University Of Tamanrasset
Science and Technology
(IASD)

Deep Learning
Long Short Term Memory (LSTM)

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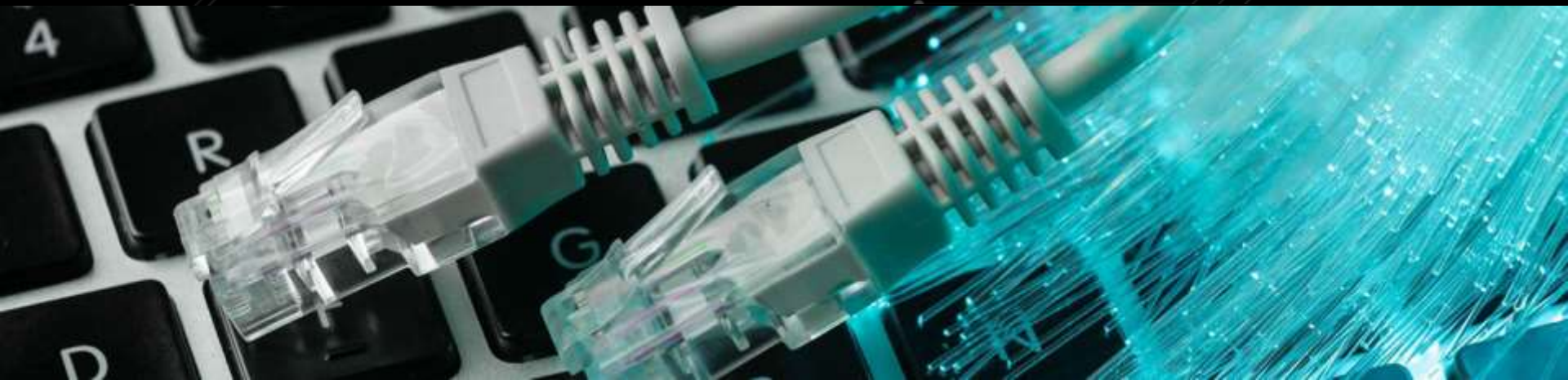Applications of (LSTM)

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01 DEEP LEARNING
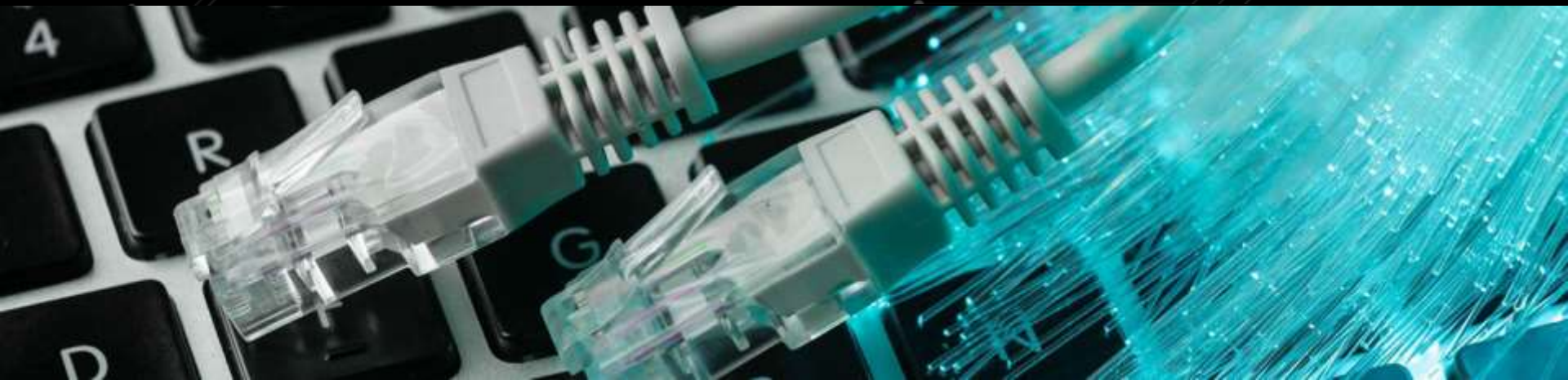
What Deep Learning?

Deep learning is a subfield of machine learning that focuses on the development and application of artificial neural networks with multiple layers, also known as deep neural networks. It is inspired by the structure and function of the human brain.

In deep learning, neural networks are composed of interconnected layers of artificial neurons, each performing simple computations. The layers are organized in a hierarchical manner, with each layer extracting increasingly complex features from the input data. The final layer, known as the output layer, produces the desired prediction or classification result.

A brief overview of how neural networks work..

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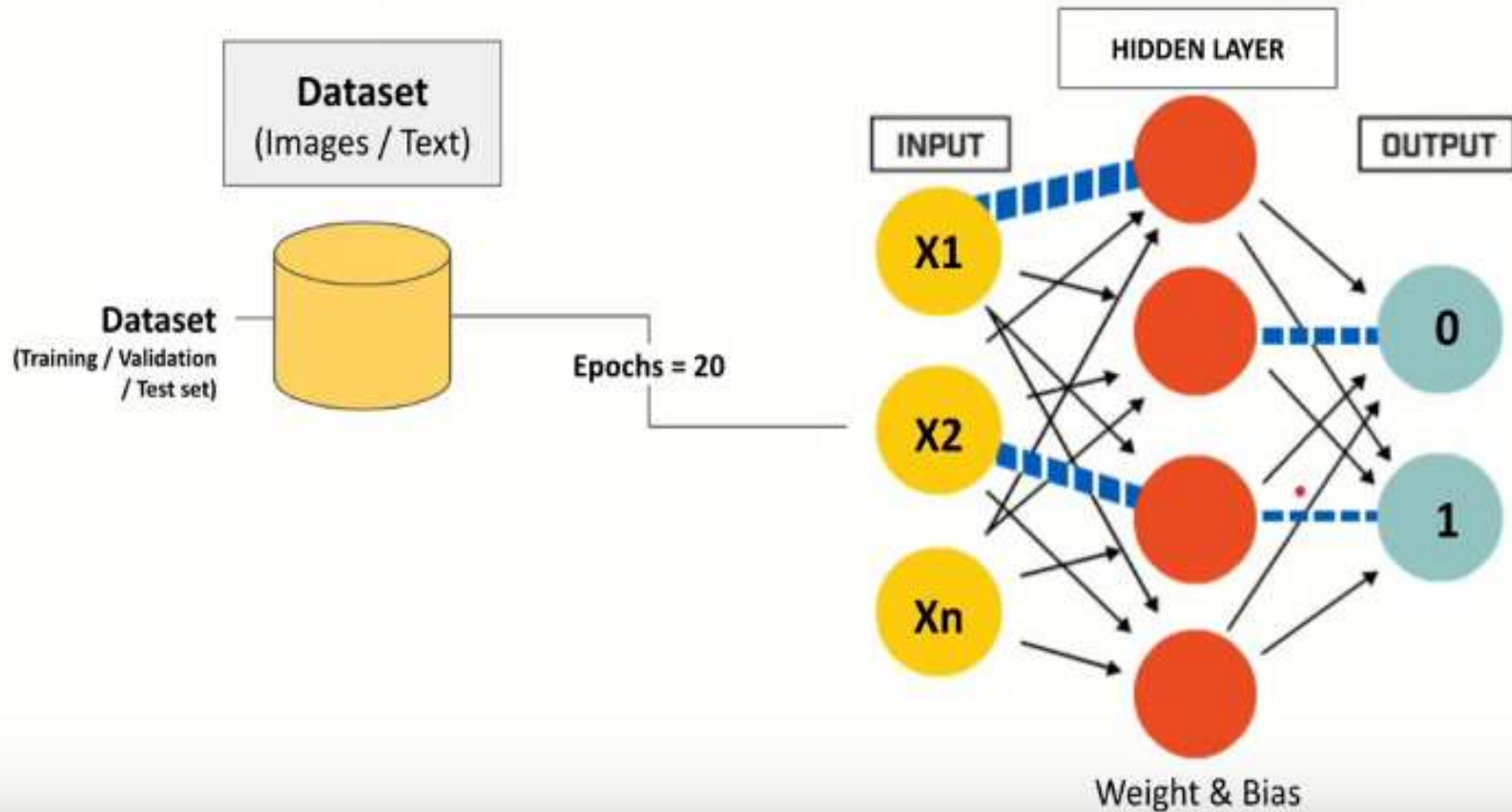
02 INTRODUCTION TO (LSTM)

What is LSTM?

Long Short Term Memory is a kind of recurrent neural network. In RNN output from the last step is fed as input in the current step. LSTM was designed by Hochreiter & Schmidhuber. It tackled the problem of long-term dependencies of RNN in which the RNN cannot predict the word stored in the long-term memory but can give more accurate predictions from the recent information. As the gap length increases RNN does not give an efficient performance. LSTM can by default retain the information for a long period of time. It is used for processing, predicting, and classifying on the basis of time-series data.

03 WHAT IS RNN ?
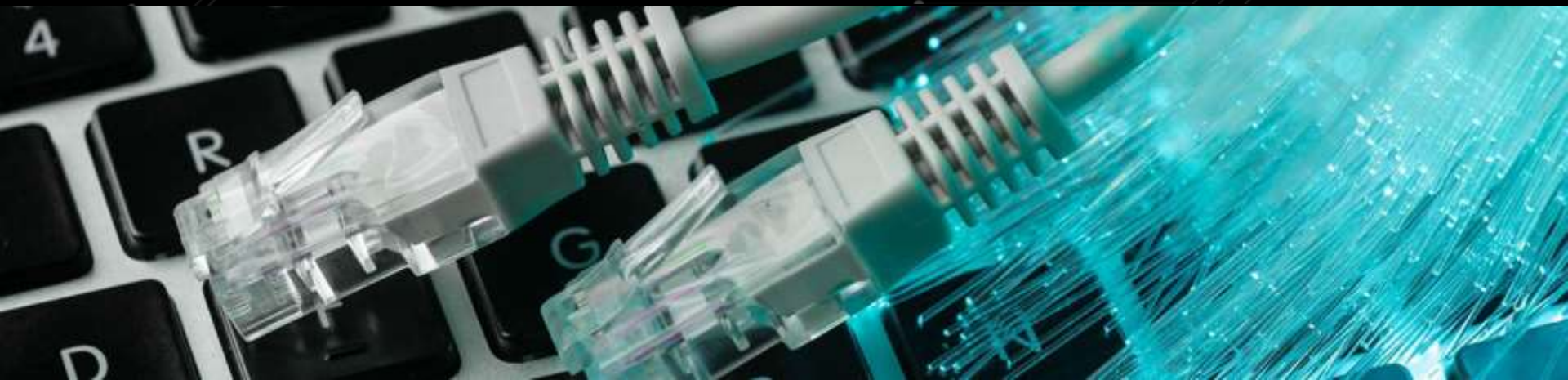
What is RNN?

Recurrent Neural Network(RNN) is a type of <u>Neural Network</u> where the output from the previous step is fed as input to the current step. In traditional neural networks, all the inputs and outputs are independent of each other, but in cases when it is required to predict the next word of a sentence, the previous words are required and hence there is a need to remember the previous words. Thus RNN came into existence, which solved this issue with the help of a Hidden Layer. The main and most important feature of RNN is its Hidden state, which remembers some information about a sequence. The state is also referred to as Memory State since it remembers the previous input to the network. It uses the same parameters for each input as it performs the same task on all the inputs or hidden layers to produce the output. This reduces the complexity of parameters, unlike other neural networks..

04 HOW DOES (LSTM) WORKS ?
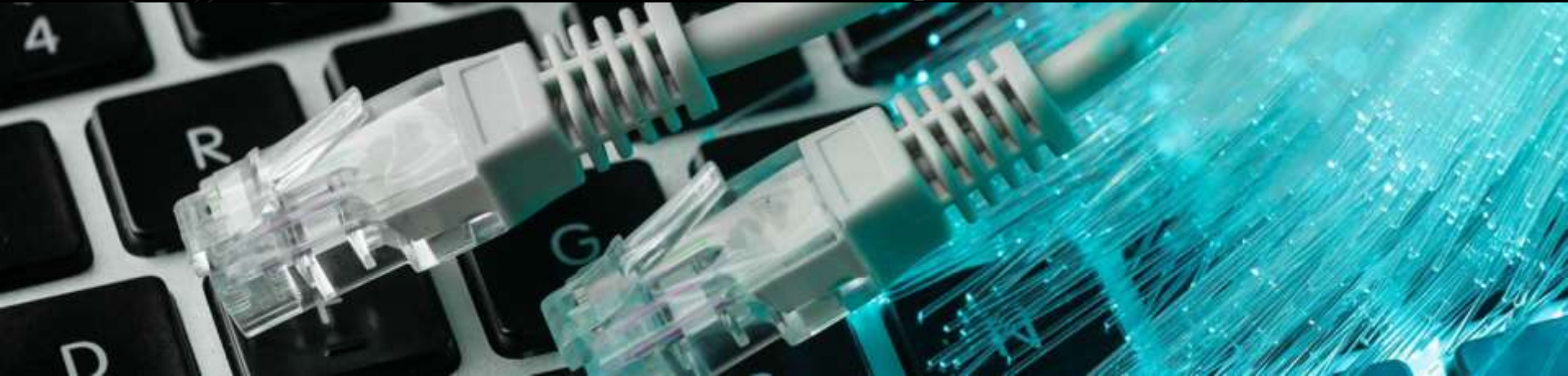
How (LSTM) works?

Long Short-Term Memory (LSTM) is a type of Recurrent Neural Network (RNN) that is specifically designed to handle sequential data, such as time series, speech, and text. LSTM networks are capable of learning long-term dependencies in sequential data, which makes them well suited for tasks such as language translation, speech recognition, and time series forecasting.
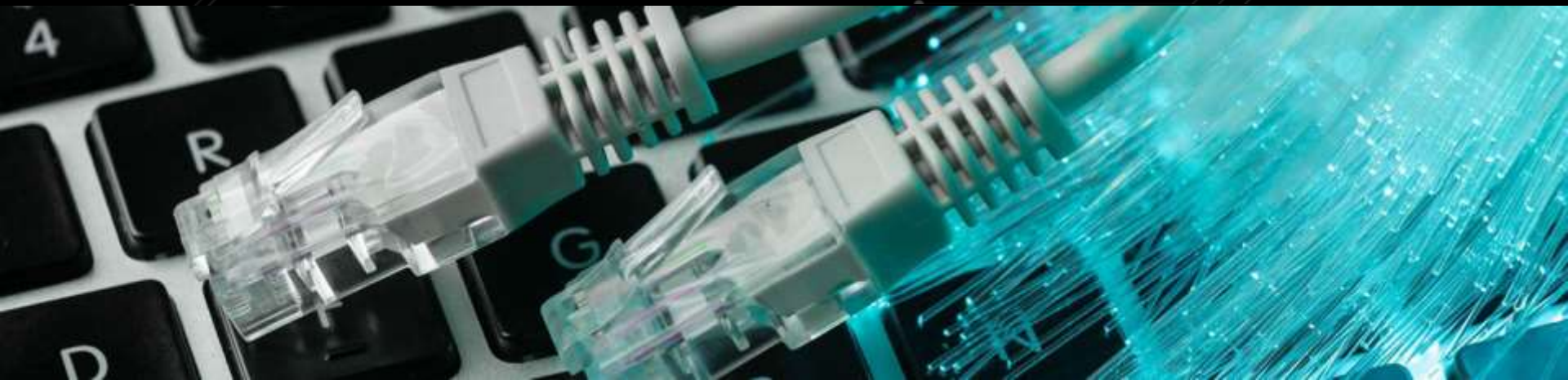
A traditional RNN has a single hidden state that is passed through time, which can make it difficult for the network to learn long-term dependencies. LSTMs address this problem by introducing a memory cell, which is a container that can hold information for an extended period of time. The memory cell is controlled by three gates: the input gate, the forget gate, and the output gate. These gates decide what information to add to, remove from, and output from the memory cell.

How (LSTM) works?

The input gate controls what information is added to the memory cell. The forget gate controls what information is removed from the memory cell. And the output gate controls what information is output from the memory cell. This allows LSTM networks to selectively retain or discard information as it flows through the network, which allows them to learn long-term dependencies. LSTMs can be stacked to create deep LSTM networks, which can learn even more complex patterns in sequential data. LSTMs can also be used in combination with other neural network architectures, such as Convolutional Neural Networks (CNNs) for image and video analysis.

05 TYPE OF GATES IN (LSTM)

Type of gates in (LSTM)

There are three types of gates in an LSTM: the input gate, the forget gate, and the output gate.
The input gate controls the flow of information into the memory cell. The forget gate controls the flow of information out of the memory cell. The output gate controls the flow of information out of the LSTM and into the output.
Three gates input gate, forget gate, and output gate are all implemented using sigmoid functions, which produce an output between 0 and 1. These gates are trained using a backpropagation algorithm through the network.
The input gate decides which information to store in the memory cell. It is trained to open when the input is important and close when it is not.
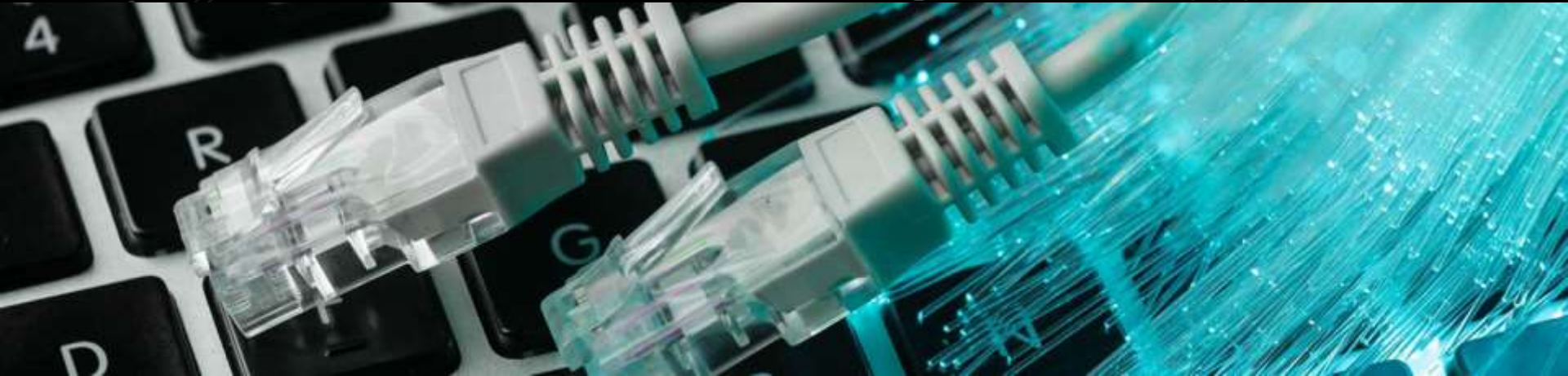
Type of gates in (LSTM)

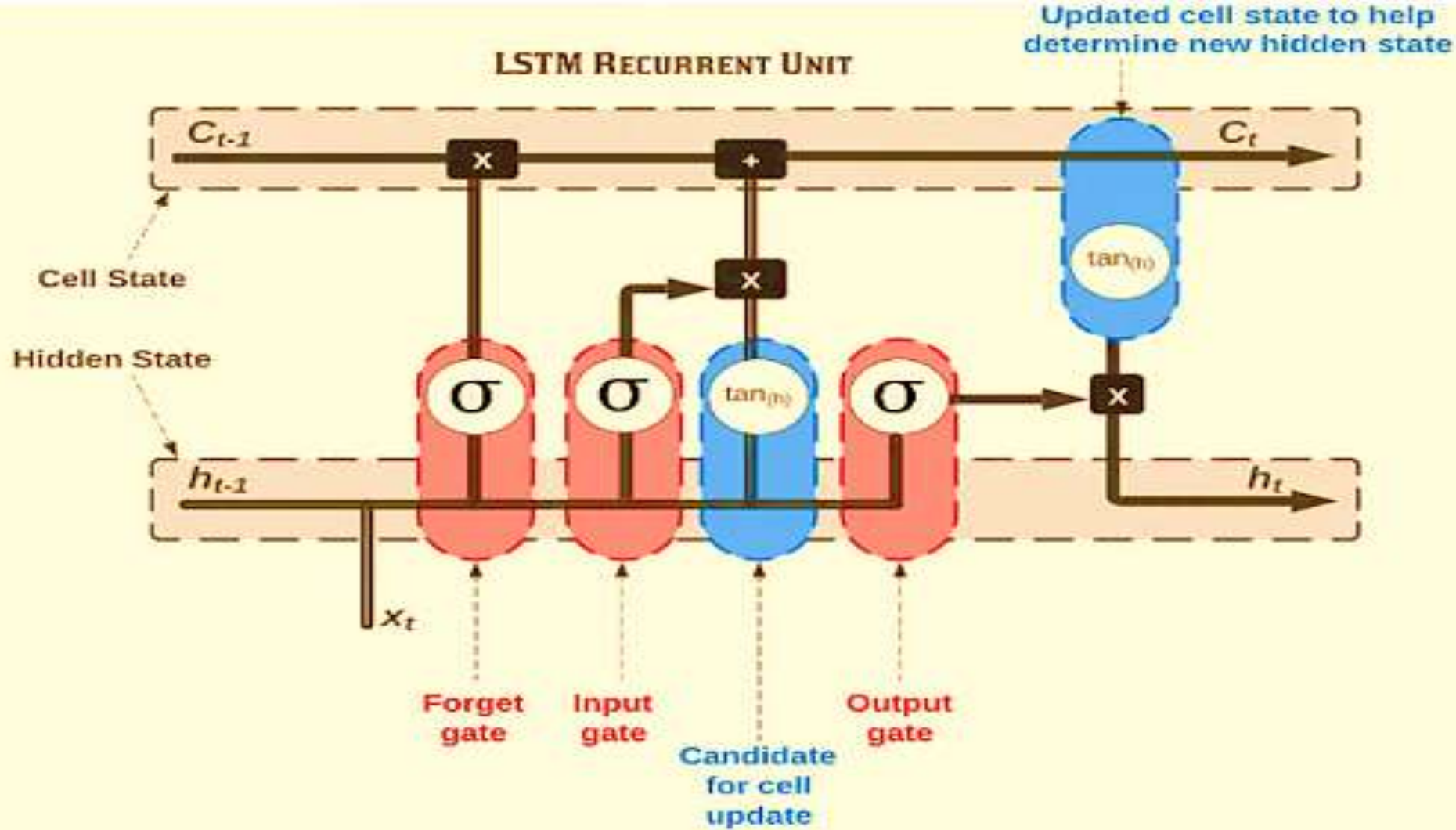The forget gate decides which information to discard from the memory cell. It is trained to open when the information is no longer important and close when it is. The output gate is responsible for deciding which information to use for the output of the LSTM. It is trained to open when the information is important and close when it is not.
The gates in an LSTM are trained to open and close based on the input and the previous hidden state. This allows the LSTM to selectively retain or discard information, making it more effective at capturing long-term dependencies.
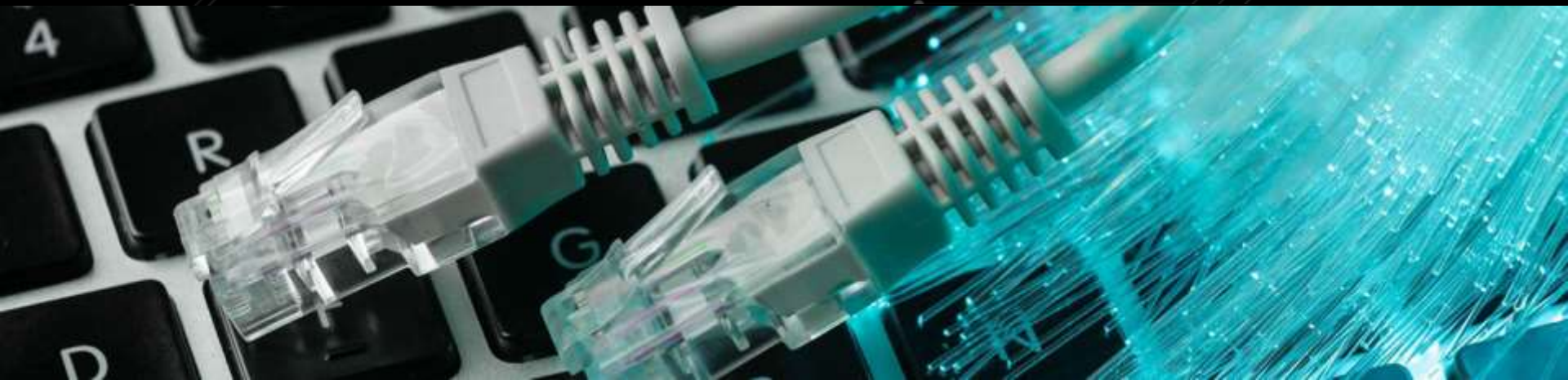
06 STRUCTURE OF (LSTM)

LSTM RECURRENT UNIT

Updated cell state to help determine new hidden state

C_{t-1} — × — + — C_t

Cell State

Hidden State

h_{t-1} — h_t

x_t

$\tan_{(h)}$

σ σ $\tan_{(h)}$ σ

Forget gate   Input gate   Output gate

Candidate for cell update

07 APPLICATIONS OF (LSTM)

APPLICATIONS

● Language Modeling

LSTMs have been used for natural language processing tasks such as language modeling, machine translation, and text summarization. They can be trained to generate coherent and grammatically correct sentences by learning the dependencies between words in a sentence.

● Speech Recognition

LSTMs have been used for speech recognition tasks such as transcribing speech to text and recognizing spoken commands. They can be trained to recognize patterns in speech and match them to the corresponding text.

● Time Series Forecasting

LSTMs have been used for time series forecasting tasks such as predicting stock prices, weather, and energy consumption. They can learn patterns in time series data and use them to make predictions about future events.

● Video Analysis

LSTMs have been used for video analysis tasks such as object detection, activity recognition, and action classification. They can be used in combination with other neural network architectures, such as Convolutional Neural Networks (CNNs), to analyze video data and extract useful information.

APPLICATIONS

Voice Recognition

LSTMs have been utilized for speech recognition tasks such as speech-to-text-to-text-transcription and command recognition. They may be taught to recognize patterns in speech and match them to the appropriate text.

Sentiment Analysis

LSTMs can be used to classify text sentiment as positive, negative, or neutral by learning the relationships between words and their associated sentiments.

Anomaly Detection

LSTMs have been used for anomaly detection tasks such as detecting fraud and network intrusion. They can be trained to identify patterns in data that deviate from the norm and flag them as potential anomalies.
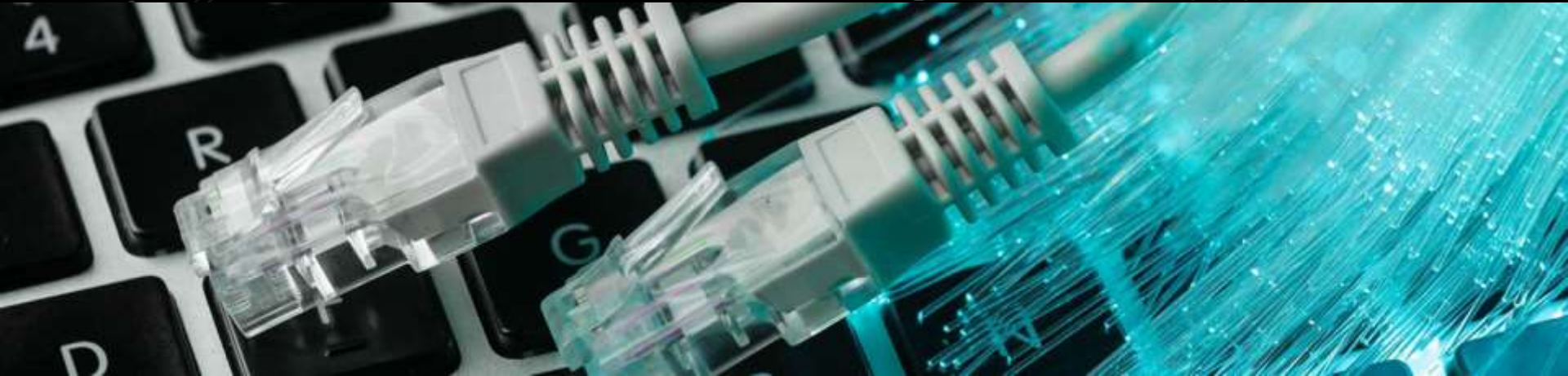
Recommender Systems

LSTMs have been used for recommendation tasks such as recommending movies, music, and books. They can learn patterns in user behavior and use them to make personalized recommendations.
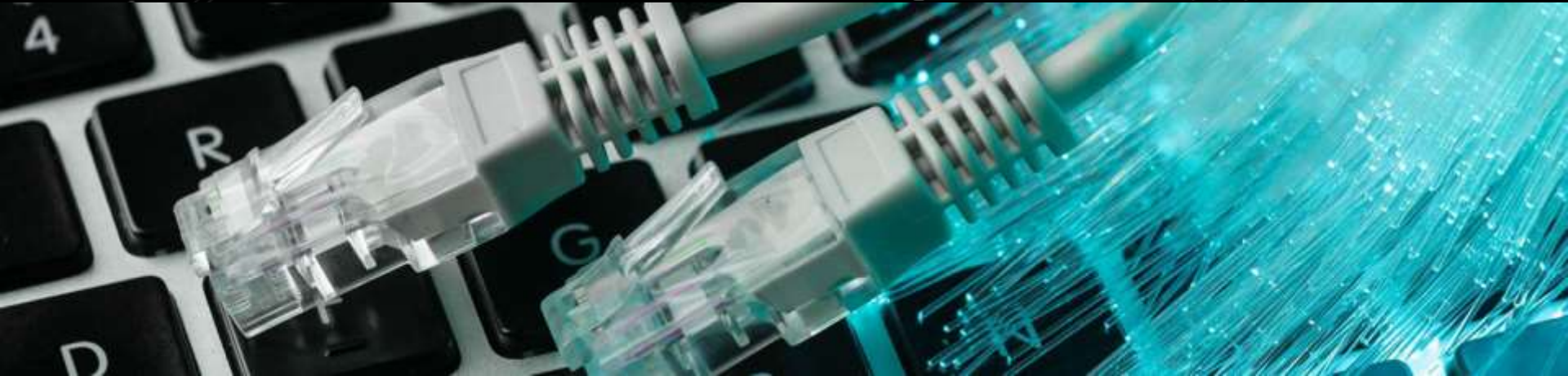
08 ADVANTAGES OF (LSTM)

Advantages of LSTM

- Long-term dependencies can be captured by LSTM networks. They have a memory cell that is capable of long-term information storage.

- In traditional RNNs, there is a problem of vanishing and exploding gradients when models are trained over long sequences. By using a gating mechanism that selectively recalls or forgets information, LSTM networks deal with this problem.

- LSTM enables the model to capture and remember the important context, even when there is a significant time gap between relevant events in the sequence. So where understanding context is important, LSTMS are used. eg. machine translation.
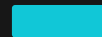
09 DISADVANTAGES OF (LSTM)

Disadvantages of LSTM

- Compared to simpler architectures like feed-forward neural networks LSTM networks are computationally more expensive. This can limit their scalability for large-scale datasets or constrained environments.

- Training LSTM networks can be more time-consuming compared to simpler models due to their computational complexity. So training LSTMs often requires more data and longer training times to achieve high performance.

- Since it is processed word by word in a sequential manner, it is hard to parallelize the work of processing the sentences..

Thanks!
For your attantion

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