**DEEP LEARNING (DL)**

Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind driverless cars, enabling them to recognize a stop sign, or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. Deep learning is getting lots of attention lately and for good reason. It’s achieving results that were not possible before.

In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labeled data and neural network architectures that contain many layers.

### How does deep learning attain such impressive results?

In a word, accuracy. Deep learning achieves recognition accuracy at higher levels than ever before. This helps consumer electronics meet user expectations, and it is crucial for safety-critical applications like driverless cars. Recent advances in deep learning have improved to the point where deep learning outperforms humans in some tasks like classifying objects in images.

While deep learning was first theorized in the 1980s, there are two main reasons it has only recently become useful:

1. Deep learning requires large amounts of **labeled data**. For example, driverless car development requires millions of images and thousands of hours of video.
2. Deep learning requires substantial **computing power**. High-performance GPUs have a parallel architecture that is efficient for deep learning. When combined with clusters or cloud computing, this enables development teams to reduce training time for a deep learning network from weeks to hours or less.

### Examples of Deep Learning at Work

Deep learning applications are used in industries from automated driving to medical devices. Automated Driving: Automotive researchers are using deep learning to automatically detect objects such as stop signs and traffic lights. In addition, deep learning is used to detect pedestrians, which helps decrease accidents. Aerospace and Defense: Deep learning is used to identify objects from satellites that locate areas of interest, and identify safe or unsafe zones for troops.

Medical Research: Cancer researchers are using deep learning to automatically detect cancer cells. Teams at UCLA built an advanced microscope that yields a high-dimensional data set used to train a deep learning application to accurately identify cancer cells. Industrial Automation: Deep learning is helping to improve worker safety around heavy machinery by automatically detecting when people or objects are within an unsafe distance of machines.

Electronics: Deep learning is being used in automated hearing and speech translation. For example, home assistance devices that respond to your voice and know your preferences are powered by deep learning applications.

**How Deep Learning Works**

Most deep learning methods use neural network architectures, which is why deep learning models are often referred to as deep neural networks.

The term “deep” usually refers to the number of hidden layers in the neural network. Traditional neural networks only contain 2-3 hidden layers, while deep networks can have as many as 150.

Deep learning models are trained by using large sets of labeled data and neural network architectures that learn features directly from the data without the need for manual feature extraction.

One of the most popular types of deep neural networks is known as convolutional neural networks (CNN or ConvNet). A CNN convolves learned features with input data, and uses 2D convolutional layers, making this architecture well suited to processing 2D data, such as images.

CNNs eliminate the need for manual feature extraction, so you do not need to identify features used to classify images. The CNN works by extracting features directly from images. The relevant features are not pretrained; they are learned while the network trains on a collection of images. This automated feature extraction makes deep learning models highly accurate for computer vision tasks such as object classification.

CNNs learn to detect different features of an image using tens or hundreds of hidden layers. Every hidden layer increases the complexity of the learned image features. For example, the first hidden layer could learn how to detect edges, and the last learns how to detect more complex shapes specifically catered to the shape of the object we are trying to recognize.

**What's the Difference Between Machine Learning and Deep Learning?**

Deep learning is a specialized form of machine learning. A machine learning workflow starts with relevant features being manually extracted from images. The features are then used to create a model that categorizes the objects in the image. With a deep learning workflow, relevant features are automatically extracted from images. In addition, deep learning performs “end-to-end learning” – where a network is given raw data and a task to perform, such as classification, and it learns how to do this automatically.

Another key difference is deep learning algorithms scale with data, whereas shallow learning converges. Shallow learning refers to machine learning methods that plateau at a certain level of performance when you add more examples and training data to the network.

A key advantage of deep learning networks is that they often continue to improve as the size of your data increases.

**Case Study on Harley Davidson**

The place we are in today is where it is difficult to break through traditional marketing. For a business like – Harley Davidson NYC, Albert (an artificial intelligence-powered robot) has a lot of appeal. Powered by machine learning and artificial intelligence*, robots are writing news stories, working in hotels, managing traffic, and even running McDonald’s.*

Albert can be applied to various marketing channels including social media and email. The software predicts which consumers are most likely to convert and adjusts personal creative copies on its own.

Harley Davidson is the only brand to make use of Albert. The company analyzed customer data to determine the behavior of previous customers whose actions were positive in terms of purchasing and spending more than the average amount of time on browsing through the website. With this information, Albert created segments of customers and scaled up the test campaigns accordingly.

Results show that Harley Davidson increased its sales by 40% with the use of Albert. The brand also had a 2,930% increase in leads, with 50% of those from high converting ‘lookalikes’ identified by artificial intelligence and machine learning.

**KEY WORDS :**

**Convolutional Neural Network –**

A convolutional neural network (CNN or ConvNet) is one of the most popular algorithms for deep learning, a type of machine learning in which a model learns to perform classification tasks directly from images, video, text, or sound.

CNNs are particularly useful for finding patterns in images to recognize objects, faces, and scenes. They learn directly from image data, using patterns to classify images and eliminating the need for manual feature extraction.

**Deep belief network -**

In machine learning, a **deep belief network** (**DBN**) is a generative graphical model, or alternatively a class of deep neural network, composed of multiple layers of latent variables ("hidden units"), with connections between the layers but not between units within each layer.

When trained on a set of examples without supervision, a DBN can learn to probabilistically reconstruct its inputs. The layers then act as feature detectors. After this learning step, a DBN can be further trained with supervision to perform classification.

**Artificial neural networks-**

A neural network is a computing model whose layered structure resembles the networked structure of neurons in the brain, with layers of connected nodes. A neural network can learn from data so it can be trained to recognize patterns, classify data, and forecast future events.

A neural network breaks down your input into layers of abstraction. It can be trained over many examples to recognize patterns in speech or images, for example, just as the human brain does. Its behavior is defined by the way its individual elements are connected and by the strength, or weights, of those connections. These weights are automatically adjusted during training according to a specified learning rule until the neural network performs the desired task correctly.

**Feature extraction-**

Feature extraction for compact representation of image data in computer vision. Feature extraction a type of dimensionality reduction that efficiently represents interesting parts of an image as a compact feature vector. This approach is useful when image sizes are large and a reduced feature representation is required to quickly complete tasks such as image matching and retrieval.

Feature detection, feature extraction, and matching are often combined to solve common computer vision problems such as object detection and recognition, content-based image retrieval, face detection and recognition, and texture classification.

**INTERNET OF THINGS(IOT)**

In a nutshell, the Internet of Things is the concept of connecting any device (so long as it has an on/off switch) to the Internet and to other connected devices. The IoT is a giant network of connected things and people – all of which collect and share data about the way they are used and about the environment around them.

That includes an extraordinary number of objects of all shapes and sizes – from smart microwaves, which automatically cook your food for the right length of time, to self-driving cars, whose complex sensors detect objects in their path, to wearable fitness devices that measure your heart rate and the number of steps you’ve taken that day, then use that information to suggest exercise plans tailored to you. There are even connected footballs that can track how far and fast they are thrown and record those statistics via an app for future training purposes.

How does it work?

Devices and objects with built in sensors are connected to an Internet of Things platform, which integrates data from the different devices and applies analytics to share the most valuable information with applications built to address specific needs.

These powerful IoT platforms can pinpoint exactly what information is useful and what can safely be ignored. This information can be used to detect patterns, make recommendations, and detect possible problems before they occur.

For example, if I own a car manufacturing business, I might want to know which optional components (leather seats or alloy wheels, for example) are the most popular. Using Internet of Things technology, I can:

* Use sensors to detect which areas in a showroom are the most popular, and where customers linger longest;
* Drill down into the available sales data to identify which components are selling fastest;
* Automatically align sales data with supply, so that popular items don’t go out of stock.

The information picked up by connected devices enables me to make smart decisions about which components to stock up on, based on real-time information, which helps me save time and money.

With the insight provided by advanced analytics comes the power to make processes more efficient. Smart objects and systems mean you can automate certain tasks, particularly when these are repetitive, mundane, time-consuming or even dangerous. Let’s look at some examples to see what this looks like in real life.

**Scenario 1: IoT in your home**

Imagine you wake up at 7am every day to go to work. Your alarm clock does the job of waking you just fine. That is, until something goes wrong. Your train’s cancelled and you have to drive to work instead. The only problem is that it takes longer to drive, and you would have needed to get up at 6.45am to avoid being late. Oh, and it’s pouring with rain, so you’ll need to drive slower than usual. A connected or IoT-enabled alarm clock would reset itself based on all these factors, to ensure you got to work on time. It could recognize that your usual train is cancelled, calculate the driving distance and travel time for your alternative route to work, check the weather and factor in slower travelling speed because of heavy rain, and calculate when it needs to wake you up so you’re not late. If it’s super-smart, if might even sync with your IoT-enabled coffee maker, to ensure your morning caffeine’s ready to go when you get up.

**Scenario 2: IoT in transport**

Having been woken by your smart alarm, you’re now driving to work. On comes the engine light. You’d rather not head straight to the garage, but what if it’s something urgent? In a connected car, the sensor that triggered the check engine light would communicate with others in the car. A component called the diagnostic bus collects data from these sensors and passes it to a gateway in the car, which sends the most relevant information to the manufacturer’s platform. The manufacturer can use data from the car to offer you an appointment to get the part fixed, send you directions to the nearest dealer, and make sure the correct replacement part is ordered so it’s ready for you when you show up.

**ARTIFICIAL INTELLIGENCE (AI)**

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.

The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal.

**Understanding Artificial Intelligence :**

When most people hear the term artificial intelligence, the first thing they usually think of is robots. That's because big-budget films and novels weave stories about human-like machines that wreak havoc on Earth. But nothing could be further from the truth.

Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the most simple to those that are even more complex. The goals of artificial intelligence include learning, reasoning, and perception.

As technology advances, previous benchmarks that defined artificial intelligence become outdated. For example, machines that calculate basic functions or recognize text through optimal character recognition are no longer considered to embody artificial intelligence, since this function is now taken for granted as an inherent computer function.

AI is continuously evolving to benefit many different industries. Machines are wired using a cross-disciplinary approach based in mathematics, computer science, linguistics, psychology, and more.

NOTE : Algorithms often play a very important part in the structure of artificial intelligence, where simple algorithms are used in simple applications, while more complex ones help frame strong artificial intelligence.

**Applications of Artificial Intelligence :**

The applications for artificial intelligence are endless. The technology can be applied to many different sectors and industries. AI is being tested and used in the healthcare industry for dosing drugs and different treatment in patients, and for surgical procedures in the operating room.

Other examples of machines with artificial intelligence include computers that play chess and self-driving cars. Each of these machines must weigh the consequences of any action they take, as each action will impact the end result. In chess, the end result is winning the game. For self-driving cars, the computer system must account for all external data and compute it to act in a way that prevents a collision.

Artificial intelligence also has applications in the financial industry, where it is used to detect and flag activity in banking and finance such as unusual debit card usage and large account deposits—all of which help a bank's fraud department. Applications for AI are also being used to help streamline and make trading easier. This is done by making supply, demand, and pricing of securities easier to estimate.

**KEY TAKEAWAYS**

* Artificial intelligence refers to the simulation of human intelligence in machines.
* The goals of artificial intelligence include learning, reasoning, and perception.
* AI is being used across different industries including finance and healthcare.
* Weak AI tends to be simple and single-task oriented, while strong AI carries on tasks that are more complex and human-like.

**Categorization of Artificial Intelligence**

Artificial intelligence can be divided into two different categories: weak and strong. **Weak artificial intelligence** embodies a system designed to carry out one particular job. Weak AI systems include video games such as the chess example from above and personal assistants such as Amazon's Alexa and Apple's Siri. You ask the assistant a question, it answers it for you.

**Strong artificial intelligence** systems are systems that carry on the tasks considered to be human-like. These tend to be more complex and complicated systems. They are programmed to handle situations in which they may be required to problem solve without having a person intervene. These kinds of systems can be found in applications like self-driving cars or in hospital operating rooms.

Special Considerations

Since its beginning, artificial intelligence has come under scrutiny from scientists and the public alike. One common theme is the idea that machines will become so highly developed that humans will not be able to keep up and they will take off on their own, redesigning themselves at an exponential rate.

Another is that machines can hack into people's privacy and even be weaponized. Other arguments debate the ethics of artificial intelligence and whether intelligent systems such as robots should be treated with the same rights as humans.

Self-driving cars have been fairly controversial as their machines tend to be designed for the lowest possible risk and the least casualties. If presented with a scenario of colliding with one person or another at the same time, these cars would calculate the option that would cause the least amount of damage.

Another contentious issue many people have with artificial intelligence is how it may affect human employment. With many industries looking to automate certain jobs through the use of intelligent machinery, there is a concern that people would be pushed out of the workforce. Self-driving cars may remove the need for taxis and car-share programs, while manufacturers may easily replace human labor with machines, making people's skills more obsolete.

**KEY WORDS :**

**Strong artificial intelligence :-**

Strong Artificial Intelligence (AI) is a theoretical form of machine intelligence that is equal to human intelligence. Key characteristics of Strong AI include the ability to reason, solve puzzles, make judgments, plan, learn, and communicate. It should also have consciousness, objective thoughts, self-awareness, sentience, and sapience.

Strong AI is also called True Intelligence or Artificial General Intelligence (AGI).

**Understanding Strong AI**

Strong AI does not currently exist. Some experts predict it may be developed by 2030 or 2045. Others more conservatively predict that it may be developed within the next century, or that the development of Strong AI may not be possible at all.

Some theorists argue that a machine with Strong AI should be able to go through the same development process as a human, starting with a childlike mind and developing an adult mind through learning. It should be able to interact with the world and learn from it, acquiring its own common sense and language. Another argument is that we will not know when we have developed strong AI (if it can indeed be developed) because there is no consensus on what constitutes intelligence.

**KEY TAKEAWAYS**

* Strong AI is the theoretical next level of artificial intelligence.
* It moves beyond Weak AI, or simulated human cognition, to include problem-solving, learning, and development.
* Strong AI raises the fear of people losing jobs to machines.

**Weak artificial intelligence :-**

Weak AI, or Narrow AI, is a machine intelligence that is limited to a specific or narrow area. Weak Artificial intelligence (AI) simulates human cognition and benefits mankind by automating time-consuming tasks and by analyzing data in ways that humans sometimes can’t.

**BREAKING DOWN Weak AI:**

Weak AI lacks human consciousness, though it may be able to simulate it. The classic illustration of weak AI is John Searle’s Chinese room thought experiment. This experiment says that a person outside a room may be able to have what appears to be a conversation in Chinese with a person inside a room who is given instructions on how to respond to conversations in Chinese. The person inside the room would appear to speak Chinese, but in reality, they couldn’t actually speak or understand a word of it absent the instructions they’re being fed. That's because the person is good at following instructions, not at speaking Chinese. They might appear to have Strong AI – machine intelligence equivalent to human intelligence – but they really only have Weak AI.

Narrow or weak AI systems do not have general intelligence; they have specific intelligence. An AI that is an expert at telling you how to drive from point A to point B is usually incapable of challenging you to a game of chess. And an AI that can pretend to speak Chinese with you probably cannot sweep your floors.

Weak AI helps turn big data into usable information by detecting patterns and making predictions. Examples include Facebook’s news feed, Amazon’s suggested purchases and Apple’s Siri, the iPhone technology that answers users’ spoken questions. Email spam filters are another example of Weak AI where a computer uses an algorithm to learn which messages are likely to be spam, then redirects them from the inbox to the spam folder.

**Limitations of Weak AI :**

Problems with Weak AI besides its limited capabilities include the possibility to cause harm if a system fails­ – think of a driverless car that miscalculates the location of an oncoming vehicle and causes a deadly collision – and the possibility to cause harm if the system is used by someone who wishes to cause harm – such as a terrorist who uses a self-driving car to deploy explosives in a crowded area. Another issue with it is determining who is at fault for a malfunction or a design flaw.

A further concern is the loss of jobs caused by the automation of an increasing number of tasks. Will unemployment skyrocket or will society come up with new ways for humans to be economically productive? Though the prospect of a large percentage of workers losing their jobs may be terrifying, it is reasonable to expect that should this happen, new jobs will emerge that we can’t yet predict, as the use of AI becomes increasingly widespread.