IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727 PP 01-09
www.iosrjournals.org

Artificial Intelligence and Expert System

[1]P.VEENA
Department of BCA
Apollo Arts and Science College Poonamallee

Abstract:
Artificial intelligence, also sometimes referred to as machine intelligence or heuristic programming, is an emerging technology that has recently attracted considerable publicity. Many applications are now under development. One simple view of the field is that it is concerned with devising computer programs to make computers smarter. Thus, research in artificial intelligence is focused on developing computational approaches to intelligent behavior. That effort has 2 goals: making machines more useful and understanding intelligence.
Expert systems ES are one of the prominent research domains of AI. It is introduced by the researchers at Stanford University, Computer Science Department.

Keywords:
Expert System, Defense Advance Research Project Agency, Conventional Computer Program, Artificial Intelligence Research , Artificial Intelligence Application .
These keywords were added by machine and not by the authors. This process is experimental and the keywords may be updated as the learning algorithm improves.

I. INTRODUCTION

The Artificial Intelligence tutorial provides an introduction to AI which will help you to understand the concepts behind Artificial Intelligence. In this tutorial, we have also discussed various popular topics such as History of AI, applications of AI, deep learning, machine learning, natural language processing, Reinforcement learning, Q-learning, Intelligent agents, Various search algorithms, etc.

A Brief History of Artificial Intelligence

Intelligent robots and artificial beings first appeared in ancient Greek myths. And Aristotle's development of syllogism and its use of deductive reasoning was a key moment in humanity's quest to understand its own intelligence. While the roots are long and deep, the history of AI as we think of it today spans less than a century. The following is a quick look at some of the most important events in AI.

1960s
(1963) John McCarthy starts the AI Lab at Stanford.
(1966) The Automatic Language Processing Advisory Committee (ALPAC) report by the U.S. government projects.
(1969) The first successful expert systems are developed in DENDRAL, a XX program, and MYCIN, designed to diagnose blood infections, are created at Stanford.
(1972) The logic programming language PROLOG is created.
(1973) The Lighthill Report, detailing the disappointments in AI research, is released by the British government and leads to severe cuts in funding for AI projects.
(1974-1980) Frustration with the progress of AI development leads to major DARPA cutbacks in academic grants. Combined with the earlier ALPAC report and the previous year's Lighthill Report, AI funding dries up and research stalls. This period is known as the "First AI Winter."
(1980) Digital Equipment Corporations develops R1 (also known as XCON), the first successful commercial expert system. Designed to configure orders for new computer systems, R1 kicks off an investment boom in expert systems that will last for much of the decade, effectively ending the first AI Winter.
(1982) Japan's Ministry of International Trade and Industry launches the ambitious Fifth Generation Computer Systems project. The goal of FGCS is to develop supercomputer-like performance and a platform for AI development.

(1983) In response to Japan's FGCS, the U.S. government launches the Strategic Computing Initiative to provide DARPA funded research in advanced computing and AI.
(1985) Companies are spending more than a billion dollars a year on expert systems and an entire industry known as the Lisp machine market springs up to support them. Companies like Symbolics and Lisp Machines Inc. build specialized computers to run on the AI programming language Lisp.
(1987-1993) As computing technology improved, cheaper alternatives emerged and the Lisp machine market collapsed in 1987, ushering in the "Second AI Winter." During this period, expert systems proved too expensive to maintain and update, eventually falling out of favor.
(1991) U.S. forces deploy DART, an automated logistics planning and scheduling tool, during the Gulf War.
(1992) Japan terminates the FGCS project in 1992, citing failure in meeting the ambitious goals outlined a decade earlier.
(1993) DARPA ends the Strategic Computing Initiative in 1993 after spending nearly $1 billion and falling far short of expectations.
(1997) IBM's Deep Blue beats world chess champion Gary Kasparov.
(2005) STANLEY, a self-driving car, wins the DARPA Grand Challenge.
(2005) The U.S. military begins investing in autonomous robots like Boston Dynamics' "Big Dog" and iRobot's "PackBot."
(2008) Google makes breakthroughs in speech recognition and introduces the feature in its iPhone app.
(2011) IBM's Watson handily defeats the competition on *Jeopardy!*.
(2011) Apple releases Siri, an AI-powered virtual assistant through its iOS operating system.
(2012) Andrew Ng, founder of the Google Brain Deep Learning project, feeds a neural network using deep learning algorithms 10 million YouTube videos as a training set. The neural network learned to recognize a cat without being told what a cat is, ushering in the breakthrough era for neural networks and deep learning funding.
(2014) Google makes the first self-driving car to pass a state driving test.
(2014) Amazon's Alexa, a virtual home smart device, is released.
(2016) Google DeepMind's AlphaGo defeats world champion Go player Lee Sedol. The complexity of the ancient Chinese game was seen as a major hurdle to clear in AI.
(2016) The first "robot citizen," a humanoid robot named Sophia, is created by Hanson Robotics and is capable of facial recognition, verbal communication and facial expression.
(2018) Google releases natural language processing engine BERT, reducing barriers in translation and understanding by ML applications.
(2018) Waymo launches its Waymo One service, allowing users throughout the Phoenix metropolitan area to request a pick-up from one of the company's self-driving vehicles.
(2020) Baidu releases its LinearFold AI algorithm to scientific and medical teams working to develop a vaccine during the early stages of the SARS-CoV-2 pandemic. The algorithm is able to predict the RNA sequence of the virus in just 27 seconds, 120 times faster than other methods.
(2020) OpenAI releases natural language processing model GPT-3, which is able to produce text modeled after the way people speak and write.
(2021) OpenAI builds on GPT-3 to develop DALL-E, which is able to create images from text prompts.
(2022) The National Institute of Standards and Technology releases the first draft of its AI Risk Management Framework, voluntary U.S. guidance "to better manage risks to individuals, organizations, and society associated with artificial intelligence."
(2022) DeepMind unveils Gato, an AI system trained to perform hundreds of tasks, including playing Atari, captioning images and using a robotic arm to stack blocks.

Our AI tutorial is prepared from an elementary level so you can easily understand the complete tutorial from basic concepts to the high-level concepts.
An expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries.
The expert system is a part of AI, and the first ES was developed in the year 1970, which was the first successful approach of artificial intelligence. It solves the most complex issue as an expert by extracting the knowledge stored in its knowledge base. The system helps in decision making for compsex problems using **both facts and heuristics like a human expert**. It is called so because it contains the expert knowledge of a specific domain and can solve any complex problem of that particular domain. These systems are designed for a specific domain, such as **medicine, science,** etc.

II. BACKGROUND OF THE STUDY

The beginning of modern AI technology can be defined as an attempt by because of new methods.

Researching on Artificial Intelligence in education goes back to the late 1970s. Methods of Artificial classical philosophers to describe human thinking as a symbolic system. This effort culminated with 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 encouraged some of the scientists to begin seriously discussing the possibility of creating an electronic brain. Even though this concept as to pass so many years with fallible progress (eg:- AI winter - 1950 - 1980) since the reasons like limited computer power, end of funding, etc, Investments and interest in AI boomed in the first decades of the 21st century when machine learning was successfully applied to many problems in academia and industry Intelligence were generally employed in two ways. First one is designing and facilitating interactive learning environments that would support for learning by doing. And the second way is designing and implementing tutoring systems by adapting instructions with respect to the knowledge state of the students. But this is just the beginning of using AI in education. In the current situation, AI is increasingly used in education, learning, and teaching contexts especially in school education in most countries. The concussion of three areas - data, computation, and education - is set to have far-reaching repercussions, raising the nature of the education; what is taught, and how it is taught.

The field of AI in school education is focused on improving teaching and learning processes. Then the past fifteen years have seen considerable AI advances in education. Even though quality education will always require active engagement by teachers, AI promises to enhance education at all levels.

The rapid advances in technology in recent decades have already created substantial changes in the education sector, by opening up new opportunities for teaching and learning processes. It provides new tools and methods to improve and develop learning outcomes and support innovative teaching and learning.

However now AI has become one of the fastest-growing areas of technology in the global education market. According to the analysis of market research firm Holonlq, in 2018, just under a billion dollars worldwide was spent on AI in education including school education. And also the number of expected to grow over 6$ billion by 2015. according to their reports, five core areas can be identified where AI is been developed and used for education.

01.	Vision	Emotion Recognition is used for detecting confusion and engagement
02.	Voice	Text to voice interfaces are utilized to support learning activities and language learning
03.	Natural Language	This technique is emerging in assessment, feedback and plagiarism detection
04.	Algorithms	This machine learning is being applied to create personalized and adaptive learning paths for students
05.	Hardware	Smart devices, robotics, laboratory technology and software system

Table 1: *five core areas where AI is been developed*

III. COMPONENTS OF AI AND EXPERT SYSTEMS

An expert system generally consists of four components: **a knowledge base, the search or inference system, a knowledge acquisition system, and the user interface or communication system**.

1. User Interface

With the help of a user interface, the expert system interacts with the user, takes queries as an input in a readable format, and passes it to the inference engine. After getting the response from the inference engine, it displays the output to the user. In other words, **it is an interface that helps a non-expert user to communicate with the expert system to find a solution**.

2. Inference Engine(Rules of Engine)

- The inference engine is known as the brain of the expert system as it is the main processing unit of the system. It applies inference rules to the knowledge base to derive a conclusion or deduce new information. It helps in deriving an error-free solution of queries asked by the user.
- With the help of an inference engine, the system extracts the knowledge from the knowledge base.
- There are two types of inference engine:
- **Deterministic Inference engine:** The conclusions drawn from this type of inference engine are assumed to be true. It is based on **facts** and **rules**.
- **Probabilistic Inference engine:** This type of inference engine contains uncertainty in conclusions, and based on the probability.

Inference engine uses the below modes to derive the solutions:

- **Forward Chaining:** It starts from the known facts and rules, and applies the inference rules to add their conclusion to the known facts.
- **Backward Chaining:** It is a backward reasoning method that starts from the goal and works backward to prove the known facts.

3. Knowledge Base

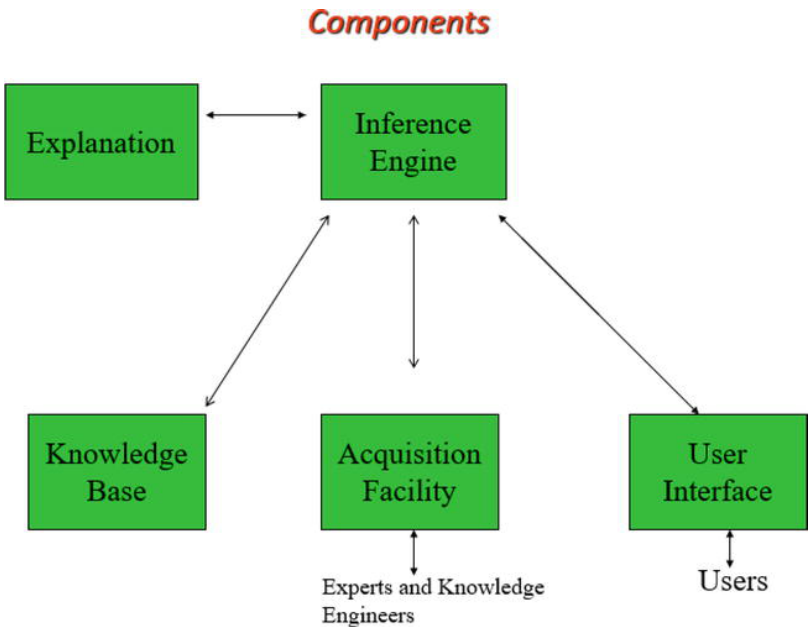
- The knowledgebase is a type of storage that stores knowledge acquired from the different experts of the particular domain. It is considered as big storage of knowledge. The more the knowledge base, the more precise will be the Expert System.
- It is similar to a database that contains information and rules of a particular domain or subject.
- One can also view the knowledge base as collections of objects and their attributes. Such as a Lion is an object and its attributes are it is a mammal, it is not a domestic animal, etc.

Components of Knowledge Base

- **Factual Knowledge:** The knowledge which is based on facts and accepted by knowledge engineers comes under factual knowledge.
- **Heuristic Knowledge:** This knowledge is based on practice, the ability to guess, evaluation, and experiences.

Knowledge Representation: It is used to formalize the knowledge stored in the knowledge base using the If-else rules.

Knowledge Acquisitions: It is the process of extracting, organizing, and structuring the domain knowledge, specifying the rules to acquire the knowledge from various experts, and store that knowledge into the knowledge base.



IV. ADVANTAGES & DISADVANTAGES OF ARTIFICIAL INTELLIGENCE

An artificial intelligence program is a program that is capable of learning and thinking. It is possible to consider anything to be artificial intelligence if it consists of a program performing a task that we would normally assume a human would perform. Let's begin with the advantages of artificial intelligence.

Advantages of Artificial Intelligence

1. Reduction in Human Error

One of the biggest advantages of Artificial Intelligence is that it can significantly reduce errors and increase accuracy and precision. The decisions taken by AI in every step is decided by information previously gathered and a certain set of algorithms. When programmed properly, these errors can be reduced to null.

2. Zero Risks

Another big advantage of AI is that humans can overcome many risks by letting AI robots do them for us. Whether it be defusing a bomb, going to space, exploring the deepest parts of oceans, machines with metal bodies are resistant in nature and can survive unfriendly atmospheres. Moreover, they can provide accurate work with greater responsibility and not wear out easily.

3. 24x7 Availability

There are many studies that show humans are productive only about 3 to 4 hours in a day. Humans also need breaks and time offs to balance their work life and personal life. But AI can work endlessly without breaks. They think much faster than humans and perform multiple tasks at a time with accurate results. They can even handle tedious repetitive jobs easily with the help of AI algorithms.

4. Digital Assistance

Some of the most technologically advanced companies engage with users using digital assistants, which eliminates the need for human personnel. Many websites utilize digital assistants to deliver user-requested content. We can discuss our search with them in conversation. Some chatbots are built in a way that makes it difficult to tell whether we are conversing with a human or a chatbot.

We all know that businesses have a customer service crew that must address the doubts and concerns of the patrons. Businesses can create a chatbot or voice bot that can answer all of their clients' questions using AI.

5. New Inventions

In practically every field, AI is the driving force behind numerous innovations that will aid humans in resolving the majority of challenging issues.

For instance, recent advances in AI-based technologies have allowed doctors to detect breast cancer in a woman at an earlier stage.

6. Unbiased Decisions

Human beings are driven by emotions, whether we like it or not. AI on the other hand, is devoid of emotions and highly practical and rational in its approach. A huge advantage of Artificial Intelligence is that it doesn't have any biased views, which ensures more accurate decision-making.

7. Perform Repetitive Jobs

We will be doing a lot of repetitive tasks as part of our daily work, such as checking documents for flaws and mailing thank-you notes, among other things. We may use artificial intelligence to efficiently automate these menial chores and even eliminate "boring" tasks for people, allowing them to focus on being more creative.

Example: In banks, it's common to see multiple document checks to obtain a loan, which is a time-consuming task for the bank's owner. The owner can expedite the document verification process for the advantage of both the clients and the owner by using AI Cognitive Automation.

8. Daily Applications

Today, our everyday lives are entirely dependent on mobile devices and the internet. We utilize a variety of apps, including Google Maps, Alexa, Siri, Cortana on Windows, OK Google, taking selfies, making calls, responding to emails, etc. With the use of various AI-based techniques, we can also anticipate today's weather and the days ahead.

Example: About 20 years ago, you must have asked someone who had already been there for instructions when you were planning a trip. All you need to do now is ask Google where Bangalore is. The best route between you and Bangalore will be displayed, along with Bangalore's location, on a Google map.

9. AI in Risky Situations

One of the main benefits of artificial intelligence is this. By creating an AI robot that can perform perilous tasks on our behalf, we can get beyond many of the dangerous restrictions that humans face. It can be utilized effectively in any type of natural or man-made calamity, whether it be going to Mars, defusing a bomb, exploring the deepest regions of the oceans, or mining for coal and oil.

For instance, the explosion at the Chernobyl nuclear power facility in Ukraine. As any person who came close to the core would have perished in a matter of minutes, at the time, there were no AI-powered robots that could assist us in reducing the effects of radiation by controlling the fire in its early phases.

Let us now look at what are the main disadvantages that Artificial intelligence holds.

Disadvantages of Artificial Intelligence

1. High Costs

The ability to create a machine that can simulate human intelligence is no small feat. It requires plenty of time and resources and can cost a huge deal of money. AI also needs to operate on the latest hardware and software to stay updated and meet the latest requirements, thus making it quite costly.

2. No creativity

A big disadvantage of AI is that it cannot learn to think outside the box. AI is capable of learning over time with pre-fed data and past experiences, but cannot be creative in its approach. A classic example is the bot Quill who can write Forbes earning reports. These reports only contain data and facts already provided to the bot. Although it is impressive that a bot can write an article on its own, it lacks the human touch present in other Forbes articles.

3. Unemployment

One application of artificial intelligence is a robot, which is displacing occupations and increasing unemployment (in a few cases). Therefore, some claim that there is always a chance of unemployment as a result of chatbots and robots replacing humans.

For instance, robots are frequently utilized to replace human resources in manufacturing businesses in some more technologically advanced nations like Japan. This is not always the case, though, as it creates additional opportunities for humans to work while also replacing humans in order to increase efficiency.

4. Make Humans Lazy

AI applications automate the majority of tedious and repetitive tasks. Since we do not have to memorize things or solve puzzles to get the job done, we tend to use our brains less and less. This addiction to AI can cause problems to future generations.

5. No Ethics

Ethics and morality are important human features that can be difficult to incorporate into an AI. The rapid progress of AI has raised a number of concerns that one day, AI will grow uncontrollably, and eventually wipe out humanity. This moment is referred to as the AI singularity.

6. Emotionless

Since early childhood, we have been taught that neither computers nor other machines have feelings. Humans function as a team, and team management is essential for achieving goals. However, there is no denying that robots are superior to humans when functioning effectively, but it is also true that human connections, which form the basis of teams, cannot be replaced by computers.

7. No Improvement

Humans cannot develop artificial intelligence because it is a technology based on pre-loaded facts and experience. AI is proficient at repeatedly carrying out the same task, but if we want any adjustments or improvements, we must manually alter the codes. AI cannot be accessed and utilized akin to human intelligence, but it can store infinite data.

Machines can only complete tasks they have been developed or programmed for; if they are asked to complete anything else, they frequently fail or provide useless results, which can have significant negative effects. Thus, we are unable to make anything conventional.

5. HOW AI WORKS

been massive advancements in computing technology, as indicated by Moore's Law, whichLess than a decade after helping the Allied forces win World War II by breaking the Nazi encryption machine Enigma, mathematician Alan Turing changed history a second time with a simple question: "Can machines think?"
Turing's 1950 paper "Computing Machinery and Intelligence" and its subsequent Turing Test established the fundamental goal and vision of AI.
At its core, AI is the branch of computer science that aims to answer Turing's question in the affirmative. It is the endeavor to replicate or simulate human intelligence in machines. The expansive goal of AI has given rise to many questions and debates. So much so that no singular definition of the field is universally accepted.
Can machines think? – Alan Turing, 1950

Defining AI
The major limitation in defining AI as simply "building machines that are intelligent" is that it doesn't actually explain what AI is and what makes a machine intelligent. AI is an interdisciplinary science with multiple approaches, but advancements in machine learning and deep learning are creating a paradigm shift in virtually every sector of the tech industry.
However, various new tests have been proposed recently that have been largely well received, including a 2019 research paper entitled "On the Measure of Intelligence." In the paper, veteran deep learning researcher and Google engineer François Chollet argues that intelligence is the "rate at which a learner turns its experience and priors into new skills at valuable tasks that involve uncertainty and adaptation." In other words: The most intelligent systems are able to take just a small amount of experience and go on to guess what would be the outcome in many varied situations.
Meanwhile, in their book *Artificial Intelligence: A Modern Approach*, authors Stuart Russell and Peter Norvig approach the concept of AI by unifying their work around the theme of intelligent agents in machines. With this in mind, AI is "the study of agents that receive percepts from the environment and perform actions."
Norvig and Russell go on to explore four different approaches that have historically defined the field of AI:

ARTIFICIAL INTELLIGENCE DEFINED: FOUR TYPES OF APPROACHES

- Thinking humanly: mimicking thought based on the human mind.
- Thinking rationally: mimicking thought based on logical reasoning.
- Acting humanly: acting in a manner that mimics human behavior.
- Acting rationally: acting in a manner that is meant to achieve a particular goal.

The first two ideas concern thought processes and reasoning, while the others deal with behavior. Norvig and Russell focus particularly on rational agents that act to achieve the best outcome, noting "all the skills needed for the Turing Test also allow an agent to act rationally."

Former MIT professor of AI and computer science Patrick Winston defined AI as "algorithms enabled by constraints, exposed by representations that support models targeted at loops that tie thinking, perception and action together."
While these definitions may seem abstract to the average person, they help focus the field as an area of computer science and provide a blueprint for infusing machines and programs with ML and other subsets of AI.

The Future of AI
When one considers the computational costs and the technical data infrastructure running behind artificial intelligence, actually executing on AI is a complex and costly business. Fortunately, there have states that the number of transistors on a microchip doubles about every two years while the cost of computers is halved.
Although many experts believe that Moore's Law will likely come to an end sometime in the 2020s, this has had a major impact on modern AI techniques — without it, deep learning would be out of the question, financially speaking. Recent research found that AI innovation has actually outperformed Moore's Law, doubling every six months or so as opposed to two years.
By that logic, the advancements artificial intelligence has made across a variety of industries have been major over the last several years. And the potential for an even greater impact over the next several decades seems all but inevitable.

Artificial General Intelligence
The creation of a machine with human-level intelligence that can be applied to any task is the Holy Grail for many AI researchers, but the quest for artificial general intelligence has been fraught with difficulty.
The search for a "universal algorithm for learning and acting in any environment," as Russel and Norvig put it, isn't new. In contrast to weak AI, strong AI represents a machine with a full set of cognitive abilities, but time hasn't eased the difficulty of achieving such a feat.
AGI has long been the muse of dystopian science fiction, in which super-intelligent robots overrun humanity, but experts agree it's not something we need to worry about anytime soon.
Although, for now, AGI is still a fantasy, there are some remarkably sophisticated systems out there now that are approaching the AGI benchmark. One of them is GPT-3, an autoregressive language model designed by OpenAI that uses deep learning to produce human-like text. GPT-3 is not intelligent, but it has been used to create some extraordinary things, including a chatbot that lets you talk to historical figures and a question-based search engine. MuZero, a computer program created by DeepMind, is another promising frontrunner in the quest to achieve true AGI. It has managed to master games it has not even been taught to play, including chess and an entire suite of Atari games, through brute force, playing games millions of times.

Superintelligence
Besides narrow AI and AGI, some consider there to be a third category known as superintelligence. For now, this is a completely hypothetical situation in which machines are completely self-aware, even surpassing the likes of human intelligence in practically every field, from science to social skills. In theory, this could be achieved through a single computer, a network of computers or something completely different, as long as it is conscious and has subjective experiences.
Nick Bostrom, a founding professor and leader of Oxford's Future of Humanity Institute, appears to have coined the term back in 1998, and predicted that we will have achieved superhuman artificial intelligence within the first third of the 21st century. He went on to say that the likelihood of this happening will likely depend on how quickly neuroscience can better understand and replicate the human brain. Creating superintelligence by imitating the human brain, he added, will require not only sufficiently powerful hardware, but also an "adequate initial architecture" and a "rich flux of sensory input."

V. CONCLUSION

Till now AI has not such a great effect directly on common people life and is limited to some areas like military, space, industry, medical, neutral networks and geological. It may be expected that at the end of 2035 with the extensive research and advancement in the field of AI, we will be able to move away from today'smachinery that necessarily come with weighty manuals regarding machine languages and develop the machinery which will be able to understand human completely. We will have robot as doctor in hospitals,professor in class room, driver in bus. According to Bostrom that will be the era of transhumanism where human beings and machines will merge into cyborgs or cybernetic organisms that are more capable and powerful than either.

REFERENCES

[1]. **A., Shaw, J. C.Newell Simon, H. A.** , Empirical explorations with the logic theory machine: acase study in heuristics, in Computers and Thought , Feigenbaum, E. A. and Feldman, J. (Eds.),McGraw Hill, New York, 1963.

[2]. **Shanon, C. E.** , Programming a computer for playing chess,Philosophical Magazine , Series 7, 41,256–275, 1950.

[3]. **Newell, A., Shaw, J. C.** and **Simon, H. A.**, A variety of intelligent learning in a general problemsolver, in Self Organising Systems , Yovits, M. C. and Cameron, S. (Eds.), Pergamon Press, New York,1960.

[4]. **McCarthy, J.**, Recursive functions of symbolic expressions and their computation by machine, Communications of the ACM , 7, 184–195, 1960.

[5]. **Weizenbaum, J.**, ELIZA - A computer program for study of natural language communicationbetween man and machine, Communications of the ACM , 9(1), 36–44, 1966.

[6]. **Minsky, M.**, A framework for representing knowledge, inThe Psychology of Computer Vision ,Winston, P. H. (Ed.), McGraw Hill, New York, 1975.

[7]. **Bobrow, D. G.**, Natural language input for a computer problem solving system, in Semantic Information Processing, Minsky, M. (Ed.), MIT Press, Cambridge, 1968.

[8]. **Winograd, T.**Understanding Natural Language, Academic Press, New York, 1972.

[9]. **Holland, J. H.** Adaptation in Natural and Artificial Systems, The University of Michigan Press,AnnArbor, 1975.

[10]. **Goldberg, D. E.**Genetic Algorithms in Search, Optimisation and Learning, Addison-WesleyPublishing Co., Reading, Mass., 1989.

[11]. **Selfridge, O. G.**, Pandemonium: a paradigm for learning, in proc. Symposium on Mechanisation oThought Processes, Balke, D. and Uttley, A. (Eds.), H. M. Stationery Office, London, 1959

[12]. **Minsky, M.** and **Papert, S.**Perceptrons, MIT Press, Cambridge, Mass., 1972.

[13]. **Hewitt, C.**, PLANNER: A language for proving theorems in robots,Proc. IJCAI, 2, 1971.

[14]. **Feigenbaum, E. A.**, The art of artificial intelligence: themes and case studies in knowledgeengineering, Proc. IJCAI , 5, 1977.Title