Neural Networks

Objective

After attending this session, you should be able

Introduction to neural network

Neuron and different layers of neural network

Introduction and Installation of Tensorflow

Class exercise: How neural network classify the handwritten digit

Class Exercise

- How neural Network work: https://medium.com/@sadafsaleem5815/neural-networks-in-10mins-simply-explained-9ec2ad9ea815

- How to Choose an Activation Function for Deep Learning: https://machinelearningmastery.com/choose-an-activation-function-for-deep-learning/

Key Processes in Neural Networks

- **Forward Propagation**: This is how data moves through the network. Each node takes inputs, does some math (using weights, biases, and an activation function), and passes the result to the next layer. It's like a conveyor belt moving information forward to get an answer.
  - **Math Example**: The output of a node is calculated as

    $y = \text{activation function}(\text{bias} + \text{sum of inputs} \times \text{weights})$.
- **Backpropagation**: This is how the network learns. It checks how wrong its predictions are (using a loss function) and adjusts the weights to reduce errors. It works backward from the output to the input, tweaking connections to improve accuracy.

Important Terms Made Simple

Weights: Numbers that control how much influence an input has on a node's output. Think of them as dials adjusting the importance of each piece of data.

Bias: A number added to a node's calculation to fine-tune the output, like a baseline adjustment.

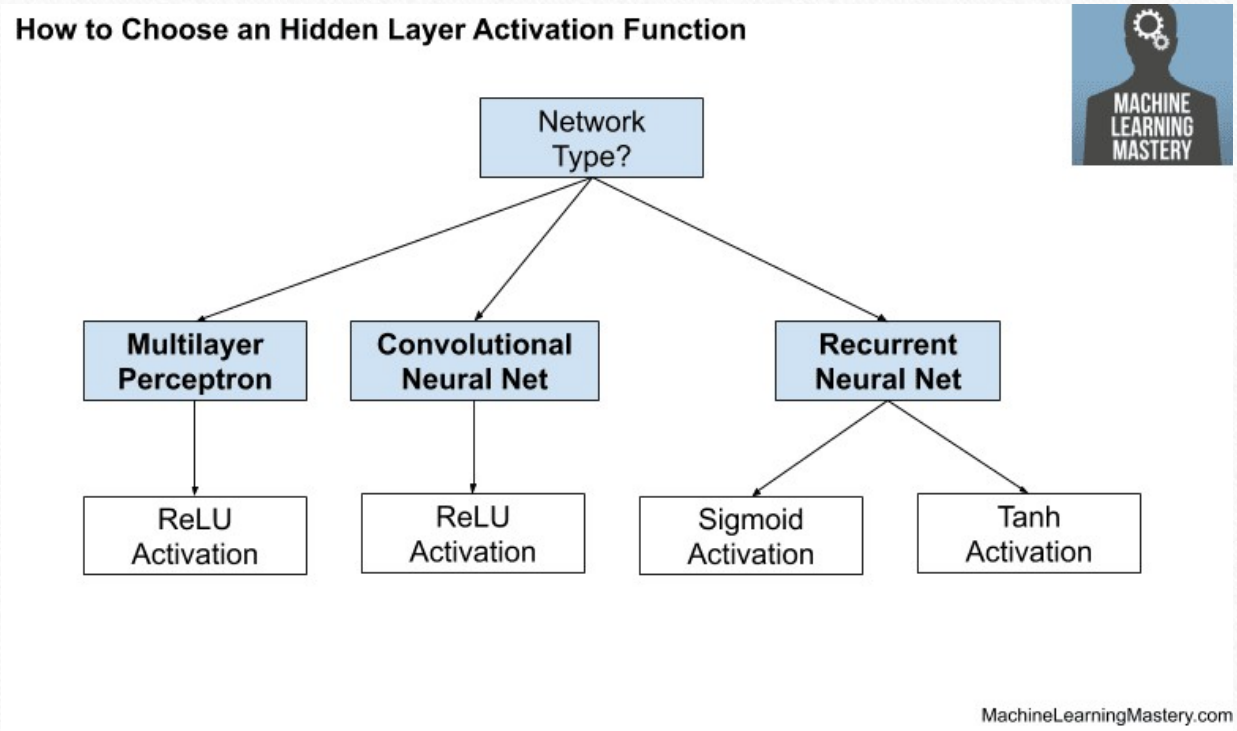
Activation Function: A rule that decides if a node "fires" or not. It adds flexibility so the network can handle complex patterns (e.g., sigmoid or ReLU functions).

Loss Function: Measures how far off the network's prediction is from the correct answer. The goal is to make this number as small as possible.

Gradient Descent: A method to adjust weights step-by-step to reduce errors, like finding the lowest point in a hilly landscape by following the steepest path down.

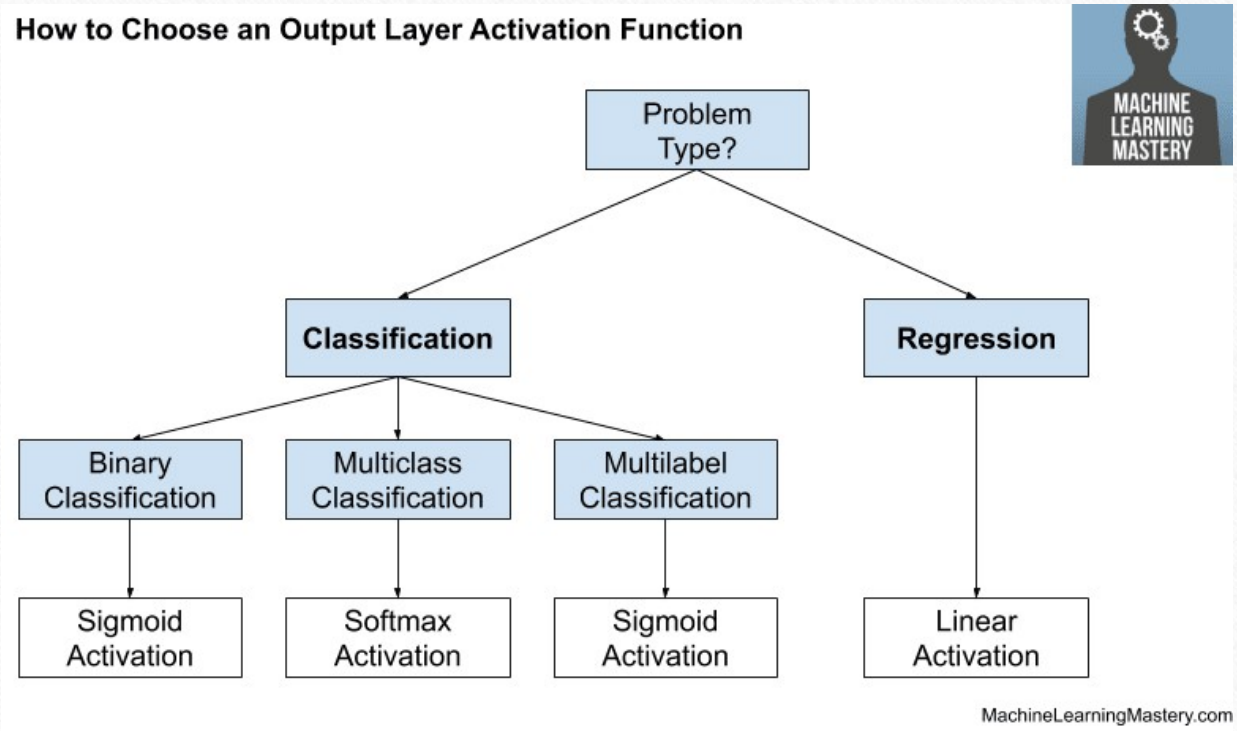
Loss Optimization: The process of tweaking weights to make predictions more accurate.

Hidden Layer Activation Function



Ref: https://machinelearningmastery.com/choose-an-activation-function-for-deep-learning/

Output Layer Activation Function



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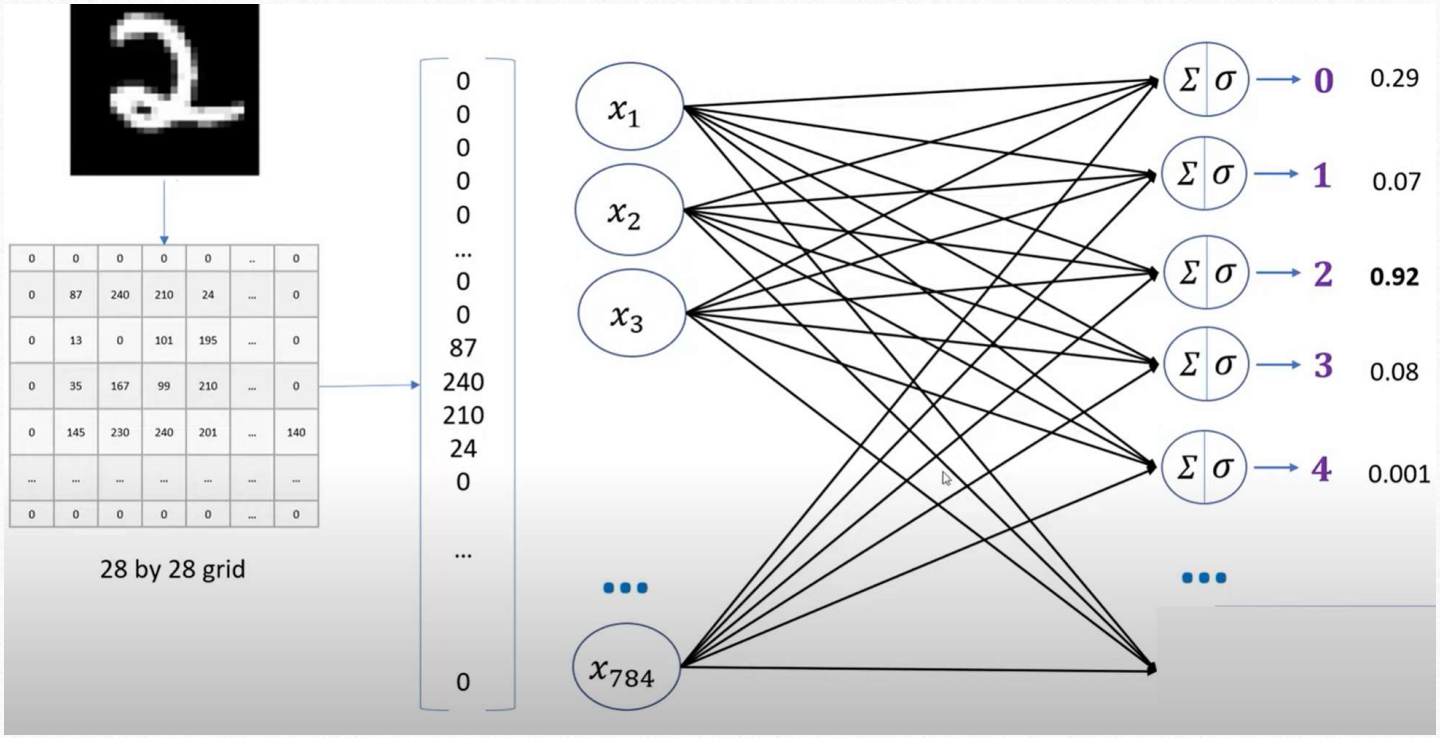
Introduction and Installation of TensorFlow

- TensorFlow is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks.
- TensorFlow was developed by the Google Brain team for internal Google use in research and production.
- Pytorch is from facebook.
- Keras is not full fledged deep learning framework like tensorflow and pytorch
- Now tensorflow 2.0
- Pip install tensorflow

Example: Handwritten Digits Classification



- An optimizer is a function or an algorithm that modifies the attributes of the neural network, such as weights and learning rate. Thus, it helps in reducing the overall loss and improve the accuracy
- One Epoch is when an ENTIRE dataset is passed forward and backward through the neural network only ONCE.
- Since one epoch is too big to feed to the computer at once we divide it in several smaller batches
- sparse_categorical_crossentropy: Used as a loss function for multi-class classification model where the output label is assigned integer value (0, 1, 2, 3…). This loss function is mathematically same as the categorical_crossentropy

  (more information: https://www.tensorflow.org/api_docs/python/tf/keras/losses)

Summary

Introduced to neural network

Neuron and different layers of neural network

See how neural network classify the handwritten digit

Activation function and bias

Installed Tensorflow

Hands on exercise

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