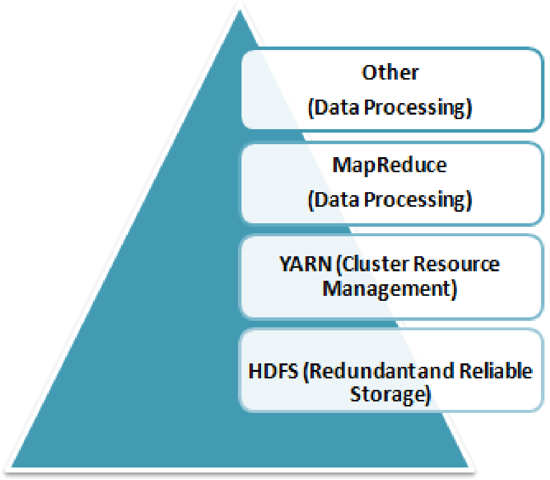
Explain the core components of Hadoop.

Answer: Hadoop is an open source framework that is meant for storage and processing of big data in a distributed manner. The core components of Hadoop are –

- **HDFS (Hadoop Distributed File System)** – HDFS is the basic storage system of Hadoop. The large data files running on a cluster of commodity hardware are stored in HDFS. It can store data in a reliable manner even when hardware fails.


Other
(Data Processing)
MapReduce
(Data Processing)
YARN (Cluster Resource Management)
HDFS (Redundant and Reliable Storage)

- **Hadoop MapReduce** – MapReduce is the Hadoop layer that is responsible for data processing. It writes an application to process unstructured and structured data stored in HDFS. It is responsible for the parallel processing of high volume of data by dividing data into independent tasks. The processing is done in two phases Map and Reduce. The Map is the first phase of processing that specifies complex logic code and the Reduce is the second phase of processing that specifies light-weight operations.

- **YARN** – The processing framework in Hadoop is YARN. It is used for resource management and provides multiple data processing engines i.e. data science, real-time streaming, and batch processing.

Define respective components of HDFS and YARN

The two main components of HDFS are-

- Name Node – This is the master node for processing metadata information for data blocks within the HDFS
- Data Node/Slave node – This is the node which acts as slave node to store the data, for processing and use by the Name Node

The two main components of YARN are–

- Resource Manager– This component receives processing requests and accordingly allocates to respective Node Managers depending on processing needs.
- Node Manager– It executes tasks on each single Data Node

Write the command used to copy data from the local system onto HDFS?

The command used for copying data from the Local system to HDFS is:
hadoop fs –copyFromLocal [source][destination]

What is partitioning in Hive?

In general partitioning in Hive is a logical division of tables into related columns such as date, city, and department based on the values of partitioned columns. Then these partitions are subdivided into buckets so that they provide extra structure to the data that may be used for more efficient querying.

Bucketing Hive

Partitions are sub-divided into **buckets,** to provide extra structure to the data that may be used for more efficient querying. Bucketing works based on the value of hash function of some column of a table.

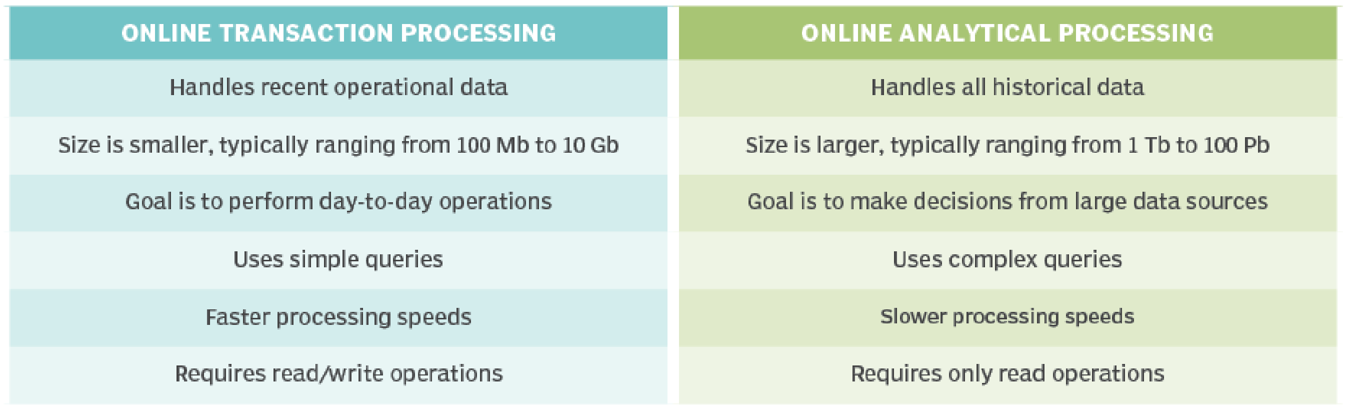
OLTP

Online transaction processing (OLTP) captures, stores, and processes data from transactions in real time.

OLAP

Online analytical processing (OLAP) uses complex queries to analyze aggregated historical data from OLTP systems.

The basic difference between OLTP and OLAP is that OLTP is an online database modifying system, whereas, OLAP is an online database query system



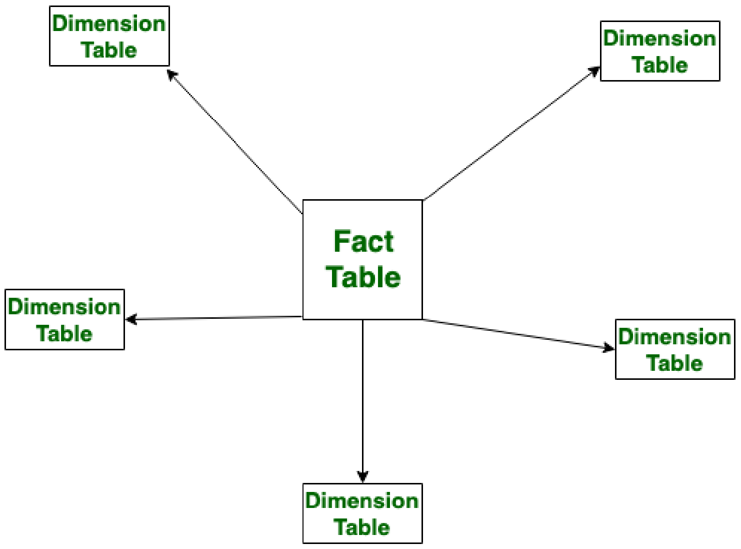
ONLINE TRANSACTION PROCESSING	ONLINE ANALYTICAL PROCESSING
Handles recent operational data	Handles all historical data
Size is smaller, typically ranging from 100 Mb to 10 Gb	Size is larger, typically ranging from 1 Tb to 100 Pb
Goal is to perform day-to-day operations	Goal is to make decisions from large data sources
Uses simple queries	Uses complex queries
Faster processing speeds	Slower processing speeds
Requires read/write operations	Requires only read operations

Fact and Dimension Table

A fact table holds the data to be analyzed, and a dimension table stores data about the ways in which the data in the fact table can be analyzed.

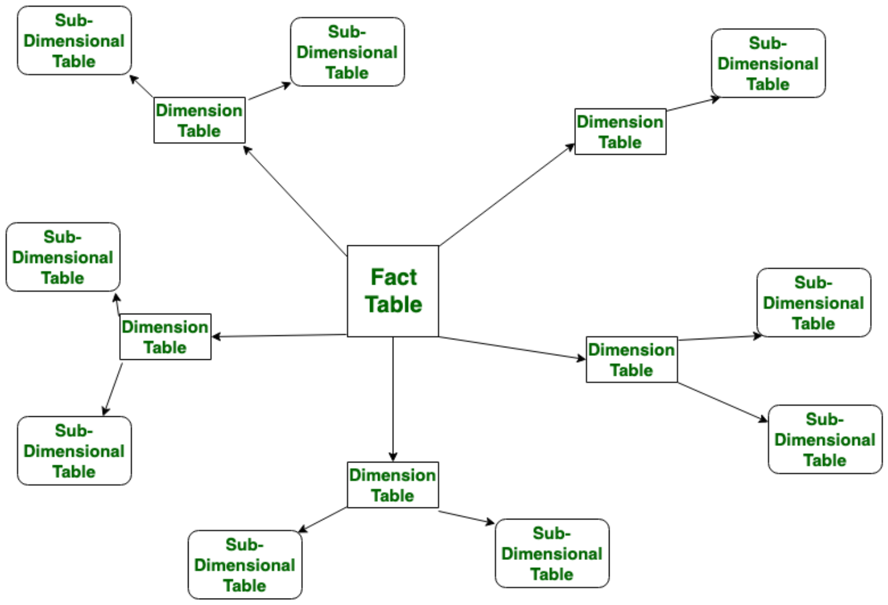
Star Schema

Star schema is the type of multidimensional model which is used for data warehouse. In star schema, the fact tables and the dimension tables are contained. In this schema fewer foreign-key join is used. This schema forms a star with fact table and dimension tables



Snowflake Schema

Snowflake Schema is also the type of multidimensional model which is used for data warehouse. In snowflake schema, the fact tables, dimension tables as well as sub dimension tables are contained. This schema forms a snowflake with fact tables, dimension tables as well as sub-dimension tables.



S.NO	**Star Schema**	**Snowflake Schema**
1.	In star schema, The fact tables and the dimension tables are contained.	While in snowflake schema, The fact tables, dimension tables as well as sub dimension tables are contained.
2.	Star schema is a top-down model.	While it is a bottom-up model.
3.	In star schema, Normalization is not used.	While in this, Both normalization and demoralization are used.
4.	It has less number of foreign keys.	While it has more number of foreign keys.
5.	It has high data redundancy.	While it has low data redundancy.

What is SCD in data warehouse?

A Slowly Changing Dimension (SCD) is **a dimension that stores and manages both current and historical data over time in a data warehouse**

- Type 1 – This model involves overwriting the old current value with the new current value. Overwrite the changes
- Type 2 – The current and the historical records are kept and maintained in the same file or table. History will be added as a new row.
- Type 3 – The current data and historical data are kept in the same record. History will be added as a new column.

File Formats:

AVRO is a row-based storage format. Writing operations in AVRO are better than in PARQUET

PARQUET is a columnar-based storage format. PARQUET is much better for analytical querying, i.e., reads and querying are much more efficient than writing. Parquet is more efficient in terms of storage and performance

ORC is Optimized Row Columnar, and it is a free and open-source columnar storage format designed for Hadoop workloads.

ORC supports ACID properties **ORC reduces the size of the original data up to 75%**. As a result the speed of data processing also increases and shows better performance than Text

CSV is a **comma-separated values file**, which allows data to be saved in a tabular format.

JSON file is **a file that stores simple data structures and objects in JavaScript Object Notation (JSON) format, which is a standard data interchange format**. It is primarily used for transmitting data between a web application and a server

Spark:

Open source distributed computing engine, you can store and process huge volume of data 100 time faster than hadoop.Its uses in memory and parallel processing which makes spark faster

Spark architecture:

Master /slave nodes, it contains three layers driver cluster manager and worker node, between driver and worker layer is cluster manager. All the components are loosely coupled within the boundary

In **master node**, you have the *driver program*, which drives our application. The code you are writing behaves as a driver program or if you are using the interactive shell, the shell acts as the driver program.Inside the driver program, the first thing you do is, you *create* a ***Spark Context.*** Assume that the Spark context is a gateway to all the Spark functionalities. It is similar to our database connection.

How does Spark work?

STEP 1: The client submits spark user application code. When an application code is submitted, the driver implicitly converts user code that contains transformations and actions into a logically *directed acyclic graph* called ***DAG.*** At this stage, it also performs optimizations such as pipelining transformations.

STEP 2: After that, it converts the logical graph called DAG into physical execution plan with many stages. After converting into a physical execution plan, it creates physical execution units called tasks under each stage. Then the tasks are bundled and sent to the cluster.

STEP 3: Now the driver talks to the cluster manager and negotiates the resources. Cluster manager launches executors in worker nodes on behalf of the driver. At this point, the driver will send the tasks to the executors based on data placement. When executors start, they register themselves with drivers. So, the driver will have a complete view of executors that are executing the task

STEP 4: During the course of execution of tasks, driver program will monitor the set of executors that runs. Driver node also schedules future tasks based on data placement.

What is meant by Lazy evaluation in spark?

Execution will not start until action is called. That means Data is not loaded until the point where action is called which helps spark engine to have better optimization

Terminologies of Spark

Driver and worker Process:

These are nothing but JVM process. Within one worker node, there could be multiple executors. Each executor runs its own JVM process.

Application:

It could be single command or combination of multiple notebooks with complex logic. When code is submitted to spark for execution, Application starts.

Jobs:

When an application is submitted to Spark, driver process converts the code into job.

Stage:

Jobs are divided into stages. If the application code demands shuffling the data across nodes, new stage is created. Number of stages is determined by number of shuffling operations. Join is example of shuffling operation

Tasks:

Stages are further divided into multiple tasks. In a stage, all the tasks would execute same logic. Each task will process 1 partition at a time. So number of partition in the distributed cluster determines the number of tasks in each stage

Transformation:

Transforms the input RDD and creates new RDD. Until action is called, transformations are evaluated lazily. Some of the transformations are

(map,filter,flatMap,mapPartitions,mapPartitionsWithIndex,groupBy,sortBy,union,intersection,subtract,distinct,Cartesian,zip,sample,randomSplit,keyBy,coalesce,repartition)

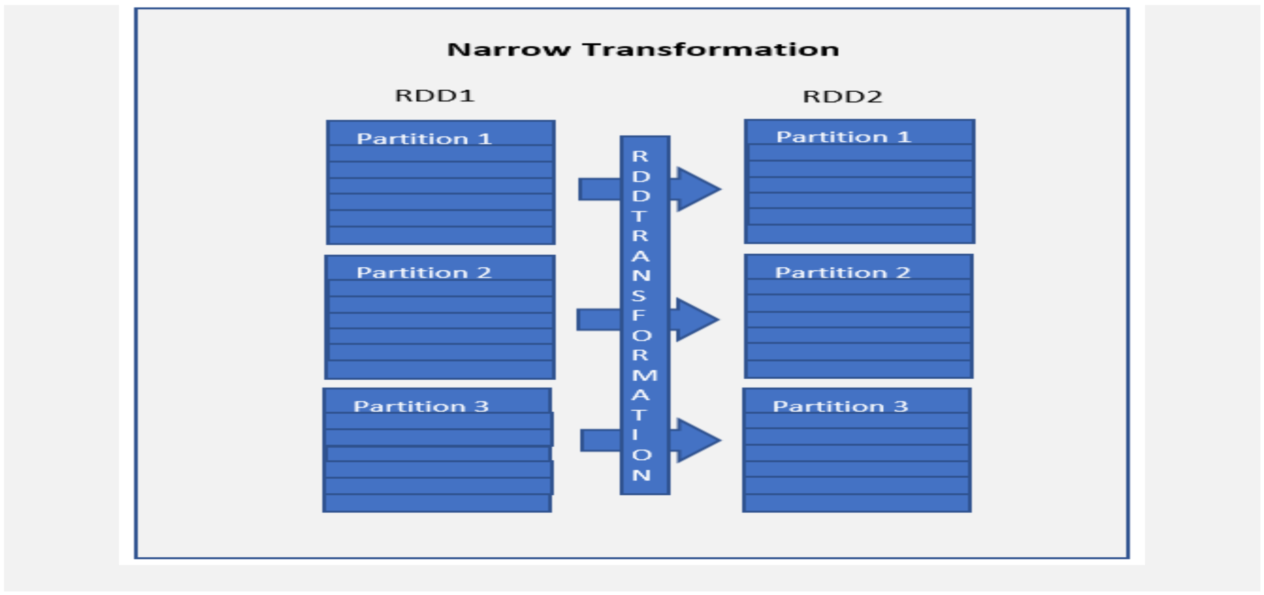
Two types of transformations in SPARK:

- Wide Transformations
- Narrow Transformations

Narrow Transformations:

These types of transformations convert each input partition to only one output partition. When each partition at the parent RDD is used by at most one partition of the child RDD or when each partition from child produced or dependent on single parent RDD.

- This kind of transformation is basically fast.
- Does not require any data shuffling over the cluster network or no data movement.
- Operation of map () and filter () belongs to this transformation.

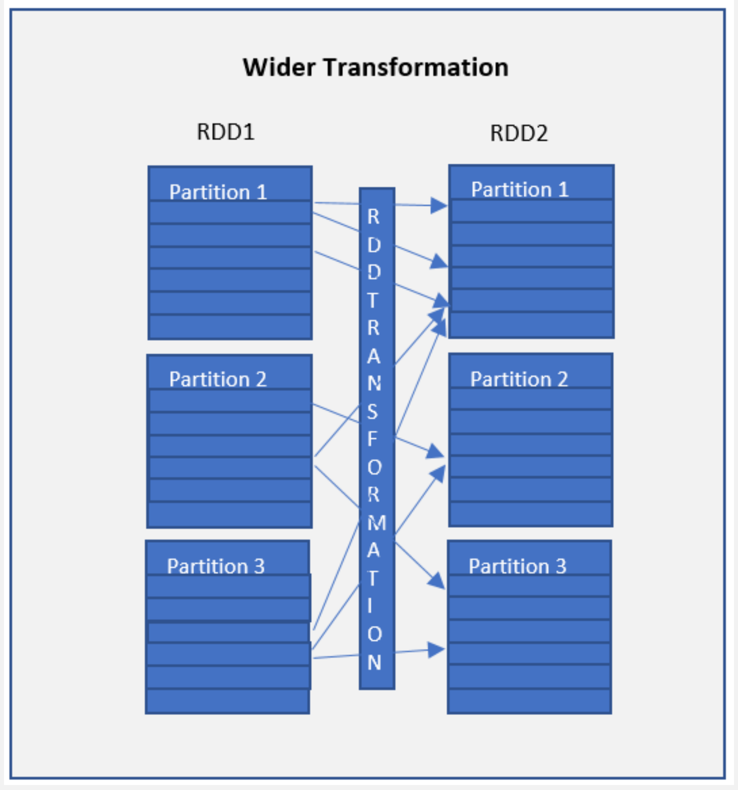


Wide Transformations:

This type of transformation will have input partitions contributing to many output partitions. When each partition at the parent RDD is used by multiple partitions of the child RDD or when each partition from child produced or dependent on multiple parents RDD.

- Slow as compare to narrow dependencies speed might be significantly affected as it might be required to shuffle data around different nodes when creating new partitions.

- Might Require data shuffling over the cluster network or no data movement.
- Functions such as groupByKey (), aggregateByKey(), aggregate(), join(), repartition() are some examples of wider transformations.



When working with Spark, it is always good or keeps in mind all operations or transformations which might require data shuffling and hence slow down the process. Try to optimize and reduce the usage of wide dependencies as much as you can.

Pesris

:

Directed Acyclic Graph keeps track of all transformation. For each transformation, logical plan is created and lineage graph is maintained by DAG

Action:

When data output is needed for developer or for storage purpose, action is called. Action would be executed based on DAG and processes the actual data.

Some of the actions are

(reduce,collect,aggregate,foldfirst,take,forEach,top,treeAggregate,treeReduce, Partitioncount,takeSample,max,min,sum,histogram,mean,variance,Save)

RDD:

RDDs expand to Resilient Distributed Datasets. These are the elements that are used for running and operating on multiple nodes to perform parallel processing on a cluster. Since RDDs are suited for parallel processing, they are immutable elements. This means that once we create RDD, we cannot modify it. RDDs are also fault-tolerant which means that whenever failure happens, they can be recovered automatically. Multiple operations can be performed on RDDs to perform a certain task. The operations can be of 2 types:

- ***Resilient:*** Fault tolerant and is capable of quickly recover from failure
- ***Distributed:*** Distributed data among the multiple nodes in a cluster
- ***FFDataset:*** Collection of partitioned data with values

What are the advantages of PySpark RDD?

PySpark RDDs have the following advantages:

- **In-Memory Processing:** Spark's RDD helps in loading data from the disk to the memory. The RDDs can even be persisted in the memory for reusing the computations.
- **Immutability:** The RDDs are immutable which means that once created, they cannot be modified. While applying any transformation operations on the RDDs, a new RDD would be created.
- **Fault Tolerance:** The RDDs are fault-tolerant. This means that whenever an operation fails, the data gets automatically reloaded from other available partitions. This results in seamless execution of the Spark applications.
- **Lazy Evolution:** The Spark transformation operations are not performed as soon as they are encountered. The operations would be stored in the DAG and are evaluated once it finds the first RDD action.
- **Partitioning:** Whenever RDD is created from any data, the elements in the RDD are partitioned to the cores available by default

Executor:

Each worker node consist of many executors.it can be configure by spark setting

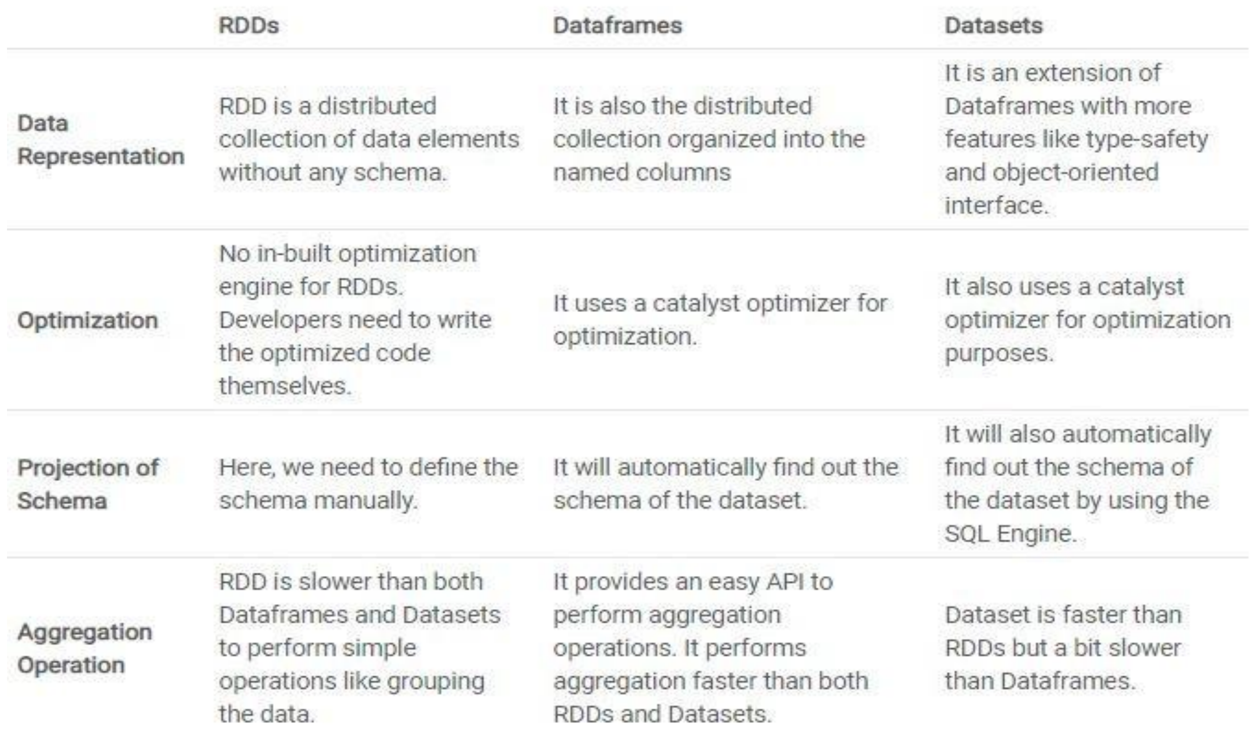
Core:

Each executor can consist of multiple cores. This is configurable by spark settings. Each core can process on task at a time

Important:

A Spark application can have many jobs. A job can have many stages. A stage can have many tasks. A task executes a series of instructions.

Different betyouen RDD vs. Dataframes vs. Datasets



	RDDs	Dataframes	Datasets
Data Representation	RDD is a distributed collection of data elements without any schema.	It is also the distributed collection organized into the named columns	It is an extension of Dataframes with more features like type-safety and object-oriented interface.
Optimization	No in-built optimization engine for RDDs. Developers need to write the optimized code themselves.	It uses a catalyst optimizer for optimization.	It also uses a catalyst optimizer for optimization purposes.
Projection of Schema	Here, we need to define the schema manually.	It will automatically find out the schema of the dataset.	It will also automatically find out the schema of the dataset by using the SQL Engine.
Aggregation Operation	RDD is slower than both Dataframes and Datasets to perform simple operations like grouping the data.	It provides an easy API to perform aggregation operations. It performs aggregation faster than both RDDs and Datasets.	Dataset is faster than RDDs but a bit slower than Dataframes.

What is DAG and how it works in Fault Tolerance?

DAG (Directed Acyclic Graph) in Apache Spark is an alternative to the MapReduce. It is a programming style used in distributed systems. In MapReduce, you just have two functions (map and reduce), while DAG has multiple levels that form a tree structure. Hence, DAG execution is faster than MapReduce because intermediate results do not write to disk.

Advantage of DAG:

- The lost RDD can recover using the Directed Acyclic Graph.
- Map Reduce has just two queries the map, and reduce but in DAG you have multiple levels. So to execute SQL query, DAG is more flexible.
- DAG helps to achieve fault tolerance. Thus you can recover the lost data.
- It can do a better global optimization than a system like Hadoop Map Reduce.

How spark achieves fault tolerance?

- Spark provides fault tolerance through lineage graph. Lineage graph keeps the track of the transformations to be executed once the action has been called. It helps in recomputing any missing RDD in case of any node failure.
- Immutability of RDD and lineage graph helps in recreating missing RDD in case of failure making it fault tolerant

```
from pyspark.sql import SparkSession
spark=SparkSession.builder.appName("Name").getOrCreate()
```

Which one do you prefer? Either groupByKey() or ReduseByKey?

groupByKey

The groupByKey can cause out of disk problems as data is sent over the network and collected on the reduced workers. You can see the below example.

```
sparkContext.textFile("hdfs://")
                    .flatMap(line => line.split(" ") )
                    .map(word => (word,1))
                    .groupByKey()
                    .map((x,y) => (x,sum(y)))
```

reducebykey

Whereas in reducebykey, Data are combined at each partition, only one output for one key at each partition to send over the network. reduceByKey required combining all our values into another value with the exact same type.

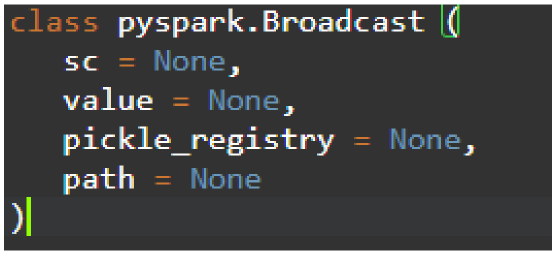
```
sparkContext.textFile("hdfs://")
                    .flatMap(line => line.split(" "))
                    .map(word => (word,1))
                    .reduceByKey((x,y)=> (x+y))
```

Broadcast Variable & Accumulator Variable

The main difference between these two is Broadcast variable is primarily used for reading some data across worker node .Accumulator is used for writing some data across worker node.

Broadcast Variable

Broadcast variables are used to save the copy of data across all nodes. This variable is cached on all the machines and not sent on machines with tasks. The following code block has the details of a Broadcast class for PySpark.



```
class pyspark.Broadcast (
   sc = None,
   value = None,
   pickle_registry = None,
   path = None
)
```

Rdd=sc.broadcast([“raju”,”tharan”])

To submit broadcast variable:

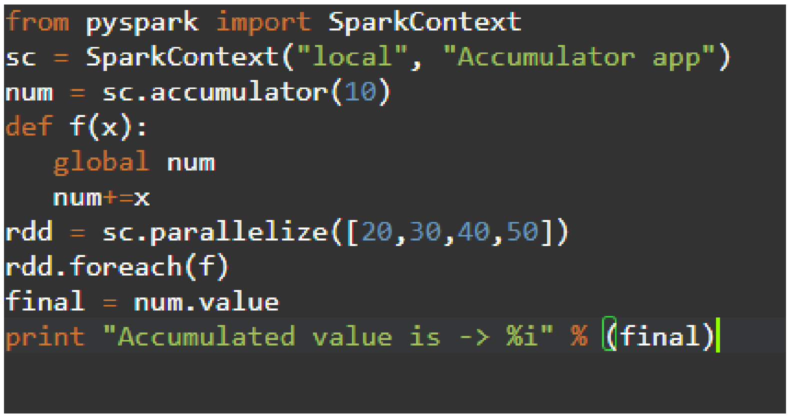
Spark-submit broadcast.py

OUTPUT:

Stored data →[‘raju’,’tharun’]

Accumulator

Accumulator variables are used for aggregating the information through associative and commutative operations. For example, you can use an accumulator for a sum operation or counters (in MapReduce).



```
from pyspark import SparkContext
sc = SparkContext("local", "Accumulator app")
num = sc.accumulator(10)
def f(x):
   global num
   num+=x
rdd = sc.parallelize([20,30,40,50])
rdd.foreach(f)
final = num.value
print "Accumulated value is -> %i" % (final)
```

Num=sc.accumulator(10)

Rdd=sc.paralellize([20,30,40,50])

When you submit accumulator variable:

Spark-submit accumulator.py

OUTPUT:

Accumulated value is: 150

Broadcasting Join

Broadcast Join is a type of join operation in PySpark that is used to join data frames by broadcasting it in PySpark application. This join can be used for the data frame that is smaller in size which can be broadcasted with the PySpark application to be used further. The data is sent and broadcasted to all nodes in the cluster. This is an optimal and cost-efficient join model that can be used in the PySpark application.

What is cluster mode and client mode in Spark?

Cluster mode puts the Spark driver in an application master process managed by YARN on the cluster. In client mode, the driver can run in the client process without an application master, which simplifies deployment and makes the driver easier to test.

What is Spark context in Spark?

A SparkContext **represents the connection to a Spark cluster, and can be used to create RDDs, accumulators and broadcast variables on that cluster**. Only one SparkContext should be active per JVM. You must stop() the active SparkContext before creating a new one.

What are PySpark serializers?

The serialization process is used to conduct performance tuning on Spark. The data sent or received over the network to the disk or memory should be persisted. PySpark supports serializers for this purpose. It supports two types of serializers, they are:

- **PickleSerializer:** This serializes objects using Python's PickleSerializer (class pyspark.PickleSerializer). This supports almost every Python object.

- **MarshalSerializer:** This performs serialization of objects. We can use it by using class pyspark.MarshalSerializer. This serializer is faster than the PickleSerializer but it supports only limited types.

Consider an example of serialization which makes use of MarshalSerializer:

```
# --serializing.py----
from pyspark.context import SparkContext
from pyspark.serializers import MarshalSerializer
sc = SparkContext("local", "Marshal Serialization", serializer =
MarshalSerializer())    #Initialize spark context and serializer
print(sc.parallelize(list(range(1000))).map(lambda x: 3 * x).take(5))
sc.stop()
```

When we run the file using the command:

```
$SPARK_HOME/bin/spark-submit serializing.py
```

The output of the code would be the list of size 5 of numbers multiplied by 3:

```
[0, 3, 6, 9, 12]
```

What is the difference between union and union all?

Union and Union All are similar except that Union only selects the rows specified in the query, while Union All selects all the rows including duplicates (repeated values) from both queries

What is a Spark session?

SparkSession is the entry point to Spark SQL. It is one of the very first objects we need to create while developing a Spark SQL application. we **create a SparkSession using the SparkSession. builder method** (that gives you access to Builder API that you use to configure the session).

cache () and persist ()?

Both persist () and cache () are the Spark optimization technique, used to store the data, but only difference is cache () method by default stores the data in-memory (MEMORY_ONLY) whereas in persist () method developer can define the storage level to in-memory or in-disk.

In cache() - default storage level is **MEMORY_ONLY**

Persist() -default storage level is **MEMORY_AND_DISK** .

Class Method	Static Method

We have many option of storage levels that can be used with persist()

- **MEMORY_ONLY,**
- **MEMORY_AND_DISK,**
- **MEMORY_ONLY_SERialized**
- **MEMORY_AND_DISK_SER,**
- **DISK_ONLY,**
- **MEMORY_ONLY_2,**
- **MEMORY_AND_DISK_2,**
- **DISK_ONLY_2**
- **MEMORY_ONLY_SER_2,**
- **MEMORY_AND_DISK_SER_2**

To check the storage level of the dataframe or RDD, we can
use ***rdd.getStorageLevel*** or ***df.storageLevel***

The class method takes cls (class) as first argument.	The static method does not take any specific parameter.
Class method can access and modify the class state.	Static Method cannot access or modify the class state.
The class method takes the class as parameter to know about the state of that class.	Static methods do not know about class state. These methods are used to do some utility tasks by taking some parameters.
@classmethod decorator is used here.	@staticmethod decorator is used here.

Class vs static method:

Decorators:

A decorator is **a design pattern in Python that allows a user to add new functionality to an existing object without modifying its structure**. Decorators are usually called before the definition of a function

we use a decorator **when you need to change the behaviour of a function without modifying the function itself**. A few good examples are when you want to add logging, test performance, perform caching, verify permissions

iterators and generators?

Iterators are the objects that use the next() method to get the next value of the sequence. A generator is a function that produces or yields a sequence of values using a yield statement. Classes are used to Implement the iterators. Functions are used to implement the generator.

Lambda function:

A lambda function is **a small anonymous function**. A lambda function can take any number of arguments, but can only have one expression.

Lambda functions are used **when you need a function for a short period of time**

Polymorphism in python defines methods in the child class that have the same name as the methods in the parent class

Isin():

The isin() method **checks if the Dataframe contains the specified value(s)**. It returns a DataFrame similar to the original DataFrame, but the original values have been replaced with True if the value was one of the specified values, otherwise False

Partition and Bucketing:

Both Partitioning and Bucketing in Hive are used to improve performance by eliminating table scans when dealing with a large set of data on a Hadoop file system (HDFS). The major difference between Partitioning vs Bucketing lives in the way how they split the data.

Partition is a way to organize large tables into smaller logical tables based on values of columns; one logical table (partition) for each distinct value.

Bucketing is a technique to split the data into more manageable files, (By specifying the number of buckets to create). The value of the bucketing column will be hashed by a user-defined number into buckets

Below are some of the differences between Partitioning vs bucketing

PARTITIONING	BUCKETING
Directory is created on HDFS for each partition.	File is created on HDFS for each bucket.
You can have one or more Partition columns	You can have only one Bucketing column
You can't manage the number of partitions to create	You can manage the number of buckets to create by specifying the count
NA	Bucketing can be created on a partitioned table
Uses PARTITIONED BY	Uses CLUSTERED BY

How to connect Hive through Spark SQL?

Solution to this is to copy your hive-site.xml and core-site.xml in spark conf folder which will give Spark job all the required metadata about Hive metastore and you have to enable Hive Support along with specifying your warehouse directory location of Hive in configuration while starting your Spark Session as given below:

```
spark = SparkSession \
    .builder \
    .appName("Python Spark SQL Hive integration example") \
    .config("spark.sql.warehouse.dir", warehouse_location) \
    .enableHiveSupport() \
    .getOrCreate()
```

Difference between Rank and Dense Rank?

This a sql question but I included it because we can expect this question if we go in window-partition section. Suppose, we have a dataset as given below:

Name	Salary	Rank	Dense_rank
Abid	1000	1	1
Ron	1500	2	2
Joy	1500	2	2
Aly	2000	4	3
Raj	3000	5	4

Here salary is in increasing order and we are getting rank() an dense_rank() for the dataset. As Ron and Joy have same salary they get the same rank, but rank() will leave hole and keep "3" as empty whereas dense_rank() will fill all the gaps even though same values are encountered

Databricks

Cluster types

1. All-purpose cluster
   - Also known as interactive cluster because
   - All-purpose cluster used for mainly used for developing purpose. While developing you should see the intermediate result.
   - All-purpose cluster also can be used for job.
   - Can be paused ,stop ,started and multiple user can share this cluster
2. Job cluster
   - Mainly used for schedule jobs
   - While scheduling jobs you need to configure the cluster parameter based on the cluster would be created during runtime and once the job got completed it will terminate automatically

    - You couldn’t control manually. Job cluster are visible during job runtime

3. Pool cluster
    - When you have multiple cluster you want to combine then you can create pool
    - Advantage of pool while creating you can set parameters such as this many number of instances should be active always and ready to use
    - Suitable for larger teams
    - It will be costly

Cluster Modes

- Standard
- High concurrency
- Single

What is auto scaling?

Databricks chooses dynamically the appropriate number of workers required to run the job based on range of number of workers.

It is one of the performance optimization technique

It is also one of cost saving technique

Auto scaling has two types

1. Standard
2. optimized

Sqoop

Apache Sqoop in Hadoop is used to fetch structured data from RDBMS systems like Teradata, Oracle, MySQL, MSSQL, PostgreSQL and on the other hand

Flume

Apache Flume is used to fetch data that is stored on various sources as like the log files on a Web Server or an Application Server.

Different Types of SQL JOINs

Here are the different types of the JOINs in SQL:

- (INNER) JOIN: Returns records that have matching values in both tables
- LEFT (OUTER) JOIN: Returns all records from the left table, and the matched records from the right table
- RIGHT (OUTER) JOIN: Returns all records from the right table, and the matched records from the left table
- FULL (OUTER) JOIN: Returns all records when there is a match in either left or right table

Set Operators:

Set operators are used to combine results from two or more SELECT statements. They combine the same type of data from two or more tables. This looks similar to SQL joins although there is a difference. SQL joins are used to combine columns whereas Set operators are used to join rows from multiple SELECT queries. They return only one result set.

These operators work on complete rows of the queries, so the results of the queries must have the same column name, same column order and the types of columns must be compatible.

There are the following 4 set operators in SQL Server: union, unionall, intersect and except

UNION

The UNION operator combines two or more result sets into a single result set, without duplications

UNION ALL

Like the UNION operator the UNION ALL operator also combines two or more result sets into a single result set. The only difference between a UNION and UNION ALL is that the UNION ALL allows duplicate rows.

INTERSECT

INTERSECT operator returns only the rows present in all the result sets. The intersection of two queries gives the rows that are present in both result sets

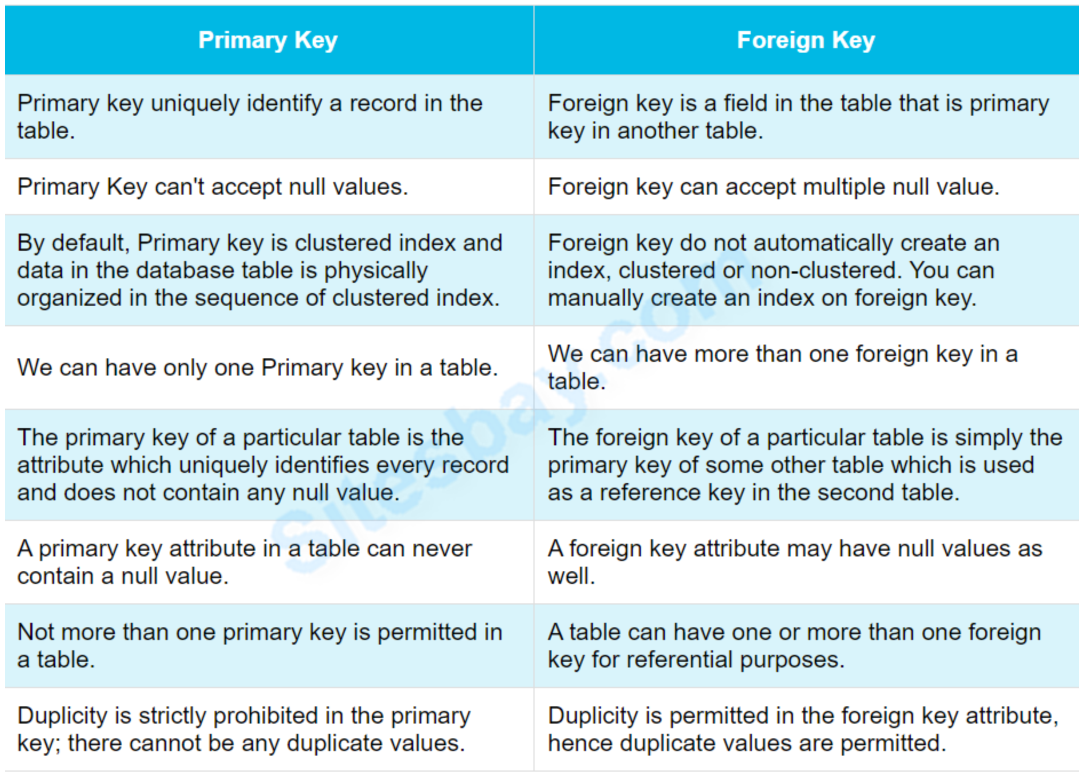
EXCEPT

EXCEPT operator returns all distinct the rows that are present in the result set of the first query, but not in the result set of the second query. It means it returns the difference between the two result sets.

Execution order of SQL

- FROM
- WHERE
- GROUP BY
- HAVING
- SELECT
- ORDER BY
- LIMIT

Primary Key vs Foreign Key



Primary Key	Foreign Key
Primary key uniquely identify a record in the table.	Foreign key is a field in the table that is primary key in another table.
Primary Key can't accept null values.	Foreign key can accept multiple null value.
By default, Primary key is clustered index and data in the database table is physically organized in the sequence of clustered index.	Foreign key do not automatically create an index, clustered or non-clustered. You can manually create an index on foreign key.
We can have only one Primary key in a table.	We can have more than one foreign key in a table.
The primary key of a particular table is the attribute which uniquely identifies every record and does not contain any null value.	The foreign key of a particular table is simply the primary key of some other table which is used as a reference key in the second table.
A primary key attribute in a table can never contain a null value.	A foreign key attribute may have null values as well.
Not more than one primary key is permitted in a table.	A table can have one or more than one foreign key for referential purposes.
Duplicity is strictly prohibited in the primary key; there cannot be any duplicate values.	Duplicity is permitted in the foreign key attribute, hence duplicate values are permitted.

JOINS IN SQL

- **INNER JOIN:** return all the rows from multiple tables where the join condition is satisfied.

- **LEFT JOIN:** return all the rows from the left table but only the matching rows from the right table where the join condition is fulfilled.
- **RIGHT JOIN:** return all the rows from the right table but only the matching rows from the left table where the join condition is fulfilled.

- **FULL JOIN:** returns all the records when there is a match in any of the tables. Therefore, it returns all the rows from the left-hand side table and all the rows from the right-hand side table.

- **SELF JOIN** − is used to join a table to itself as if the table were two tables, temporarily renaming at least one table in the SQL statement.
- **CARTESIAN JOIN** − returns the Cartesian product of the sets of records from the two or more joined tables.

Common clauses used with SELECT query in SQL?

The following are some frequent SQL clauses used in conjunction with a SELECT query:

WHERE clause: In SQL, the WHERE clause is used to filter records that are required depending on certain criteria.

```
Example: SELECT ID, NAME, SALARY
FROM CUSTOMERS
WHERE SALARY > 2000;
```

ORDER BY clause: The ORDER BY clause in SQL is used to sort data in ascending (ASC) or descending (DESC) order depending on specified field(s) (DESC).

```
SELECT * FROM CUSTOMERS
 ORDER BY NAME DESC;
```

GROUP BY clause: GROUP BY clause in SQL is used to group entries with identical data and may be used with aggregation methods to obtain summarized database results.

```
SELECT DEPT, SUM(SALARY) FROM CUSTOMERS GROUP BY DEPT;
SELECT DEPT, min(SALARY) FROM CUSTOMERS GROUP BY DEPT ;
SELECT DEPT, MAX(SALARY) FROM CUSTOMERS GROUP BY DEPT ;
SELECT DEPT, AVG(SALARY) FROM CUSTOMERS GROUP BY DEPT ;
```

HAVING clause in SQL is used to filter records in combination with the GROUP BY clause. It is different from WHERE, since the WHERE clause cannot filter aggregated records Syntax:

SELECT FROM WHEREGROUP BY

HAVING
ORDER BY

Example

```
SELECT ID, NAME, AGE, ADDRESS, SALARY
FROM CUSTOMERS
GROUP BY age
HAVING COUNT(age) >= 2;
```

How to remove duplicate rows in SQL?

A.) DISTINCT

```
SELECT DISTINCT SALARY FROM CUSTOMERS
 ORDER BY SALARY;
```

B.)DELETE BY ROW

- If the SQL table has duplicate rows, the duplicate rows must be removed.
- Let's assume the following table as our dataset:

ID	Name	Age
1	A	21
2	B	23
2	B	23
4	D	22

5	E	25
6	G	26
5	E	25

```
DELETE FROM table WHERE ID IN (
SELECT
ID, COUNT (ID)
FROM   table
GROUP BY ID
HAVING
COUNT (ID) > 1);
```

How to find the nth highest salary in SQL?

```
select salary AS SecondHighestSalary from ( select row_number () over ( order by
salary desc ) row_ , salary from CUSTOMERS )  as emp where emp.row_ = 2

select salary AS ThirdHighestSalary from ( select row_number () over ( order by
salary desc ) row_ , salary from CUSTOMERS ) as emp where emp.row_ = 3
```

What is the ACID property in a database?

ACID stands for Atomicity, Consistency, Isolation, and Durability. It is used to ensure that the data transactions are processed reliably in a database system.

- **Atomicity** - each statement in a transaction (to read, write, update or delete data) is treated as a single unit. Either the entire statement is executed, or none of it is executed. This property prevents data loss and corruption from occurring if, for example, if you’re streaming data source fails mid-stream.
- **Consistency** - ensures that transactions only make changes to tables in predefined, predictable ways. Transactional consistency ensures that corruption or errors in your data do not create unintended consequences for the integrity of your table.
- **Isolation** - when multiple users are reading and writing from the same table all at once, isolation of their transactions ensures that the concurrent transactions don’t interfere with or affect one another. Each request can

occur as though they were occurring one by one, even though they're actually occurring simultaneously.

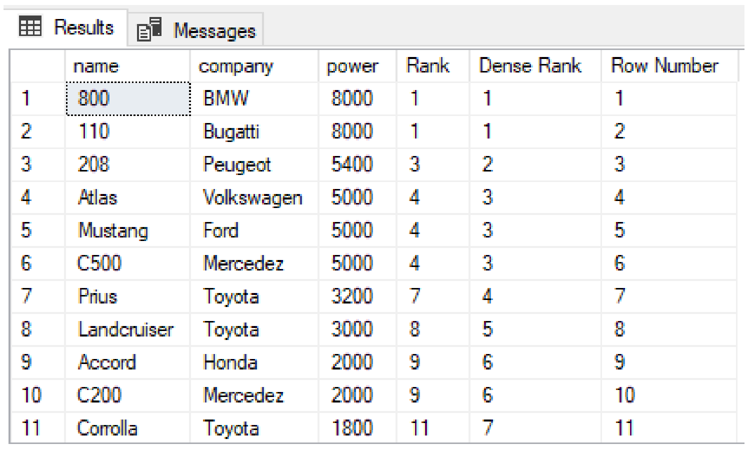
- **Durability** - ensures that changes to your data made by successfully executed transactions will be saved, even in the event of system failure

Rank vs Dense Rank vs Row _Number:

RANK function skips the next N-1 ranks if there is a tie between N previous ranks.

DENSE_RANK function does not skip ranks if there is a tie between ranks

ROW_NUMBER function has no concern with ranking. It simply returns the row number of the sorted records

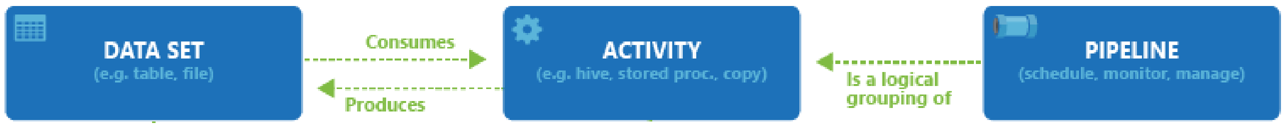


	name	company	power	Rank	Dense Rank	Row Number
1	800	BMW	8000	1	1	1
2	110	Bugatti	8000	1	1	2
3	208	Peugeot	5400	3	2	3
4	Atlas	Volkswagen	5000	4	3	4
5	Mustang	Ford	5000	4	3	5
6	C500	Mercedez	5000	4	3	6
7	Prius	Toyota	3200	7	4	7
8	Landcruiser	Toyota	3000	8	5	8
9	Accord	Honda	2000	9	6	9
10	C200	Mercedez	2000	9	6	10
11	Corrolla	Toyota	1800	11	7	11

AZURE

What is Activity in Azure Data Factory?

The activity is the task we performed on our data. We use activity inside the Azure Data Factory pipelines. ADF pipelines are a group of one or more activities. For ex: When you create an ADF pipeline to perform ETL you can use multiple activities to extract data, transform data and load data to your data warehouse. Activity uses Input and output datasets. Dataset represents your data if it is tables, files, folders etc. Below diagram shows the relationship between Activity, dataset and pipeline:



An Input dataset simply tells you about the input data and it's schema. And an Output dataset will tell you about the output data and it's schema. You can attach zero or more Input datasets and one or more Output datasets. Activities in Azure Data Factory can be broadly categorized as:

1- Data Movement Activities

2- Data Transformation Activities

3- Control Activities

DATA MOVEMENT ACTIVITIES:

1- Copy Activity: It simply copies the data from Source location to destination location. Azure supports multiple data store locations such as Azure Storage, Azure DBs, NoSQL, Files, etc.

DATA TRANSFORMATION ACTIVITIES:

1- Data Flow: In data flow, First, you need to design data transformation workflow to transform or move data. Then you can call Data Flow activity inside the ADF pipeline. It runs on Scaled out Apache Spark Clusters. There are two types of DataFlows: Mapping and Wrangling DataFlows

MAPPING DATA FLOW: It provides a platform to graphically design data transformation logic. You don't need to write code. Once your data flow is complete, you can use it as an Activity in ADF pipelines.

WRANGLING DATA FLOW: It provides a platform to use power query in Azure Data Factory which is available on Ms excel. You can use power query M functions also on the cloud.

2- Hive Activity: This is a HD insight activity that executes Hive queries on windows/linux based HDInsight cluster. It is used to process and analyze structured data.

3- Pig activity: This is a HD insight activity that executes Pig queries on windows/linux based HDInsight cluster. It is used to analyze large datasets.

4- MapReduce: This is a HD insight activity that executes MapReduce programs on windows/linux based HDInsight cluster. It is used for processing and generating large datasets with a parallel distributed algorithm on a cluster.

5- Hadoop Streaming: This is a HD Insight activity that executes Hadoop streaming program on windows/linux based HDInsight cluster. It is used to write mappers and reducers with any executable script in any language like Python, C++ etc.

6- Spark: This is a HD Insight activity that executes Spark program on windows/linux based HDInsight cluster. It is used for large scale data processing.

7- Stored Procedure: In Data Factory pipeline, you can use execute Stored procedure activity to invoke a SQL Server Stored procedure. You can use the following data stores: Azure SQL Database, Azure Synapse Analytics, SQL Server Database, etc.

8- U-SQL: It executes U-SQL script on Azure Data Lake Analytics cluster. It is a big data query language that provides benefits of SQL.

9- Custom Activity: In custom activity, you can create your own data processing logic that is not provided by Azure. You can configure .Net activity or R activity that will run on Azure Batch service or an Azure HDInsight cluster.

10- Databricks Notebook: It runs your databricks notebook on Azure databricks workspace. It runs on Apache spark.

11- Databricks Python Activity: This activity will run your python files on Azure Databricks cluster.

12- Azure Functions: It is Azure Compute service that allows us to write code logic and use it based on events without installing any infrastructure. It stores your code into Storage and keep the logs in application Insights.Key points of Azure Functions are :

1- It is a Serverless service.

2- It has Multiple languages available : C#, Java, Javascript, Python and PowerShell

3- It is a Pay as you go Model.

3- Control Flow Activities:

1- Append Variable Activity: It assigns a value to the array variable.

2- Execute Pipeline Activity: It allows you to call Azure Data Factory pipelines.

3- Filter Activity: It allows you to apply different filters on your input dataset.

4- For Each Activity: It provides the functionality of a for each loop that executes for multiple iterations.

5- Get Metadata Activity: It is used to get metadata of files/folders. You need to provide the type of metadata you require: childItems, columnCount, contentMDS, exists, itemName, itemType, lastModified, size, structure, created etc.

6- If condition Activity: It provides the same functionality as If statement, it executes the set of expressions based on if the condition evaluates to true or false.

7- Lookup Activity: It reads and returns the content of multiple data sources such as files or tables or databases. It could also return the result set of a query or stored procedures.

8- Set Variable Activity: It is used to set the value to a variable of type String, Array, etc.

9- Switch Activity: It is a Switch statement that executes the set of activities based on matching cases.

10- Until Activity: It is same as do until loop. It executes a set of activities until the condition is set to true.

11- Validation Activity: It is used to validate the input dataset.

12- Wait Activity: It just waits for the given interval of time before moving ahead to the next activity. You can specify the number of seconds.

13- Web Activity: It is used to make a call to REST APIs. You can use it for different use cases such as ADF pipeline execution.

14- Webhook Activity: It is used to to call the endpoint URLs to start/stop the execution of the pipelines. You can call external URLs also.