, was created in 1972 and designed to handle computational linguistics, especially natural language processing. At that time, because expert systems were considered

revolutionary solutions capable of solving problems in any areas of human activity, AI was perceived as a direct threat to humans. It was a perception that would later bring an inevitable backlash .

The success of these systems stimulated a near-magical fascination with smart applications. Expert systems were largely deemed as a competitive tool to sustain technological advantages by the industry. By the end of 1980s, over half of the Fortune 500 companies were involved in either developing or maintaining of expert systems . The usage of expert systems grew at a rate of 30% a year. Companies like DEC, TI, IBM, Xerox and HP, and universities such as MIT, Stanford, Carnegie-Mellon, Rutgers and others have all taken part in pursuing expert system technology and developing practical applications. Nowadays, expert systems has expanded into many sectors of our society and can be found in a broad spectrum of arenas such as health care, chemical analysis, credit authorization, financial management, corporate planning, oil and mineral prospecting, genetic engineering, automobile design and manufacture and air-traffic control.As K. S. Metaxiotis and colleagues pointed out, expert systems are becoming increasingly more important in both decision support which provides options and issues to decision makers, and decision making where people can make decisions beyond their level of knowledge and experience. They have distinct advantages over traditional computer programs. In contrast to humans, expert systems can provide permanent storage for knowledge and expertise; offer a consistent level of consultation once they are programmed to ask for and use

inputs; and serve as a depository of knowledge from potentially unlimited expert sources and thereby providing comprehensive decision support.

In 1981 the first IBM PC was introduced, with MS-DOS operating system. Its low price started to multiply users and opened a new market for computing and expert systems. In the 80's the image of AI was very good and people believed it would succeed within a short time.The development of expert systems was aided by the development of the symbolic processing languages Lisp and Prolog. To avoid re-inventing the wheel, expert system shells were created that had more specialized features for building large expert systems.

Many companies began to market expert systems shells, some commercial developments of tools from universities, others written by venture capital backed startup companies. These claimed to allow rules to be written in plain language and thus, theoretically, allowed expert systems to be written without programming language expertise. The best known tools were Guru (USA inspired by Emycin), Personal Consultant Plus (USA), Nexpert Object (developed by Neuron Data, company founded in California by three French), Genesia (developed by French public company Electricité de France and marketed by Steria), VP Expert (USA), Xi (developed by Expertech, UK) and Crystal (developed by Intelligent Environments, UK).

Some of these included rule induction tools which they called 'generators', which theoretically allowed the production of rules by no experts based on raw data.But eventually the tools were only used in research projects and feasibility studies. They did not show commercial value in the business market, showing that AI technology was not mature.

**A.I WINTER**

In the history of artificial intelligence, an AI winter is a period of reduced funding and interest in artificial intelligence research. The term was coined by analogy to the idea of a nuclear winter. The field has experienced several cycles of hype, followed by disappointment and criticism, followed by funding cuts, followed by renewed interest years or decades later. There were two major winters in 1974–80 and 1987–93 and several smaller episodes, including:

* 1966: the failure of machine translation,
* 1970: the abandonment of connectionism,
* 1971–75: DARPA's frustration with the Speech Understanding Research program at Carnegie Mellon University,
* 1973: the large decrease in AI research in the United Kingdom in response to the Lighthill report,
* 1973–74: DARPA's cutbacks to academic AI research in general,
* 1987: the collapse of the Lisp machine market,
* 1988: the cancellation of new spending on AI by the Strategic Computing Initiative,
* 1993: expert systems slowly reaching the bottom,
* 1990s: the quiet disappearance of the fifth-generation computer project's original goals,

The term first appeared in 1984 as the topic of a public debate at the annual meeting of AAAI (then called the "American Association of Artificial Intelligence"). It is a chain reaction that begins with pessimism in the AI community, followed by pessimism in the press, followed by a severe cutback in funding, followed by the end of serious research. At the meeting, Roger Schank and Marvin Minsky—two leading AI researchers who had survived the "winter" of the 1970s—warned the business community that enthusiasm for AI had spiraled out of control in the '80s and that disappointment would certainly follow. Just three years later, the billion-dollar AI industry began to collapse.

Many researchers in AI today deliberately call their work by other names, such as informatics, machine learning, knowledge-based systems, business rules management, cognitive systems, intelligent systems, intelligent agents or computational intelligence, to indicate that their work emphasizes particular tools or is directed at a particular sub-problem. Although this may be partly because they consider their field to be fundamentally different from AI, it is also true that the new names help to procure funding by avoiding the stigma of false promises attached to the name "artificial intelligence.

Technologies developed by AI researchers have achieved commercial success in a number of domains, such as machine translation, data mining, industrial robotics, logistics, speech recognition, banking software, medical diagnosis and Google's search engine.

Fuzzy logic controllers have been developed for automatic gearboxes in automobiles (the 2006 Audi TT, VW Toureg and VW Caravell feature the DSP transmission which utilizes Fuzzy logic, a number of Škoda variants (Škoda Fabia) also currently include a Fuzzy Logic based controller). Camera sensors widely utilize fuzzy logic to enable focus.

Data analytics technology utilizing algorithms for the automated formation of classifiers that were developed in the supervised machine learning community in the 1990s (for example, TDIDT, Support Vector Machines, Neural Nets, IBL) are now used pervasively by companies for marketing survey targeting and discovery of trends and features in data sets.

A survey of recent reports suggests that AI's reputation is still less than stellar:

* Alex Castro, quoted in The Economist, 7 June 2007: "[Investors] were put off by the term 'voice recognition' which, like 'artificial intelligence', is associated with systems that have all too often failed to live up to their promises."
* Patty Tascarella in Pittsburgh Business Times, 2006: "Some believe the word 'robotics' actually carries a stigma that hurts a company's chances at funding."
* John Markoff in the New York Times, 2005: "At its low point, some computer scientists and software engineers avoided the term artificial intelligence for fear of being viewed as wild-eyed dreamers."

The AI winters can be partly understood as a sequence of over-inflated expectations and subsequent crash seen in stock-markets and exemplified by the railway mania and dotcom bubble. The hype cycle concept for new technology looks at perception of technology in more detail. It describes a common pattern in development of new technology, where an event, typically a technological breakthrough, creates publicity which feeds on itself to create a "peak of inflated expectations" followed by a "trough of disillusionment" and later recovery and maturation of the technology. The key point is that since scientific and technological progress can't keep pace with the publicity-fueled increase in expectations among investors and other stakeholders, a crash must follow. AI technology seems to be no exception to this rule.

The fall of the Lisp machine market and the failure of the fifth generation computers were cases of expensive advanced products being overtaken by simpler and cheaper alternatives. This fits the definition of a low-end disruptive technology, with the Lisp machine makers being marginalized. Expert systems were carried over to the new desktop computers by for instance CLIPS, so the fall of the Lisp machine market and the fall of expert systems are strictly speaking two separate events. Still, the failure to adapt to such a change in the outside computing milieu is cited as one reason for the 1980s AI winter.

**JAPAN’S FIFTH GENERATION COMPUTER SYSTEM**

The Japanese Fifth Generation Project in computer technology was an attempt to leapfrog Western computer expertise and create an entirely new computer technology. Although the generation terminology is a bit murky, there was the general perception that there had been a a number of generations of computer design and the accompanying operating methods.

The first generation was the mainframe computers created by Sperry Rand and IBM during and after World War II. They were hard-wired to carry out the desired sequence of computations. John Von Neumann and Herman Goldstine showed how hard wiring could be replaced by an internally stored program. Machine language program was feasible but oh so tedious. Assembly language programming was a great advance in its day. Mnemonic commands could be assembled and compiled into the machine language coding required by the computers. But assembly language programming was still almost unbearably tedious so when John Bachus and his group created Fortran (short for Formula Translation) and John McCarthy created LISP (short for List Processing) it was a whole new day in computer technology, a new generation. Fortran became the language for routine number crunching and still is to some extent despite the development of other more sophisticated computer languages. McCarthy's LISP had an entirely different career. It was founded upon a bit of esoteric mathematics called the Lambda Calculus. LISP had a value at the fringes of computer technology, in particular for what became known as Artificial Intelligence or AI. AI researchers in the U.S. made LISP their standard. While was LISP was mathematically sophisticated it was almost terminally klutzy in its terminology. Standard operations such as finding the head of a list and the tail of a list were known as CAR and CDR, for cumulative additive register and cumulative decrement register. Outsiders could easily mistake the klutziness of LISP for primitiveness. In Europe a new computer language was developed called PROLOG (short for logic programming) that was slicker than LISP and had potential for AI.

The Japanese Fifth Generation project was a collaborative effort of the Japanese computer industry coordinated by the Japanese Government that intended not only to update the hardware technology of computers but alleviate the problems of programming by creating AI operating systems that would ferret out what the user wanted and then do it. The Project chose to use PROLOG as the computer language for the AI programming instead of the LISP-based programming of the American AI researchers.

The Fifth Generation project is a large Japanese research project aiming at producing a new kind of computer by 1991. It was originally started after much debate about the necessity for significantly more usable computers which should proliferate "like air" throughout society and among other things take care of the ageing population and life-long learning. The MITI people who sponsored the project must have had a good marketing consultant to pick the name of the project, for just its very name has inspired a lot of interest around the world.

This conference was held to report on the results from the intermediate phase of the project just before the final phase of integrating together all the innovations to a complete computer system. Unfortunately, the results were somewhat disappointing from the perspective of whether something new could be done with the fifth generation computer. Most of the applications presented at the conference were interesting because they were "X done in logics programming"-not because they were "X done better than before." The hope of course is that the final computer will be fast enough to run programs which are infeasible on normal computers. We will have to wait and see.

The project director, Kazuhiro Fuchi gave the keynote speech and compared the three project stages to "hop, step, and jump," saying that they had now taken the step and were getting ready to jump in the final part of the project when they will produce a massively parallel machine. Fuchi was also very enthusiastic about natural language processing which he said would be the link between human and machine in their project.

Many of the Japanese scientists and engineers I talked to from outside the Fifth Generation project were actually quite confused about the direction of the project and not very hopeful about spectacular results. Maybe even some of the project leaders themselves have had this feeling since they had started a new laboratory for applications-oriented research within the project. The purpose of this laboratory is to verify whether the parallel computers and systems software built by the other laboratories can be used for the next generation of expert systems.

Many AI researchers, particularly in the USA, were surprised when Japanese AI scientist Hiroaki Kitano was chosen to receive the 1993 'Computers and Thought' award for his work in AI and parallelism.

Actually, to some extent, the biggest result of the Fifth generation project came by before they even started on their own research, since the very fact that the Japanese were doing a big computer project scared a lot of European and American decision makers half to death. Fortunately they were not scared completely to death but instead decided to "counter-attack" by funding a lot of new research in different computer fields. Some of the projects which were started as a result of this are the European Esprit, the British Alvey, and the American MCC.

Representatives from these three initiatives were invited to the conference to report on their own progress which has been fairly substantial. Timothy Walker from the U.K. Information Engineering Directorate told of the varying British information technology projects which had succeeded in getting a number of key scientists to return to the U.K. from overseas. Several changes had been made in the projects over the years, including some name changes, such as changing "AI" to "knowledge based systems" because of lowered expectations. On the other hand, the area of human-computer interaction was receiving more emphasis now: At the start of the Alvey project 5 years ago, HCI might have been seen as important but not so much was done about it, whereas now they realized that they had to make a serious effort to ensure usability. Walker said that HCI could either be done as an independent field of study or integrated with other topics and that they had chosen to base their projects mostly on the latter view.

**DARMOUTH CONFERENCE**

The history of artificial intelligence (AI) began in antiquity, with myths, stories and rumors of artificial beings endowed with intelligence or consciousness by master craftsmen; as Pamela McCorduck writes, AI began with "an ancient wish to forge the gods."The seeds of modern AI were planted by classical philosophers who attempted to describe the process of human thinking as the mechanical manipulation of symbols. This work culminated in the invention of the programmable digital computer in the 1940s, a machine based on the abstract essence of mathematical reasoning. This device and the ideas behind it inspired a handful of scientists to begin seriously discussing the possibility of building an electronic brain.

The field of AI research was founded at a conference on the campus of Dartmouth College in the summer of 1956. Those who attended would become the leaders of AI research for decades. Many of them predicted that a machine as intelligent as a human being would exist in no more than a generation and they were given millions of dollars to make this vision come true. Eventually it became obvious that they had grossly underestimated the difficulty of the project. In 1973, in response to the criticism of James Lighthill and ongoing pressure from congress, the U.S. and British Governments stopped funding undirected research into artificial intelligence. Seven years later, a visionary initiative by the Japanese Government inspired governments and industry to provide AI with billions of dollars, but by the late 80s the investors became disillusioned and withdrew funding again. This cycle of boom and bust, of "AI winters" and summers, continues to haunt the field. Undaunted, there are those who make extraordinary predictions even now.The 1956 Dartmouth Artificial Intelligence (AI) conference gave birth to the field of AI, and gave succeeding generations of scientists their first sense of the potential for information technology to be of benefit to human beings in a profound way.

In 1956, John McCarthy invited many of the leading researchers of the time in a wide range of advanced research topics such as complexity theory, language simulation, neuron nets, abstraction of content from sensory inputs, relationship of randomness to creative thinking, and learning machines to Dartmouth in New Hampshire to discuss a subject so new to the human imagination that he had to coin a new term for it: Artificial Intelligence.

This conference was the largest gathering on the topic that had yet taken place, and laid the foundation for an ambitious vision that has affected research and development in engineering, mathematics, computer science, psychology, and many other fields ever since. It was no coincidence that, as early as 1956, evidence indicated that electronic capacity and functionality were doubling approximately every eighteen months, and the rate of improvement showed no signs of slowing down. The conference was one of the first serious attempts to consider the consequences of this exponential curve. Many participants came away from the discussions convinced that continued progress in electronic speed, capacity, and software programming would lead to the point where computers would someday have the resources to be as intelligent as human beings, the only real question was when and how it would happen.

Five of the attendees from the original project attended AI@50 (figure 1). Each gave some recollections. McCarthy acknowledged that the 1956 project did not live up to expectations in terms of collaboration. The attendees did not come at the same time and most kept to their own research agenda.

The following are some aspects of the artificial intelligence problem:

**1. AUTOMATIC COMPUTERS**

If a machine can do a job, then an automatic calculator can be programmed to simulate the machine. The speeds and memory capacities of present computers may be insufficient to simulate many of the higher functions of the human brain, but the major obstacle is not lack of machine capacity, but our inability to write programs taking full advantage of what we have.

**2. HOW CAN A COMPUTER BE PROGRAMMED TO USE A LANGUAGE** It may be speculated that a large part of human thought consists of manipulating words according to rules of reasoning and rules of conjecture. From this point of view, forming a generalization consists of admitting a new word and some rules whereby sentences containing it imply and are implied by others. This idea has never been very precisely formulated nor have examples been worked out.

**3. NEURON NET**

How can a set of (hypothetical) neurons be arranged so as to form concepts. Considerable theoretical and experimental work has been done on this problem by Uttley, Rashevsky and his group, Farley and Clark, Pitts and McCulloch, Minsky, Rochester and Holland, and others. Partial results have been obtained but the problem needs more theoretical work.

**4. THEORY OF THE SIZE OF CALCULATION**

If we are given a well-defined problem (one for which it is possible to test mechanically whether or not a proposed answer is a valid answer) one way of solving it is to try all possible answers in order. This method is inefficient, and to exclude it one must have some criterion for efficiency of calculation. Some consideration will show that to get a measure of the efficiency of a calculation it is necessary to have on hand a method of measuring the complexity of calculating devices which in turn can be done if one has a theory of the complexity of functions. Some partial results on this problem have been obtained by Shannon, and also by McCarthy.

**5. SELF-IMPROVEMENT**

Probably a truly intelligent machine will carry out activities which may best be described as self-improvement. Some schemes for doing this have been proposed and are worth further study. It seems likely that this question can be studied abstractly as well.

**6. ABSTRACTIONS**

A number of types of ``abstraction'' can be distinctly defined and several others less distinctly. A direct attempt to classify these and to describe machine methods of forming abstractions from sensory and other data would seem worthwhile.

The originators of this proposal are:

**1. C. E. Shannon**, Mathematician, Bell Telephone Laboratories. Shannon developed the statistical theory of information, the application of propositional calculus to switching circuits, and has results on the efficient synthesis of switching circuits, the design of machines that learn, cryptography, and the theory of Turing machines. He and J. McCarthy are co-editing an Annals of Mathematics Study on ``The Theory of Automata'' .

**2. M. L. Minsky,** Harvard Junior Fellow in Mathematics and Neurology. Minsky has built a machine for simulating learning by nerve nets and has written a Princeton PhD thesis in mathematics entitled, ``Neural Nets and the Brain Model Problem'' which includes results in learning theory and the theory of random neural nets.

**3. N. Rochester**, Manager of Information Research, IBM Corporation, Poughkeepsie, New York. Rochester was concerned with the development of radar for seven years and computing machinery for seven years. He and another engineer were jointly responsible for the design of the IBM Type 701 which is a large scale automatic computer in wide use today. He worked out some of the automatic programming techniques which are in wide use today and has been concerned with problems of how to get machines to do tasks which previously could be done only by people. He has also worked on simulation of nerve nets with particular emphasis on using computers to test theories in neurophysiology.

**4. J. McCarthy**, Assistant Professor of Mathematics, Dartmouth College. McCarthy has worked on a number of questions connected with the mathematical nature of the thought process including the theory of Turing machines, the speed of computers, the relation of a brain model to its environment, and the use of languages by machines. Some results of this work are included in the forthcoming ``Annals Study'' edited by Shannon and McCarthy. McCarthy's other work has been in the field of differential equations.

The Rockefeller Foundation is being asked to provide financial support for the project on the following basis:

1. Salaries of $1200 for each faculty level participant who is not being supported by his own organization. It is expected, for example, that the participants from Bell Laboratories and IBM Corporation will be supported by these organizations while those from Dartmouth and Harvard will require foundation support.

2. Salaries of $700 for up to two graduate students.

3. Railway fare for participants coming from a distance.

4. Rent for people who are simultaneously renting elsewhere.

5. Secretarial expenses of $650, $500 for a secretary and $150 for duplicating expenses.

6. Organization expenses of $200. (Includes expense of reproducing preliminary work by participants and travel necessary for organization purposes.

7. Expenses for two or three people visiting for a short time.

**ROBOT AND ARTIFICIAL INTELLEGENCE**

Artificial intelligence (AI) is arguably the most exciting field in robotics. It's certainly the most controversial: Everybody agrees that a robot can work in an assembly line, but there's no consensus on whether a robot can ever be intelligent.

Like the term "robot" itself, artificial intelligence is hard to define. Ultimate AI would be a recreation of the human thought process -- a man-made machine with our intellectual abilities. This would include the ability to learn just about anything, the ability to reason, the ability to use language and the ability to formulate original ideas. Roboticists are nowhere near achieving this level of artificial intelligence, but they have made a lot of progress with more limited AI. Today's AI machines can replicate some specific elements of intellectual ability.

Computers can already solve problems in limited realms. The basic idea of AI problem-solving is very simple, though its execution is complicated. First, the AI robot or computer gathers facts about a situation through sensors or human input. The computer compares this information to stored data and decides what the information signifies. The computer runs through various possible actions and predicts which action will be most successful based on the collected information. Of course, the computer can only solve problems it's programmed to solve -- it doesn't have any generalized analytical ability. [Chess computers](http://entertainment.howstuffworks.com/chess.htm) are one example of this sort of machine.

Some modern robots also have the ability to learn in a limited capacity. Learning robots recognize if a certain action (moving its legs in a certain way, for instance) achieved a desired result (navigating an obstacle). The robot stores this information and attempts the successful action the next time it encounters the same situation. Again, modern computers can only do this in very limited situations. They can't absorb any sort of information like a human can. Some robots can learn by mimicking human actions. In Japan, roboticists have taught a robot to dance by demonstrating the moves themselves.

The real challenge of AI is to understand how natural [intelligence](http://people.howstuffworks.com/genius.htm) works. Developing AI isn't like building an artificial heart -- scientists don't have a simple, concrete model to work from. We do know that the braincontains billions and billions of neurons, and that we think and learn by establishing electrical connections between different neurons. But we don't know exactly how all of these connections add up to higher reasoning, or even low-level operations. The complex circuitry seems incomprehensible.Artificial Intelligence (AI) is a general term that implies the use of a computer to model and/or replicate intelligent behavior. Research in AI focuses on the development and analysis of algorithms that learn and/or perform intelligent behavior with minimal human intervention. These techniques have been and continue to be applied to a broad range of problems that arise in robotics, e-commerce, medical diagnosis, gaming, mathematics, and military planning and logistics, to name a few.

Several research groups fall under the general umbrella of AI in the department, but are disciplines in their own right, including: robotics, natural language processing (NLP), computer vision, computational biology, and e-commerce. Specifically, research is being conducted in estimation theory, mobility mechanisms, multi-agent negotiation, natural language interfaces, machine learning, active computer vision, probabilistic language models for use in spoken language interfaces, and the modeling and integration of visual, haptic, auditory and motor information.

**ADVANTAGES OF A.I**

* With a combination of position-specific screening questions and the language matching and resume parsing capabilities of TurboAI, detailed application forms are effectively made redundant, making the application process simpler and less stressful for your applicant.
* As the experience is more straightforward for your applicants, you will see the results in dramatically improved completion rates on applications.
* You know the main sections in a resume – Name, Address, Contact Info, Employment History, Skills, etc. TurboAI intelligently parses resumes to source this information and extract it into the format you desire – a patented tagging technology that is over 95% accurate – the most precise in the industry!
* Whether a resume has been submitted in Word, PDF, cfmL, or one of over 100 formats, TurboAI can analyse it.
* TurboAI’s leading-edge Statistical Natural Language Processing (SNLP) technology extracts the full range of resume data into standardised, export-ready formats (including HR-XML). This means that resumes can be extracted into uniform formats for side-by-side review and effective presentation to hiring managers.
* TurboAI’s resume and job description parsing and matching is fully automated. No manual review or editing is required.
* **Quantified Matches:** Our unique technology calculates the mathematical probability of a match. TurboAI tells you how well a resume matches a job description on a scale of 0 to 100%.
* **Fast, Easy, Flexible:** Recruiters can manage the deluge of resumes by setting thresholds of acceptance, speeding up the screening process.
* **Consistent & Reliable:** TurboAI offers an objective and reliable way of screening resumes, eliminating the potential for errors.

**APPLICATIONS OF A.I**

Artificial intelligence has been used in a wide range of fields including medical diagnosis, stock trading, robot control, law, remote sensing, scientific discovery and toys. However, many AI applications are not perceived as AI: "A lot of cutting edge AI has filtered into general applications, often without being called AI because once something becomes useful enough and common enough it's not labeled AI anymore," Nick Bostrom reports. "Many thousands of AI applications are deeply embedded in the infrastructure of every industry.” the late 90s and early 21st century, AI technology became widely used as elements of larger systems, but the field is rarely credited for these successes.

* **FINANCE**

Banks use artificial intelligence systems to organize operations, invest in stocks, and manage properties. In August 2001, robots beat humans in a simulated financial trading competition.Financial institutions have long used artificial neural network systems to detect charges or claims outside of the norm, flagging these for human investigation.

Creative Virtual has deployed artificial intelligence customer support systems, or automated online assistants, at E\*TRADE, HSBC, Intuit and Lloyds Banking Group, to assist financial services customers with services such as checking an account balance, signing up for a new credit card or retrieving a forgotten password.

* **HOSPITAL AND MEDICINES**

A medical clinic can use artificial intelligence systems to organize bed schedules, make a staff rotation, and provide medical information.

Artificial neural networks are used as clinical decision support systems for medical diagnosis, such as in Concept Processing technology in EMR software.

Other tasks in medicine that can potentially be performed by artificial intelligence include:

* Computer-aided interpretation of medical images. Such systems help scan digital images, e.g. from computed tomography, for typical appearances and to highlight conspicuous sections, such as possible diseases. A typical application is the detection of a tumor.
* Heart sound analysis
* **HEAVY INDUSTRY**

Robots have become common in many industries. They are often given jobs that are considered dangerous to humans. Robots have proven effective in jobs that are very repetitive which may lead to mistakes or accidents due to a lapse in concentration and other jobs which humans may find degrading. Japan is the leader in using and producing robots in the world. In 1999, 1,700,000 robots were in use worldwide. For more information, see survey about artificial intelligence in business.

* **ONLINE AND TELEPHONE CUSTOMER SERVICES**

Artificial intelligence is implemented in automated online assistants that can be seen as avatars on web pages. It can avail for enterprises to reduce their operation and training cost. A major underlying technology to such systems is natural language processing.

Similar techniques may be used in answering machines of call centres, such as speech recognition software to allow computers to handle first level of customer support, text mining and natural language processing to allow better customer handling, agent training by automatic mining of best practices from past interactions, support automation and many other technologies to improve agent productivity and customer satisfaction.

* **TRANSPORTATION**

Fuzzy logic controllers have been developed for automatic gearboxes in automobiles (the 2006 Audi TT, VW Toureg[citation needed] and VW Caravell feature the DSP transmission which utilizes Fuzzy Logic, a number of Škoda variants (Škoda Fabia) also currently include a Fuzzy Logic based controller).

* **TELECOMMUNICATIONS**

Many telecommunications companies make use of heuristic search in the management of their workforces, for example BT Group has deployed heuristic search[9] in a scheduling application that provides the work schedules of 20,000 engineers.

* **TOYS AND GAMES**

The 1990s saw some of the first attempts to mass-produce domestically aimed types of basic Artificial Intelligence for education, or leisure. This prospered greatly with the Digital Revolution, and helped introduce people, especially children, to a life of dealing with various types of Artificial Intelligence, specifically in the form of Tamagotchis and Giga Pets, iPod Touch, the Internet (example: basic search engine interfaces are one simple form), and the first widely released robot, Furby. A mere year later an improved type of domestic robot was released in the form of Aibo, a robotic dog with intelligent features and autonomy. AI has also been applied to video games.

* **MUSIC**

The evolution of music has always been affected by technology. With AI, scientists are trying to make the computer emulate the activities of the skillful musician. Composition, performance, music theory, sound processing are some of the major areas on which research in Music and Artificial Intelligence are focusing.