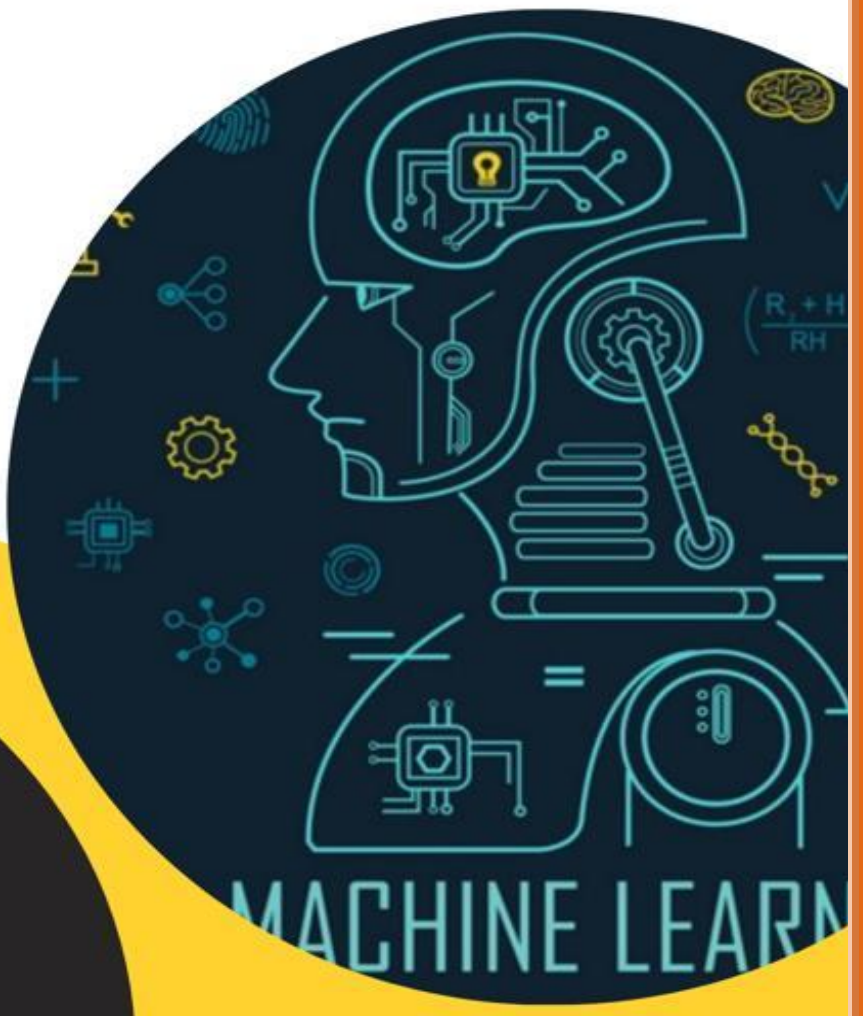
SANT HIRDARAM GIRLS COLLEGE
BHOPAL

DEPARTMENT OF COMPUTER SCIENCE

TECHMANIA



E- MAGAZINE

Vol. IX

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A legend human being, a noble soul and selfish charismatic person who dedicated whole of his life Serving the mankind, especially those who need support the most. A true visionary, he directed his magnanimous social work especially in the field of health & education. Excellent health care units and adorable education institutions established in the remote sub urban area of Bhopal erstwhile known as Bairagarh and now renamed as Sant Hirdaram Nagar are epitomes of his great deeds. His spiritual power & moral ethos continue inspiring us to uphold his ideas and philosophy.

We bow our heads in his lotus feet and our deep tributes to the great soul.

His Holiness Sant Hirdaram Sahibji's golden service philosophy states that

"The Old, the Infirm and the children are all forms of God.

Serve them with heart and soul and win laurels of the Lord."

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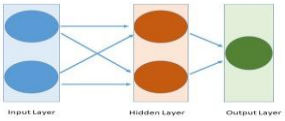
Deep Neural Network (DNN)

A Deep Neural Network (DNN) is an ANN with multiple hidden layers between the input and output layers. Similar to shallow ANNs, DNNs can model complex non-linear relationships.

The main purpose of a Neural Network is to receive a set of inputs, perform progressively complex calculations on them, and give output to solve real world problems like classification.

Deep Neural Networks (DNNs) are typically **Feed Forward Networks (FFNNs)** in which data flows from the input layer to the output layer without going backward and the links between the layers are one way which is in the forward direction and they never touch a node again.



The outputs are obtained by supervised learning with datasets of some information based on 'what we want' through back propagation.

Deep learning has produced good results for a few applications such as computer vision, language translation, image captioning, audio transcription, molecular biology, speech recognition, natural language processing, self-driving cars, brain tumour detection, real-time speech translation, music composition, automatic game playing and so on.

Deep learning is currently one of the best solution provider's fora wide range of real-world problems. Developers are building AI programs that, instead of using previously given rules, learn from examples to solve complicated tasks. With deep learning being used by many data scientists, deeper neural networks are delivering results that are ever more accurate.

The idea is to develop deep neural networks by increasing the number of training layers for each network; machine learns more about the data until it is as accurate as possible. Developers can use deep learning techniques to implement complex machine learning tasks, and train AI networks to have high levels of perceptual recognition.

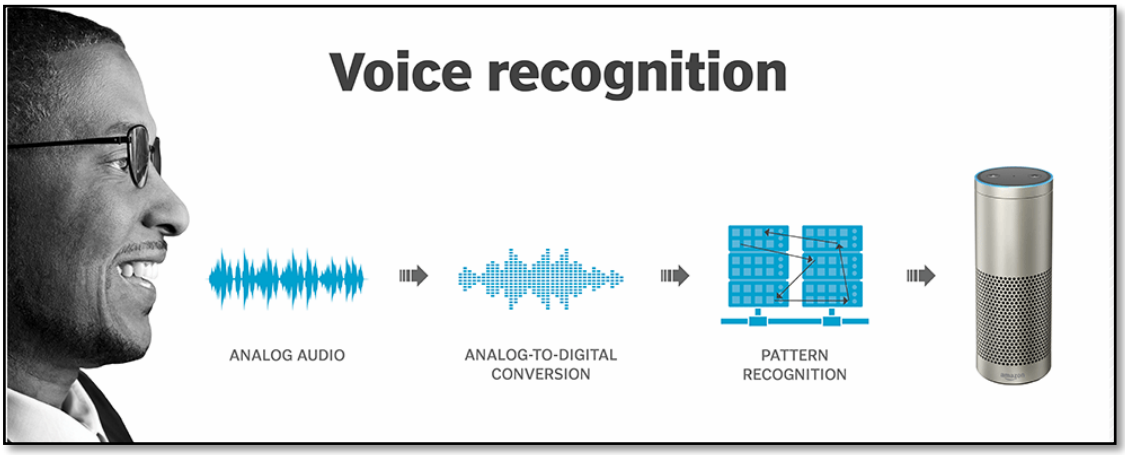
Deep learning finds its popularity in Computer vision. Here one of the tasks achieved is image classification where given input images are classified as cat, dog, etc. or as a class or label that best describe the image. We as humans learn how to do this task very early in our lives and have these skills of quickly recognizing patterns, generalizing from prior knowledge, and adapting to different image environments.

Dr. Dalima Parwani
Principal, SHGC

Speech Recognition in Machine Learning

Speech recognition is one of the fastest-growing engineering technologies. It has several applications in different areas, and provides many potential benefits. A lot of people are unable to communicate due to language barriers. While using Google, we get an option of "Search by voice," it comes under speech recognition, and it's a popular application of machine learning.

Speech recognition is a process of converting voice instructions into text, and it is also known as "Speech to text", or "Computer speech recognition." At present, machine learning algorithms are widely used by various applications of speech recognition. Google assistant, Siri, Cortana, and Alexa are using speech recognition technology to follow the voice instructions.



Algorithm is Used in Speech Recognition

The algorithms used in this form of technology include PLP features, Viterbi search, deep neural networks, discrimination training, WFST framework, etc. If you are interested in Google's new inventions, keep checking their recent publications on speech. The algorithms used by Google are available in an open-source format.

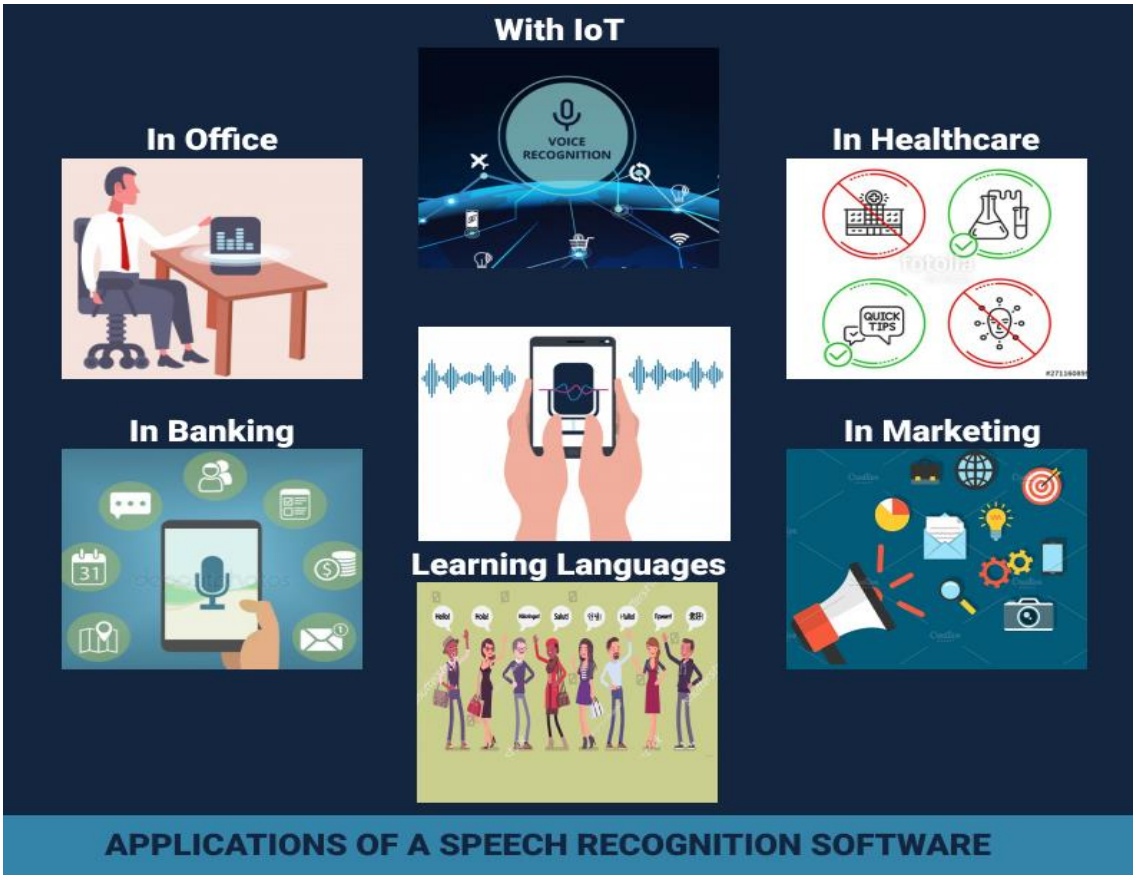
Advantages of the Speech Recognition System

- **Makes Work Processes More Efficient**
  Through the use of speech recognition, document processing becomes shorter and efficient. Documents can be generated within a short period quicker and faster than ever before as they are typed. The software also saves a great deal of employment of labour for documentation work.

- **Playing Back Simple Information**
  Nowadays customers want to have fast access to their queries. In many circumstances, customers do not want to speak to an operator. That moment, speech recognition can be used to provide basic information to the user.

- **Helping Aid for Visually and Hearing Impaired**
  People with visual and hearing impairments can highly rely on screen readers along with text-to-speech dictation systems. This software can help to convert audio into text which is regarded as critical for people having visual and hearing impairments.

- **Enables Hands-Free Communication**
  When your eyes and hands are unable to interact, then speech becomes incredibly powerful. Devices like Amazon's Alexa, Apple's Siri or Google Maps come to rescue to reduce misinterpreted navigation or communication.



Ms. Madhu Singh
HOD Dept. of Comp.Sci
SHGC

Machine Learning in Autonomous Vehicle

An autonomous vehicle, or a driverless vehicle, is one that is able to operate itself and perform necessary functions without any human intervention, through ability to sense its surroundings.

An autonomous vehicle utilizes a fully automated driving system in order to allow the vehicle to respond to external conditions that a human driver would manage.

Need of Autonomous Vehicle

- Government data identifies driver behavior or error as a factor in 94 percent of crashes, and self-driving vehicles can help reduce driver error.
- Higher levels of autonomy have the potential to reduce risky and dangerous driver behaviors. The greatest promise may be reducing the devastation of impaired driving, drugged driving, unbelted vehicle occupants, speeding and distraction.
- People with disabilities, like the blind, are capable of self-sufficiency, and highly automated vehicles can help them live the life they want.
- These vehicles can also enhance independence for seniors.
- Ride-sharing of HAVs could reduce costs of personal transportation, providing more affordable mobility.
- In the future, HAVs could offer the convenience of dropping vehicle occupants at their destination, whether an airport or shopping mall, while the vehicle parks itself.
- HAVs maintain a safe and consistent distance between vehicles, helping to reduce the number of stop-and-go waves that produce road congestion.
- Fewer traffic jams save fuel and reduce greenhouse gases from needless idling.

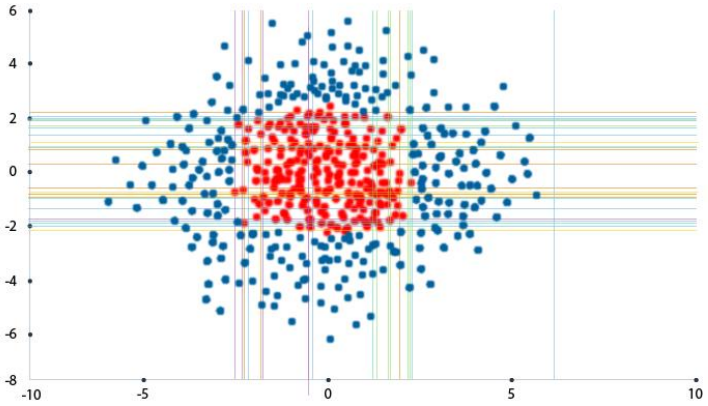
- Machine learning algorithms used by self-driving cars

SIFT (scale-invariant feature transform) for feature extraction

SIFT algorithms detect objects and interpret images. For example, for a triangular sign, the three points of the sign are entered as features. A car can then easily identify the sign using those points.

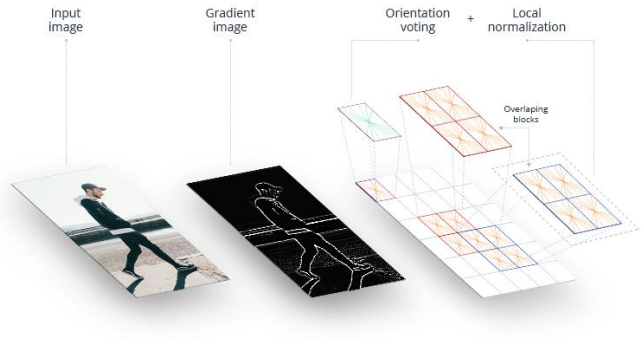
AdaBoost for data classification

This algorithm collects data and classifies it to boost the learning process and performance of vehicles. It groups different low-performing classifiers to get a single high-performing classifier for better decision-making.



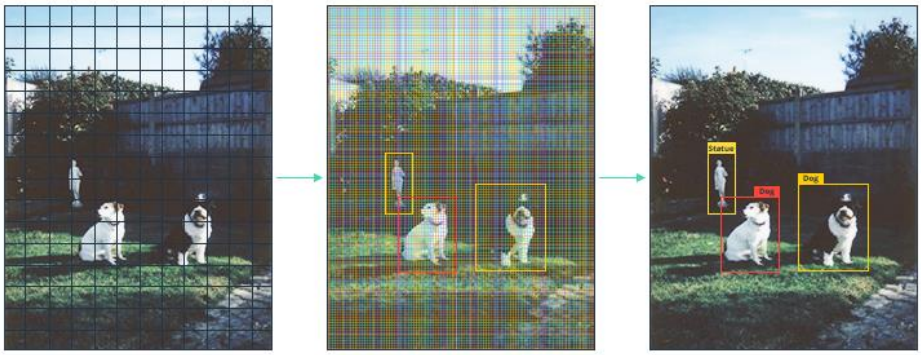
Histogram of oriented gradients (HOG)

HOG facilitates the analysis of an object's location, called a cell, to find out how the object changes or moves.



YOLO (You Only Look Once)

This algorithm detects and groups objects like humans, trees, and vehicles. It assigns specific features to each class of object that it groups to help the car easily identify them. YOLO is best for identifying and grouping objects.



Machine learning algorithms make it possible for self-driving cars to exist. They allow a car to collect data on its surroundings from cameras and other sensors, interpret it, and decide what actions to take. Machine learning even allows cars to learn how to perform these tasks as better as humans.

Ms. Reeta Budhani
Asst. Professor Dept. of Comp.Sci
SHGC

Real world Applications of Machine Learning

Artificial Intelligence (AI) is everywhere. Possibility is that you are using it in one way or the other and you don't even know about it. One of the popular applications of AI is Machine Learning (ML), in which computers, software, and devices perform via cognition (very similar to human brain). Herein, we share few examples of machine learning that we use every day and perhaps have no idea that they are driven by ML.

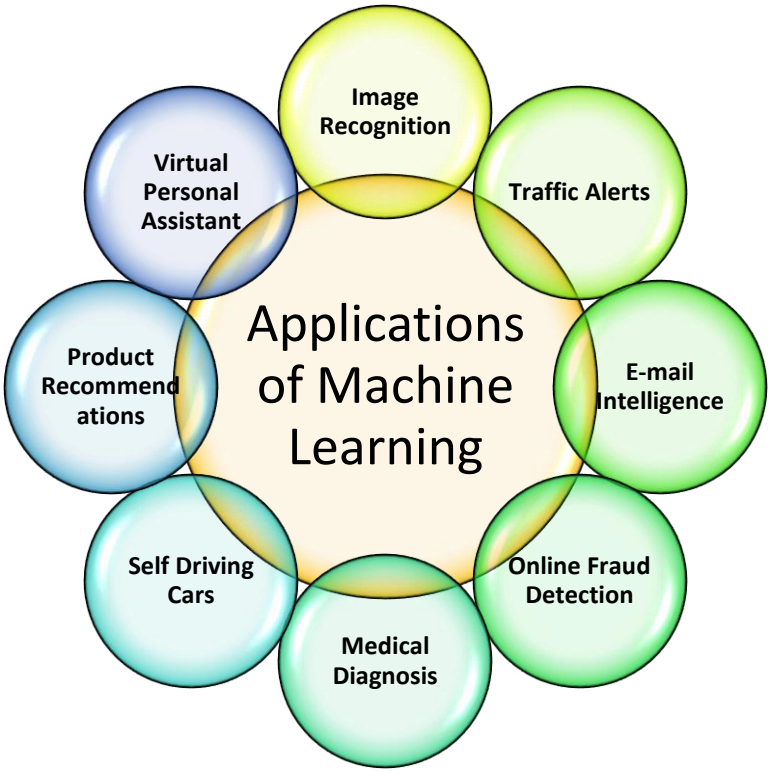


Image Recognition

Image recognition is one of the most common applications of machine learning. It is used to identify objects, persons, places, digital images, etc. The popular use case of image recognition and face detection is, **Automatic friend tagging suggestion**:

Facebook provides us a feature of auto friend tagging suggestion. Whenever we upload a photo with our Facebook friends, then we automatically get a tagging suggestion with name, and the technology behind this is machine learning's **face detection** and **recognition algorithm**. It is based on the Facebook project named "**Deep Face**," which is responsible for face recognition and person identification in the picture.

Traffic Alerts Now, **Google Maps** is probably **THE** app we use whenever we go out and require assistance in directions and traffic. The other day I was traveling to another city and took the expressway and Maps suggested: "***Despite the Heavy Traffic, you are on the fastest route***". But, **How does it know that?**

Well, It's a combination of People currently using the service, Historic Data of that route collected over time and few tricks acquired from other companies. Everyone using maps is providing their location, average speed, the route in which they are traveling which in turn helps Google collect massive Data about the traffic, which makes them predict the upcoming traffic and adjust your route according to it.

E-mail Intelligence

1. **Spam Filters:** Some rules-based filters aren't served actively in an email inbox such as when, for example, a message comes with the words "online consultancy", "online pharmacy", or from "unknown address".

   ML is offering a powerful feature that filters email from a variety of signals, like words in the message, metadata of the message (such as who sent the message, from where it is sent). Even though it filters the emails based on "everyday deals" or "welcome messages" etc. With the use of ML, Gmail filters 99.9% of spam messages.

2. **Email Classification:** Gmail categories emails into groups Primary, Promotions, Social, and Update and label the email as important.

3. **Smart Replies:** You must have observed how Gmail prompts simple phrases to respond to emails like "Thank You", "Alright", "Yes, I'm interested". These responses are customized per email when ML and AI understand, estimate, and reflect on how one counters over time.

Online Fraud Detection

Machine learning is proving its potential to make cyberspace a secure place and tracking monetary frauds online is one of its examples. For example: Paypal is using ML for protection against money laundering. The company uses a set of tools that helps them to compare millions of transactions taking place and distinguish between legitimate or illegitimate transactions taking place between the buyers and sellers.

Medical Diagnosis

Machine Learning incorporates a soup of techniques and tools to deal with the diagnostic and prognostic issues in the diverse medical realms. ML algorithms are highly used for;

- *The analysis of medical data for detecting regularities in data,*
- *Handling inappropriate data,*
- *Explaining data generated by medical units,*
- *Also for effective monitoring of patients.*

Machine learning also helps i*n estimating disease breakthroughs, driving medical information for outcomes research, planning and assisting therapy, and entire patient management.*

Self-Driving Cars

One of the most exciting applications of machine learning is self-driving cars. Machine learning plays a significant role in self-driving cars. Tesla, the most popular car manufacturing company is working on self-driving car. It is using unsupervised learning method to train the car models to detect people and objects while driving.

Product Recommendations

Machine learning is widely used by various e-commerce and entertainment companies such as **Amazon**, **Netflix**, etc., for product recommendation to the user. Whenever we search for some product on Amazon, then we started getting an advertisement for the same product while internet surfing on the same browser and this is because of machine learning.

Google understands the user interest using various machine learning algorithms and suggests the product as per customer interest.

As similar, when we use Netflix, we find some recommendations for entertainment series, movies, etc., and this is also done with the help of machine learning.

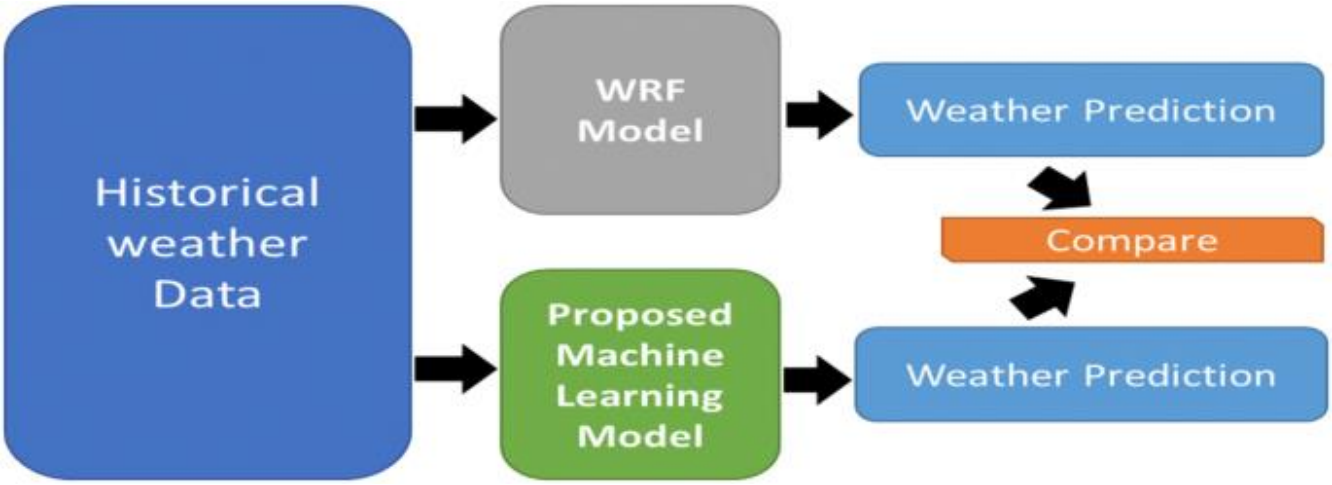
Virtual Personal Assistant

As the name suggests, Virtual Personal Assistants assist in finding useful information, when asked via text or voice. Few of the major applications of Machine Learning here are:

- Speech Recognition
- Speech to Text Conversion
- Natural Language Processing
- Text to Speech Conversion

Dr. Meenu Tahilyani
Asst. Professor Dept. of Comp.Sci
SHGC

Machine Learning in Weather Forecasting



Weather forecasting, the prediction of the weather through application of the principles of physics, supplemented by a variety of statistical and empirical techniques.

A forecast of heavy rainfall two days in advance is now as good as a same-day forecast was in the mid-1990s. Errors in the predicted tracks of hurricanes have been cut in half in the last 30 years.

There still are major challenges. Thunderstorms that produce tornadoes, large hail or heavy rain remain difficult to predict. And then there's chaos, often described as the "butterfly effect" – the fact that small changes in complex processes make weather less predictable. Chaos limits our ability to make precise forecasts beyond about 10 days.

As in many other scientific fields, the proliferation of tools like artificial intelligence and machine learning holds great promise for weather prediction. We have seen some of what's possible in our research on applying machine learning to forecasts of high-impact weather. But we also believe that while these tools open up new possibilities for better forecasts, many parts of the job are handled more skillfully by experienced people.

Predictions based on storm history

Today, weather forecasters' primary tools are numerical weather prediction models. These models use observations of the current state of the atmosphere from sources such as weather stations, weather balloons and satellites, and solve equations that govern the motion of air.

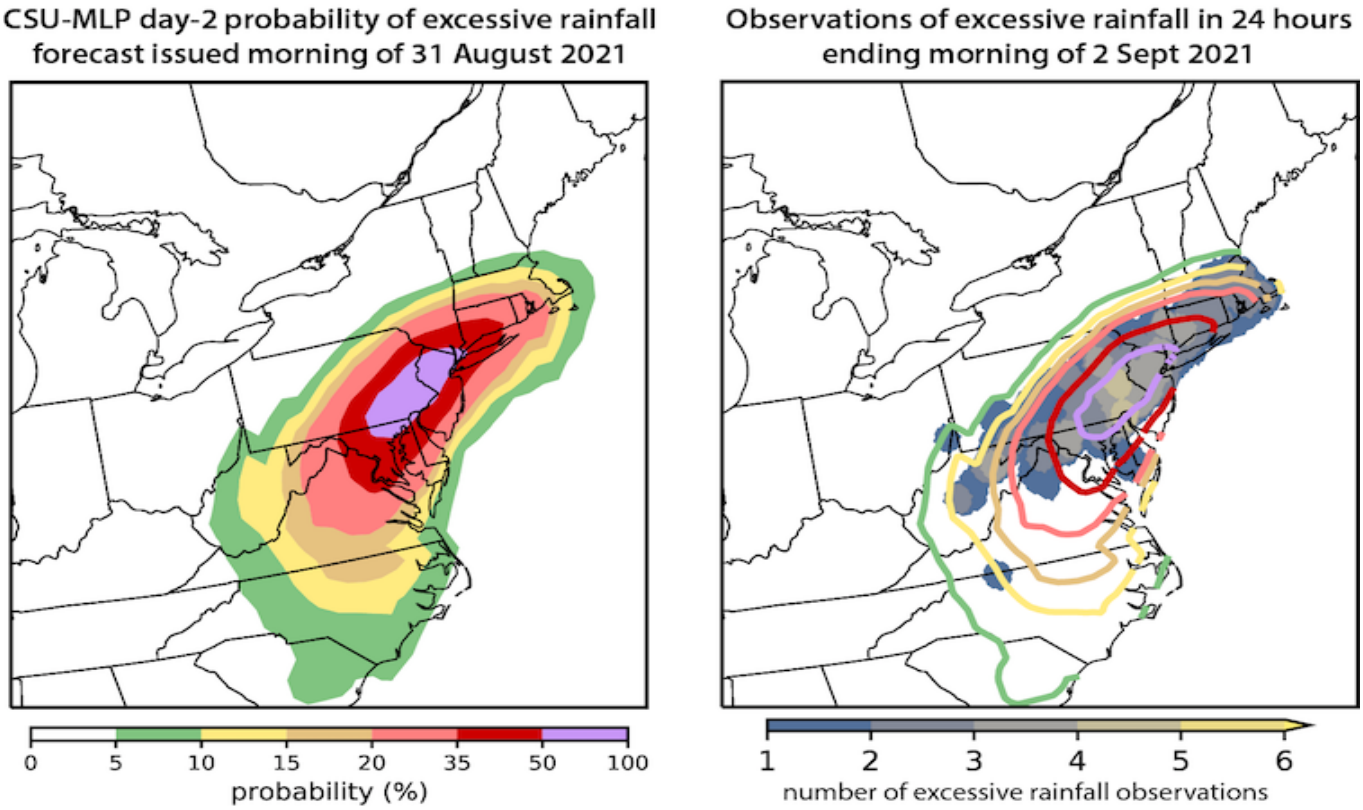
These models are outstanding at predicting most weather systems, but the smaller a weather event is, the more difficult it is to predict. As an example, think of a thunderstorm that dumps

Heavy rain on one side of town and nothing on the other side. Furthermore, experienced forecasters are remarkably good at synthesizing the huge amounts of weather information they have to consider each day, but their memories and bandwidth are not infinite.

Artificial intelligence and machine learning can help with some of these challenges. Forecasters are using these tools in several ways now, including making predictions of high-impact weather that the models can't provide.

In a project that started in 2017 and was reported in a 2021 paper, we focused on heavy rainfall. Of course, part of the problem is defining "heavy": Two inches of rain in New Orleans may mean something very different than in Phoenix. We accounted for this by using observations of unusually large rain accumulations for each location across the country, along with a history of forecasts from a numerical weather prediction model.

We plugged that information into a machine learning method known as "random forests," which uses many decision trees to split a mass of data and predict the likelihood of different outcomes. The result is a tool that forecasts the probability that rains heavy enough to generate flash flooding will occur.



Some studies have shown that machine learning-based forecast systems can predict general weather patterns as well as numerical weather prediction models while using only a fraction of the computing power the models require. These new tools don't yet forecast the details of

local weather that people care about, but with many researchers carefully testing them and inventing new methods, there is promise for the future.

AI can reduce the workload of meteorologists, thereby improving the accuracy of weather forecasts. The speed and accuracy of AI technologies when it comes to processing data in extreme weather conditions means that scientists will have a better chance of alerting people in danger.

Today, high-performance computing is more accessible from a cost perspective, thanks to the evolution of cloud computing. This boosts the potential of leveraging AI to predict weather conditions more accurately and consistently. Truckloads of data can be analysed using a diverse range of models powered by several algorithms in a matter of seconds to uncover granular details about weather patterns.

Using a convolutional neural network, the authors developed a machine learning weather prediction system called Deep Learning Weather Prediction (DLWP). The model is trained on past weather data, which differs from standard numerical weather prediction models that create mathematical representations of physical laws.

The role of human expertise

There are also reasons for caution. Unlike numerical weather prediction models, forecast systems that use machine learning are not constrained by the physical laws that govern the atmosphere. So it's possible that they could produce unrealistic results – for example, forecasting temperature extremes beyond the bounds of nature. And it is unclear how they will perform during highly unusual or unprecedented weather phenomena.

And relying on AI tools can raise ethical concerns. For instance, locations with relatively few weather observations with which to train a machine learning system may not benefit from forecast improvements that are seen in other areas.

Another central question is how best to incorporate these new advances into forecasting. Finding the right balance between automated tools and the knowledge of expert human forecasters has long been a challenge in meteorology. Rapid technological advances will only make it more complicated.

A machine learning-based weather forecasting model was proposed, the model was implemented using 4 classifier algorithms which include Random Forest classifier, Decision Tree Algorithm, Gaussian Naïve Bayes model, Gradient Boosting Classifier, these algorithms were trained using a publicly available ECMWF weather model (European Centre for

Medium-Range Weather Forecasts) The ECMWF is a European global forecast seamless model and it is widely regarded as the best and most reliable model currently in existence.

Forecasting is a task and supervised learning describes a certain type of algorithm. So, saying that "forecasting belong to supervised learning" is incorrect. However, you can use supervised learning algorithms on forecasting tasks, even though this has well-known pitfalls you should be aware of. There are limitations for present AI models such as limited data availability for certain weather conditions, gated information highways set up by certain countries, differences in technology and hardware standards used by weather systems across different countries, and so on.

As with any sector, AI in weather forecasting is not a fully developed ecosystem. It is continuously evolving as more countries and private organizations invest in building better data governance and information exchange systems globally for seamless weather prediction capabilities. There are limitations for present AI models such as limited data availability for certain weather conditions, gated information highways set up by certain countries, differences in technology and hardware standards used by weather systems across different countries, and so on.

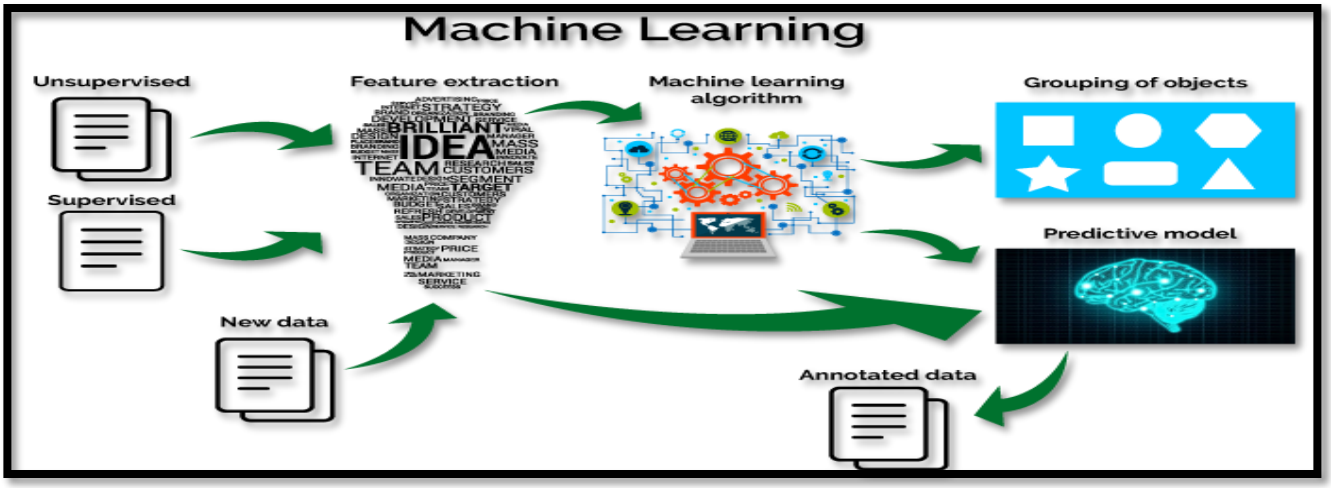
However, over time, AI will be a key pillar in enabling mankind to predict and handle nature’s fiercest avatars and create widespread socio-economic safety frameworks globally against weather uncertainties.

Ms. Sonia Sharma
Asst. Professor Dept. of Comp. Sci
SHGC

Machine Learning

What is Machine Learning?

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. The main aim is to allow the computers learn automatically without human interference or support and adjust actions accordingly.

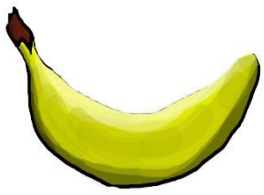


Categories of Machine Learning Algorithms:

Supervised learning: Supervised learning as the name indicates a presence of supervisor as teacher. It is a learning in which we teach or train the machine using data which is well labeled that means some data is already tagged with correct answer.

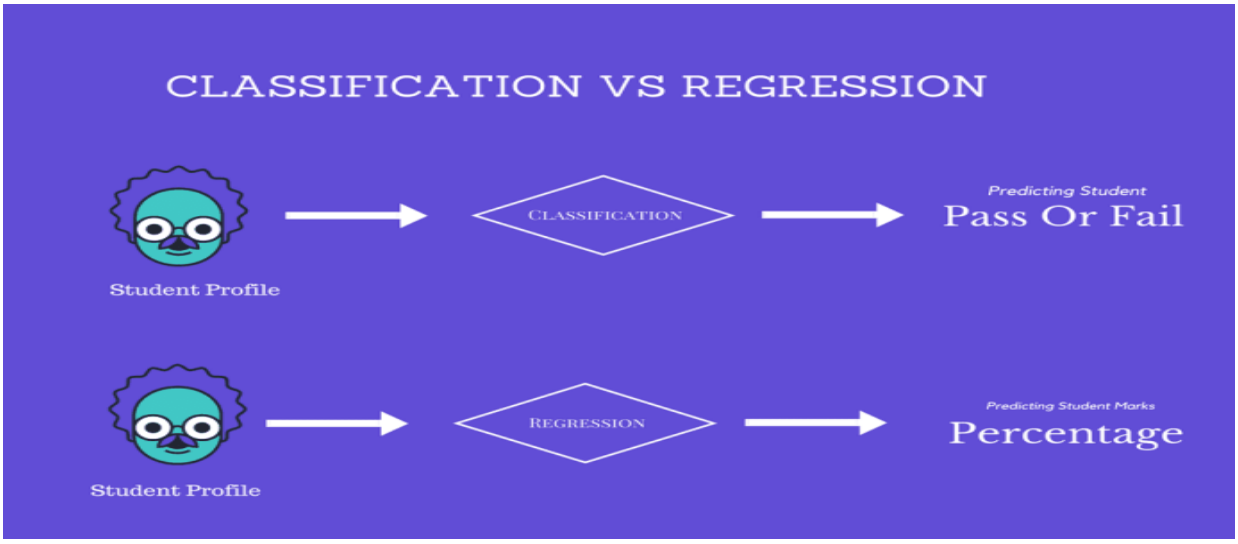
For example, suppose you are given a basket filled with different types of fruits. Now the first step is to train the machine with all different fruits one by one like this:

- If shape of object is rounded and despair at top having color Red then it will be labelled as –**Apple**.
- If shape of object is long curving cylinder having color Green-Yellow then it will be labelled as –**Banana**.



Now assume after training the data, you have given a new distinct fruit say Banana from basket and asked to identify it. Since machine has already learnt the things from previous data. It will first classify the fruit with its shape and color, and would confirm the fruit name as BANANA. Thus machine learns the things from training data (basket containing fruits) and then apply the knowledge to test data (new fruit).

Supervised learning classified into two categories of algorithms:

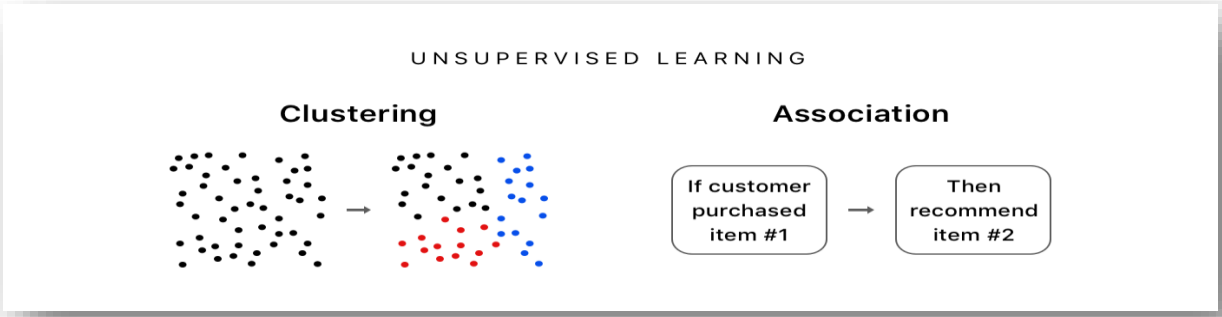


Unsupervised learning: Unsupervised learning is the training of machine using information

that is neither classified nor labeled and allowing the algorithm to act on that information without guidance. It is used for clustering population in different groups. Unsupervised learning can be a goal in itself (discovering hidden patterns in data).

For Example: suppose it is given an image having both dogs and cats which have not seen ever. Thus machine has no any idea about the features of dogs and cat so we can't categorize it in dogs and cats. But it can categorize them according to their similarities, patterns and differences.

<u>Unsupervised learning classified into two categories of algorithms:</u>



Ms. Manju Devnani
Asst. Professor Dept. of Comp.Sci
SHGC

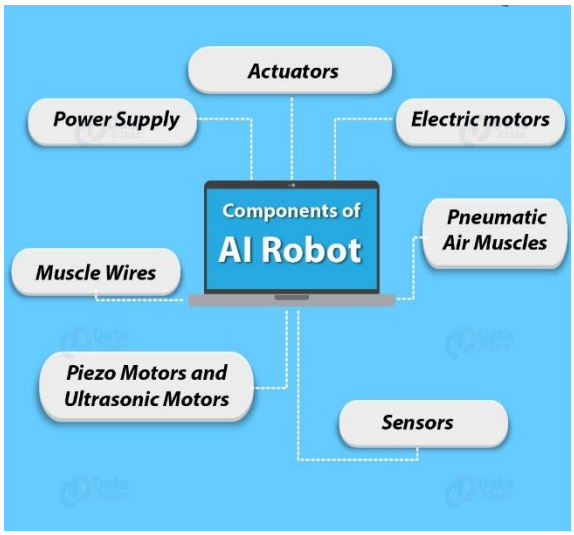
Robotics - Artificial Intelligence

Robotics is a branch of AI, which is composed of different branches and application of robots.
AI Robots are the artificial agents acting in the real-world environment.

Aspects of Robotics

- The robots have **mechanical construction**, form, or shape designed to accomplish a particular task.
- They have **electrical components** which power and control the machinery.
- They contain some level of **computer program** that determines what, when and how a robot does something.

Components of AI Robot



a. Power Supply: As AI robots are powered by batteries, solar power, hydraulic.

b. Actuators: We use this to convert energy into movement.

c. Electric motors (AC/DC): We need this for the rotational movement.

d. Pneumatic Air Muscles: As we can say that they contract almost 40% when the air is sucked in them.

e. Muscle Wires: Although, we have noticed that it contract by 5% when an electric current is passed through them.

f. Piezo Motors and Ultrasonic Motors: we use it for industrial robots.
g. Sensors: Generally, we use it in task environment. As it provides information of real-time knowledge.

Robot Locomotion

Locomotion is the mechanism that makes a robot capable of moving in its environment. There are various types of locomotion −

- Legged
- Wheeled
- Combination of Legged and Wheeled Locomotion
- Tracked slip/skid

Legged Locomotion

- This type of locomotion consumes more power while demonstrating walk, jump, trot, hop, climb up or down, etc.
- It requires more number of motors to accomplish a movement. It is suited for rough as well as smooth terrain where irregular or too smooth surface makes it consume more power for a wheeled locomotion. It is little difficult to implement because of stability issues.
- It comes with the variety of one, two, four, and six legs. If a robot has multiple legs then leg coordination is necessary for locomotion.

The total number of possible **gaits** (a periodic sequence of lift and release events for each of the total legs) a robot can travel depends upon the number of its legs.
If a robot has k legs, then the number of possible events N = (2k-1)!.
In case of a two-legged robot (k=2), the number of possible events is N = (2k-1)! = (2*2-1)! = 3! = 6.
Hence there are six possible different events −

- Lifting the Left leg
- Releasing the Left leg
- Lifting the Right leg
- Releasing the Right leg
- Lifting both the legs together
- Releasing both the legs together

In case of k=6 legs, there are 39916800 possible events. Hence the complexity of robots is directly proportional to the number of legs.

Wheeled Locomotion

It requires fewer number of motors to accomplish a movement. It is little easy to implement as there are less stability issues in case of more number of wheels. It is power efficient as compared to legged locomotion.

- **Standard wheel** − Rotates around the wheel axle and around the contact
- **Castor wheel** − Rotates around the wheel axle and the offset steering joint.
- **Swedish 45º and Swedish 90º wheels** − Omni-wheel, rotates around the contact point, around the wheel axle, and around the rollers.
- **Ball or spherical wheel** − Omnidirectional wheel, technically difficult to implement.

Slip/Skid Locomotion

In this type, the vehicles use tracks as in a tank. The robot is steered by moving the tracks with different speeds in the same or opposite direction. It offers stability because of large contact area of track and ground.

Applications of Artificial Intelligence Robotics

a. Industries: we use AI robot in industries for various purposes. Such as handling material, cutting, welding, color coating, drilling, polishing, etc.
b. Medicine: AI Robots are very helpful. As they are capable of carrying out hundreds of clinical tests.
c. Exploration: rock climbing, space exploration we use AI robot.
d. Entertainment: movie making, Disney's engineers have created hundreds of AI robot.

Ms. Geeta Guwalani
Asst. Professor Dept. of Comp.Sci
SHGC