20CYS304 AI & NN
Deep Learning

Unit 3

Applications of AI

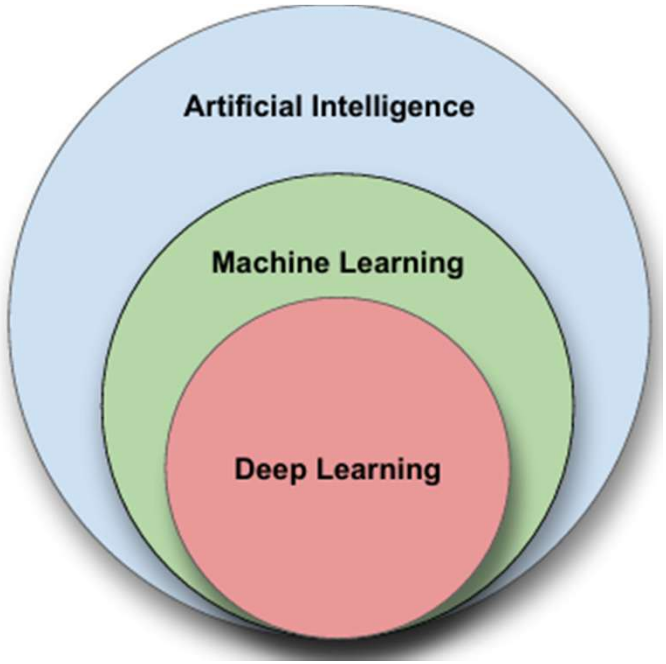
Speech Recognition

Understanding Natural Language

Image Recognition

Relationship of AI, ML and DL

- Artificial Intelligence (AI) is anything about man-made intelligence exhibited by machines.
- Machine Learning (ML) is an approach to achieve AI.
- Deep Learning (DL) is one technique to implement ML



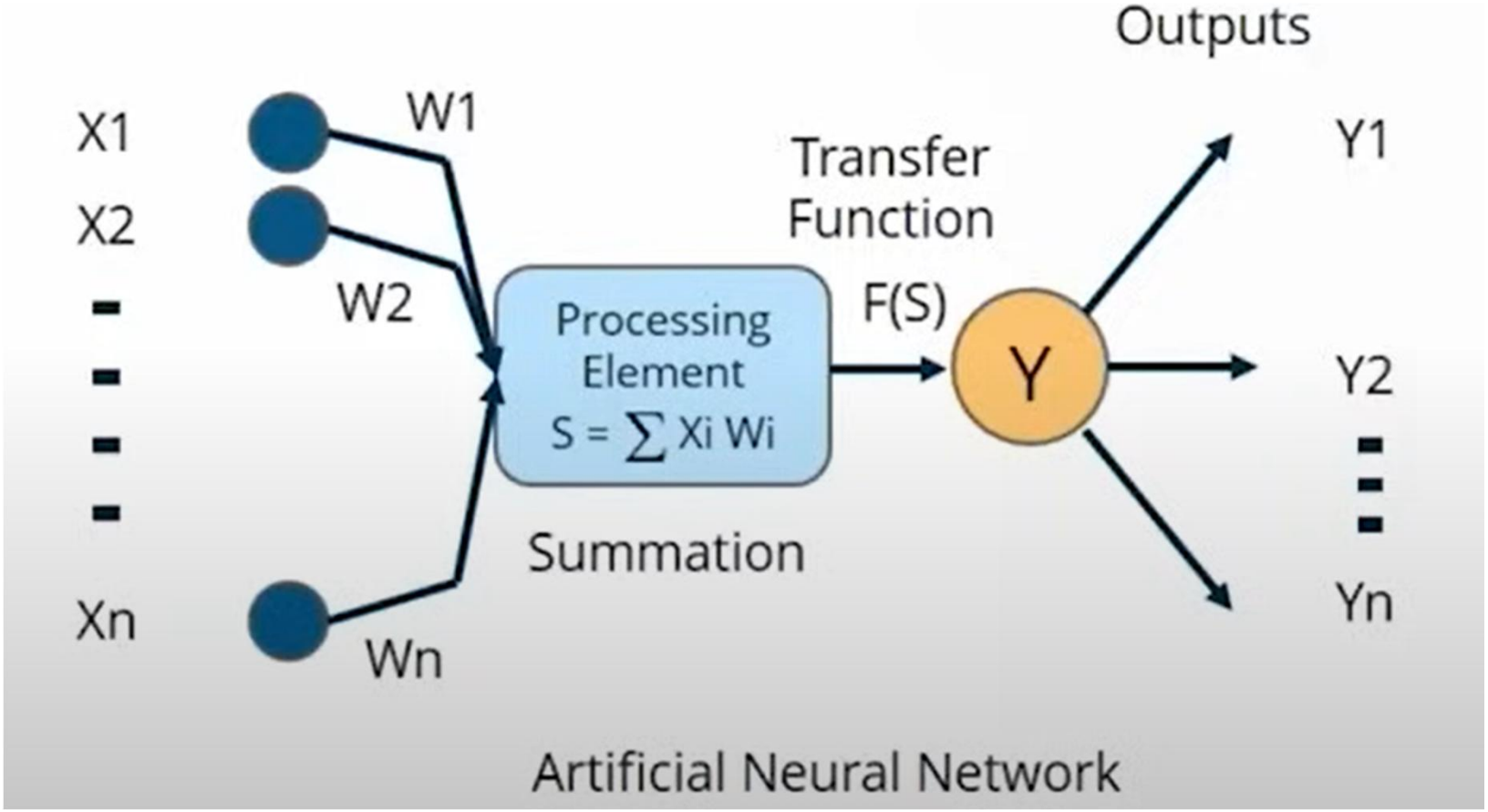
What is Deep Learning?

- Deep learning is a class of machine learning algorithms that:
  - use a cascade of multiple layers of nonlinear processing units for feature extraction and transformation. Each successive layer uses the output from the previous layer as input.
  - learn in supervised (e.g., classification) and/or unsupervised (e.g., pattern analysis) manners.
  - learn multiple levels of representations that correspond to different levels of abstraction; the levels form a hierarchy of concepts.

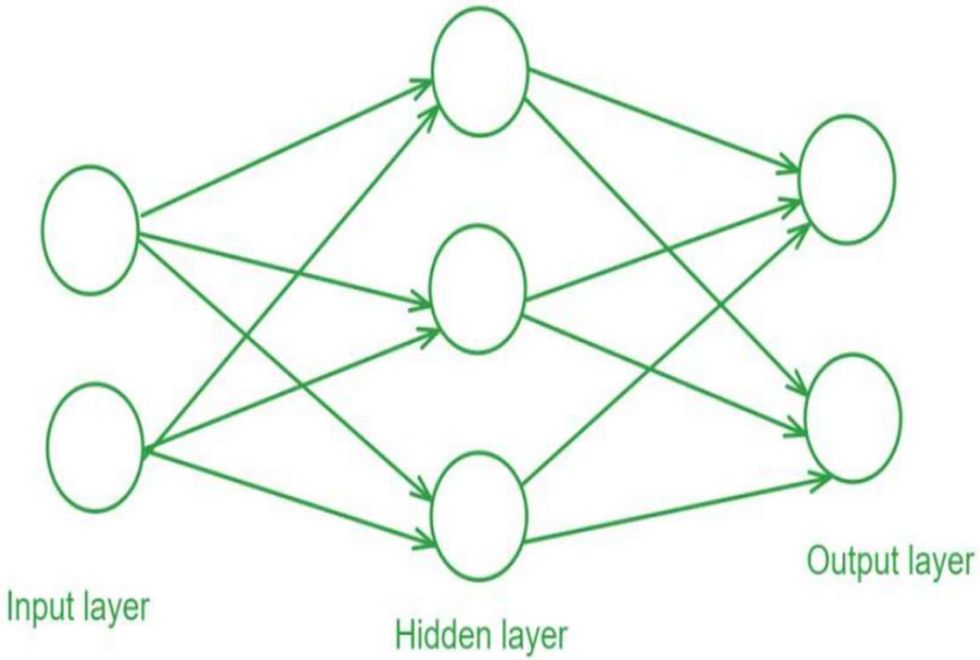
Why Deep Learning?

- Limitations of traditional machine learning algorithms
  - not good at handling high dimensional data.
  - difficult to do feature extraction and object recognition.
- Advantages of deep learning
  - DL is computationally expensive, but it is capable of handling high dimensional data.
  - feature extraction is done automatically

- DL is implemented through Neural Networks



- Feedforward Neural Network (FNN) is one of the most fundamental and widely used.
- **Structure of a Feedforward Neural Network**

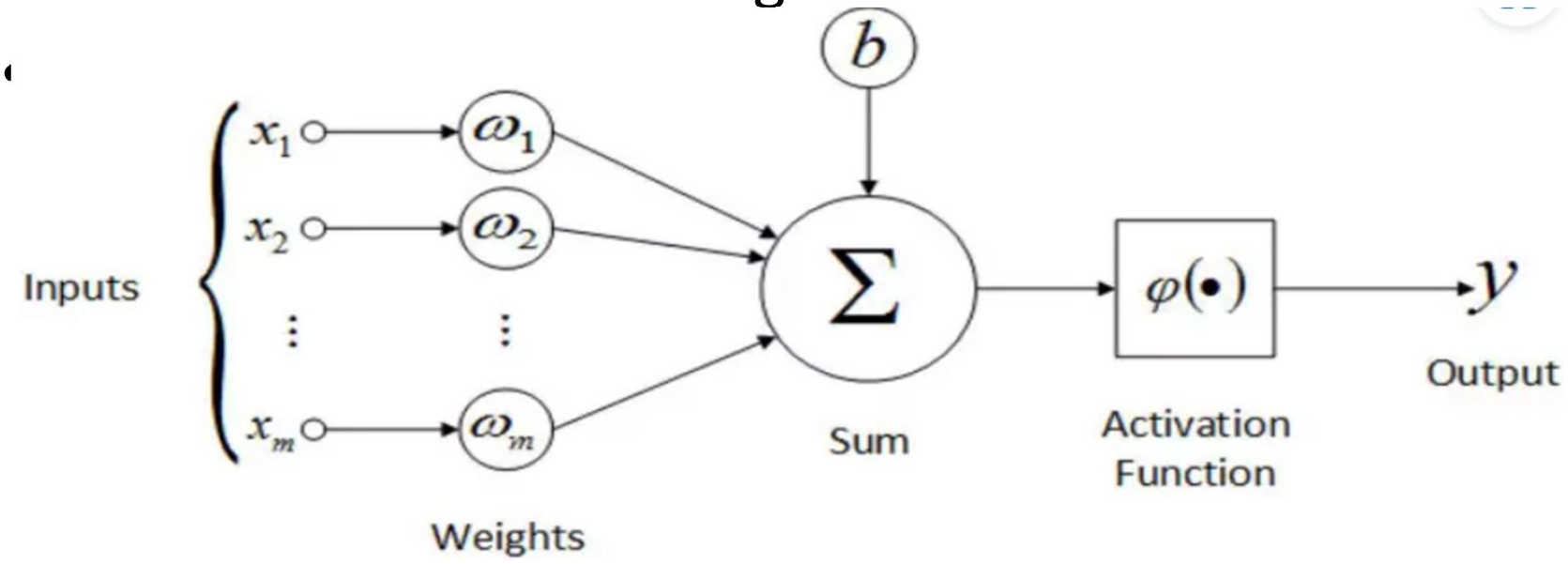


- **Input Layer**: The input layer consists of neurons that receive the input data. Each neuron in the input layer represents a feature of the input data.
- **Hidden Layers**: One or more hidden layers are placed between the input and output layers. These layers are responsible for learning the complex patterns in the data. Each neuron in a hidden layer applies a weighted sum of inputs followed by a non-linear activation function.
- **Output Layer**: The output layer provides the final output of the network. The number of neurons in this layer corresponds to the number of classes in a classification problem or the number of outputs in a regression problem.

- The dataset and the type of challenge determine the number of neurons in the final layer and the first layer.
- Trial and error will be used to determine the number of neurons in the hidden layers and the number of hidden layers.
- a Feed-Forward Neural Network is a single layer perceptron. A sequence of inputs enter the layer and are multiplied by the weights in this model.
- The weighted input values are then summed together to form a total

- Each connection between neurons in these layers has an associated weight that is adjusted during the training process to minimize the error in predictions.
- A weight is being applied to each input to an artificial neuron. First, the inputs are multiplied by their weights, and then a bias is applied to the outcome. This is called the weighted sum.
- After that, the weighted sum is processed via an activation function, as a non-linear function.

- If the sum of the values is more than a predetermined threshold, which is normally set at zero, the output value is usually 1, and if the sum is less than the threshold, the output value is usually -1.
- The single-layer perceptron is a popular feed-forward neural network model that is frequently used for classification. Single-layer perceptrons can also contain machine learning features.



- The neural network can compare the outputs of its nodes with the desired values using a property known as the delta rule, allowing the network to alter its weights through training to create more accurate output values.
- This training and learning procedure results in gradient descent.
- The technique of updating weights in multi-layered perceptrons is virtually the same, however, the process is referred to as back-propagation.
- In such circumstances, the output values provided by the final layer are used to alter each hidden layer inside the network.

Convolutional Neural Networks : one of the FFN

- CNNs are a class of deep neural networks typically used for image processing, object detection, and tasks involving spatial data like images or videos.

- They are designed to automatically and adaptively learn spatial hierarchies of features by using convolutional layers.

For your information,

- a gradient is a measure of how much a function's output changes when its inputs change a little. It's also known as the slope of a function.
- Gradient descent: An optimization algorithm that uses gradients to minimize errors in machine learning models. It's a common way to train neural networks.
- How does gradient descent work?

– Start at a random point
– Move in the direction of the steepest descent
– Recompute the gradient at the new position
– Repeat until the function is close to or equal to zero