**Deep Learning**

Deep learning uses artificial neural networks to process large amounts of data, acting the way the human brain works. It's a type of machine learning where machines learn by example. Industries like healthcare, eCommerce, entertainment, and advertising commonly use deep learning for various applications.

**How Deep Learning Algorithms Work?**

* Deep learning algorithms use artificial neural networks (ANNs) mirroring the brain's computation to learn from data examples.
* During training, algorithms extract features, group objects, and identify data patterns from unknown elements in input distributions.
* Similar to training machines for self-learning, deep learning occurs at multiple levels, contributing to the construction of models.
* Deep learning models employ various algorithms, each suited for specific tasks, with no single network considered perfect.
* A solid understanding of primary algorithms is essential for informed decision-making in choosing the right ones.
* Serves as a gateway for individuals to explore deep learning algorithms in the context of cybersecurity.
* Participants gain insights into using deep learning for threat detection, anomaly recognition, and predictive analysis in cybersecurity.

**Some of the type of algorithm used in Deep Learning**

1. Convolutional Neural Networks (CNNs)
2. Long Short Term Memory Networks (LSTMs)
3. Recurrent Neural Networks (RNNs)
4. Multilayer Perceptrons (MLPs)

**Convolutional Neural Networks (CNNs)**

* + Consists of multiple layers designed for image processing and object detection.
  + Developed by Yann LeCun in 1988, initially known as LeNet, for recognizing characters like ZIP codes and digits.
  + Widely used for satellite image identification, medical image processing, time series forecasting, and anomaly detection.
* Working Mechanism of CNNs:
  + Convolution Layer: Employs filters to perform the convolution operation on input data.
  + Rectified Linear Unit (ReLU): Applies operations on elements, producing a rectified feature map as output.
  + Pooling Layer: Down-samples the rectified feature map, reducing its dimensions.
  + Flattening: Converts resulting two-dimensional arrays into a single, continuous, linear vector.
  + Fully Connected Layer: Utilizes the flattened matrix to classify and identify images.
* Example Image Processing:
  + Demonstrates how CNN processes an image to extract features and make classifications.

**Long Short Term Memory Networks (LSTMs)**

A subset of Recurrent Neural Networks (RNNs) designed to learn and remember long-term dependenciesLSTMs naturally excel at recalling past information over extended periods.

Applications:

* + Time-Series Prediction: Particularly effective for predicting sequences over time.
  + Other Uses: Commonly employed in speech recognition, music composition, and pharmaceutical development.

Chain-Like: LSTMs exhibit a chain-like structure with four interacting layers that communicate uniquely.

How LSTMs Work:

* + Initial Step: LSTMs start by forgetting irrelevant parts of the previous state.
  + Selective Update: The network then selectively updates the cell-state values based on the current input.
  + Final Step: LSTMs produce the output by considering specific parts of the cell state.

**Recurrent Neural Networks (RNNs)**

RNNs feature connections that create directed cycles, enabling outputs from the Long Short-Term Memory (LSTM) to serve as inputs in the current phase. The LSTM's output, serving as an input to the current phase, allows for the retention of previous inputs through its internal memory.

Applications:

* + Image Captioning: RNNs are employed for generating descriptive captions for images.
  + Time-Series Analysis: Widely used for analyzing sequential data over time.
  + Natural-Language Processing: Applied in tasks involving language understanding and generation.
  + Handwriting Recognition: Utilized for recognizing and interpreting handwritten text.
  + Machine Translation: Commonly used for translating text between languages.

**Multilayer Perceptrons (MLPs)**

MLPs serve as an excellent starting point for understanding deep learning technology.

Architecture:

* + MLPs belong to the class of feedforward neural networks.
  + Comprise multiple layers of perceptrons with activation functions.
  + Fully connected structure, including an input layer and an output layer.

Configuration:

* + Input and Output Layers: Have the same number of nodes, while multiple hidden layers can be incorporated.
  + Applications: Used for building speech recognition, image recognition, and machine translation software.

How MLPs Work:

* + MLPs input data into the network through the input layer.
  + Neurons in consecutive layers are connected in a graph, allowing signals to pass in a single direction.
  + Computing Inputs: MLPs calculate inputs using the weights between the input layer and hidden layers.
  + Activation functions, such as ReLUs, sigmoid functions, and tanh, determine which nodes activate in response.
  + Model Learning: MLPs train by understanding correlations and dependencies between independent and target variables from a training dataset.