# KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

TIRUCHENGODE -637 215.

## DEPARTMENT OF INFORMATION TECHNOLOGY

VOLUME 9
ISSUE 1 AUGUST 2022

# DIGITIMES

## ARTIFICIAL INTELLIGENCE

## KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

**Vision**

To become a globally recognized Institution in Engineering Education, Research and Entrepreneurship.

**Mission**

| | |
|---|---|
| **M1** | Accomplish quality education through improved teaching learning process |
| **M2** | Enrich technical skills with state of the art laboratories and facilities |
| **M3** | Enhance research and entrepreneurship activities to meet the industrial and societal needs |

## DEPARTMENT OF INFORMATION TECHNOLOGY

**Vision**

To produce competent Information Technology Professionals and Entrepreneurs with ethical values to meet the global challenges.

**Mission**

| | |
|---|---|
| **MD1** | Impart quality education with ethical values in Information Technology through improved teaching learning process |
| **MD2** | Provide an ambient learning environment using state of the art laboratories and facilities |
| **MD3** | Encourage research and entrepreneurship activities to meet the dynamic needs of Information Technology industry and society |

**Program Educational Objectives (PEOs)**

| PEO | Key Words | Description |
|---|---|---|
| **PEO 1** | **Core Competency** | Graduates will be successful professionals in career by applying the knowledge of mathematics, science and engineering with appropriate techniques and modern tools. |
| **PEO 2** | **Professionalism** | Graduate will exhibit soft skills, professional and ethical values and thrust for continuous learning to maintain professionalism in the IT industries. |
| **PEO 3** | **Higher Studies and Entrepreneurship** | Graduates will engage in higher studies and outshine as entrepreneurs through life-long learning which leads to societal benefits. |

# DIGITIMES

# *Editorial*

We would like to wholeheartedly thank our honorable Chairman, **Lion.Dr.K.S.Rangasamy** and vice chairman **Mr.R.Srinivasan**, and Principal **Dr.M.Venkatesan** and Director Academics **Dr.P.MeenakshiDevi** for their continuous encouragement and constant support for bringing out the magazine. We profoundly thank our Head of the Department **Dr. L. Selvam** for encouraging and motivating us to lead the magazine a successful one right from the beginning. **DIGITIMES** serves as a platform for updating and enhancing upcoming technologies in Information Technology. We are also grateful to all the contributors and faculty coordinator to bring this magazine.

**By,**

**Editorial Board**

# CONTENTS


| S. No. | Topics | Page No. |
|---|---|---|
| 1. | Introduction of Artificial Intelligence | 4 |
| 2. | Why Artificial Intelligence? | 5 |
| 3. | Machine learning Traditional AI | 6 |
| 4. | What is Artificial Intelligence | 7 |
| 5. | Categories of Artificial Intelligence | 9 |
| 6. | Reactive type | 10 |
| 7. | Limited memory | 15 |
| 8. | Artificial Neural Networks | 19 |
| 9. | Theory of mind | 21 |
| 10. | Skill for Artificial Intelligence | 28 |
| 11. | Implementing Artificial Intelligence | 30 |
| 12. | Artificial Intelligence Conclusion | 33 |

# ARTIFICIAL INTELLIGENCE

In today's world, technology is growing very fast, and we are getting in touch with different new technologies day by day. Here, one of the booming technologies of computer science is Artificial Intelligence which is ready to create a new revolution in the world by making intelligent machines. The Artificial Intelligence is now all around us. It is currently working with a variety of subfields, ranging from general to specific, such as self-driving cars, playing chess, proving theorems, playing music, Painting.


**By,**

**ASHOK R, III/IT**

# WHY ARTIFICIAL INTELLIGENCE?

Artificial Intelligence (AI) is a rapidly growing field that has the potential to revolutionize many aspects of our lives. By enabling machines to perform tasks that would typically require human intelligence, AI can increase efficiency, accuracy, and innovation in a variety of industries. AI is also improving the quality of life by making our homes and cities smarter, enhancing healthcare, and improving transportation systems. Additionally, AI can have a positive impact on the environment by monitoring and reducing energy usage, waste, and improving resource efficiency. As AI technology continues to advance, it will likely bring significant benefits to society and play a critical role in shaping the future of our world.

**By,**

**DIVYASHRUTHI S, III/IT**

# TRADITIONAL AI

## Statistical Techniques

The development of today's AI applications started with using the age-old traditional statistical techniques. we must have used straight-line interpolation in schools to predict a future value. There are several other such statistical techniques which are successfully applied in developing so-called AI programs. We say "so-called" because the AI programs that we have today are much more complex and use techniques far beyond the statistical techniques used by the early AI programs.

Some of the examples of statistical techniques that are used for developing AI applications in those days and are still in practice are listed here:

- Regression
- Classification
- Clustering
- Probability Theories
- Decision Trees

**By,**

**JAMES SALOMAN J**

**III/IT**

# WHAT IS ARTIFICIAL INTELLIGENCE

AI has rapidly evolved over the last few decades, driven by advances in computing power, data storage, and machine learning algorithms.

Machine learning is a key component of AI, enabling machines to learn from data and improve their performance over time without being explicitly programmed. Deep learning, a subset of machine learning, uses artificial neural networks to simulate the way the human brain works, allowing machines to recognize patterns and make decisions based on vast amounts of data.

Natural language processing (NLP) is another important component of AI, enabling machines to understand and interpret human language. NLP is used in a wide range of applications, from virtual assistants like Siri and Alexa to chatbots and language translation services. Computer vision, another area of AI, enables machines to interpret and analyze visual data, such as images and videos. Computer vision is used in many applications, such as facial recognition, object detection, and autonomous driving.

AI has the potential to transform many industries and aspects of our lives, from healthcare and transportation to education and entertainment. It can enable us to automate tedious and repetitive tasks, analyze vast amounts of data with great accuracy and speed, and make more informed decisions. As AI continues to advance, it will likely bring significant benefits to society, but it also raises important ethical and societal questions that we must address as we develop and deploy this technology.

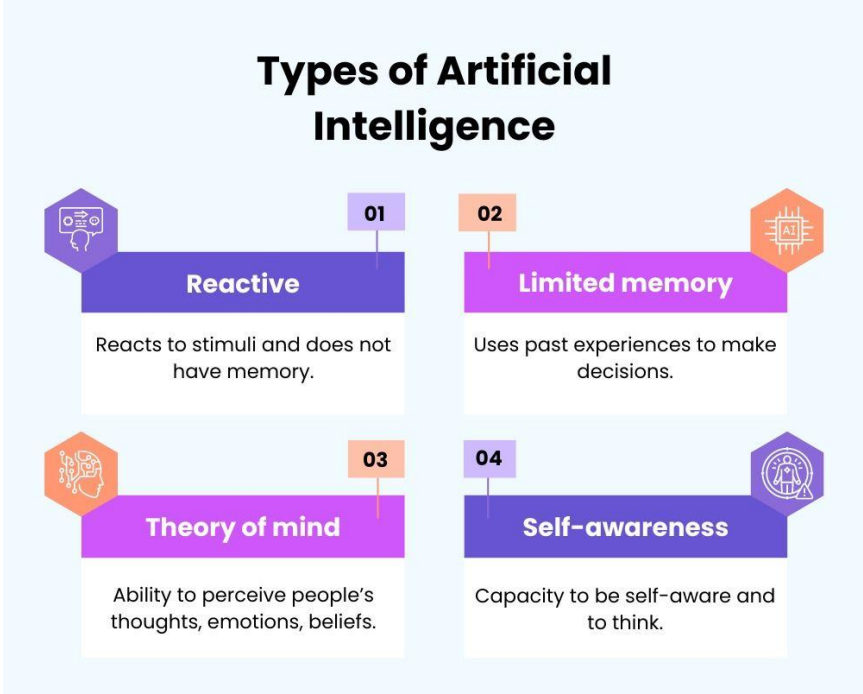

**By,**

**MANOJ KUMAR E**

**III/IT**

# CATEGORIES OF ARTIFICIAL INTELLIGENCE

It is broadly categorized under the following headings:




Initially, researchers started out with Supervised Learning. This is the case of prediction technique discussed earlier. Basically AI is broadly classifies into 4 types which is presented above.

**By,**

**KABISH S, III/IT**

# REACTIVE TYPE

Reactive type is a category of Artificial Intelligence (AI) that refers to systems that can only react to specific situations based on pre-defined rules. Reactive machines do not have the ability to learn from experience or make decisions based on past data. Instead, they rely on a set of if-then statements or rules to determine their response to a specific input.

Reactive AI is typically used in tasks that require quick, decisive action, such as playing games or controlling robots. One example of a reactive AI system is Deep Blue, the computer that defeated world chess champion Garry Kasparov in 1997. Deep Blue relied on a set of rules programmed by chess experts to determine its moves and did not learn from its past experiences playing chess. Reactive AI is limited in its ability to handle complex situations and is unable to learn from experience. It can only respond to inputs based on its pre-defined rules, which can result in unpredictable behavior in some situations.

However, reactive AI systems are highly specialized and can be very effective in tasks that require quick, decisive action. For example, autonomous vehicles use reactive AI systems to make real-time decisions about steering, braking, and accelerating based on sensor inputs from their environment.

# Classification

Classification is a fundamental task in Artificial Intelligence (AI) that involves categorizing data into different classes or groups based on its features. Classification is used in a wide range of applications, such as image recognition, natural language processing, and spam filtering.

Rule-Based Classification: Rule-based classification involves defining a set of rules to determine the class of a given input.

Instance-Based Classification: Instance-based classification involves comparing new inputs to a set of existing examples to determine the class.

Decision Tree Classification: Decision tree classification involves creating a tree-like structure to represent the classification rules. Each node of the tree represents a feature, and the branches represent the possible outcomes based on that feature.

Neural Network Classification: Neural network classification involves using artificial neural networks to learn from data and make predictions. This approach is commonly used in image recognition and natural language processing and has shown great promise in many other applications.

Overall, classification is an essential task in AI that enables machines to recognize patterns and make predictions based on data. The choice of classification approach depends on the specific problem at hand and the available data.

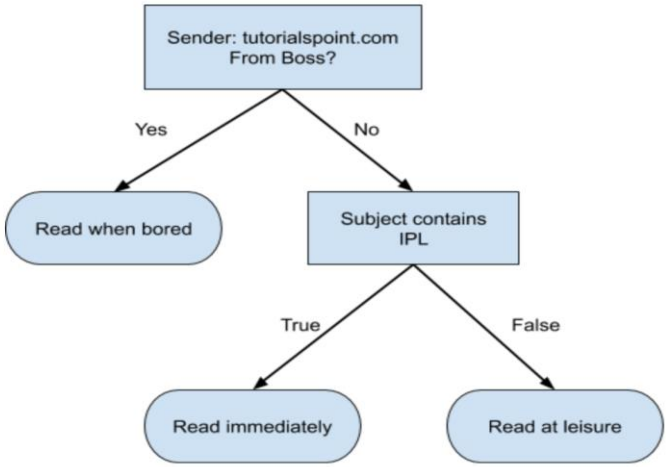
## Algorithms for Reactive Type :

The algorithms used in Reactive AI are typically focused on quickly analyzing real-time data and responding with an appropriate action. Some of the algorithms commonly used in Reactive AI include:

- Decision Trees
- Random Forests
- Support Vector Machines (SVMs)
- Reinforcement Learning
- Genetic Algorithms
- Naive Bayes

## Decision Trees:

A simple decision tree in a flowchart format is shown below:



You would write a code to classify your input data based on this flowchart. The flowchart is self-explanatory and trivial. In this scenario, you are trying to classify an incoming email to decide when to read it.

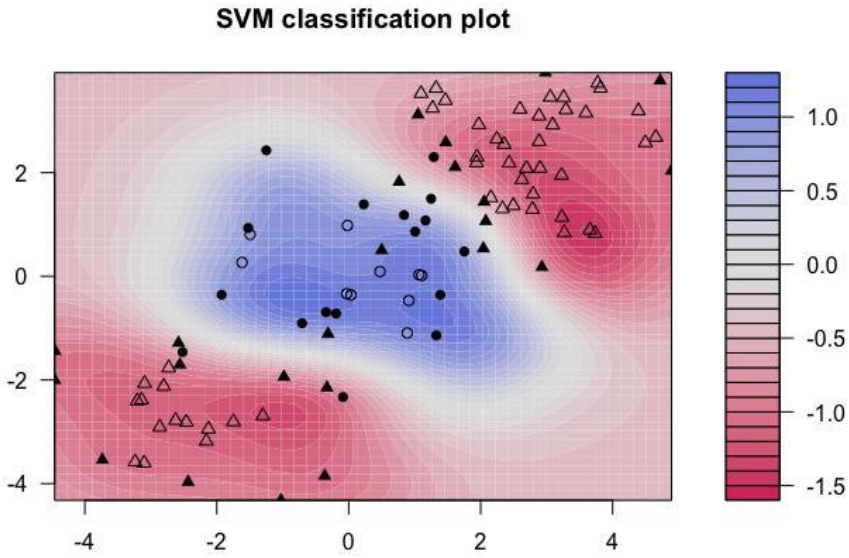
In reality, the decision trees can be large and complex. There are several algorithms available to create and traverse these trees. As a Machine Learning enthusiast, you need to understand and master these techniques of creating and traversing decision trees.

## Naive Bayes

Naive Bayes is used for creating classifiers. Suppose you want to sort out (classify) fruits of different kinds from a fruit basket. You may use features such as color, size and shape of a fruit, For example, any fruit that is red in color, is round in shape and is about 10 cm in diameter may be considered as Apple. So to train the model, you would use these features and test the probability that a given feature matches the desired constraints. The probabilities of different features are then combined to arrive at a probability that a given fruit is an Apple. Naive Bayes generally requires a small number of training data for classification.

# Support Vector Machines

Look at the following distribution of data. Here the three classes of data cannot be linearly separated. The boundary curves are non-linear. In such a case, finding the equation of the curve becomes a complex job.




The Support Vector Machines (SVM) comes handy in determining the separation boundaries in such situations.

**By,**

**KEERDHANA K, III/IT**

# LIMITED MEMORY

Limited memory in AI refers to a situation where an AI system has a finite amount of memory available for storing data and performing computations. This can create challenges for AI systems that need to process large amounts of data, as they may not be able to hold all the data in memory at once.

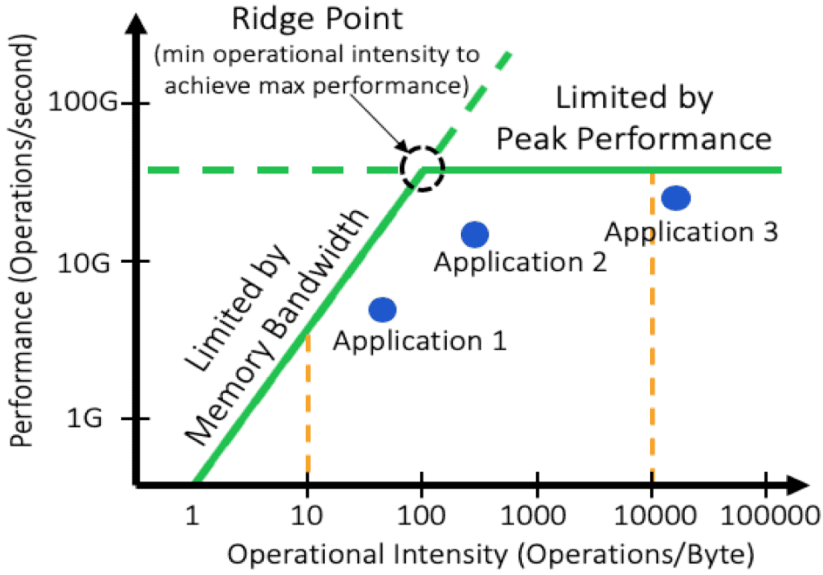
**Sampling**: Sampling involves selecting a smaller subset of the data to work with, rather than trying to process the entire dataset at once.

**Incremental learning**: Incremental learning involves processing the data in small batches, rather than trying to process the entire dataset at once.

**Compression**: Compression involves reducing the size of the data by removing redundancies or encoding it in a more compact form.

**Approximation**: Approximation involves using simplified models or approximations of the data, rather than working with the full dataset. This can be particularly effective for tasks where the data is noisy or has a large amount of variability.

**Hierarchical processing**: Hierarchical processing involves breaking down the data into smaller, more manageable chunks and processing them independently. This can help to reduce the memory requirements of the system and make it more scalable.




The Limited memory has shown a great success in many modern AI applications, such as face detection, object detection, and so on.

## Algorithms for Limited Memory

Let us now discuss one of the widely used algorithms for classification in Limited memory in AI.

## Stochastic Gradient Descent (SGD)

Stochastic gradient descent is an optimization algorithm often used in machine learning applications to find the model parameters that correspond to the best fit between predicted and actual outputs. It's an inexact but powerful technique.

Stochastic gradient descent is widely used in machine learning applications. Combined with backpropagation, it's dominant in neural network training applications.

## Cost Function: The Goal of Optimization

The cost function, or loss function, is the function to be minimized (or maximized) by varying the decision variables. Many machine learning methods solve optimization problems under the surface. They tend to minimize the difference between actual and predicted outputs by adjusting the model parameters (like weights and biases for neural networks, decision rules for random forest or gradient boosting, and so on).

In a regression problem, you typically have the vectors of input variables $\mathbf{x} = (x_1, \ldots, x_r)$ and the actual outputs $y$. You want to find a model that maps $\mathbf{x}$ to a predicted response $f(\mathbf{x})$ so that $f(\mathbf{x})$ is as close as possible to $y$. For example, you might want to predict an output such as a person's salary given inputs like the person's number of years at the company or level of education.

Your goal is to minimize the difference between the prediction $f(\mathbf{x})$ and the actual data $y$. This difference is called the residual. In this type of problem, you want to minimize the sum of squared residuals (SSR), where $\text{SSR} = \Sigma_i(y_i - f(\mathbf{x}_i))^2$ for all observations $i = 1, \ldots, n$, where $n$ is the total number of observations. Alternatively, you could use the mean squared error ($\text{MSE} = \text{SSR} / n$) instead of SSR.

# Gradient of a Function: Calculus Refresher

In calculus, the derivative of a function shows you how much a value changes when you modify its argument (or arguments). Derivatives are important for optimization because the zero derivatives might indicate a minimum, maximum, or saddle point.

The gradient of a function $C$ of several independent variables $v_1, \ldots, v_r$ is denoted with $\nabla C(v_1, \ldots, v_r)$ and defined as the vector function of the partial derivatives of $C$ with respect to each independent variable.

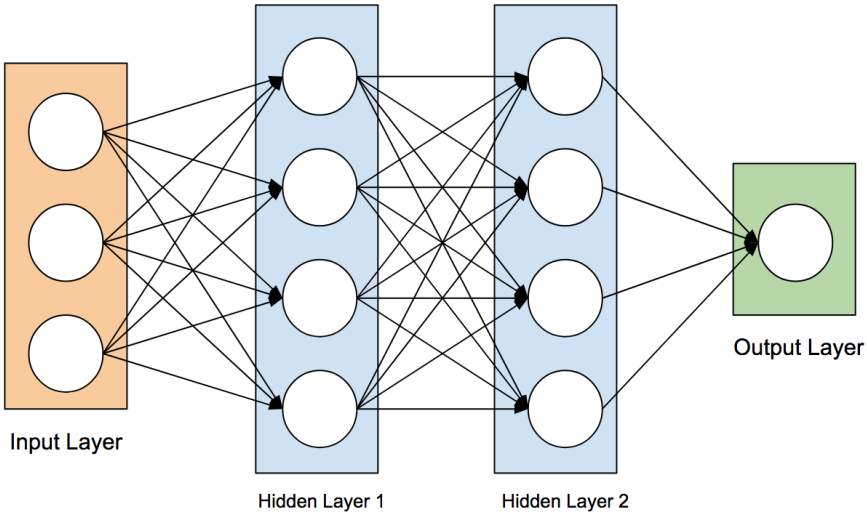
$\nabla C = (\partial C/\partial v_1, \ldots, \partial C/v_r)$. The symbol $\nabla$ is called nabla.

**By,**

**HARISH S, III/IT**

# ARTIFICIAL NEURAL NETWORK

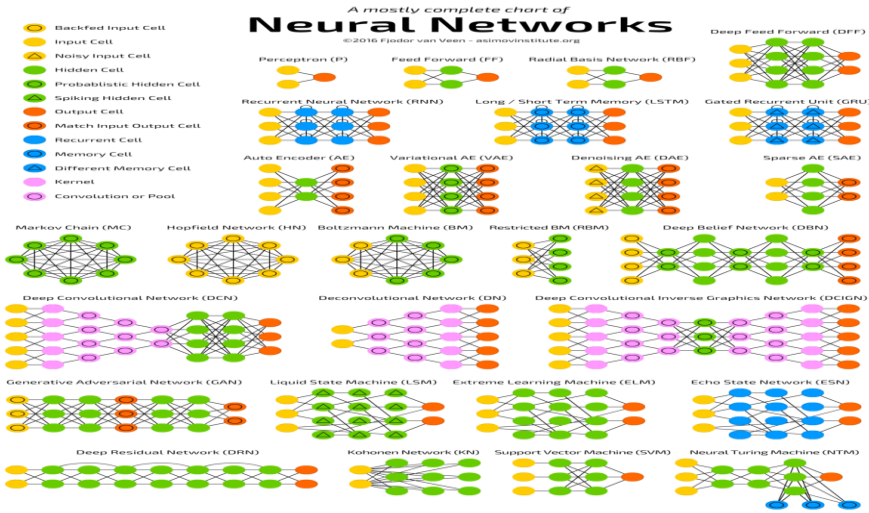
The idea of artificial neural networks was derived from the neural networks in the human brain. The human brain is really complex. Carefully studying the brain, the scientists and engineers came up with an architecture that could fit in our digital world of binary computers. One such typical architecture is shown in the diagram below:




There is an input layer which has many sensors to collect data from the outside world. On the right hand side, we have an output layer that gives us the result predicted by the network.

# ANN Architecture

The diagram below shows several ANN architectures developed over a period of time and are in practice today.




Each architecture is developed for a specific type of application. Thus, when you use a neural network for your machine learning application, you will have to use either one of the existing architecture or design your own. The type of application that you finally decide upon depends on your application needs.

**By,**

**DILIPKUMAR S, III/IT**

# THEORY OF MIND

Theory of Mind AI is still under research and development, we already know what will differentiate it from the other branches of AI we have seen. A computer equipped with Theory of Mind AI will better understand the entities it interacts with.

To do this, it will need to discern the needs, emotions, beliefs, and thinking of the aforementioned individual. This isn't easy since computers will need to understand that human beings have a mind, which might have been conditioned by several factors.

## Applications

The Theory of Mind (ToM) is a cognitive ability that allows individuals to understand and attribute mental states to themselves and others. Here are some applications of the Theory of Mind:

1. Psychology: ToM is used in psychology to understand and treat conditions such as autism, schizophrenia, and other mental health disorders that affect an individual's ability to understand and interpret social cues and mental states.

2. Education: ToM is used in education to develop strategies that promote social and emotional learning in children. For example, teaching children how to recognize and interpret the mental states of others can help them develop empathy and social skills.
3. Human-Robot Interaction: ToM is used in human-robot interaction to create more natural and intuitive interfaces between humans and robots. By giving robots the ability to recognize and respond to human mental states, we can create robots that are more effective and efficient at performing tasks.
4. Artificial Intelligence: ToM is used in artificial intelligence to create intelligent systems that can understand and respond to human mental states. For example, natural language processing algorithms that can recognize and interpret sarcasm, irony, and other mental states can improve the accuracy and effectiveness of virtual assistants and chatbots.
5. Marketing: ToM is used in marketing to create more personalized and engaging experiences for customers. By understanding the mental states of customers, marketers can create targeted campaigns and messaging that resonate with their audience and drive sales.

# Characteristics Theory of Mind AI

Since Theory of Mind AI is still under research & development, its characteristics will likely evolve. However, based on the available information at the time of writing, we can anticipate that it will have the following characteristics:

- Computers equipped with Theory of Mind AI will infer the objectives of entities around them from visible cues.
- A system powered by Theory of Mind AI will answer simple "what if" questions about potential actions that entities around them might undertake.
- Theory of Mind AI-powered systems will be able to simulate the consequences of their actions.
- A robot or a system powered by Theory of Mind AI will be more communicative with human beings. E.g., such robots/systems will be able to explain their actions, and this is different from the current generation of AI.
- Theory of Mind AI will consist of ML systems that can explain their decisions in languages that human beings understand.
- A robot/system equipped by Theory of Mind AI should be able to understand the intent of another similar robot/system.

.

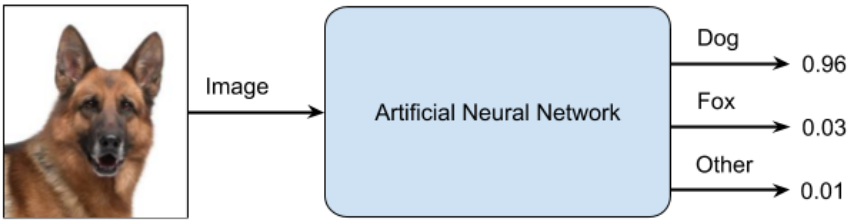
## Theory of mind - Disadvantages

While the Theory of Mind (ToM) has many benefits and applications, there are also some disadvantages and limitations to consider. Here are some of them:

- Developmental Differences.
- Measurement Challenges
- Limitations in Autism Research

## Black Box approach

An ANN is like a blackbox. You give it a certain input and it will provide you a specific output. The following diagram shows you one such application where you feed an animal image to a neural network and it tells you that the image is of a dog.




Why this is called a black-box approach is that you do not know why the network came up with a certain result. You do not know how the network concluded that it is a dog? Now consider a banking application where the

bank wants to decide the creditworthiness of a client. The network will definitely provide you an answer to this question. However, will you be able to justify it to a client? Banks need to explain it to their customers why the loan is not sanctioned?

## Future of theory of Mind

The process of training a neural network is depicted in the diagram below:

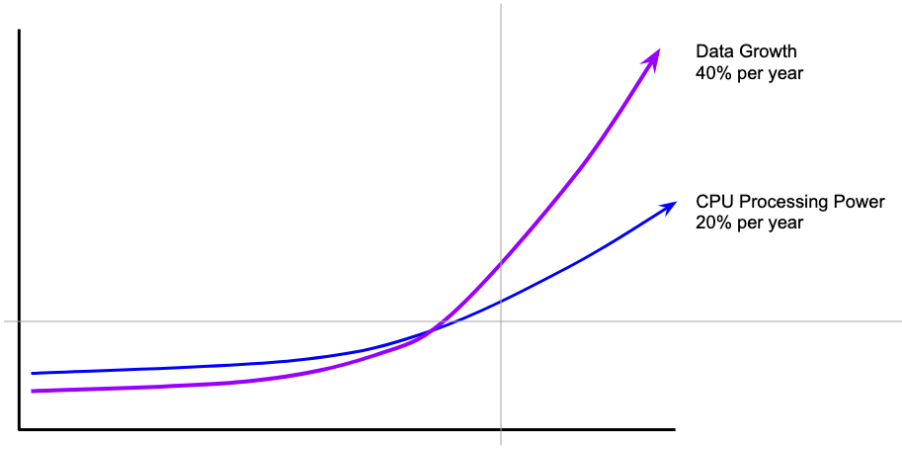

Given that research and development on Theory of Mind AI are still ongoing, it's hard to predict how this branch of AI will fare. However, if the Theory of Mind AI matures, then it will create the following:

- Machines that think;
- Machines that experience emotion;
- Conscious machines.

Such innovations can have a large impact beyond the value that AI currently offers. E.g., robots can be responsive and understanding co-workers of human beings in the workplace.

## Amount of Data

The deep learning networks usually require a huge amount of data for training, while the traditional machine learning algorithms can be used with a great success even with just a few thousands of data points. Fortunately, the data abundance is growing at 40% per year and CPU processing power is growing at 20% per year as seen in the diagram given below:



## Computationally Expensive

Training a neural network requires several times more computational power than the one required in running traditional algorithms. Successful training of deep Neural Networks may require several weeks of training time.

In contrast to this, traditional Artificial Intelligence algorithms take only a few minutes/hours to train. Also, the amount of computational power needed for training deep neural network heavily depends on the size of your data and how deep and complex the network is?

After having an overview of what Artificial Intelligence is, its capabilities, limitations, and applications, let us now dive into learning "Artificial Intelligence".

**By,**

**NIVETHA V, IV/IT**

# SKILLS FOR ARTIFICIAL INTELLIGENCE

Artificial Intelligence has a very large width and requires skills across several domains. The skills that you need to acquire for becoming an expert in Artificial Intelligence are listed below:

- Mathematics and Statistics
- Programming
- Data Analysis
- Problem Solving
- Domain Expertise

## Necessity of Various Skills of Artificial Intelligence:

### Mathematical Notation

Artificial Intelligence (AI) is a field that heavily relies on mathematical notation to represent concepts and algorithms. Here are some examples of mathematical notation used in AI:

**Linear Algebra Notation:** Linear algebra notation is commonly used in AI for representing matrices and vectors, which are the building blocks of many machine learning algorithms

**Calculus Notation**: Calculus notation is used in AI for representing optimization problems and gradient-based algorithms.

## Optimization Problem

Here is an optimization function

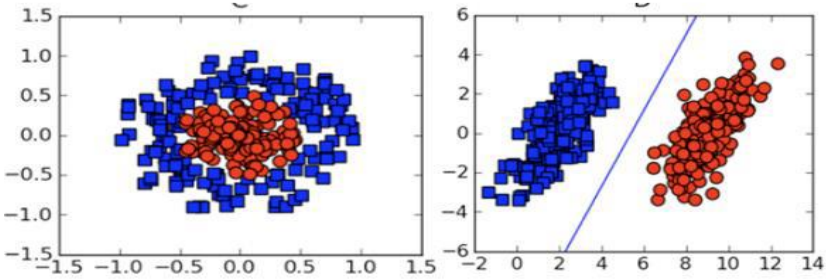
$$\max_{\alpha}\left[\sum_{i=1}^{m}\alpha-\frac{1}{2}\sum_{i,j=1}^{m}label^{(i)}\cdot label^{(j)}\cdot a_i\cdot a_j\langle x^{(i)},x^{(j)}\rangle\right]$$

Subject to the following constraints:

$$\alpha\geq 0, and \sum_{i-1}^{m}\alpha_i\cdot label^{(i)}=0$$

## Visualization

In many cases, you will need to understand the various types of visualization plots to understand your data distribution and interpret the results of the algorithm's output.




**By,**

**MUKESH KANNA R, IV/IT**

# IMPLEMENTING ARTIFICIAL INTELLIGENCE

To develop AI applications, you will have to decide on the platform, the IDE and the language for development. There are several choices available. Most of these would meet your requirements easily as all of them provide the implementation of AI algorithms discussed so far.

If you are developing the AI algorithm on your own, the following aspects need to be understood carefully:

The language of your choice – this essentially is your proficiency in one of the languages supported in AI development.

The IDE that you use – This would depend on your familiarity with the existing IDEs and your comfort level.

Development platform – There are several platforms available for development and deployment. Most of these are free-to-use. In some cases, you may have to incur a license fee beyond a certain amount of usage. Here is a brief list of choice of languages, IDEs and platforms for your ready reference.

## Language Choice

Here is a list of languages that support AI development:

- Python
- R
- Mat lab
- Octave
- Julia
- C++
- C

This list is not essentially comprehensive; however, it covers many popular languages used in machine learning development. Depending upon your comfort level, select a language for the development, develop your models and test.

## IDEs

Here is a list of IDEs which support AI development:

- R Studio
- Pycharm
- iPython / Jupyter Notebook
- Julia
- Spyder
- Anaconda

## Platforms

Here is a list of platforms on which AI applications can be deployed:

- IBM
- Microsoft Azure
- Google Cloud
- Amazon

The above list is not essentially comprehensive. Each one has its own merits and demerits. The reader is encouraged to try out these different IDEs before narrowing down to a single one.

**By,**

**PAVITHRA S, IV/IT**

# ARTIFICIAL INTELLIGENCE CONCLUSION

In conclusion, Artificial Intelligence (AI) is a rapidly growing field that is revolutionizing the way we live and work. AI has the potential to transform many industries, from healthcare and finance to transportation and logistics, by enabling us to automate complex tasks, make better decisions, and create more personalized experiences for customers.

AI is a multidisciplinary field that draws on many different areas of knowledge, including mathematics, computer science, statistics, and cognitive psychology

While AI has many exciting applications, it also raises important ethical and societal issues, such as privacy, bias, and job displacement for researchers, policymakers, and the public to work together to ensure that AI is developed in a responsible and ethical way, and that its benefits are shared widely across society.

**By,**

**PRIYADHARSHINI P, IV/IT**

**Program Outcomes (POs)**

| | |
|---|---|
| **PO1** | **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the IT enabled solution of complex engineering problems. |
| **PO2** | **Problem Analysis:** Identify, analyze and provide solutions to the problems reaching substantiated IT enabled conclusions. |
| **PO3** | **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the desired needs within realistic constraints. |
| **PO4** | **Conduct Investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO5** | **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO7** | **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. |
| **PO9** | **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO10** | **Communication:** Communicate effectively on engineering activities with the engineering community and with society. |
| **PO11** | **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO12** | **Life Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**Program Specific Outcomes(PSOs)**

| | | |
|---|---|---|
| **PSO1** | **Programming Skill** | Work as Software Engineers for providing solutions to real world problems using programming languages and open source software. |
| **PSO2** | **Web Designing Skill** | Ability to use the web designing skill to establish new solutions for the societal needs. |


M/S K.S.R.
INSTITUE
FOR
ENGINEERING
AND
TECHOLOGY
Where future begins.