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A BRIEF REVIEW OF THE DEVELOPMENT PATH OF ARTIFICIAL INTELLIGENCE AND ITS SUBFIELDS

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ABSTRACT

The broad discipline of Artificial Intelligence (AI) aims to automate processes that currently require human intelligence. Understanding intelligence and creating intelligent systems are the two clear objectives of AI. AI is interested in decision-making tools including knowledge representation, machine learning, heuristic reasoning, and inference approaches. The roots of AI can be found in philosophy, literature, and the human imagination. Early advancements in engineering, electronics, and many other fields have inspired AI. In this paper, we begin with a general introduction to the area of AI, then move on to its inception, history, subfields, and various applications.

Keywords: Artificial Intelligence, Artificial Neural Network, Expert System, Support Vector Machine

1. INTRODUCTION

The ability to solve any problem and evaluate huge amounts of data using abilities like analytical thinking, logical reasoning, statistical understanding, and mathematical or computational intelligence makes humans the most intelligent species on the planet. Artificial Intelligence (AI) is a technology created for machines and robots that imposes the ability to solve complicated issues in the machines as equivalent to those that can be done by people. AI is built for machines and robots with all these combinations of talents in mind.

Systems that combine powerful hardware and software with intricate databases and knowledge-based processing models to mimic the features of efficient human decision-making are referred to as AI systems.

Nowadays, intelligence is no longer a characteristic of humans. Industry 4.0 is built on AI and machine learning since Industry 3.0 created a critical demand for automation and intelligent systems. AI aims to enable computers to exhibit human-like thinking and intelligence without experiencing human-like fatigue. AI is used in a variety of industries, including chatbots, autonomous vehicles, speech recognition, and facial recognition.

1.1. HISTORY OF ARTIFICIAL INTELLIGENCE

The origins of AI can be traced back to ancient myths, tales, and legends of man-made creatures that were given intellect or consciousness by master craftsmen. Philosophers' attempts to characterise human thought as the mechanical manipulation of symbols laid the groundwork for modern AI.

Although this idea has been around for a while, until 1950, no one knew about it. In the year 1955, John McCarthy, the man credited with creating AI, first used the word. John McCarthy famously described the field as "enabling a computer to accomplish tasks that, when done by people, are supposed to involve intelligence." The purpose of the definition was to give him the confidence to continue his investigation without having to first defend a particular philosophical interpretation of what the term "intelligence" implies. McCarthy is regarded as one of the fathers of AI, along with Alan Turing, Allen Newell, Herbert A. Simon, and Marvin Minsky. Alan argued that if humans can use reason and the knowledge at hand to solve issues and arrive at judgements, then machines can also do so.

The wave of computers started slowly over time. They improved over time, becoming quicker, more inexpensive, and more data-storage capable. The fact that they were capable of abstract thought, self-recognition, and Natural Language Processing was the best feature.

With increased funding and algorithmic tools, AI research took off again in 1980. Deep learning methods allow the computer to learn from user experience. The technology was successfully established after all the failed attempts, but the historic objectives weren't reached until the 2000s Ertel and Black (2018). Despite a lack of government funding and public awareness at the time, AI flourished. A list of significant developments in AI from Godel to the present is represented in Table 1.

Table 1

Table 1 The Development Path of Artificial Intelligence

Year	Description
1931	Kurt Godel, an Austrian, demonstrated that all true assertions may be derived in first-order predicate logic. On the other hand, there are unprovable true assertions in higher-order logics.
1937	The halting problem developed by Alan Turing highlights the limitations of intelligent machines.
1943	Making a relationship between neural network modelling and propositional logic, McCulloch and Pitts.
1950	In his writings on learning machines and genetic algorithms, Alan Turing uses the Turing test to describe machine intelligence.
1951	Inventor Marvin Minsky creates a neural network computer. The 40 neurons he replicates with 3000 vacuum tubes.
1955	A learning checkers algorithm created by Arthur Samuel (IBM) plays the game better than its creator.

1956	McCarthy plans a meeting at Dartmouth University. Here, artificial intelligence was given its first official name. The Logic Theorist is the first symbol-processing computer software, and it is presented by Newell and Simon from Carnegie Mellon University (CMU).
1958	The high-level language LISP is created by McCarthy at MIT (Massachusetts Institute of Technology). He creates programmes with the ability to change themselves.
1959	The Geometry Theorem Prover is created by Gelernter (IBM).
1961	Human cognition is mimicked by The General Problem Solver (GPS) by Newell and Simon.
1963	McCarthy establishes Stanford University's AI Lab.
1965	The resolution calculus for predicate logic is created by Robinson.
1966	Eliza, a programme created by Weizenbaum, converses in natural language with users.
1969	In their book Perceptrons, Minsky and Papert demonstrate that the extremely basic neural network known as a perceptron can only represent linear functions.
1972	Alain Colmerauer, a French scientist, creates the logic programming language PROLOG. De Dombal, a British physician, creates an excellent approach for diagnosing sudden stomach pain. The mainstream AI community of the moment ignores it.
1976	MYCIN is an expert system for infectious disease diagnosis created by Shortliffe and Buchanan that can handle uncertainty.
1981	To create a potent PROLOG machine, Japan launches the "Fifth Generation Project" at tremendous expense.
1982	R1, a computer configuration expert system, helps Digital Equipment Corporation save $40 million annually.
1986	Rumelhart, Hinton, and Sejnowski, among others, contributed to the renaissance of neural networks. The Nettalk system gains the ability to read aloud text.
1990	With Bayesian networks, Pearl, Cheeseman, Whittaker, and Spiegelhalter apply probability theory to artificial intelligence. Multi-agent systems gain acceptance.
1992	The advantages of reinforcement learning are demonstrated by Tesauros' TD-gammon programme.
1993	RoboCup is a global endeavour to create autonomous robots that can play soccer.
1995	Vapnik created support vector machines, which are crucial today, from statistical learning theory.
1997	World chess champion Gary Kasparov is defeated by IBM's Deep Blue chess machine. Japan hosts the first global RoboCup competition.
2003	The RoboCup robots are an outstanding example of what AI and robotics are capable of.
2006	One of the main fields of AI research is service robots.
2009	The first self-driving Google automobile makes its way along a California motorway.
2010	Learning allows autonomous robots to start changing their behaviour.
2011	On the television game programme "Jeopardy!" IBM's "Watson" defeats two human champions. Watson can respond to challenging inquiries rapidly and understands natural language.
2015	On the Autobahn, Daimler makes its autonomous truck debut. Over a million miles have been logged by Google's autonomous vehicles, which only drive in populated areas. Excellent picture classification is made possible by deep learning. Deep learning can be used to automatically create Old Master-inspired paintings.
2016	In January, the European champion was defeated 5:0 by the Google DeepMind Go programme, and in March, one of the finest Go players in the world, Lee Sedol of Korea, was defeated 4:1. This achievement is made possible by deep learning methods used for pattern recognition, reinforcement learning, and Monte Carlo tree search.
2018	Large artificial intelligence models known as "foundation models," which may be used to a variety of downstream tasks, have started to be constructed. These models are trained on enormous amounts of unlabeled data.
2020	OpenAI's (GPT-3) autoregressive language model creates text that resembles human speech using deep learning. It will produce text that follows the prompt when given a beginning text as input.
2022	Gato is a multimodal deep neural network that performs a variety of challenging tasks. It is capable of doing a variety of things, like conversing, playing video games, operating a

robot arm to stack blocks, and more. It was developed by scientists at the London-based DeepMind AI company.

1.2. ELEMENTS OF INTELLIGENCE

Learning, reasoning, problem-solving, perception, and linguistic intelligence are the five fundamental facets of AI Littman et al. (2021). Software developers and engineers have been able to produce a wide range of technologies and services that users all over the world have grown to like and want through the use of these five fundamental components. Figure 1 shows the Elements of Artificial Intelligence.

Reasoning: It is the process that enables us to offer the fundamental standards and principles for making an assessment, a prediction, and a choice with regard to any situation. There are two different sorts of reasoning. The first is generalised reasoning, which is based on broad observable instances and assertions. In this instance, the conclusion might not always be accurate. The other is logical reasoning, which is founded on data, facts, precise claims, and mentioned or witnessed occurrences.

Learning : It is the process of learning new information and developing existing skills from a variety of sources, including books, real-life experiences, lessons from experts, etc. The person gains knowledge in areas that he was previously ignorant of, thanks to the learning. Not only do humans have the capacity for learning, but some animals and artificially intelligent machines also do.

Problem solving is the process of determining the issue's root cause and looking for potential solutions. This is accomplished by first understanding the issue, making a decision, and then researching several potential solutions before choosing the best one. The best solution should be chosen among those that are offered in order to solve the problem effectively and quickly.

Perception: It is the process of gathering, deducing, selecting, and systematizing the pertinent facts from the unfiltered input. Human perception is influenced by past experiences, sensory organs, and contextual factors in the surrounding environment. However, in terms of artificial intelligence perception, it is logically obtained by the artificial sensor mechanism in conjunction with the data.

Linguistic Intelligence: It is the phenomenon of a person's ability to use, comprehend, read, and write verbal information in several languages. It is a fundamental part of every communication between two or more people and is required for both logical and analytical understanding.

Figure 1

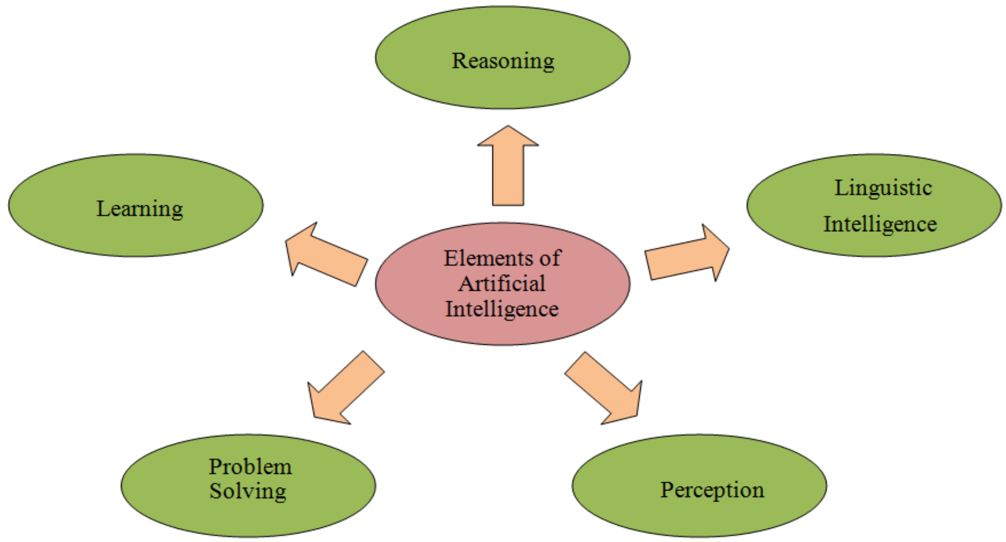

Figure 1 Elements of Artificial Intelligence

2. SUBFIELDS OF ARTIFICIAL INTELLIGENCE

Many innovative computational intelligence algorithms have been created throughout the AI development phase, including the Artificial Neural Network (ANN), Fuzzy Logic (FL), and Support Vector Machine (SVM) Mohan et al. (2010). The classification of frequently used AIs is shown in Figure 2. Prediction, optimization, and diagnosis are the key three application areas for AI in Power Electronics and Power system. Numerous evolutionary and population-based optimization techniques, including the genetic algorithm (GA), the particle swarm algorithm (PSO), and others, have also been developed Chitrakala et al. (2017) As a result, it has become more common to combine intelligent algorithms with optimization algorithms.

Figure 2

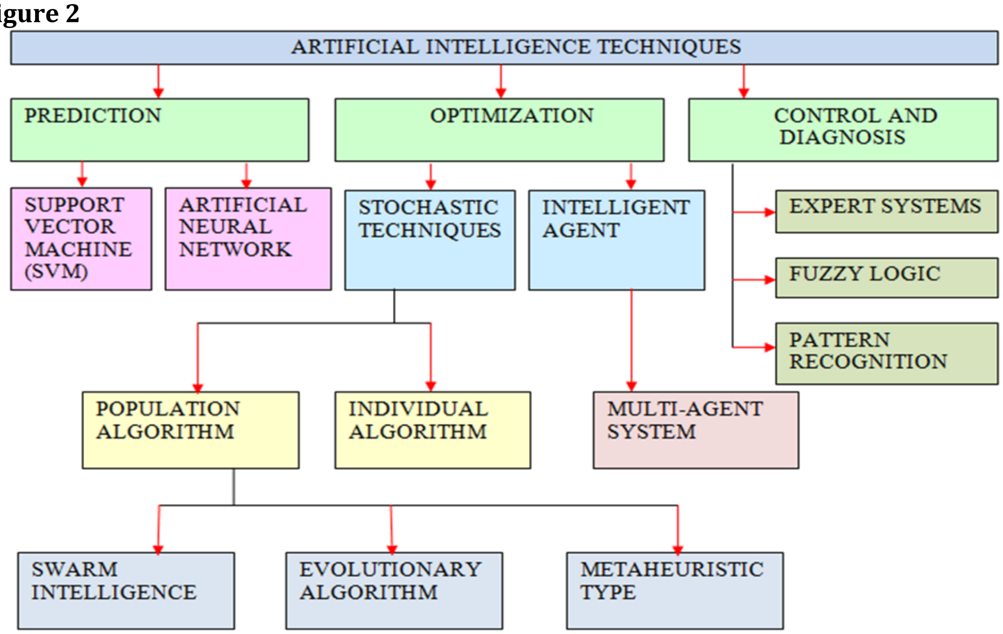

Figure 2 Classification of Frequently used AI

2.1. SUPPORT VECTOR MACHINE

One of the most well-liked supervised learning algorithms SVM, is used to solve Classification and Regression problems. However, it is largely employed in Machine Learning Classification issues Krithiga and Mohan (2022). In order to make it simple to place new data points in the appropriate category in the future, the goal of the VM algorithm is to construct the best line or decision boundary that can divide n-dimensional space into classes. A hyperplane is the name given to this optimal decision boundary. SVM selects the extreme vectors and points that aid in the creation of the hyperplane Mohan et al. (2017). Support vectors, which are used to represent these extreme instances, form the basis for the SVM method.

2.2. ARTIFICIAL NEURAL NETWORK

ANNs are a branch of AI inspired by biology and fashioned after the brain. A computational network based on biological neural networks, which create the structure of the human brain, is typically referred to as an ANN Mohan and Senthilkumar (2022). ANN also feature neurons that are linked to each other in different layers of the networks, just as neurons are in a real brain. Nodes are the name for these neurons. Figure 3 shows the simple ANN model, and Figure 4 shows the classification of ANN.

Figure 3

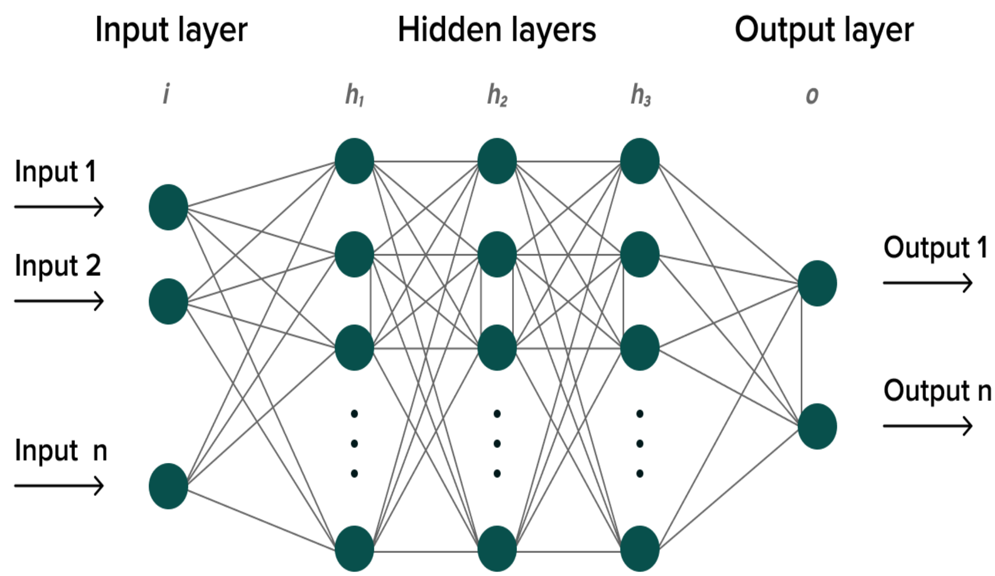

Figure 3 Simple ANN Model

Figure 4

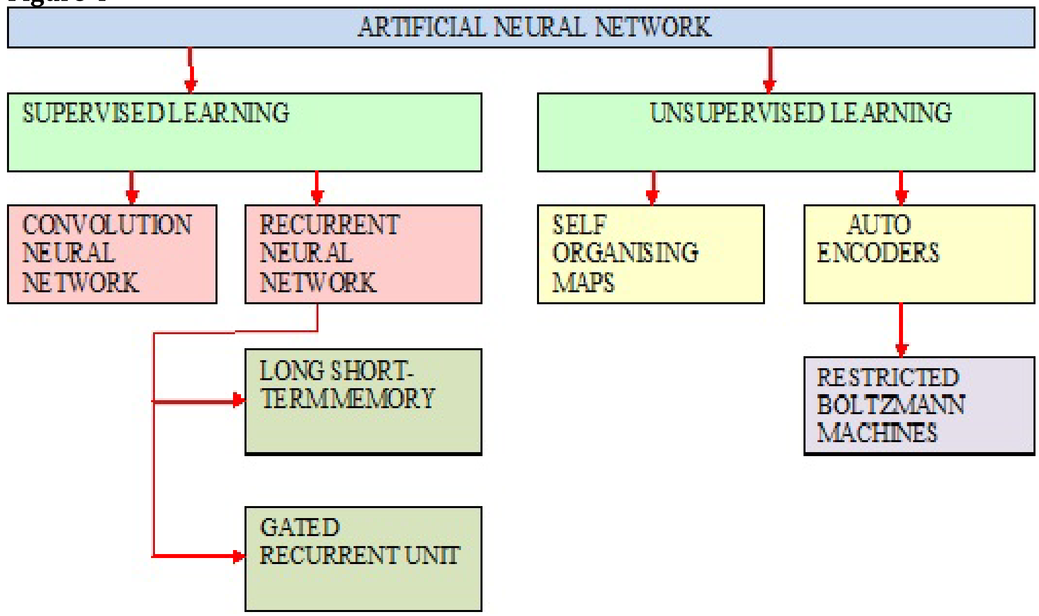

Figure 4 Types of Artificial Neural Network

When learning is being done under supervision, the objective that needs to be predicted is explicitly identified in the training data. A CNN is a multilayer neural network that takes its biological cues from the visual brain of animals. The design is especially beneficial for applications that include image processing Senthilkumar et al. (2022) . Yann LeCun developed the original CNN, whose architecture was centred on reading handwritten characters, such as postal codes. Early layers in a deep network identify features (like edges), while later layers reassemble this information into higher-level input qualities. Figure 5 shows the basic block diagram of CNN.

Figure 5

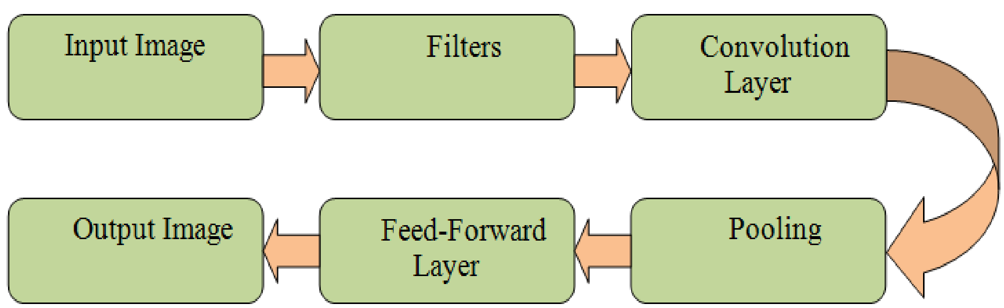

Figure 5 Basic Block Diagram of Convolution Neural Network

One of the basic network architectures on which other deep learning architectures are based is the RNN. A recurrent network may feature connections that feed back into earlier layers in addition to purely feed-forward connections, which is the main distinction between a standard multilayer network and a recurrent network (or into the same layer). RNNs can keep track of previous inputs and model problems over time thanks to this feedback.

Hochreiter and Schimdhuber invented the LSTM in 1997, but it has gained prominence as an RNN architecture for a variety of applications recently. Products that you use every day, like smart phones, contain LSTMs. In order to achieve ground-breaking conversational voice recognition, IBM used LSTMs in IBM Watson. The LSTM introduced the idea of a memory cell in place of standard neuron-based neural network topologies Mohan et al. (2010). The memory cell's ability to keep its value for a limited or unlimited period of time depending on its inputs enables it to recall essential information rather than just its most recent calculated value.

The gated recurrent unit, a simplified version of the LSTM, was introduced in 2014. The output gate from the LSTM model is replaced with two gates in this model. These are a reset gate and an update version of the LSTM, was introduced in 2014. The output gate from the LSTM model is replaced with two gates in this model. These are a reset gate and an update gate. How much of the previous cell's contents should be preserved is indicated by the update gate. The reset gate specifies how to combine new input with the contents of the preceding cell. Simply by changing the reset gate to 1 and the update gate to 0, a GRU may represent a typical RNN Mohan et al. (2015). The GRU is easier to understand, can be trained more rapidly, and has the potential to be more effective when used. With more data, the LSTM can be more expressive and produce better outcomes.

Dr. Teuvo Kohonen created the self-organised map (SOM), also referred to as the Kohonen map, in 1982. SOM is an unsupervised neural network that divides the input data set into smaller groups by lowering the input's dimensionality. SOMs differ significantly from the conventional ANN in a number of ways. Although it is unclear when auto encoders were created, LeCun discovered their first known application in 1987. Three layers make up this particular ANN variant: input, hidden, and output layers.

2.3. STOCHASTIC TECHNIQUES

Numerous machine learning methods exhibit stochastic behaviour and performance. Stochastic refers to a changeable process where the result contains some element of uncertainty and randomness. It is a mathematical phrase that is connected to "randomness" "probabilistic" and can be used to contrast with "deterministic" thinking Krithiga et al. (2023). To properly analyse the behaviour of various prediction models, it is necessary to comprehend the stochastic character of machine learning algorithms, which is a crucial machine learning core idea.

An algorithm that keeps track of all potential options, each one corresponding to a specific location in the problem's search space, is called the population algorithm. Examples of population algorithms are the Intelligent Water Drops Algorithm and the Artificial Immune System Algorithm.

2.4. EXPERT SYSTEMS

Computer scientist Edward Feigenbaum, a professor of computer science at Stanford University and the creator of Stanford's Knowledge Systems Laboratory, invented the idea of expert systems in the 1970s. Computer software known as an expert system uses AI techniques to mimic the decision-making and actions of a person or group of people who have knowledge and experience in a certain field Senthilkumar et al. (2023). Expert systems are often designed to support human experts rather than replace them. Figure 6 shows the architecture of an expert system.

Figure 6

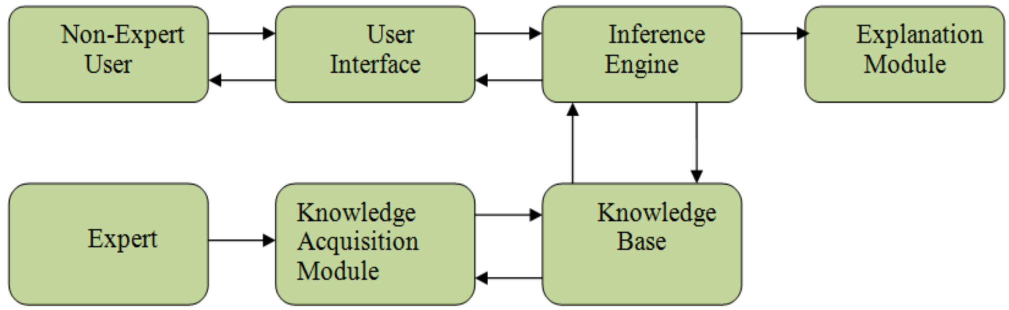

Figure 6 Architecture of an Expert System

2.5. FUZZY LOGIC

A form of thinking that mimics human reasoning is FL Masri et al. (2021). The FL method mimics how humans make decisions by considering all middle-ground options between the digital values YES and NO. A computer can interpret a conventional logic block that receives precise input and outputs TRUE or FALSE, which is similar to a human saying YES or NO. Fuzzy logic's creator, Lotfi Zadeh, noted that, in contrast to computers, human decision-making involves a spectrum of options between YES and NO. Fuzzy logic uses various degrees of input possibilities to produce a clear result. Figure 7 shows the block diagram of Fuzzy System.

Figure 7

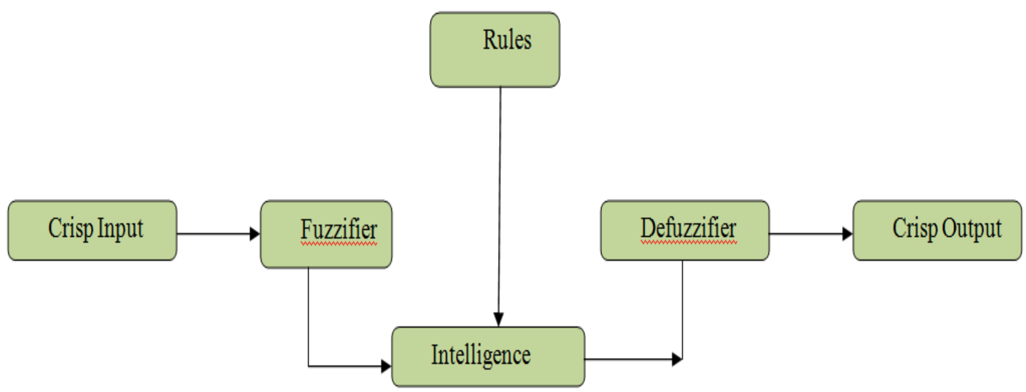

Figure 7 Block Diagram of Fuzzy System

3. APPLICATIONS OF ARTIFICIAL INTELLIGENCE

The world's many industries are changing their tendencies as a result of AI. Numerous uses of AI are changing our lives with the aid of technological breakthroughs. The world is becoming digital as a result of the integration of AI technologies with different applications and hardware Sy et al. (2018). It is capable of handling complicated problems in a variety of fields, including many different industries, including robotics, banking, gaming, chatbots, business, marketing, transportation, healthcare, automotive, and business. The numerous applications of AI are making our daily lives more effective and convenient.

4. FUTURE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE

AI is changing how individuals will act in practically every field. Big data, robotics, and the Internet of Things are currently evolving technologies, and this will continue to be the driving force behind them in the near future. Technology moved to model- and algorithm-based machine learning after such an evolutionary phase that began with "knowledge representation" and lasted over many generations, was marked by periodic inactivity, and became increasingly focused on observation, reasoning, and generalization Alkrimi et al. (2013). In a way that was never before feasible, AI has now seized centre stage, and there are no plans to do so anytime soon.

Predictions can improve the economic efficiency of common users by assisting individuals and organizations in locating pertinent opportunities, products, and services, linking producers and consumers, as AI becomes increasingly practical in lower-data regimes. We anticipate that in the near future, AI systems will take over a lot of boring and potentially hazardous duties *Peter Norvig*. In most situations, it is not the algorithms themselves that are preventing these applications from progressing, but rather the gathering and management of pertinent data and their efficient integration into larger socio-technical systems.

5. CONCLUSION

In the last five years, AI has advanced remarkably and is now having an actual impact on society, institutions, and culture. The key issues that have pushed the area since its inception in the 1950s, the ability of computer systems to do complex language and image processing tasks, have come a long way. Although research and development teams are utilising these developments and implementing them into applications that will benefit society, the level of AI technology is still quite distant from the field's founding aim of replicating fully human-like intelligence in computers.

CONFLICT OF INTERESTS

None.

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