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CHENNAI

Convolutional Deep Neural Networks

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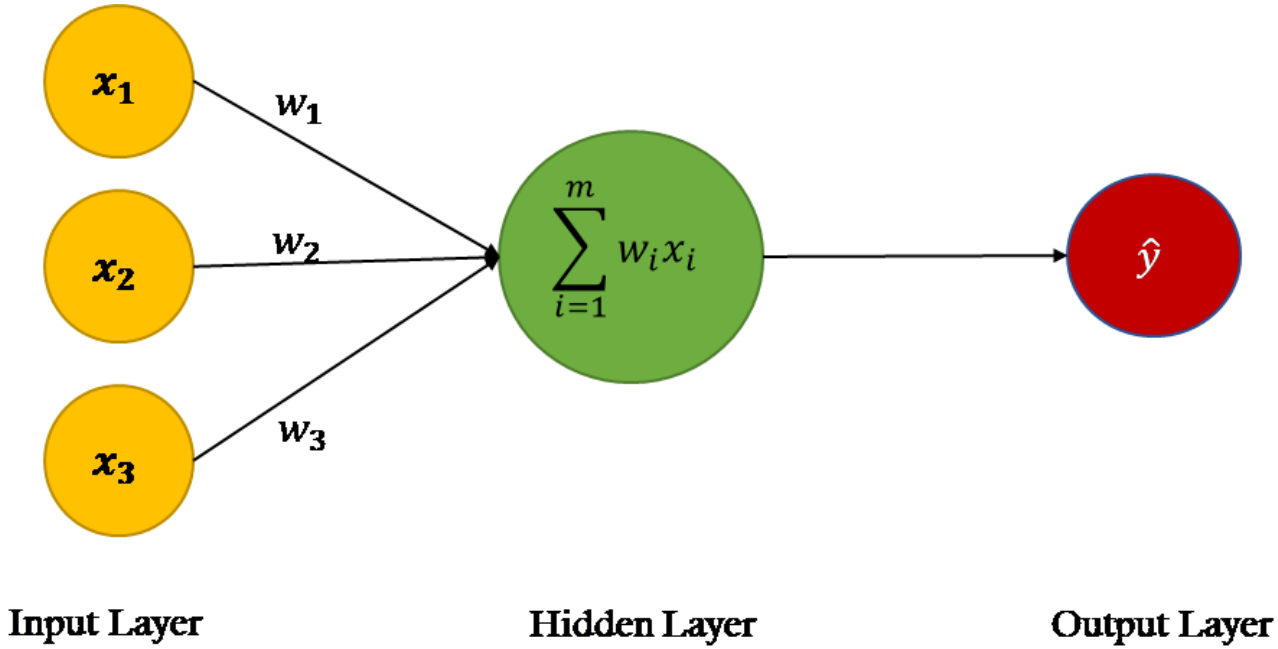
Outline

Neural Network

A neural network is a method in artificial intelligence that teaches computers to process data in a way that is inspired by the human brain.

It is a type of machine learning process, called **deep learning**, that uses interconnected nodes or neurons in a layered structure that resembles the human brain.

It creates an adaptive system that computers use to learn from their mistakes and improve continuously.


x_1
x_2
x_3
w_1
w_2
w_3
$\sum_{i=1}^{m} w_i x_i$
$\hat{y}$
Input Layer
Hidden Layer
Output Layer

Artificial neural networks attempt to solve complicated problems, like summarizing documents or recognizing faces, with greater accuracy.

1. Neural networks can help computers make intelligent decisions with limited human assistance.
2. This is because they can learn and model the relationships between input and output data that are nonlinear and complex.

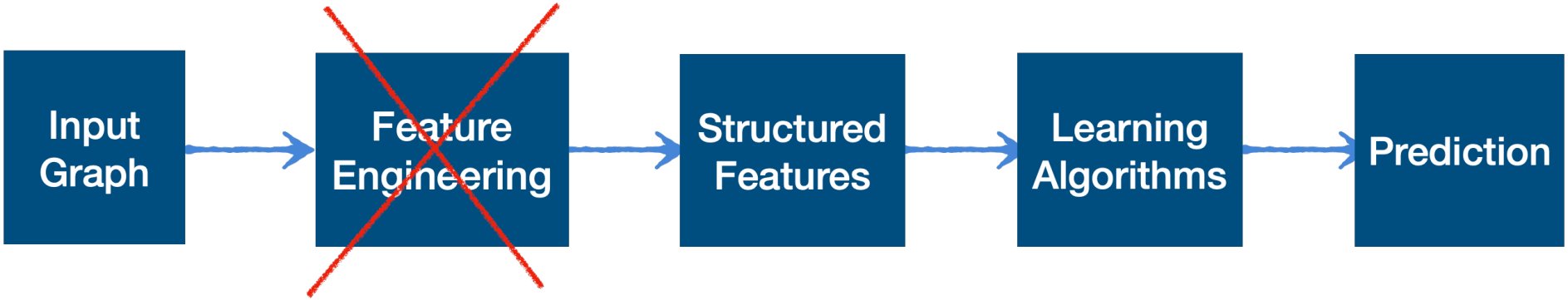
ML vs Deep Learning

Machine Learning:

ML vs Deep Learning

Machine Learning:

Neural Network / Deep Learning:



What are neural networks used for?

Neural networks have several use cases across many industries, such as the following:

1. Medical diagnosis by medical image classification
2. Targeted marketing by social network filtering and behavioral data analysis
3. Financial predictions by processing historical data of financial instruments
4. Electrical load and energy demand forecasting
5. Process and quality control
6. Chemical compound identification

Computer vision

Computer vision is the ability of computers to extract information and insights from images and videos. With neural networks, computers can distinguish and recognize images similar to humans. Computer vision has several applications, such as the following:

1. Visual recognition in self-driving cars so they can recognize road signs and other road users
2. Content moderation to automatically remove unsafe or inappropriate content from image and video archives
3. Facial recognition to identify faces and recognize attributes like open eyes, glasses, and facial hair
4. Image labeling to identify brand logos, clothing, safety gear, and other image details

Speech recognition

Neural networks can analyze human speech despite varying speech patterns, pitch, tone, language, and accent. Virtual assistants like Amazon Alexa and automatic transcription software use speech recognition to do tasks like these:

1. Assist call center agents and automatically classify calls
2. Convert clinical conversations into documentation in real time
3. Accurately subtitle videos and meeting recordings for wider content reach

Natural language processing

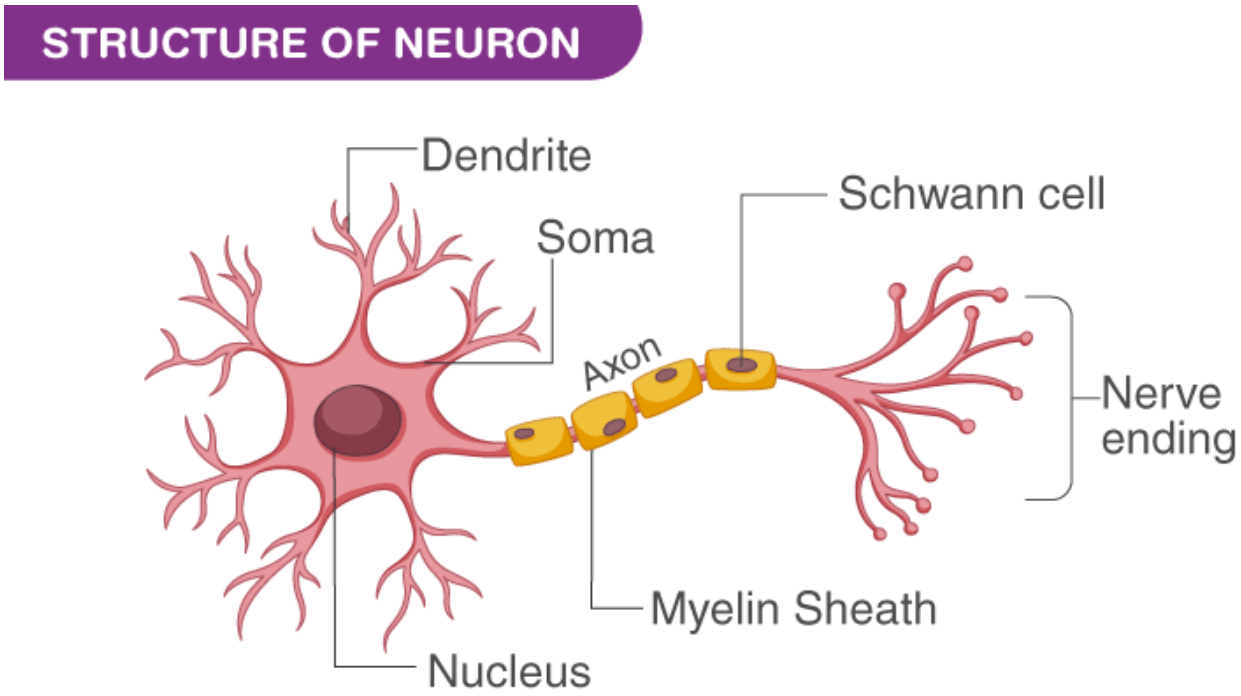
Natural language processing (NLP) is the ability to process natural, human-created text. Neural networks help computers gather insights and meaning from text data and documents. NLP has several use cases, including in these functions:

1. Automated virtual agents and chatbots
2. Automatic organization and classification of written data
3. Business intelligence analysis of long-form documents like emails and forms
4. Indexing of key phrases that indicate sentiment, like positive and negative comments on social media
5. Document summarization and article generation for a given topic

Recommendation engines

1. Neural networks can track user activity to develop personalized recommendations.
2. They can also analyze all user behavior and discover new products or services that interest a specific user.

How do neural networks work?



1. The human brain is the inspiration behind neural network architecture.
2. Human brain cells, called neurons, form a complex, highly interconnected network and send electrical signals to each other to help humans process information.

Artificial neurons are software modules, called nodes, and artificial neural networks are software programs or algorithms that, at their core, use computing systems to solve mathematical calculations.

Simple neural network architecture

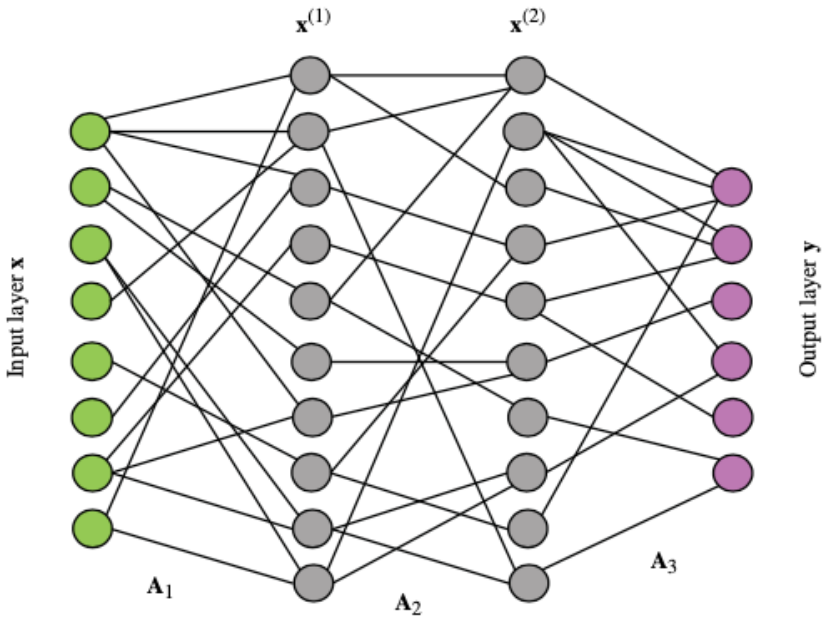
A basic neural network has interconnected artificial neurons in three layers:

- **Input Layer**
- **Hidden Layer**
- **Output Layer**

What are the types of neural networks?

1. Feedforward neural networks
2. Backpropagation algorithm
3. Convolutional neural networks

Deep Neural Network



For a linear mapping between layers, the following relations hold

$$x^{(1)} = A_1 x,$$
$$x^{(2)} = A_2 x^{(1)},$$
$$y = A_3 x^{(2)}$$

Hence, we have

$$y = A_3 A_2 A_1 x.$$

Activation Function

Nonlinear transformations from input to output space represented by

$$y = f(A, x)$$

where $f(\cdot)$ is a specified activation function (transfer function).

$$f(x) = x, \qquad \text{linear},$$

$$f(x) = \begin{cases} 0 & \text{for } x \leq 0, \\ 1 & \text{for } x > 0, \end{cases} \qquad \text{binary step},$$

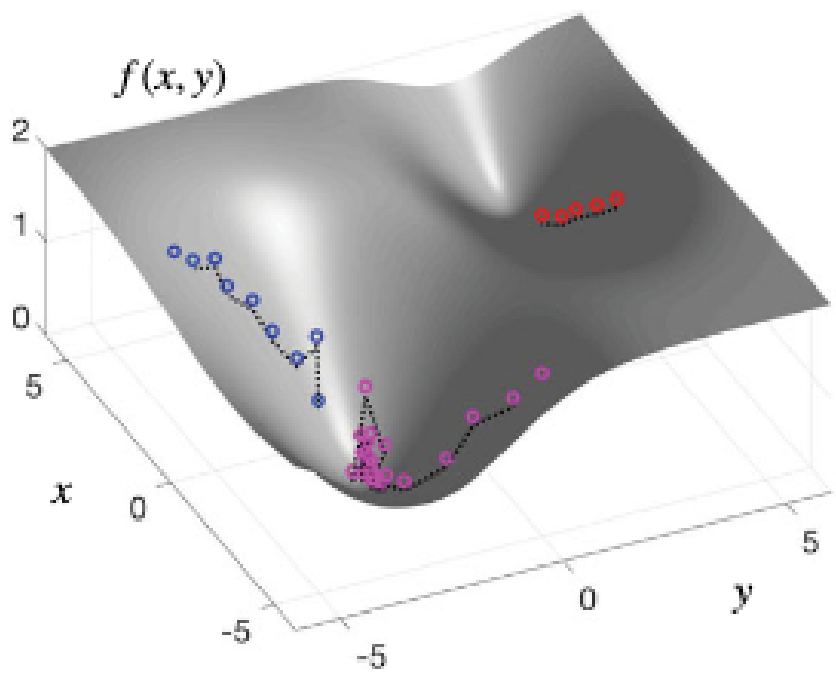
$$f(x) = \frac{1}{1 + \exp(-x)}, \qquad \text{logistic (soft step)},$$

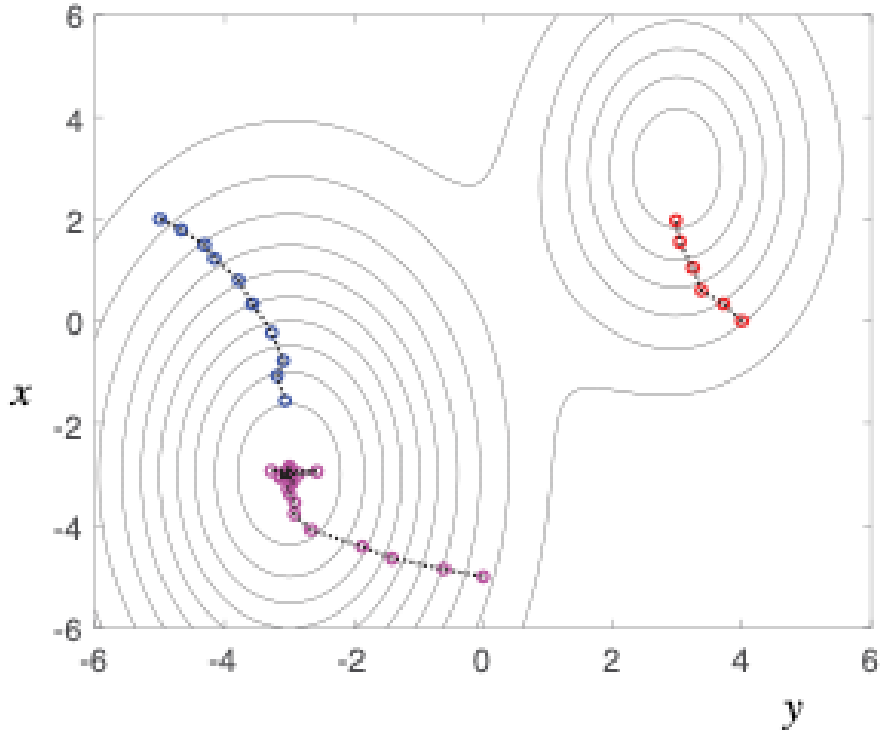
$$f(x) = \tanh(x), \qquad \tanh,$$

$$f(x) = \begin{cases} 0 & \text{for } x \leq 0, \\ x & \text{for } x > 0, \end{cases} \qquad \text{rectified linear unit (ReLU)}.$$

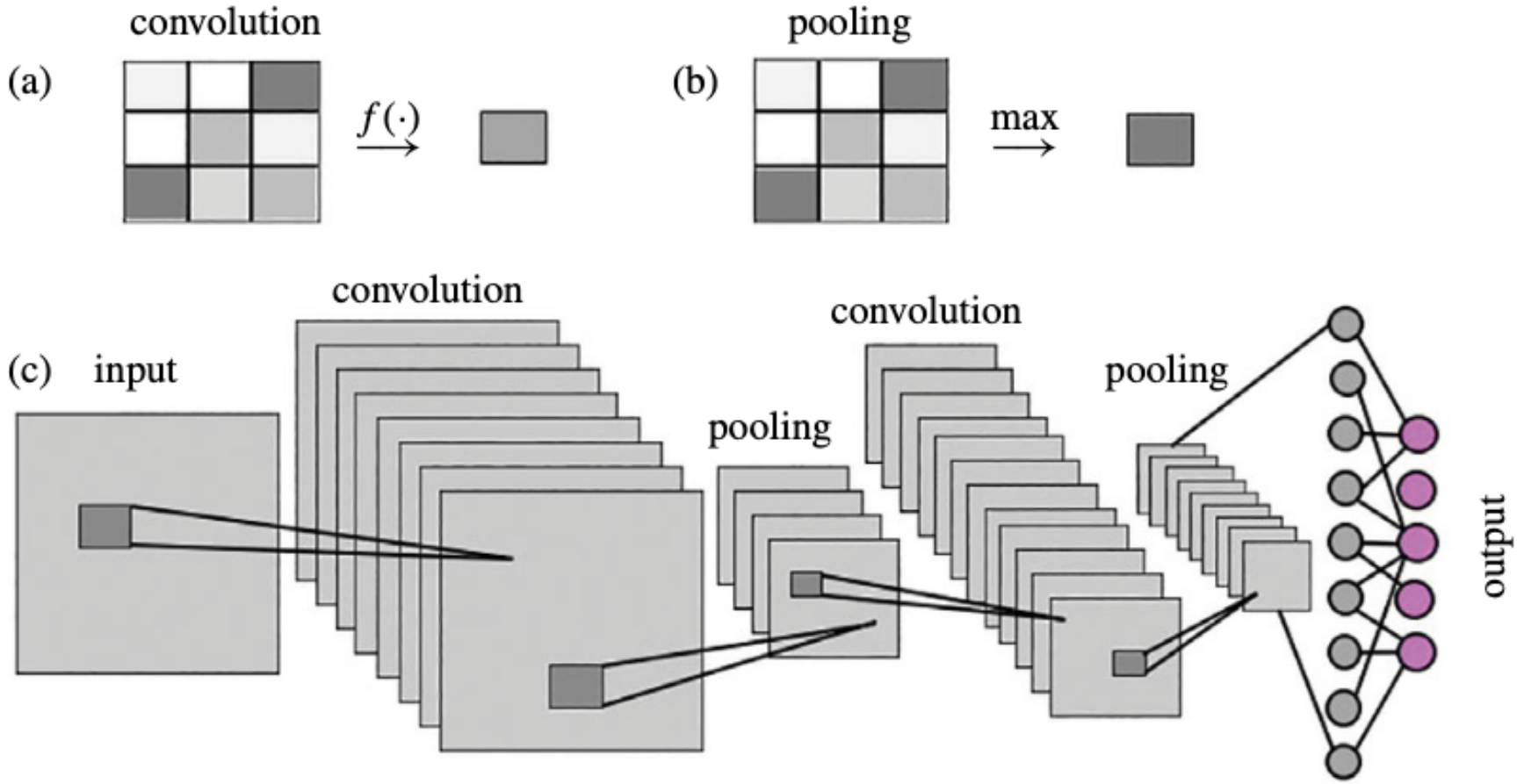
Loss Function

Error Minimization





Convolutional Neural Network



Summary

1. Neural Networks are evolved to model the complex data structure and has ability to learn the features from the raw data such as images, documents, etc.,
2. Deep Neural Networks are nothing but the Neural networks having more hidden layers
3. Convolution neural Networks have two major blocks such as the convolution block and ML task block.
4. NNs have significant potential for overfitting of data so that cross-validation must be carefully considered.
5. Activation Functions technically prepares the input for the next layer, evidently, the output layer too.
6. Back propagation is a technique to correct the errors from the output to the input weights.

If you do not cross-validate, you is dumb

THANK YOU!