MACHINE LEARNING

A Seminar Report

Submitted by

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ABSTRACT

In this Project, we were asked to study the Artificial Intelligence and its codomains and to perform detailed study on Machine Learning. We were expected to gain experience about machine learning tools and machine learning algorithms. To study about the challenges and problems that machine learning technology is facing and to find out multiple possible solutions for the same. How machine learning as a full-grown carrier and business models can developed for the development of the society and nation. Introduction to machine learning and its major aspects. Suggestions and conclusions that can be given to nowadays machine learning tools and problems associated with machine learning as well as artificial intelligence. Machine learning has been recognized as central to the success of Artificial Intelligence, and it has applications in various areas of science, engineering and society. Artificial Intelligence is the intelligence demonstrated by machines or computers, that are programmed into them through codes to mimic the natural intelligence demonstrated by humans. Studied real World Problems Effectively Solved by the AI and Machine learning.

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I will be falling in duty . If I do not acknowledge with grateful thanks to the authors of the references and other literature referred in this seminar.

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Last but not the least ; I am very much thankful to my parents who guided me in every step which I took.

CHAPTER 1.
INTRODUCTION

Machine Learning (ML) is a sub-field of **Artificial Intelligence (AI)** which concerns with developing computational theories of learning and building learning machines.

Machine Learning (ML) is the computerized approach to analyzing computational work that is based on both a set of theories and a set of technologies. And, being a very active area of research and development, there is not a single agreed-upon definition that would satisfy everyone, but there are some aspects, which would be part of any knowledgeable person's definition. The definition mostly offers is:

Definition: Ability of a machine to improve its own performance through the use of a software that employs artificial intelligence techniques to mimic the ways by which humans seem to learn, such as repetition and experience.

- ➢ The goal of machine learning, closely coupled with the goal of AI, is to achieve a thorough understanding about the nature of learning process (both human learning and other forms of learning), about the computational aspects of learning behaviors, and to implant the learning capability in computer systems.

- ➢ Machine learning has been recognized as central to the success of Artificial Intelligence, and it has applications in various areas of science, engineering and society.

Machine Learning has gained a lot of prominence in the recent years because of its ability to be applied across scores of industries to solve complex problems effectively and quickly. Contrary to what one might expect, Machine Learning use cases are not that difficult to come across. The most common examples of problems solved by machine learning are image tagging by Facebook and spam detection by email providers.

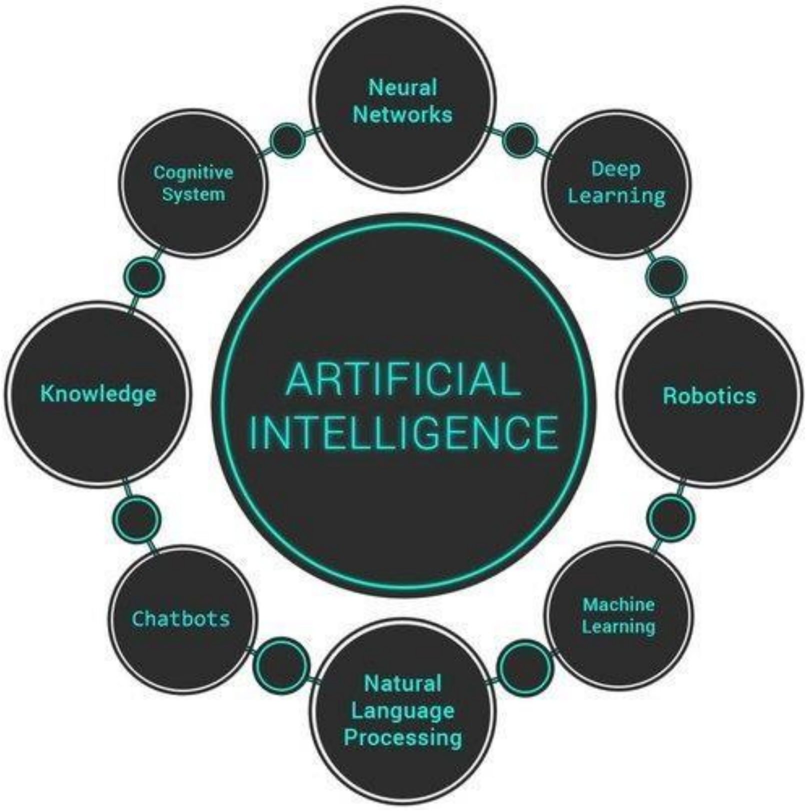


Fig No. 1.1 Artificial Intelligence and its codomains.

1. 1 WHAT IS MACHINE LEARNING?

A sub-area of artificial intelligence – machine learning is IT systems' ability to recognize patterns in large databases to independently find solutions to problems. Put simply; it is an umbrella term for various techniques and tools that can help computers learn and adapt on their own.

Unlike traditional programming, which is a manually created program that uses input data and runs on a computer to produce the output, in Machine Learning or augmented analytics, the input data and output are given to an algorithm to create a program. It leads to powerful insights that can be used to predict future outcomes.

Machine learning algorithms do all of that and more, using statistics to find patterns in vast amounts of data that encompasses everything from images, numbers, words, etc. If the data can be stored digitally, it can be fed into a machine-learning algorithm to solve specific problems.

1.2 Why Machine Learning?

To answer this question, we should look at two issues:

(1). What are the goals of machine learning;

(2). Why these goals are important and desirable.

1.2.1 The Goals of Machine Learning

The goal of ML, in simple words, is to understand the nature of (human and other forms of) learning, and to build learning capability in computers. To be more specific, there are three aspects of the goals of ML.

- To make the computers smarter, more intelligent. The more direct objective in this aspect is to develop systems (programs) for specific practical learning tasks in application domains.
- To develop computational models of human learning process and perform computer simulations. The study in this aspect is also called *cognitive modeling*.
- To explore new learning methods and develop general learning algorithms independent of applications.

1.2.2 Why the goals of ML are important and desirable.

It is self-evident that the goals of ML are important and desirable.
However, we still give some more supporting argument to this issue.

First of all, implanting learning ability in computers is practically necessary. Present day computer applications require the representation of huge amount of complex knowledge and data in programs and thus require tremendous amount of work.

- Our ability to code the computers falls short of the demand for applications. If the computers are endowed with the learning ability, then our burden of coding the machine is eased (or at least reduced).
- This is particularly true for developing expert systems where the

"bottle-neck" is to extract the expert's knowledge and feed the knowledge to computers.

- The present-day computer programs in general (with the exception of some ML programs) cannot correct their own errors or improve from past mistakes, or learn to perform a new task by analogy to a previously seen task.
- In contrast, human beings are capable of all the above. ML will produce smarter computers capable of all the above intelligent behavior.

Second, the understanding of human learning and its computational aspect is a worthy scientific goal.

- We human beings have long been fascinated by our capabilities of intelligent behaviors and have been trying to understand the nature of intelligence.
- It is clear that central to our intelligence is our ability to learn. Thus a thorough understanding of human learning process is crucial to understand human intelligence.
- ML will gain us the insight into the underlying principles of human learning and that may lead to the discovery of more effective education techniques. It will also contribute to the design of machine learning systems.

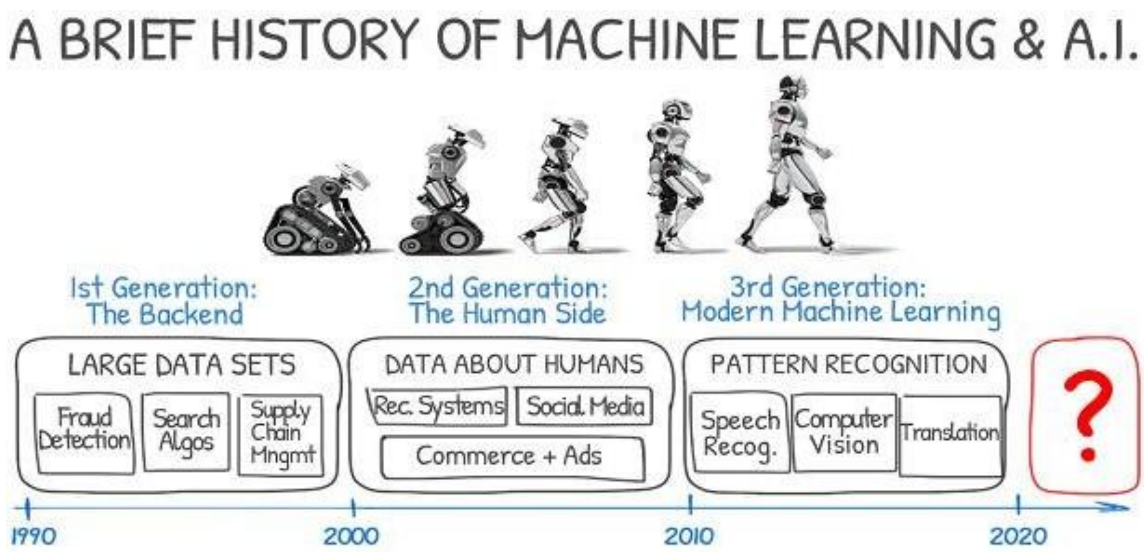
Finally, it is desirable to explore alternative learning mechanisms in the space of all possible learning methods.

We remark that Machine Learning has become feasible in many important applications (and hence the popularity of the field) partly because the recent progress in learning algorithms and theory, the rapidly increase of computational power, the great availability of huge amount of data, and interests in commercial ML application development.

Dimension	Human Learning	Machine Learning
Speed	Slow	Slow - hope to find tricks for machine to learn fast
Ability to transfer	No copy mechanism	Easy to copy
Require repetition	Yes	Yes/No
Error-prone	Yes	Yes
Noise-tolerant	Yes	No

CHAPTER 2

HISTORY OF MACHINE LEARNING



2.1 Learning Means?

Learning is a phenomenon and process which has manifestations of various aspects. Roughly speaking, learning process

Over the years, research in machine learning has been pursued with varying degrees of intensity, using different approaches and placing emphasis on different, aspects and goals. Within the relatively short history of this discipline, one may distinguish three major periods, each centered on a different concept:

- Neural modeling and decision-theoretic techniques.
- Symbolic concept-oriented learning.
- Knowledge-intensive approaches combining various learning strategies

2.2 Neural Modelling (Self Organized System)

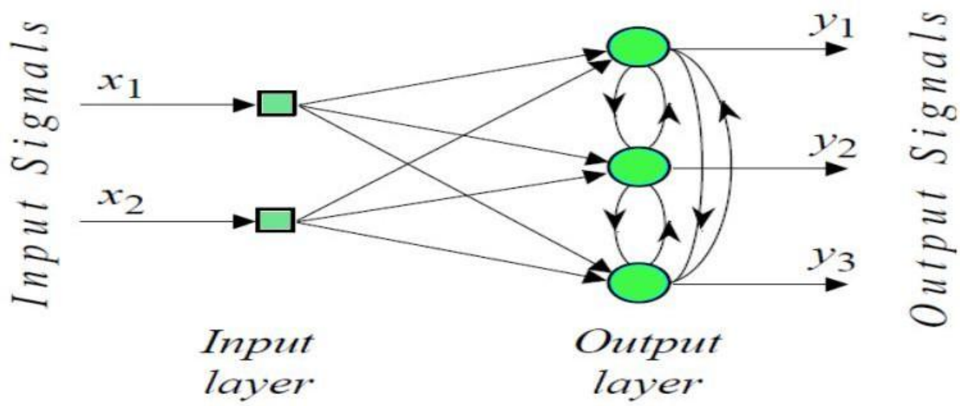


Fig 2.1 Self Organizing Neural Network (SONN)

- The distinguishing feature of the first concept was the interest in building general purpose learning systems that start with little or no initial structure or task-oriented knowledge.
- The major thrust of research based on this approach involved constructing a variety of neural model-based machines, with random or partially random initial structure.
- These systems were generally referred to as neural networks or self-organizing systems. Learning in such systems consisted of incremental changes in the probabilities that neuron-like elements would transmit a signal.
- Due to the early computer technology, most of the research under this neural network model was either theoretical or involved the construction of special purpose experimental hardware systems.

2.3 The Symbolic Concept Acquisition Paradigm

A second major paradigm started to emerge in the early sixties stemming from the work of psychologist and early AI researchers on models of human learning by Hunt. The paradigm utilized logic or graph structure representations rather than numerical or statistical methods Systems learned symbolic descriptions representing higher level knowledge and made strong structural assumptions about the concepts to be acquired.

Examples of work in this paradigm include research on human concept acquisition and various applied pattern recognition systems.

***SSLA* Results Across Journal, Time, and Paradigm**

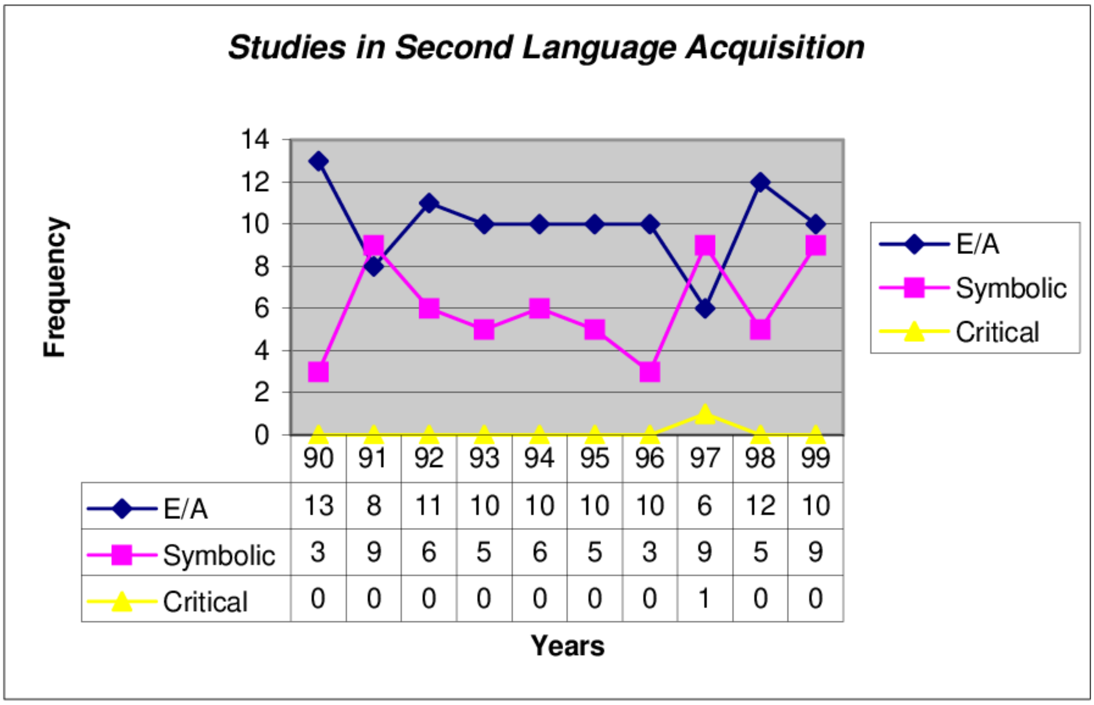


Fig 2.2 Graph against frequency of Symbolic Acquisition Paradigm.

2.4 The Modern Knowledge-Intensive Paradigm

The third paradigm represented the most recent period of research starting in the mid-seventies.

Researchers have broadened their interest beyond learning isolated concepts from examples, and have begun investigating a wide spectrum of learning methods, most based upon knowledge-rich systems specifically, this paradigm can be characterizing by several new trends, including:

2.4.1. Knowledge-Intensive Approaches: Researchers are strongly emphasizing the use of task-oriented knowledge and the constraints it provides in guiding the learning process One lesson from the failures of earlier knowledge and poor learning systems that is acquire and to acquire new knowledge a system must already possess a great deal of initial knowledge.

2.4.2 Exploration of alternative methods of learning: In addition to the earlier research emphasis on learning from examples, researchers are now investigating a wider variety of learning methods such as learning from instruction.

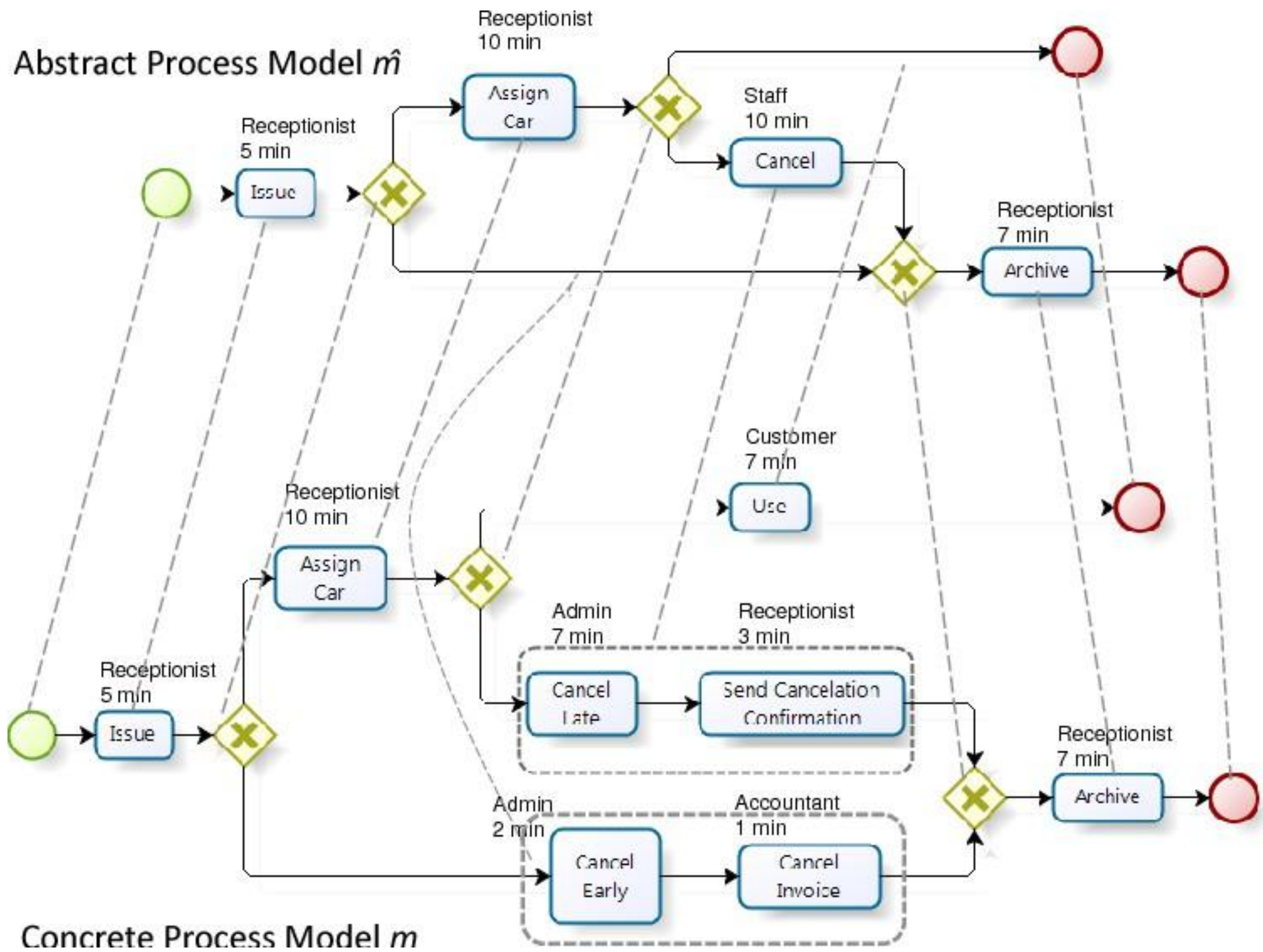


Fig. 2.3 Knowledge-intensive processes

CHAPTER 3

MACHINE LEARNING OVERVIEW

Machine Learning can still be defined as learning the theory automatically from the data, through a process of inference, model fitting, or learning from examples:

- Automated extraction of useful information from a body of data by building good probabilistic models.
- Ideally suited for areas with lots of data in the absence of a general theory.

3.1 The Aim of Machine Learning

The field of machine learning can be organized around three primary research Areas:

- **Task-Oriented Studies:** The development and analysis of learning systems oriented toward solving a predetermined set, of tasks (also known as the "engineering approach").
- **Cognitive Simulation:** The investigation and computer simulation of human learning processes (also known as the "cognitive modeling approach").
- **Theoretical Analysis:** The theoretical exploration of the space of possible learning methods and algorithms independent application domain.

Although many research efforts strive primarily towards one of these objectives, progress in on objective often lends to progress in another.

For example, in order to investigate the space of possible learning methods, a reasonable starting point may be to consider the only known example of robust learning behavior, namely humans (and perhaps other biological systems) Similarly, psychological investigations of human learning may held by theoretical analysis that may suggest various possible learning models.

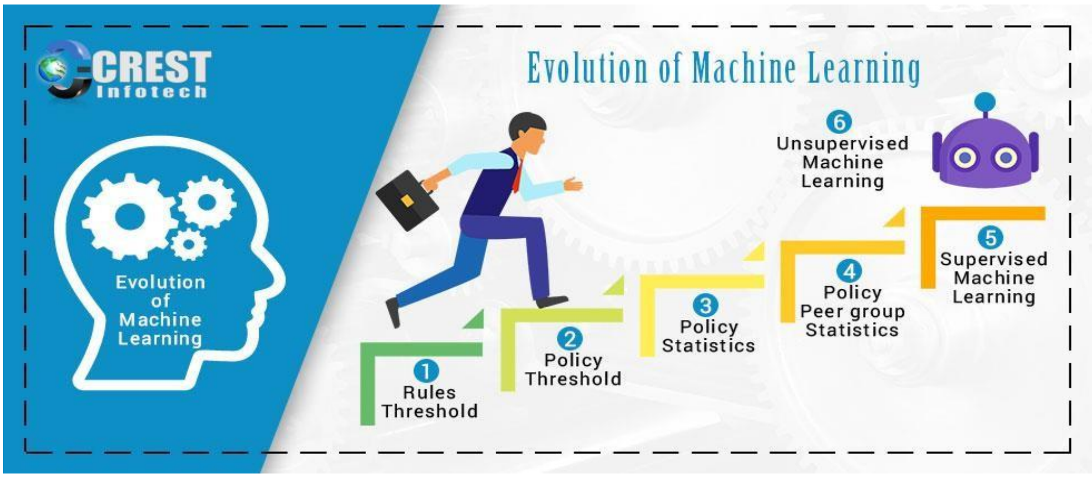
The need to acquire a particular form of knowledge in stone taskoriented study may itself spawn new theoretical analysis or pose the question: "how do humans acquire this specific skill (or knowledge)?" The existence of these mutually supportive objectives reflects the entire field of artificial intelligence where expert system research, cognitive simulation, and theoretical studies provide some cross-fertilization of problems and ideas.

3.2 Machine Learning as a Science

- The clear contender for a cognitive invariant in human is the learning mechanism which is the ability facts, skills and more abstractive concepts. Therefore, understanding human learning well enough to reproduce aspect of that learning behavior in a computer system is, in itself, a worthy scientific goal.

- Moreover, the computer can render substantial assistance to cognitive psychology, in that it may be used to test the consistency and completeness of learning theories and enforce a commitment to the fine-structure process level detail that precludes meaningless tautological or untestable theories (Bishop,2006).

- The study of human learning processes is also of considerable practical significance. Gaining insights into the principles underlying human learning abilities is likely to lead to more effective educational techniques.
- Machine learning research is all about developing intelligent computer assistant or a computer tutoring systems and many of these goals are shared within the machine learning fields. According to Jaime et al who stated computer tutoring are starting to incorporate abilities to infer models of student competence from observed performance.



3.3 Classification of machine learning

There are several areas of machine learning that could be exploited to solve the problems of email management and our approach implemented unsupervised machine learning method. Today, Machine Learning algorithms are primarily trained using three essential methods. These are categorized as three types of machine learning, as discussed below –

3.3.1. Supervised Learning

One of the most elementary types of machine learning, supervised learning, is one where data is labeled to inform the machine about the exact patterns it should look for. Although the data needs to be labeled accurately for this method to work, supervised learning is compelling and provides excellent results when used in the right circumstances.

For instance, when we press play on a Netflix show, we're informing the Machine Learning algorithm to find similar shows based on our preference.

How it works –

- The Machine Learning algorithm here is provided with a small training dataset to work with, which is a smaller part of the bigger dataset.

- It serves to give the algorithm an idea of the problem, solution, and various data points to be dealt with.

- The training dataset here is also very similar to the final dataset in its characteristics and offers the algorithm with the labeled parameters required for the problem.

- The Machine Learning algorithm then finds relationships between the given parameters, establishing a cause and effect relationship between the variables in the dataset.

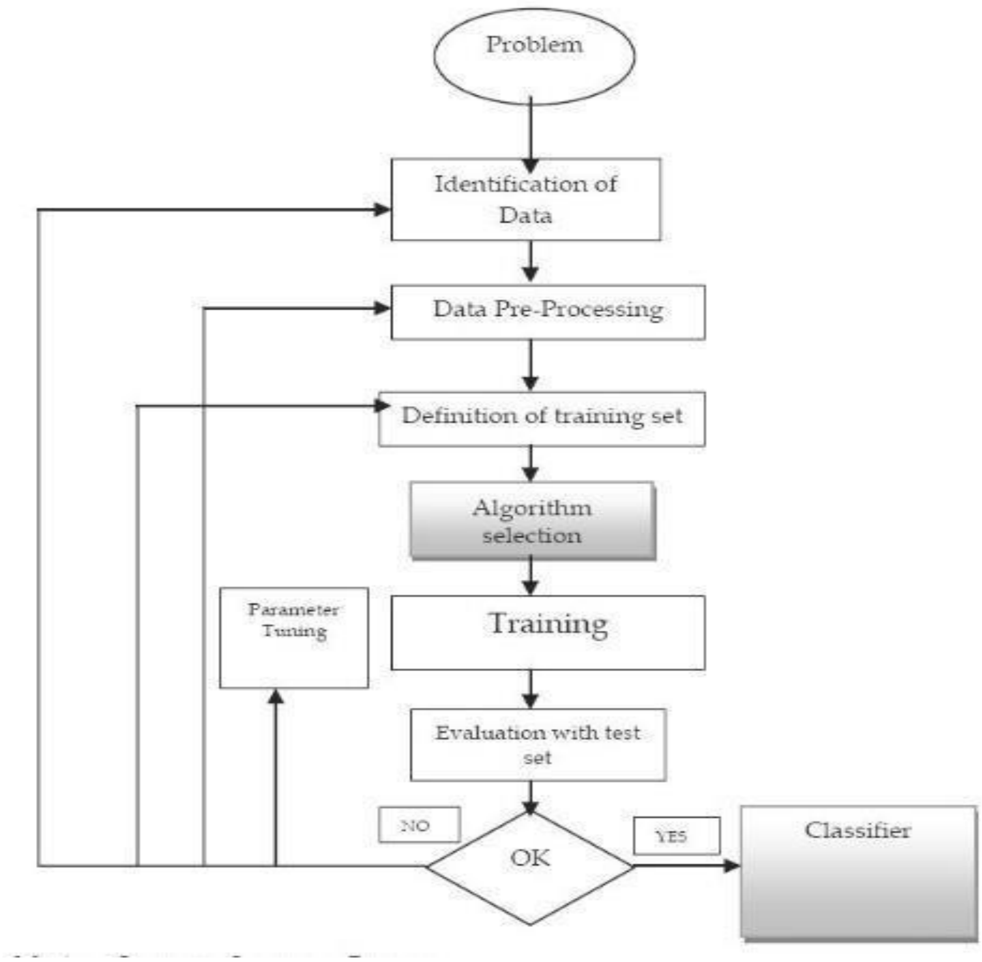


Fig. 3.1: Machine Learning Supervise Process

3.3.2. Unsupervised Learning

Unsupervised learning, as the name suggests, has no data labels. The machine looks for patterns randomly. It means that there is no human labor required to make the dataset machine-readable. It allows much larger datasets to be worked on by the program. Compared to supervised learning, unsupervised Machine Learning services aren't much popular because of lesser applications in day-to-day life.

How does it work?

- Since unsupervised learning does not have any labels to work off, it creates hidden structures.

- Relationships between data points are then perceived by the algorithm randomly or abstractly, with absolutely no input required from human beings.

- Instead of a specific, defined, and set problem statement, unsupervised learning algorithms can adapt to the data by changing hidden structures dynamically.

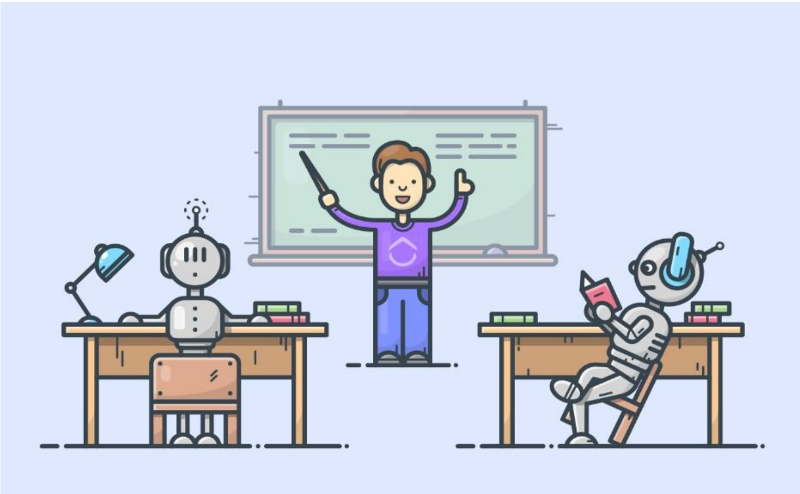


Fig 3.1 Supervised vs Unsupervised Learning

3.3.3. Reinforcement Learning

Reinforcement learning primarily describes a class of machine learning problems where an agent operates in an environment with no fixed training dataset. The agent must *know* how to work using feedback.

How does it work?

- Reinforcement learning features a machine learning algorithm that improves upon itself.
- It typically learns by trial and error to achieve a clear objective.
- In this Machine Learning algorithm, favorable outputs are reinforced or encouraged, whereas non-favorable outputs are discouraged.

CHAPTER 4

MACHINE LEARNING ALGORITHMS

Machine learning algorithms are organized into taxonomy, based on the desired outcome of the algorithm. Common algorithm types include:

1. **Supervised learning:** Where the algorithm generates a function that maps inputs to desired outputs. One standard formulation of the supervised learning task is the classification problem: the learner is required to learn (to approximate the behavior of) a function which maps a vector into one of several classes by looking at several input-output examples of the function.

2. **Unsupervised learning:** Which models a set of inputs, labeled examples are not available.

3. **Semi-supervised learning** Which combines both labeled and unlabeled examples to generate an appropriate function or classifier.

4. **Reinforcement learning:** Where the algorithm learns a policy of how to act given an observation of the world.

Learning to learn: Where the algorithm learns its own inductive bias based on previous experience.

Transduction: Similar to supervised learning, but does not explicitly construct a function: instead, tries to predict new outputs based on training inputs, training outputs, and new inputs.

The performance and computational analysis of machine learning algorithms is a branch of statistics known as computational learning theory. Machine learning is about designing algorithms that allow a computer to learn.

Learning is not necessarily involving consciousness but learning is a matter of finding statistical regularities or other patterns in the data. Thus, many machine learning algorithms will barely resemble how human might approach a learning task.

However, learning algorithms can give insight into the relative difficulty of learning in different environments.

4.1 Algorithm Types:

In the area of supervised learning which deals much with classification. These are the algorithms types:

1. **Linear Classifiers**

1. Fisher's linear discriminant
2. Naïve Bayes Classifier
3. Perceptron
4. Support Vector Machine

2. **Quadratic Classifiers**

3. **Boosting**

4. **Neural networks**

5. **Bayesian Networks**

6. **Decision Tree**

4.1.1. Linear Classifiers

In machine learning, the goal of classification is to group items that have similar feature values, into groups. A linear classifier achieves this by making a classification decision based on the value of the linear combination of the features. If the input feature vector to the classifier is a real vector x, then the output score is

$$\boxed{y = f(\vec{w} \cdot \vec{x}) = f\left(\sum_j w_j x_j\right)}$$

where is a real vector of weights and *f* is a function that converts the dot product of the two vectors into the desired output.

4.1.1.1. Fisher's linear discriminant :

The resulting combination may be used as a linear classifier or, more commonly, for dimensionality reduction before later classification.

Linear discriminant analysis (LDA) and the related Fisher's linear discriminant are methods used in machine learning to find a linear combination of features which characterizes or separates two or more classes of objects or events.

4.1.1.2. Naïve Bayes Classifier:

A naive Bayes classifier is a simple probabilistic classifier based on applying Bayes' theorem with strong

(naive) independence assumptions. A more descriptive term for the underlying probability model would be "independent feature". In simple terms, a naive Bayes classifier assumes that the presence or absence of a particular feature is unrelated to the presence or absence of any other feature, given the class variable. A naive Bayes classifier considers each of these features to contribute independently to the probability that this fruit is an apple, regardless of the presence or absence of the other features.

4.1.1.3. Perceptron:

The perceptron is an algorithm for supervised classification of an input into one of several possible non-binary outputs.

The learning algorithm for perceptron's is an online algorithm, in that it processes elements in the training set one at a time.

4.1.1.4. Support vector machines:

In machine learning, support vector machines (SVMs) are supervised learning models with associated learning algorithms that analyze

data and recognize patterns, used for classification and regression analysis.

The basic SVM takes a set of input data and predicts, for each given input, which of two possible classes forms the output, making it a nonprobabilistic binary linear classifier. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other.

An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on.

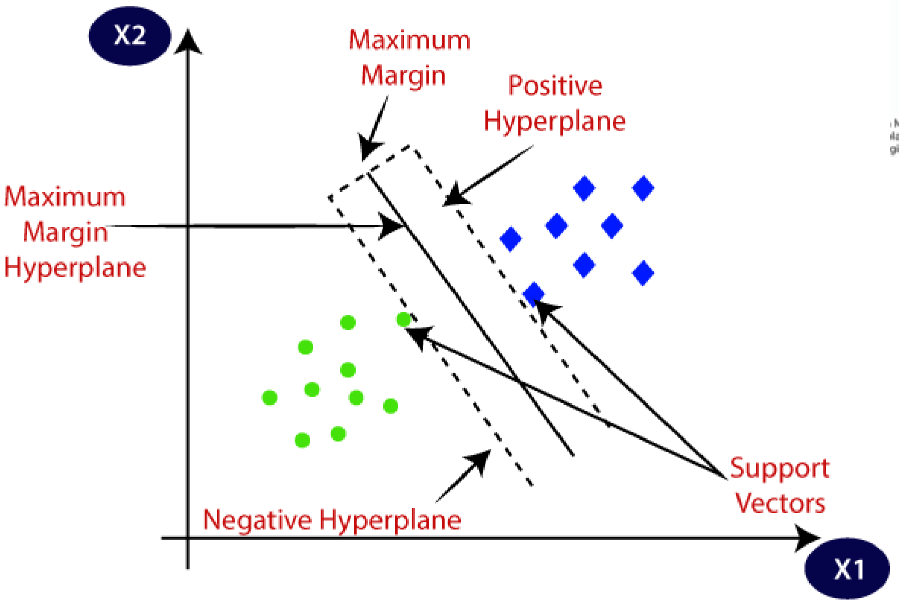


Fig 4.1 Support Vector Machine Algorithm

4.1.2. Quadratic classifier

A quadratic classifier is used in machine learning and statistical classification to separate measurements of two or more classes of objects or events by a quadric surface. It is a more general version of the linear classifier.

4.1.3. Boosting

Boosting is a machine learning meta-algorithm for reducing bias in supervised learning. Boosting is based on the question posed as “Can a set of weak learners create a single strong learner?” A weak learner is defined to be a classifier which is only slightly correlated with the true classification. In contrast, a strong learner is a classifier that is arbitrarily well-correlated with the true classification.

4.1.4. Neural networks

Neural networks are capable of machine learning and pattern recognition. They are usually presented as systems of interconnected "neurons" that can compute values from inputs by feeding information through the network. Neural networking is the science of creating computational solutions modeled after the brain.

Like the human brain, neural networks are trainable-once they are taught to solve one complex problem, they can apply their skills to a new set of problems without having to start the learning process from scratch.

4.1.5 Bayesian network

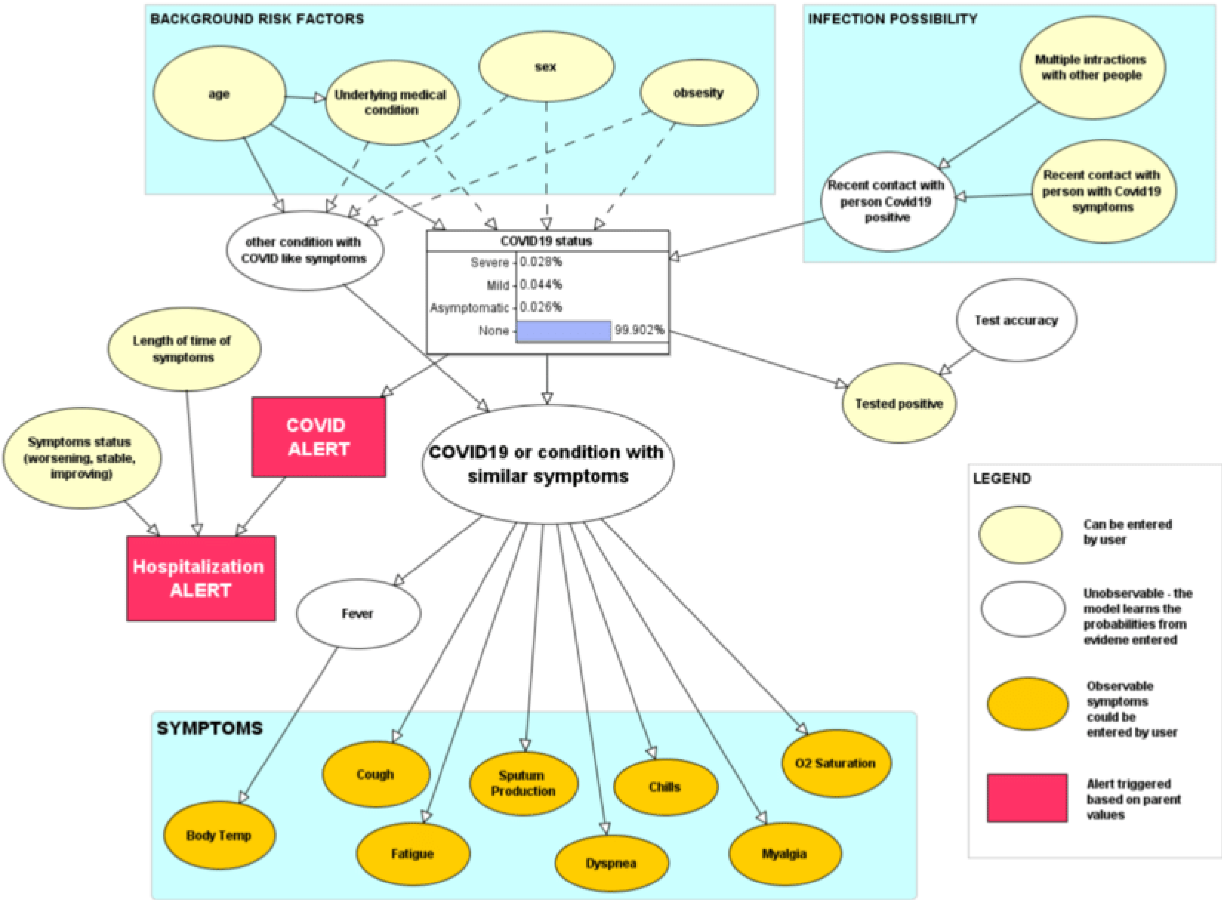


Fig 4.2 Covid-19 Bayesian network model structure

A Bayesian network, Bayes network, belief network, Bayes(ian) model or probabilistic directed acyclic graphical model is a probabilistic graphical model (a type of statistical that represents a set of random variables and their conditional dependencies via a directed acyclic graph (DAG).

For example, suppose that there are two events which could cause grass to be wet: either the sprinkler is on or it's raining.

Also, suppose that the rain has a direct effect on the use of the sprinkler (namely that when it rains, the sprinkler is usually not turned on). Then the situation can be modeled with a Bayesian network (shown). All three variables have two possible values, T (for true) and F (for false).

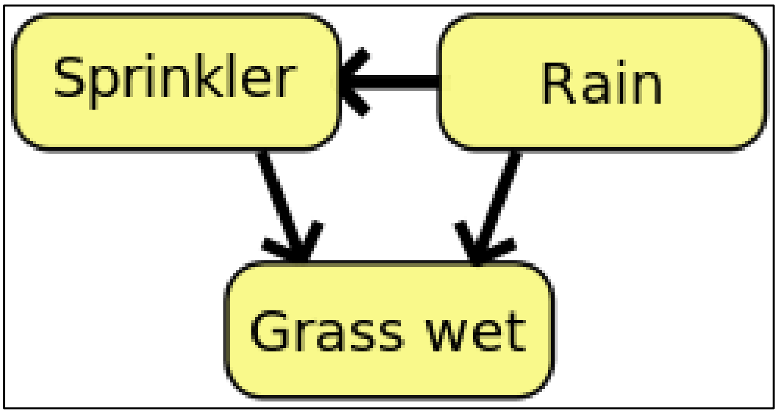


Fig. 5.1: Bayesian network

4.1.6. Decision Trees

A decision tree is a hierarchical data structure implementing the divide-and-conquer strategy. It is an efficient nonparametric method, which can be used for both classification and regression.

A decision tree is a hierarchical model for supervised learning whereby the local region is identified in a sequence of recursive splits in a smaller number of steps. Given an input, at each node, a test is applied and one of the branches is taken depending on the outcome. This process starts at the root and is repeated recursively until a leaf node is hit, at which point the value written in the leaf constitutes the output.

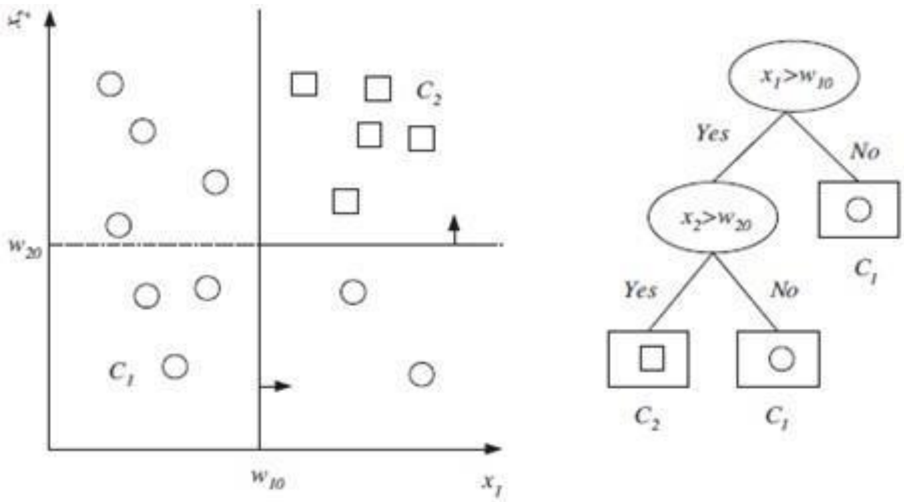
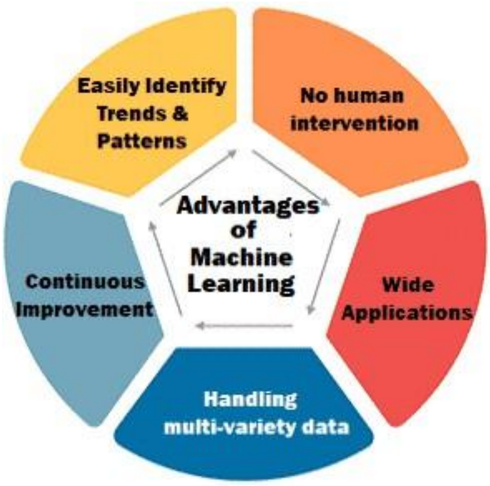


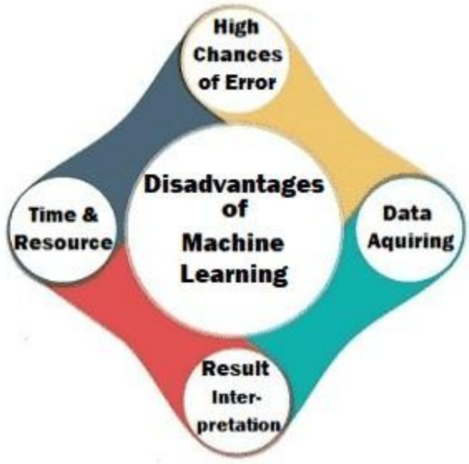
Fig.5.2: Decision Tree

CHAPTER 5

MACHINE LEARNING PROBLEMS AND SOLUTIONS

5.1. Machine learning problems





5.1.1. Data Acquisition

Machine Learning requires massive data sets to train on, and these should be inclusive/unbiased, and of good quality. There can also be times where they must wait for new data to be generated.

5.1.2. Time and Resources

ML needs enough time to let the algorithms learn and develop enough to fulfill their purpose with a considerable amount of accuracy and relevancy. It also needs massive resources to function. This can mean additional requirements of computer power for you.

5.1.3. Interpretation of Results

Another major challenge is the ability to accurately interpret results generated by the algorithms. You must also carefully choose the algorithms for your purpose.

5.1.4. High error-susceptibility

Machine Learning is autonomous but highly susceptible to errors. Suppose you train an algorithm with data sets small enough to not be inclusive. You end up with biased predictions coming from a biased training set. This leads to irrelevant advertisements being displayed to customers. In the case of ML, such blunders can set off a chain of errors that can go undetected for long periods of time. And when they do get noticed, it takes quite some time to recognize the source of the issue, and even longer to correct it.

There are many examples of machine learning problems. Much of this course will focus on classification problems in which the goal is to categorize objects into a fixed set of categories. Here are several examples:

- **Optical character recognition:** categorize images of handwritten characters by the letters represented.
- **Face detection:** find faces in images (or indicate if a face is present).
- **Spam filtering:** identify email messages as spam or non-spam.
- **Topic spotting:** categorize news articles (say) as to whether they are about politics, sports, entertainment, etc.
- **Spoken language understanding:** within the context of a limited domain, determine the meaning of something uttered by a speaker to the extent that it can be classified into one of a fixed set of categories.
- **Medical diagnosis:** diagnose a patient as a sufferer or non-sufferer of some disease.
- **Customer segmentation:** predict, for instance, which customers will respond to a particular promotion.
- **Fraud detection:** identify credit card transactions (for instance) which may be fraudulent in nature.
- **Weather prediction:** predict, for instance, whether or not it will rain tomorrow.

5.2. Real-World Problems Solved by Machine Learning

Machine learning algorithms are typically used in areas where the solution requires continuous improvement post-deployment. Adaptable machine learning solutions are incredibly dynamic and are adopted by companies across verticals.

5.2.1. Identifying Spam

Spam identification is one of the most basic applications of machine learning. Most of our email inboxes also have an unsolicited, bulk, or spam inbox, where our email provider automatically filters unwanted spam emails.
But how do they know that the email is spam?

They use a trained Machine Learning model to identify all the spam emails based on common characteristics such as the email, subject, and sender content.
If you look at your email inbox carefully, you will realize that it is not very hard to pick out spam emails because they look very different from real emails. Machine learning techniques used nowadays can automatically filter these spam emails in a very successful way.
Spam detection is one of the best and most common problems solved by Machine Learning. Neural networks employ content-based filtering to classify unwanted emails as spam. These neural networks are quite similar to the brain, with the ability to identify spam emails and messages.

5.2.2. Making Product Recommendations

Recommender systems are one of the most characteristic and ubiquitous machine learning use cases in day-to-day life. These systems are used everywhere by search engines, e-commerce websites (Amazon), entertainment platforms (Google Play, Netflix), and multiple web & mobile apps.
Prominent online retailers like Amazon and eBay often show a list of recommended products individually for each of their consumers. These recommendations are typically based on behavioral data and parameters such as previous purchases, item views, page views, clicks, form fill-ins, purchases, item details (price, category), and contextual data (location, language, device), and browsing history.
These recommender systems allow businesses to drive more traffic, increase customer engagement, reduce churn rate, deliver relevant content and boost profits. All such recommended products are based on a machine learning model's analysis of customer's behavioral data. It is an excellent way for online retailers to offer extra value and enjoy various upselling opportunities using machine learning.

5.2.3. Customer Segmentation

Customer segmentation, churn prediction and customer lifetime value (LTV) prediction are the main challenges faced by any marketer. Businesses have a huge amount of marketing relevant data from various sources such as email campaigns, website visitors and lead data.
Using data mining and machine learning, an accurate prediction for individual marketing offers and incentives can be achieved. Using ML, savvy marketers can eliminate guesswork involved in data-driven marketing.
For example, given the pattern of behavior by a user during a trial period and the past behaviors of all users, identifying chances of conversion to paid version can be predicted. A model of this

decision problem would allow a program to trigger customer interventions to persuade the customer to convert early or better engage in the trial.

5.2.4. Image & Video Recognition

Advances in deep learning (a subset of machine learning) have stimulated rapid progress in image & video recognition techniques over the past few years. They are used for multiple areas, including object detection, face recognition, text detection, visual search, logo and landmark detection, and image composition.
Since machines are good at processing images, Machine Learning algorithms can train Deep Learning frameworks to recognize and classify images in the dataset with much more accuracy than humans.
Similar to image recognition, companies such as Shutterstock, eBay, Salesforce, Amazon, and Facebook use Machine Learning for video recognition where videos are broken down frame by frame and classified as individual digital images.

5.2.5. Fraudulent Transactions

Fraudulent banking transactions are quite a common occurrence today. However, it is not feasible (in terms of cost involved and efficiency) to investigate every transaction for fraud, translating to a poor customer service experience.
Machine Learning in finance can automatically build super-accurate predictive maintenance models to identify and prioritize all kinds of possible fraudulent activities. Businesses can then create a data-based queue and investigate the high priority incidents.

It allows you to deploy resources in an area where you will see the greatest return on your investigative investment. Further, it also helps you optimize customer satisfaction by protecting their accounts and not challenging valid transactions. Such fraud detection using machine learning can help banks and financial organizations save money on disputes/chargebacks as one can train Machine Learning models to flag transactions that appear fraudulent based on specific characteristics.

5.2.6. Demand Forecasting

The concept of demand forecasting is used in multiple industries, from retail and e-commerce to manufacturing and transportation. It feeds historical data to Machine Learning algorithms and models to predict the number of products, services, power, and more.
It allows businesses to efficiently collect and process data from the entire supply chain, reducing overheads and increasing efficiency.
ML-powered demand forecasting is very accurate, rapid, and transparent. Businesses can generate meaningful insights from a constant stream of supply/demand data and adapt to changes accordingly.

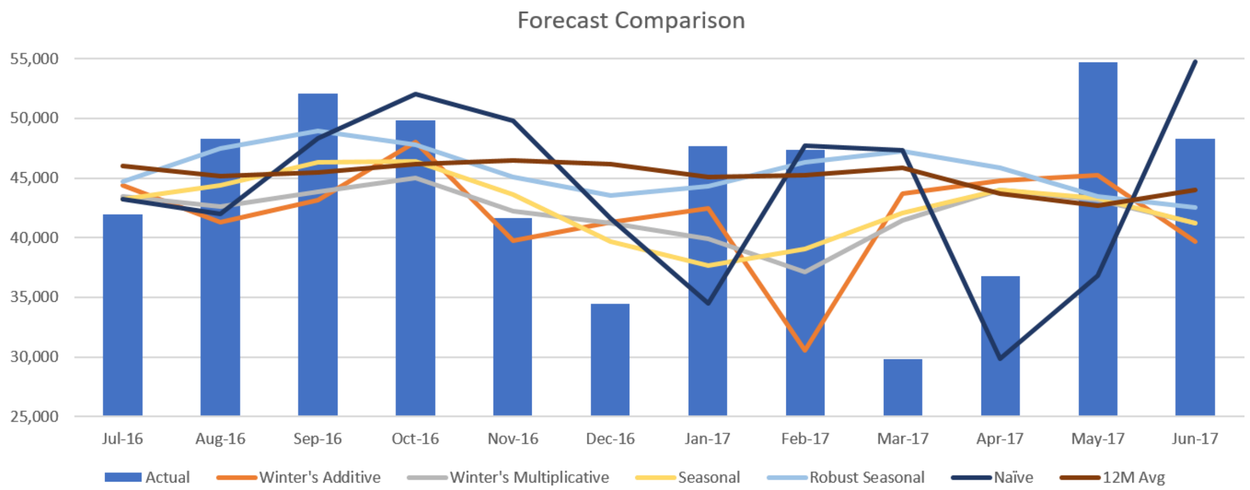


Fig 5.1 Demand Forecasting

5.2.7. Virtual Personal Assistant

From Alexa and Google Assistant to Cortana and Siri, we have multiple virtual personal assistants to find accurate information using our voice instruction, such as calling someone, opening an email, scheduling an appointment, and more.
These virtual assistants use Machine Learning algorithms for recording our voice instructions, sending them over the server to a cloud, followed by decoding them using Machine Learning algorithms and acting accordingly.

5.2.8. Sentiment Analysis

Sentiment analysis is one of the beneficial and real-time machine learning applications that help determine the emotion or opinion of the speaker or the writer.
For instance, if you've written a review, email, or any other form of a document, a sentiment analyzer will be able to assess the actual thought and tone of the text. This sentiment analysis application can be used to analyze decision-making applications, review-based websites, and more.

5.2.9. Customer Service Automation

Managing an increasing number of online customer interactions has become a pain point for most businesses. It is because they simply don't have the customer support staff available to deal with the sheer number of inquiries they receive daily.
Machine learning algorithms have made it possible and super easy for chatbots and other similar automated systems to fill this gap. This application of machine learning enables companies to automate routine and low priority tasks, freeing up their employees to manage more high-level customer service tasks.

Further, Machine Learning technology can access the data, interpret behaviors and recognize the patterns easily. This could also be used for customer support systems that can work identical to a real human being and solve all of the customers' unique queries. The Machine Learning models behind these voice assistants are trained on human languages and variations in the human voice because it has to efficiently translate the voice to words and then make an on-topic and intelligent response.

If implemented the right way, problems solved by machine learning can streamline the entire process of customer issue resolution and offer much-needed assistance along with enhanced customer satisfaction.

5.3. Real World Problems Effectively Solved by the AI

Smart assistants building impressive gadget at our command and terminator machines destroying the world, these are the first pictures that come into our mind when someone mentions the name Machine Learning and AI.

In real life, however, AI is more positive and grounded. While AI has not reached the level of assembling gadgets yet, it has made the world a better place by solving many complex problems.

5.3.1. Online Shopping Made Easy

Shopping online for a product without knowing its name was a nightmare a few years back. It took hours to find that product from the catalog.

However, all thanks to AI trends like predictive technology, things are entirely different these days. When you search for an item even with a vague query, thousands of search results appear in the blink of an eye.

We even get suggestions based on our searches like these search engines can reading our mind. It appears that everything we want is not too far anymore.

Companies like CamFind are even taking this one step further by letting you identify objects by just clicking their picture. We are not far from the day when consumers will be able to shop items just by clicking their picture.

5.3.2. Consumer Queries Resolved Faster & More Accurately

The biggest challenge among businesses is to ensure the queries of their consumers are resolved on time. Things become even more tough when you are a big organization with millions of customers.

India’s leading finance bank, HDFC was facing the same difficulty. So, they developed EVA (Electronic Virtual Assistant), an AI-based chatbot which can provide simple answers in less than 0.4 seconds by collected knowledge from thousands of resources.

The virtual assistant has been responsible for addressing 3 million queries, interacting with half a million unique users, and holding over half a million conversations.

So, you can see how much impact can adopting AI in customer support can create.

5.3.3. Frauds Prevented

Tracing and preventing frauds have always been a big challenge that AI is helping us overcome. Organizations are using AI solutions to prevent fraud and enhance security in a number of sectors.

Companies like MasterCard and RBS WorldPay are using AI and deep learning to recognize doubtful transaction patterns and thwart card frauds. Other industries are using the same approach to prevent such cons from happening. It has helped them save millions of people from getting conned off their hard-earned money.

5.3.4. Farmers Producing More Crops with Less Resources

According to stats, we will need to produce 50% more food by the year 2050 because we are consuming a lot. For this, farmers will have to produce crops while using their resources wisely.

Yet the question is how!

Blue River Technology, the subsidiary of American corporation John Deere figured out the solution by creating a robot called See and Spray. The robot uses object detection (a computer vision technology) to monitor and spray weedicide on cotton plants in precise amount.

Not only this, an agriculture startup called PEAT has created an app called Plantix that makes use of image recognition technology to identify potential defects and provide techniques, tips, and solutions.

So, you can realize how these little things can improve the agriculture industry and help us meet the crop requirements.

Fig 5.2 PyTorch Blue river robots.

5.3.5. We No Longer Have to Worry about Diseases

What if we can identify and prevent diseases even before they occur? We will live a lot longer.

You might have read this a hundred times till now. Yet the only question you find yourself asking is: “how is that possible?”

The answer is: With the power of AI.

A healthcare organization called **Cambio Health Care** has developed a clinical decision support system that warns a physician in advance when a patient is at the risk of having a heart stroke so that they can prevent it from happening by taking appropriate measures.

Another company called Coala life also created a digitalized device that can detect Cardiac diseases. Even another company called Aifloo is creating a system that will keep track on patients’ health in nursing homes and healthcare centers.

Fig 5.3 Coala Heart Monitor to detect cardiac diseases

These examples prove that we are not far from days when we no longer have to worry about finding a cure for new diseases. Instead, we can use existing cures to save more lives.

5.3.6. E-learning is Much Interactive & Fun Now

With an expected worth of over $325 billion by the year 2025, e-learning is one of the fastest-growing industries. However, keeping up with its pace is a real challenge.

There are millions of e-learning courses available. How many you think do receive the attention they deserve?

Thankfully, with the help of AI, designing interactive courses is easy these days. With features like learning pathways, personalized tutoring sessions, content analytics, targeted marketing, automatic grading, and real-time questioning — AI is changing the face of e-learning.

No wonder why platforms like Duolingo (30 million registered users) and Massive Open Online Courses (101 million registered users) are getting so popular.

Another interesting example of AI playing a critical role in e-learning is an online PM training website I recently found on the internet. It uses AI and behavior science for designing interactive courses of online training.

So, AI is truly reforming the fate of e-learning and online education, making it more fun and an interactive experience.

5.3.7. Solving Puzzles is No Longer a Challenge

We all love solving puzzles. However, staying stuck for hours while trying to solve them is something we would never want.

For example, I am addicted to Scrabble. However, it used to take a toll me because I could not think of enough words. The most frustrating part was that I used to lose every time I played.

However, with the scrabble word finder I recently found online, losing while playing this game is out of the question because I can easily find the best scoring words.

Not only this, AI is even helping historians solve ancient puzzles to restore and recreate historical artifacts from photos of fragments. Things like this can be a great contribution to mankind.

So, we are no far from days when there will no mystery that AI cannot uncover and no puzzle it can't solve.

5.3.8. We are Learning through Games

However, all thanks to AI, this notion is going to change soon. Games are using AI to train players and improve their skills.The game F.E.A.R (First Encounter Assault Recon) uses AI to train players. The actions of the opponent AI in this game are so unpredictable that it will train you throughout the game to never make the same mistakes. You get better as the game gets harder. No wonder people like it.

Another interesting example is Google DeepMind's AlphaZero which is taking the game of chess to the next level by defeating grandmasters like Gary Kasparov and Vladimir Kramnik. Similar is happening in the case of AlphaGo.

So, all thanks to AI, games are teaching us to expand our limits and improve like we never did before.

5.3.9. Fighting Hate Speech and Trolls on Social Media has Become Easy

Fighting hate speech and trolls on social media has been one of the biggest challenges to date. Not only tracking these trolls and hatemongers is difficult, but there is also little you can do about them.

Twitter was facing the same issue. So, it built an AI that can easily identify hate speech and terrorist language with the help of deep learning, machine learning, and natural language processing.

As a result, the social media mogul has banned over 300,000 terrorist accounts. Even Facebook and Instagram have also started using AI to over spammers, hatemongers, and trolls.

So, we are not far from days when fighting hate speech and trolls will not be a challenge anymore.

5.3.10. Athletes are Able to Enhance Their Performance

Being a sportsman demands sheer dedication and endless practice. However, sometimes just practicing alone is not enough. You have to combine it with the right strategy.

AI is helping athletes push their limits and accomplishing the impossible by breaking the game into small chunks and then studying it closely with the help of machine learning algorithms.

Not only this, the combination of sensor technology and AI is helping coaches improve players' techniques. It is also helping them prevent player injuries by keeping a close check on the levels of strain and exertion players are experiencing.

All these little things are helping players achieve impossible milestones and take their performance to whole new level.

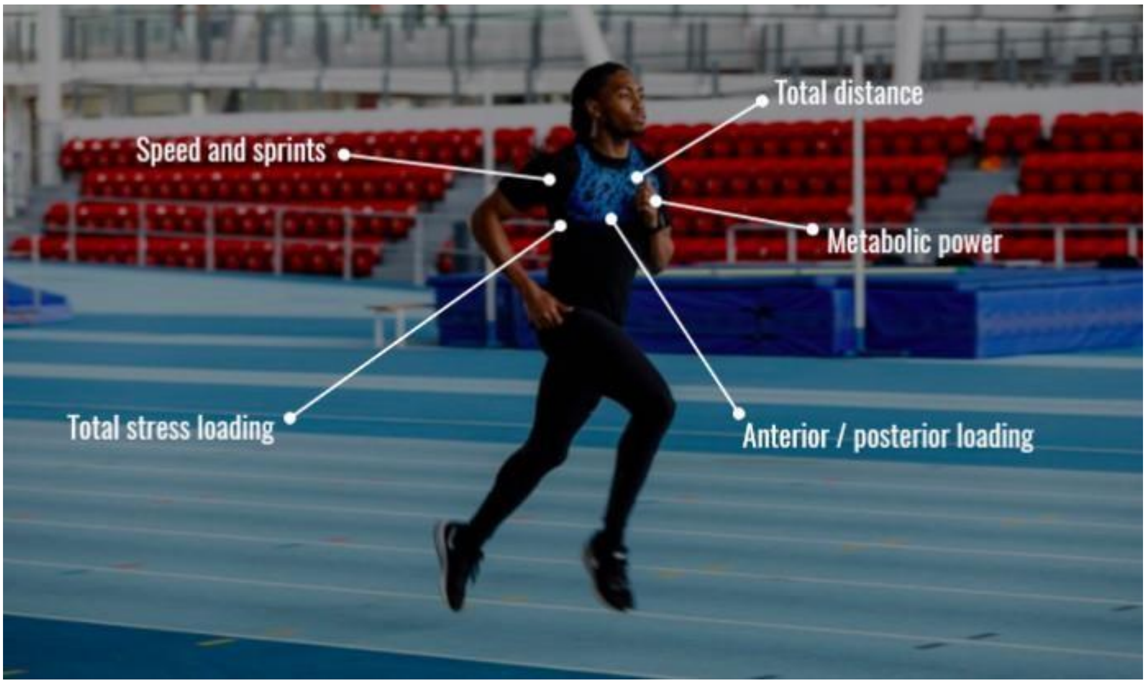


Fig 5.4 A.I. run sports wearable technology

5.4. Machine Learning Applications

The other aspect for classifying learning systems is the area of application which gives a new dimension for machine learning. Below are areas to which various existing learning systems have been applied. They are:

- Computer Programming
- Game playing (chess, poker, and so on)
- Image recognition, Speech recognition
- Medical diagnosis
- Agricultures
- Physics
- Email management
- Robotics
- Music
- Mathematics
- Natural Language Processing and many more.

CHAPTER 6

FUTURE DIRECTIONS

Research in Machine Learning Theory is a combination of attacking established fundamental questions, and developing new frameworks for modeling the needs of new machine learning applications. While it is impossible to know where the next breakthroughs will come, a few topics one can expect the future to hold include:

- Better understanding how auxiliary information, such as unlabeled data, hints from a user, or previously-learned tasks, can best be used by a machine learning algorithm to improve its ability to learn new things. Traditionally, Machine Learning Theory has focused on problems of learning a task (say, identifying spam) from labeled examples (email labeled as spam or not).
- However, often there is additional information available. One might have access to large quantities of unlabeled data (email messages not labeled by their type, or discussion-group transcripts on the web) that could potentially provide useful information. One might have other hints from the user besides just labels, e.g. highlighting relevant portions of the email message.
- Further developing connections to economic theory. As software agents based on machine learning are used in competitive settings, "strategic" issues become increasingly important.
- Most algorithms and models to date have focused on the case of a single learning algorithm operating in an environment that, while it may be changing, does not have its own motivations and strategies.
- However, if learning algorithms are to operate in settings dominated by other adaptive algorithms acting in their own users' interests, such as bidding on items or performing various kinds of negotiations, then we have a true merging of computer science and economic models.

CHAPTER 7

SUMMARY AND CONCLUSION

We have finished detail study of machine learning about its various aspects, history, overview and its classification. Various algorithms and methods included in AI and machine learning. Many real life and work problems associated with everyday lives and the various suggestions and solutions of the problems discussed for the same. Its future aspects and directions that could be done and are necessary for its development.

Machine Learning Theory is both a fundamental theory with many basic and compelling foundational questions, and a topic of practical importance that helps to advance the state of the art in software by providing mathematical frameworks for designing new machine learning algorithms. It is an exciting time for the field, as connections to many other areas are being discovered and explored, and as new machine learning applications bring new questions to be modeled and studied.

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