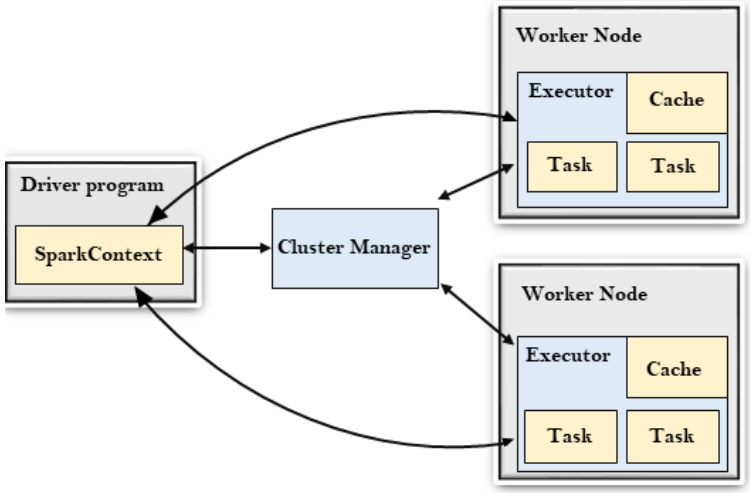
1. Explain the Architecture of spark?

The Spark follows the master-slave architecture. Its cluster consists of a single master and multiple slaves.

It depends on two abstractions:

1) Resilient Distributed Dataset (RDD)
   RDD Stands for:
   Resilient: Restore the data on failure.
   Distributed: Data is distributed among different nodes.
   Dataset: Group of data.
   They are the group of data items that can be stored in-memory on worker nodes. It enables you to recheck data in the event of a failure, and it acts as an interface for immutable data. It helps in recomputing data in case of failures, and it is a data structure. There are two methods for modifying RDDs: transformations and actions.
2) Directed Acyclic Graph (DAG)
   Directed Acyclic Graph is a finite direct graph that performs a sequence of computations on data. Each node is an RDD partition, and the edge is a transformation on top of data.
   The driver converts the program into a DAG for each job. A sequence of connection between nodes is referred to as a driver. As a result, you can read volumes of data using the Spark shell. You can also use the Spark context -cancel, run a job, task (work), and job (computation) to stop a job



The Spark driver

The master node (process) in a driver process coordinates workers and oversees the tasks. Spark is split into jobs and scheduled to be executed on executors in clusters. Spark contexts (gateways) are created by the driver to monitor the job working in a specific cluster and to connect to a Spark cluster. In the diagram, the driver programmes call the main application and create a spark context (acts as a gateway) that jointly monitors the job working in the cluster and connects to a Spark cluster. Everything is executed using the spark context.

The Spark executors

An executor is responsible for executing a job and storing data in a cache at the outset. Executors first register with the driver programme at the beginning. These executors have a number of time slots to run the application concurrently.

Cluster Manager

A driver program controls the execution of jobs and stores data in a cache. At the outset, executors register with the drivers. This executor has a number of time slots to run the application concurrently. Executors read and write external data in addition to servicing client requests.

Worker Nodes

The slave nodes function as executors, processing tasks, and returning the results back to the spark context. The master node issues tasks to the Spark context and the worker nodes execute them. They make the process simpler by boosting the worker nodes (1 to n) to handle as many jobs as possible in parallel by dividing the job up into sub-jobs on multiple machines.

2. Explain Activation function

- It is a important and crucial component in neural network.
- This activation function decides whether a neuron should be activated or not by calculating the weighted sum and adding bias to it.
- It is also known as transfer function.
- It introduces non-linearity. The activation function will do this non linear transformation to make and perform more complex tasks and to get more accuracy to the model.
- It is performed in hidden layer.
- It takes the input from the input layer.

3. List different types of activation function with their formula.

1) SIGMOID FUNCTION

- The range of the sigmoid function is (0,1).
- This function gives a S-Shape curve.
- As the range is in between 0 to 1 – It is used to predict the probability.
- Formula – X=(1/1+e^-x)
- It is a continuous function.
- It maps to input and gives the prediction.
- It is done in hidden layer.

2) TAN-H FUNCTION (HYPERBOLIC TANGENT)

- The range of tanh function is (-1,1).
- This function also gives S-shape curve same like a sigmoid function.

- As the range is in between -1 to 1 -It plots the negative points and also zero input will be plotted near zero(i.e. Origin)
- Formula – (e^x – e^-x)/(e^x + e^-x(
- It is centred at 0. It is symmetry about origin.

3) RELU (RECTIFIED LINEAR UNIT)

- The range or relu function is [0, infinity].
- Formula – F(X)=max(0,x).
- It is mostly and widely used in neural networks.
- It is simple. So ,the computational efficiency is also good.

4) LeakyRELU

- It increases the range of RELU function.
- The range is (-infinity,infinity)
- LRELU(X)=X if X>0,otherwise Ax
- It allows small values too, other than this its same as relu.
- Non – zero gradient when the input is negative.
- It also prevents dying neurons.

4. Explain Hybrid inheritance with code.

Done in jupyter notebook

5. Explain Neural Networks.

Neural networks are computational models composed of interconnected nodes, known as neurons or perceptrons, organized in layers. These networks are capable of learning complex patterns and relationships from data through a process called training.

1. Neuron/Perceptron:
   - Neurons are the basic building blocks of neural networks. They receive input signals, perform computations on them, and produce an output signal.
   - Each neuron applies an activation function to the weighted sum of its inputs to introduce non-linearity and determine its output.
   - Mathematically, a neuron computes:
     $$\text{Output} = f(\sum_{i=1}^{n} w_i \cdot x_i + b)$$
     where w_i are the weights, x_i are the inputs, b is the bias, and f is the activation function.

2. Layers:
   - Neurons are organized into layers within a neural network.
   - The input layer receives input data, the output layer produces the network's output, and hidden layers process intermediate representations.
   - Deep neural networks consist of multiple hidden layers, allowing them to learn hierarchical representations of data.

3. Weights and Biases:
   - Weights (w) and biases (b) are parameters that adjust the strength of connections between neurons.
   - During training, these parameters are updated iteratively using optimization algorithms like gradient descent to minimize the difference between the actual and predicted outputs.

4. Activation Functions:
   - Activation functions introduce non-linearity into the network, enabling it to learn complex patterns.
   - Common activation functions include sigmoid, tanh, ReLU (Rectified Linear Unit), and softmax (for the output layer in classification tasks).