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A review on Artificial Intelligence and its application areas

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ABSTRACT

Artificial intelligence is the intelligence that is created artificially by using computer or a machine so that it helps in solving real world problems like human. Their way of responding and performing is just like humans. This paper gives the review about Artificial Intelligence and its application areas. It gives huge knowledge about how to deal with machines, gadgets, and all real world objects. With the help of Artificial Intelligence, machines will replace the human work and enhance human capabilities in various fields. Artificial intelligence can involve mechanical machines as well as software systems or we can also say expert systems.

Keywords *: AI, Neural Networks, Machine Learning, Vision systems*

INTRODUCTION

Artificial intelligence is a branch of computer science that deals with the ability to learn, understand and think.

Artificial Intelligence is a way of

- To make a computer
- A computer-controlled robot
- A software think intelligently

in the same way as the intelligent humans think.

The intelligence should be exhibited by

- Thinking
- Decision making capabilities
- Problem Solving
- Learning

Artificial Intelligence is concerned with the study and creation of the Computer Systems that can perceive, reason and act and behave in some form of intelligence which are more intelligent than human.Artificial intelligence (AI), also machine intelligence (MI) is an intelligence that is demonstrated by machines.

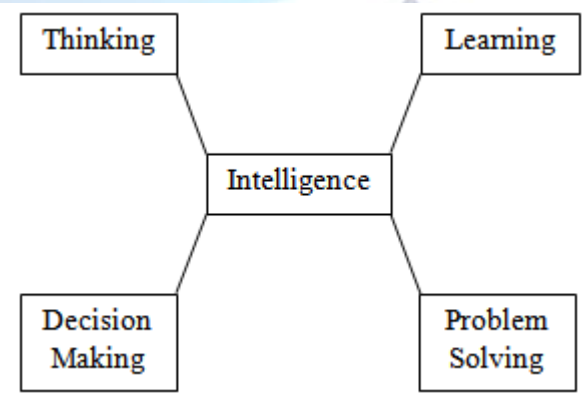

Figure 1.1: Intelligence

CONTRIBUTES TO ARTIFICIAL INTELLIGENCE

Artificial intelligence is an art of science and technology that is based upon various disciplines like Computer Sciences, Biology, Psychology,

Linguistics, Mathematics, Engineering, Natural Language Processing (NLP), and Neural Sciences.

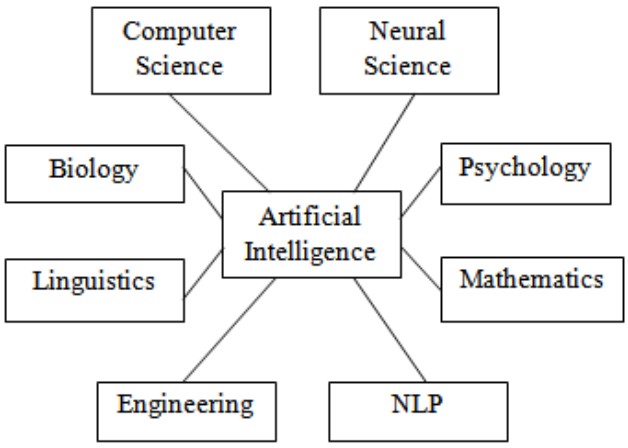

Figure2.1: Contributes to AI

Related Work

The history of Artificial Intelligence is a long time process. Artificial Intelligence is not totally developed right now. Developments in AI systems are rapidly grown day by day. Researchers work for developing new things for making human life easy and work with machines more suitable to human beings.

Here we will discuss the history of AI during 20th century.

Table 3.1: History of Artificial Intelligence

YEAR	INNOVATION / MILESTONE
1923	Firstly use word **Robot** in Universal Robots of Rossum's that was opened in London
1943	Foundations laid for **Neural Networks**.
1945	Columbia University alumni, Isaac Asimov, Introduce the new term as **Robotics**.
1950	**Turing Test** was introduced by Alan Turing for the evaluation of intelligence and for publishing Computing Machinery & Intelligence.
1956	The term **Artificial Intelligence** coined by John McCarthy. At University of Carnegie Mellon, first running AI program was demonstrated.
1958	**LISP,** which is a programming language for AI was invented by John McCarthy.
1964	To understand **Natural Language** for solving algebra word problems was done by Danny Bobrow's dissertation at MIT.
1965	**The ELIZA**- An interactive problem that works on a dialogue in English was built by Joseph Weizenbaum at MIT.
1969	**Shakey**- A robot, having locomotion, perception, and problem solving was developed by Scientists worked at Stanford Research Institute.
1973	**Freddy-** The Famous Scottish Robot, having capability of using vision for locating and assembling models was built by a group Assembly Robotics at Edinburgh University.
1979	**Stanford Cart**- The first computer-controlled autonomous vehicle was built.
1985	**Aaron**- The drawing program created and demonstrated by Harold Cohen
1990	**Advancements** in areas of AI – • Demonstrations in machine learning • Reasoning of Case-based systems • Planning for Multi-agents • Schedule making • Mining of Data • Natural language understanding • Vision systems and concepts of Virtual Reality • In Game playing
1997	The **Deep Blue Chess Program** worn out the world chess champion, Garry Kasparov.
2000	**Kismet-** A Robot having face that expresses emotions displayed by MIT.

Application Areas of Artificial Intelligence

Artificial intelligence is a very broad field that has numerous applications in our day to day life. There are a lot of systems where artificial intelligence plays vital role to make human work easier and smart as well. Here are some applications areas where AI is dominant:

A. Robotics

Robotics is a field of the Artificial Intelligence which deals with the creation of efficient robots that works as like humans can do. It also provides study on it. Robotics is composed of

- **Electrical Engineering** for providing power and control to the machinery.
- **Mechanical Engineering** for providing form, or shape designed for accomplishing a particular task.
- **Computer Science** is used for designing of robots, their construction, and also for providing applications to robots. They also contain some level of computer program that determines what, when and how a robot does something.

Robots behave like artificial systems in real world environment. Main objective behind making robots

is that they are designed for manipulating the objects by

- Feeling or touching
- Separation
- Making them dynamic
- Modifying the physical properties of an object
- Destroying them
- To have an effect for working freely manpower while doing repeated tasks without getting bored, distracted, or exhausted.

Robot Locomotion

Locomotion is a mechanism that is responsible for making a robot capable of moving in its environment. There are various types of locomotion –

- **Legged**: This takes more power while walking, jumping, trotting, hoping, climbing up or down, etc.
- **Wheeled**: It requires a few numbers of motors for accomplishing the movement. It is an easy way to implement because of lesser stability issues having more number of wheels. It is more power efficient than legged locomotion.
- **Combination of Legged and Wheeled Locomotion**
- **Tracked Slip/Skid**: In this, vehicles can use tracks like as in a tank. Then, robot is steered by moving them on tracks having different speeds in same or in an opposite direction. It offers stability because of large contact areas of track and ground.

Application areas of Robotics

- In Industry: for reducing manpower.
- In Military: for working like soldiers.
- In Medical: for surgery.
- In Exploration: by extracting compounds for producing them as rocket ignition.
- In Entertainment: for recreation of entertainment venues.

B. Gaming

Artificial Intelligence in gaming, is used for generating responsive, adaptive or intelligent behaviors mainly in non-player characters (NPCs), that is almost same as human-like intelligence. Gaming in AI refers to a broad set of algorithms that involves techniques from

- Control Theory
- Robotics
- Computer Graphics
- Computer Science

Application areas of Gaming

- In computer simulations of board games to check decision making capability of other player.
- In modern video games to find path of upcoming tracks.

C. Natural-Language Processing

Natural-language processing i.e., NLP is an important field of computer sciences, artificial intelligence is concerned with the interactions between the computers and the human languages, and especially concerned with programming computers to process natural language data.

Challenges involved in Natural-Language Processing are

- Speech Recognition,
- Natural Language Understanding,
- Natural Language Generation.

Some Major Evaluations and Tasks

There is a list of some tasks researched in Natural-language processing:

- **Syntax** involves
  - Lemmatization
  - Morphological segmentation
  - Part-of-speech
  - Parsing
  - Sentence breaking
  - Stemming
  - Word segmentation
  - Terminology extraction
- **Semantics** involves
  - Lexical semantics
  - Machine translation
  - Named entity recognition (NER)
  - Natural language generation
  - Natural language understanding
  - Optical character recognition (OCR)
  - Question answering
  - Recognizing Textual entailment
  - Relationship extraction
  - Sentiment analysis
  - Topic segmentation and recognition
  - Word sense disambiguation
- **Discourse** involves
  - Automatic summarization
  - Co-reference resolution
  - Discourse analysis

- **Speech** involves
  - Speech recognition
  - Speech segmentation
  - Text-to-speech

Application areas of Natural Language Processing

- For machine translation
- For fighting with spam filters
- For information extraction
- For summarization of information

D. Expert Systems

An expert system is basically a computer system which works as the decision-making ability of a human expert. Expert systems are usually designed for solving complex problems by using reasoning through bodies of the knowledge, represented mainly by if–then rules.

An expert system is divided into two subsystems:

- **Knowledge Base**: It can represent the facts/cases and the rules.
- **Inference Engine**: The inference engine applies the rules derived from KB to the known facts to deduct new facts. Inference engine also includes explanation and debugging abilities.
- **User Interface**: A user interface is the method through which the expert systems interact with user.

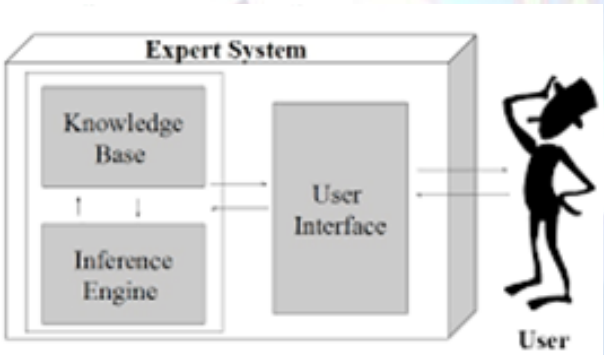

Figure 4.4.1: Components of Expert System

Application areas of Expert Systems

- For designing of equipments
- In medical sciences
- In process control systems
- For detection of frauds
- For finding faults in vehicles

E. Machine Learning

Machine learning provides the ability to computers to learn new things without actually program them. Machine learning examines the study and the construction of algorithms that can learn values from given data and can make predictions on data that is provided to them. Machine learning tasks are generally classified into two categories:

- **Supervised Learning:** A system is presented with an example having some input values and its desired output values, provided by "tutor", and main idea behind this is to understand a general rule that matches the provided inputs to desired outputs. In some special cases, input can be partially available, or it can be restricted to some feedback.
- **Unsupervised Learning:** A system is presented with an example having only input values and no knowledge about its output. There is no pattern to be provided. User is independent to solve the problem and can provide output on that basis and having no restrictions regarding to the pattern.
- **Reinforcement Learning:** In this type user does not knows the exact output, but it can receive feedback according to its pattern.

Application areas of Machine Learning

- For traffic predictions
- For video surveillance
- For providing services to social media
- For face recognition
- For malware detection

F. Probabilistic Reasoning

Probabilistic Reasoning is a way to merge the capability of probability theory for handling ambiguity with the capability of deducted logics to specify the construction of formal argument. It is appropriate for complex and uncertain environments.

Probability Axioms (Kolmogorov's Axioms)

Various useful facts can be derived by using following three axioms:

1. $0 \le P(A) \le 1$
2. $P(true) = 1$, $P(false) = 0$
3. $P(A \vee B) = P(A) + P(B) - P(A \wedge B)$

Application areas of Probabilistic Reasoning

- *In Argumentation theory*
- *In Artificial intelligence*
- *In Bioinformatics*
- *Game theory*
- *Philosophy of science*
- Psychology

G. Vision Systems

This is a discipline of AI through which the robots can see or visualize the things. The vision system plays an important role in the areas of

- Providing safety
- For security purpose
- In health issues
- Providing access to systems
- In the field of entertainment

Vision System by its own nature can extract, analyze, and appreciates necessary and appropriate information from one image or from a set of images. This process includes developing algorithms for accomplishment of automatic visual comprehension.

Hardware of Vision System

It contains –

- Power System
- Image accession device such as camera
- A processing element
- A software product
- A device that displays monitoring of system
- Accessories like stands for camera, cords, and joins.

Tasks of Vision Systems

OCR – In computer systems, OCR i.e., Optical Character Reader is a software which is used for converting scanned documents into formatted text, which take out a scanner.

Detection of face – Many cameras having the feature for enabling to read face and then it will take the picture of that expression. By using it user can access the software on correct match.

Recognition of objects – It is used in malls, video cameras, markets, mobile cameras, high-range cars like BMW, GM, and Volvo.

Estimation of Position – It is for estimating the position of an object respectively to the camera.

Application areas of Vision Systems

- In Agricultural field
- In vehicles
- For biometrics
- For character recognitio
- In forensic
- For industrial quality inspectio
- For face recognitio
- For analyzing gesture
- In process contro
- In remote sensin
- In transport

H. Neural Networks

Neural network is composed of a model that processes information which is inspired similar to the way as human brain processes information. It works similar to the biological neuron.

Basic Models of Neural Network

- Synaptic interconnections include various types of connections like single layer network, multi layer network, single layer feed forward network, multi layer feed forward network, and recurrent network.
- Learning rules involves supervised learning, unsupervised learning, and reinforcement learning.
- Activation Functions have linear activation function, binary activation function, sigmoidal activation function, and ramp function.

Tasks performed by Neural Networks

Pattern classification and matching, Optimization Functions, Data Clustering, and Vector Quantization

Application areas of Neural Network

- Predicting animal behavior
- Air traffic control
- Criminal Sentencing
- Fraud Detection
- Voice Recognition
- Music Composition

I. Fuzzy Logic Systems

Fuzzy logic is a form of artificial intelligence, so it would be considered as a subset of AI. Fuzzy logic (FL) is a reasoning method which is similar to reasoning power of humans. The ordinary logic block which computer can understand and can take précised input for producing a yield as TRUE or FALSE, that resembles to YES or NO and 0 or 1. Fuzzy logics system is made up of four **components/ modules**:

- **Fuzzification**: It converts system input (crisp values) into fuzzy sets.
- **Knowledge Base(KB)**: It contains IF-THEN rule set.
- **Inference engine**: It works similar to human reasoning power by making fuzzy inferences on the basis of given input and IF-THEN rule sets.
- **Defuzzification**: Fuzzy set obtained from inference engine is converted into crisp values.

Application areas of Fuzzy Logic Systems

- In Automotive Systems
- In Electronic Goods
- In Domestic Goods
- In Environmental control equipments

J. Handwriting Recognition

It is the possession of a system for receiving and interpreting handwritten inputs from sources like documents, images, and various other devices. It is of two types:

- **Offline Recognition**: It automatically converts text written on an image into letter codes. The data obtained from it is termed as static representation of handwriting.
- **Online Recognition**: It generally converts the text which has been written in digitizers or in PDAs, by using sensor, it picks up the pen tip movements. This type of data is termed as digital representation of handwriting.

Application areas of Handwriting Recognition

- To detect criminals
- For pattern matching

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