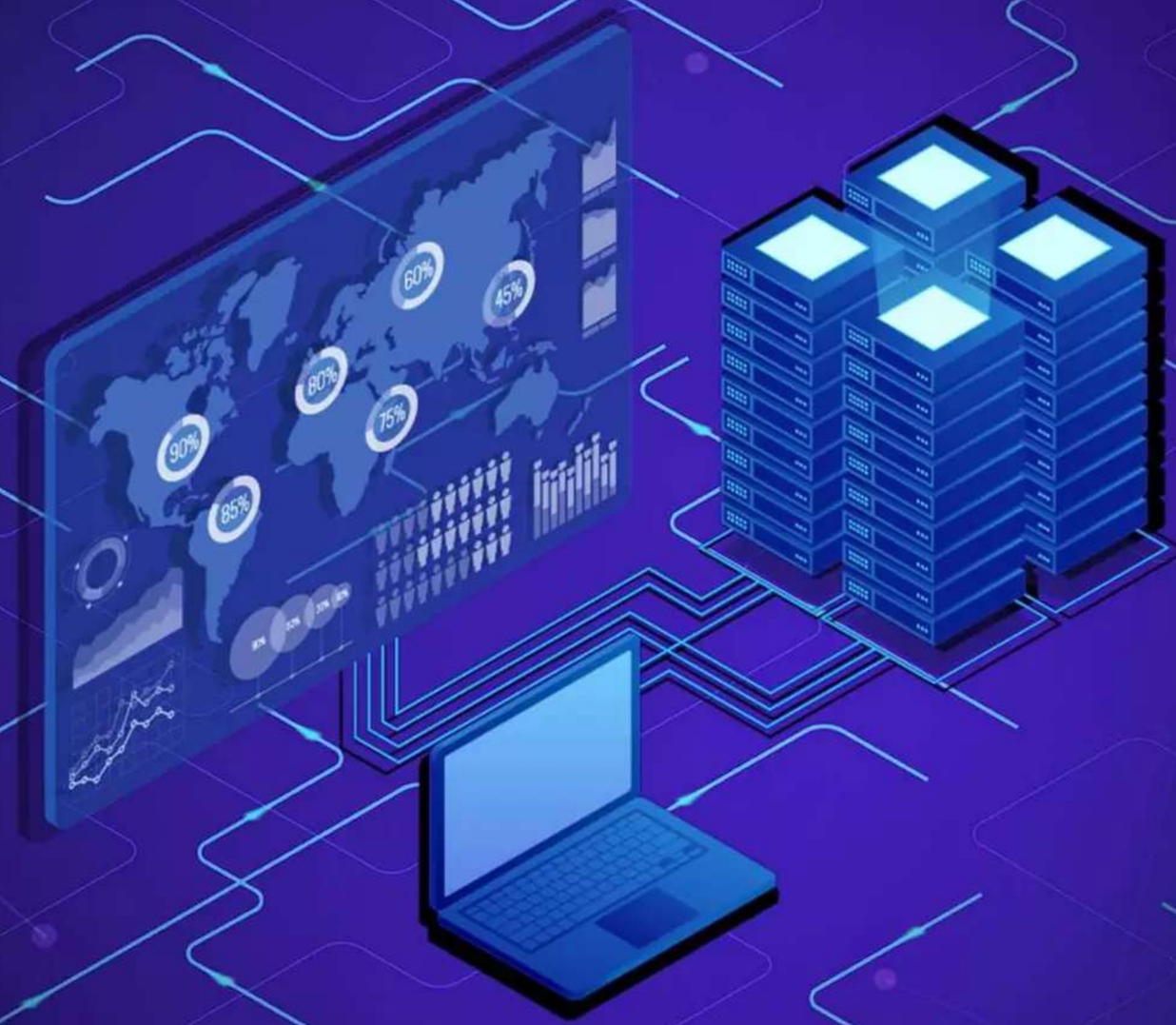
Apache Spark Architecture



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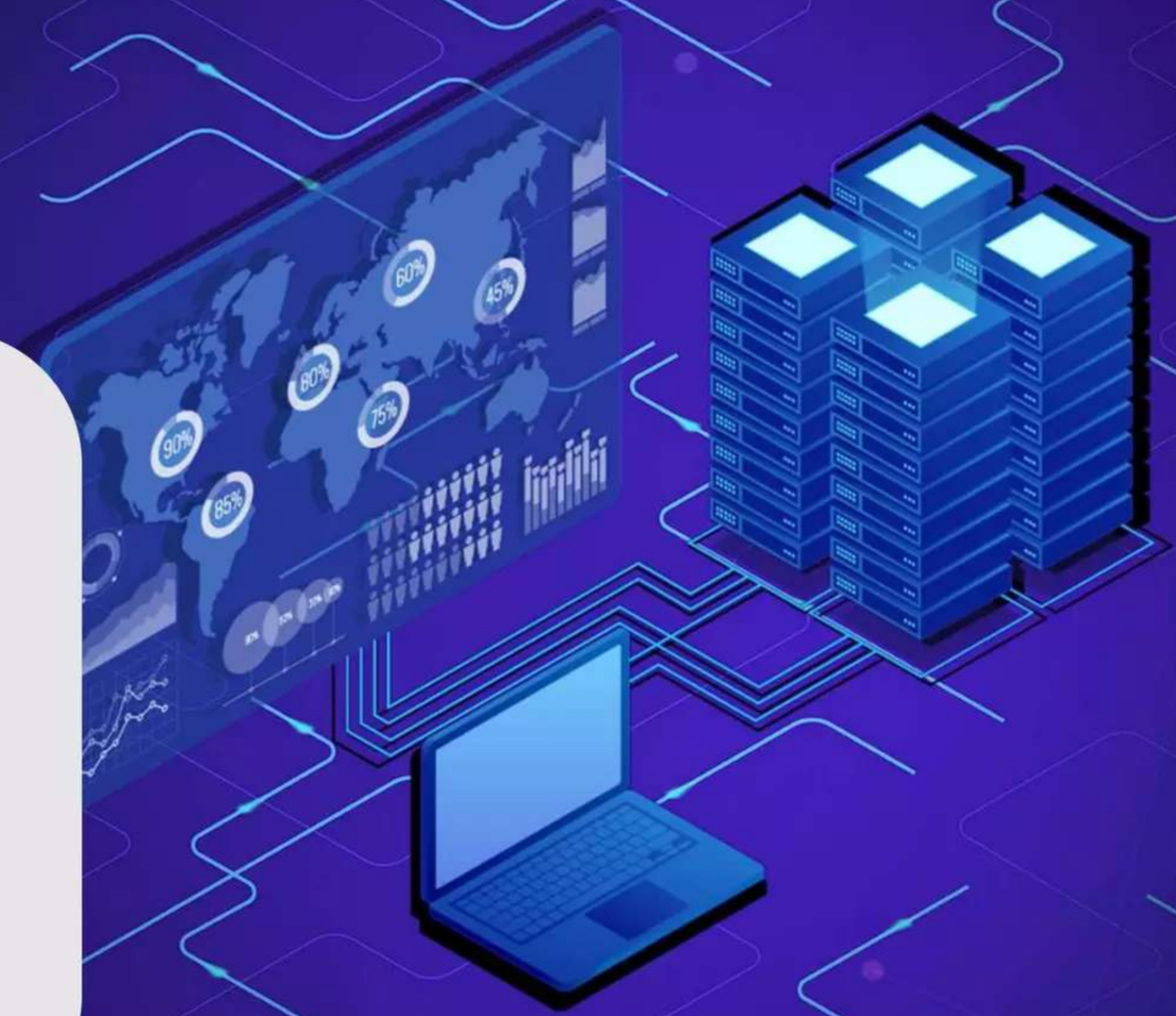
What's in it for you?

1. What is Spark?
2. Components of Spark
    - Spark Core
    - Spark SQL
    - Spark Streaming
    - Spark MLlib
    - GraphX
3. Apache Spark Architecture
4. Running a Spark Application



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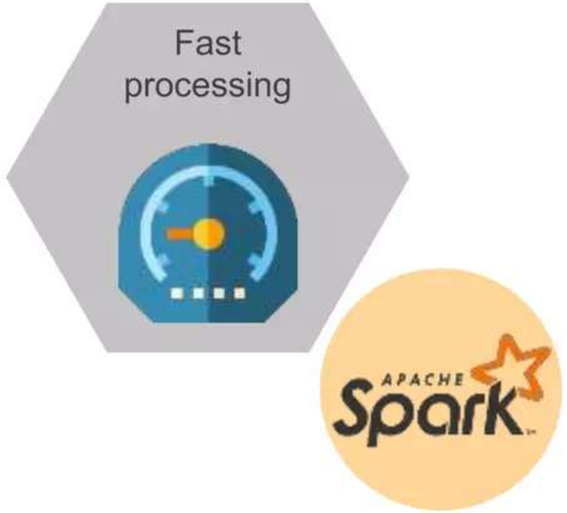

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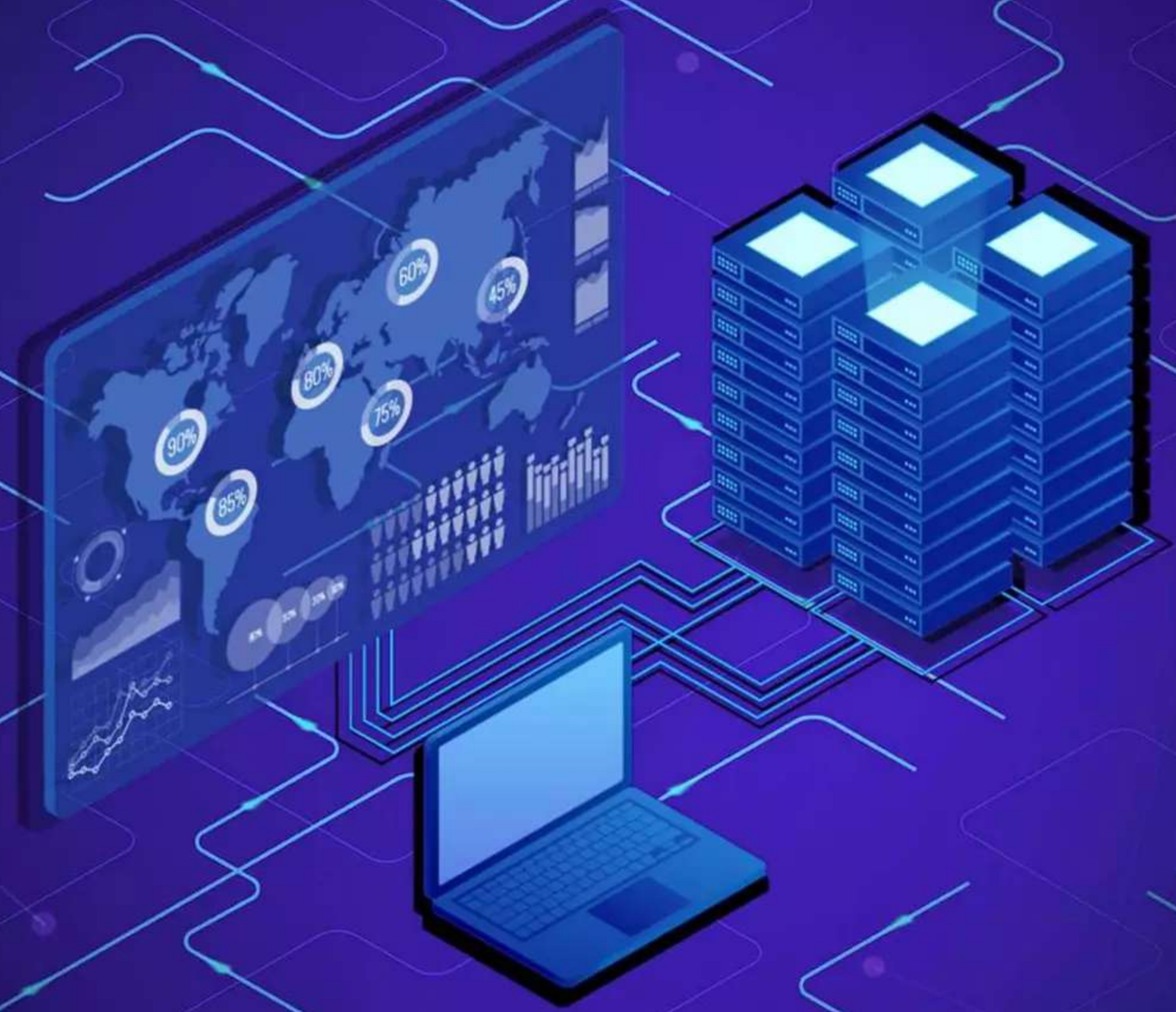
Spark Components



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Apache Spark Components

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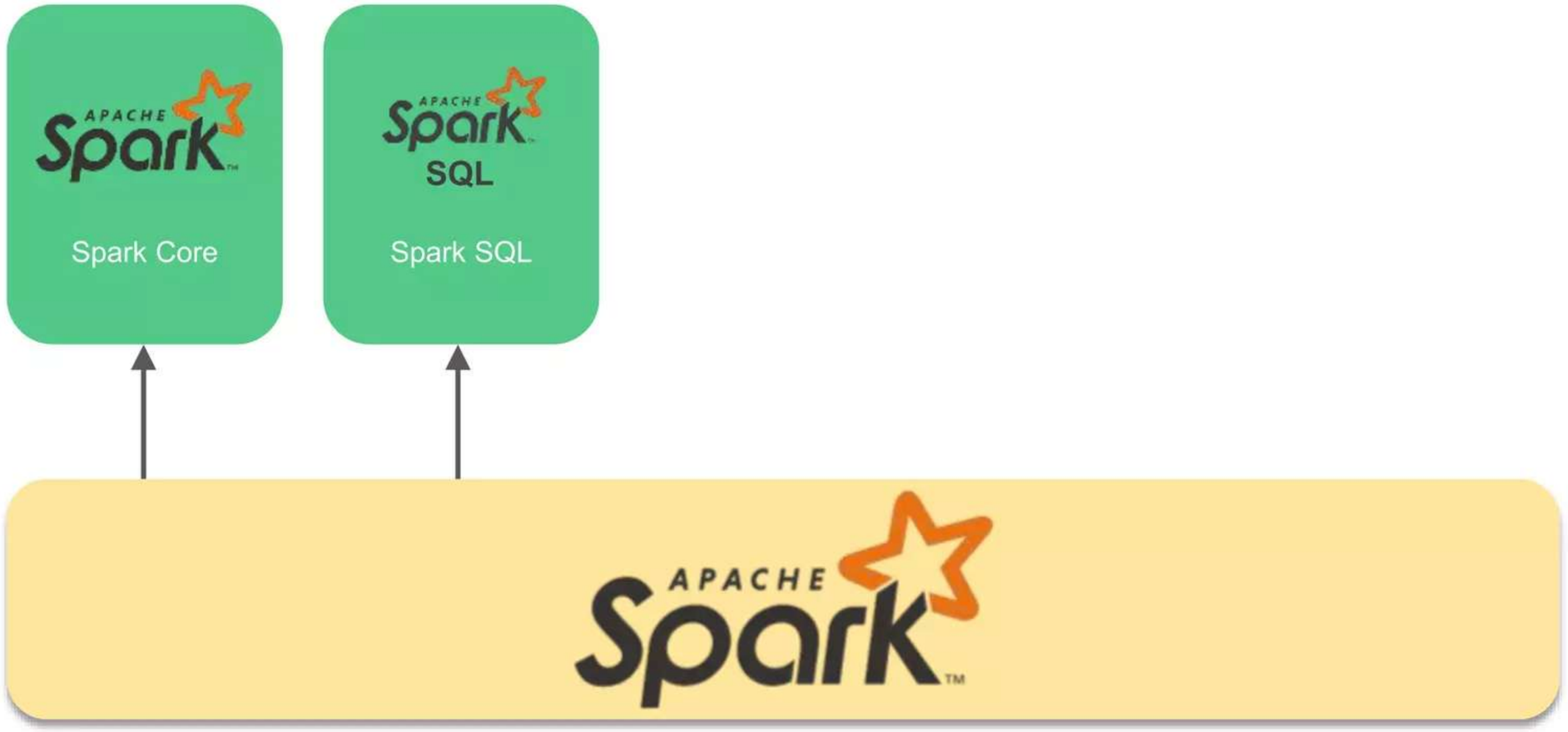

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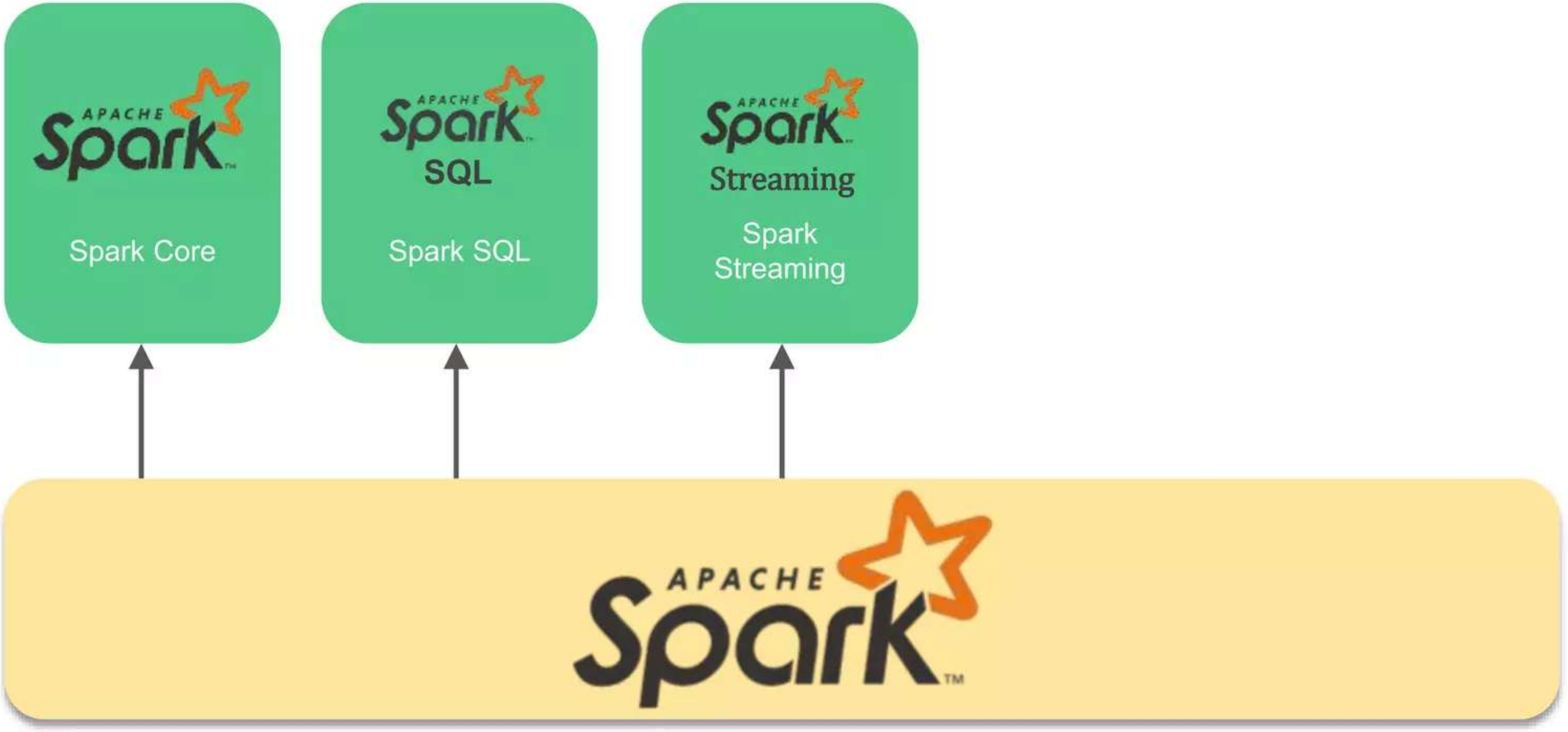

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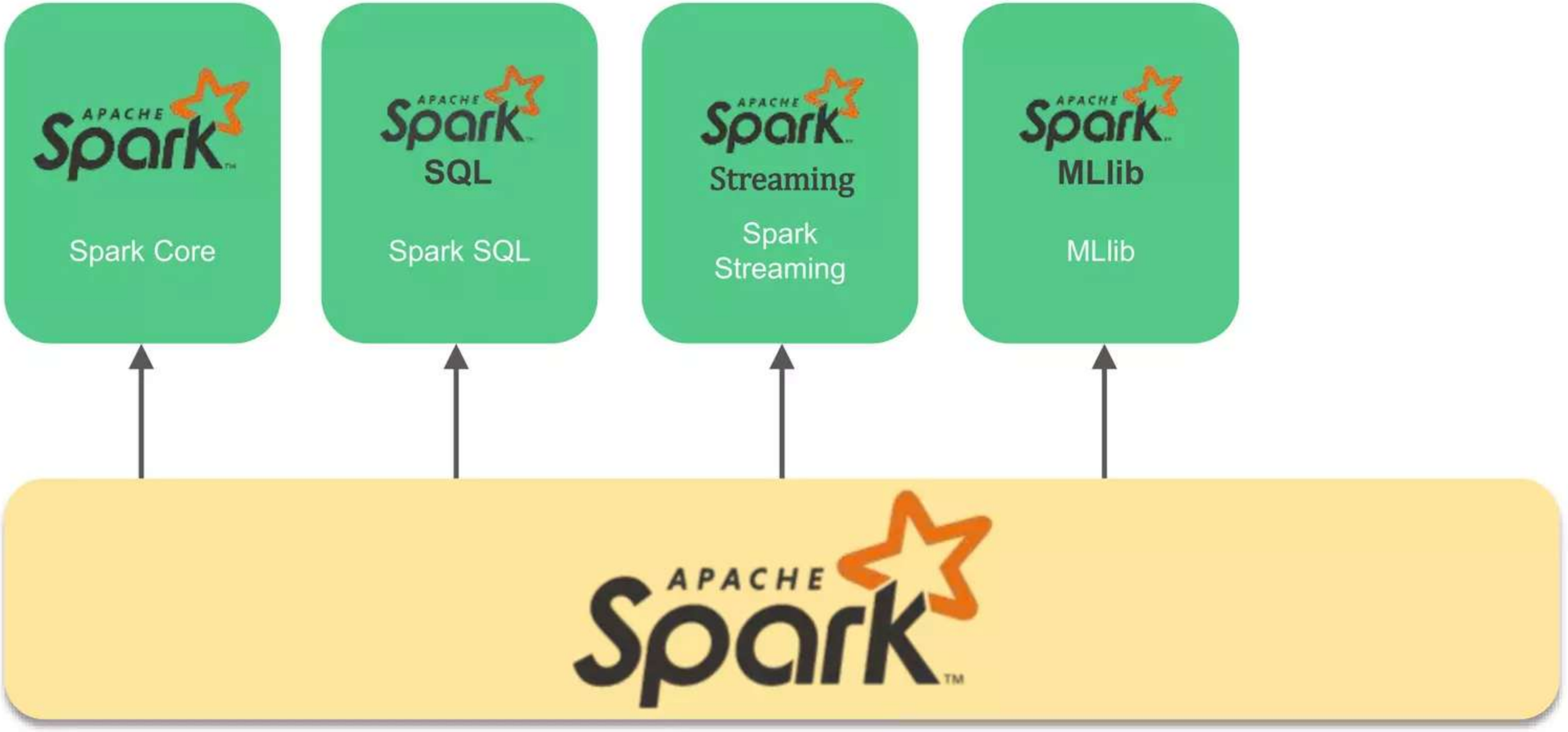

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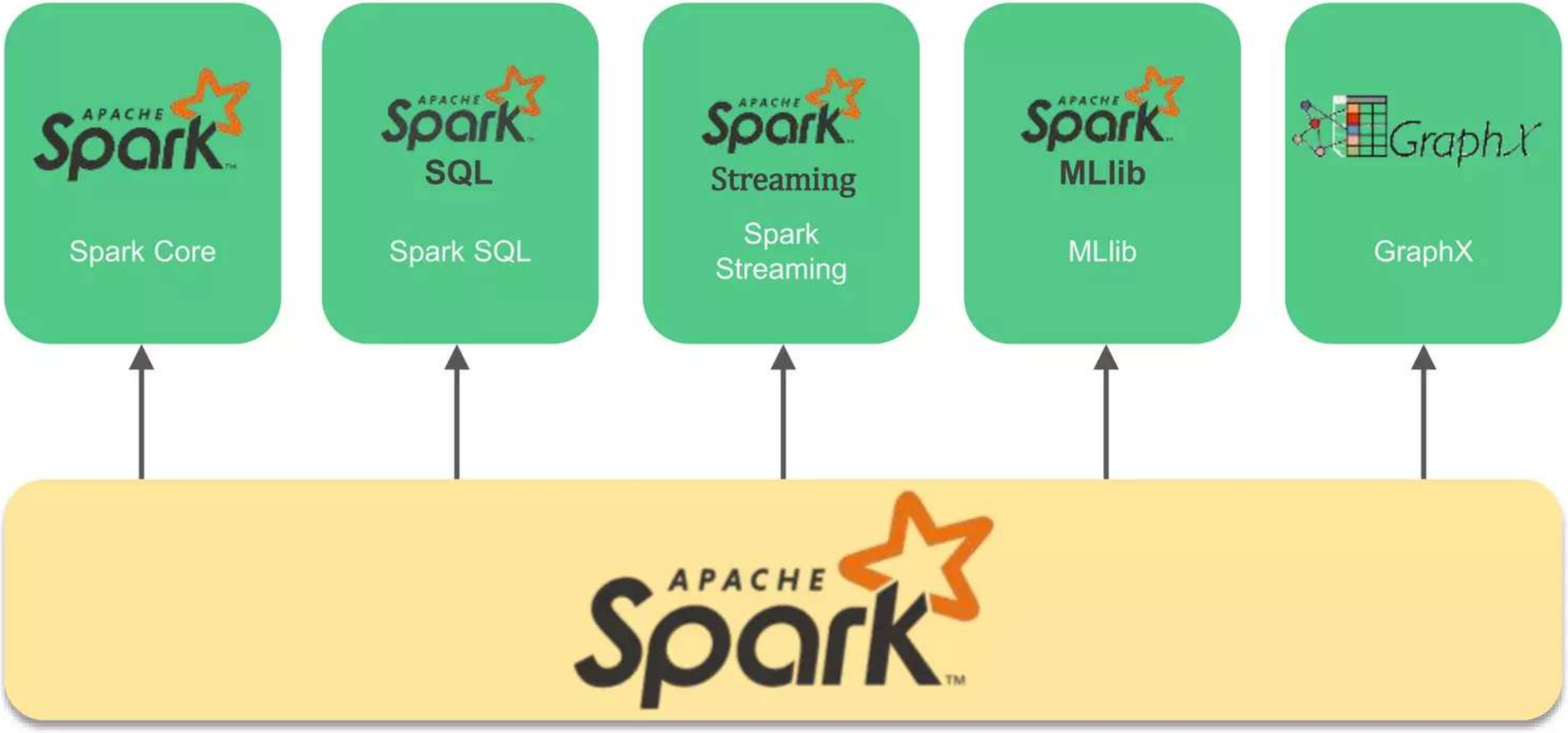

Spark Core

Spark is the core engine for large-scale parallel and distributed data processing

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Performs the following:

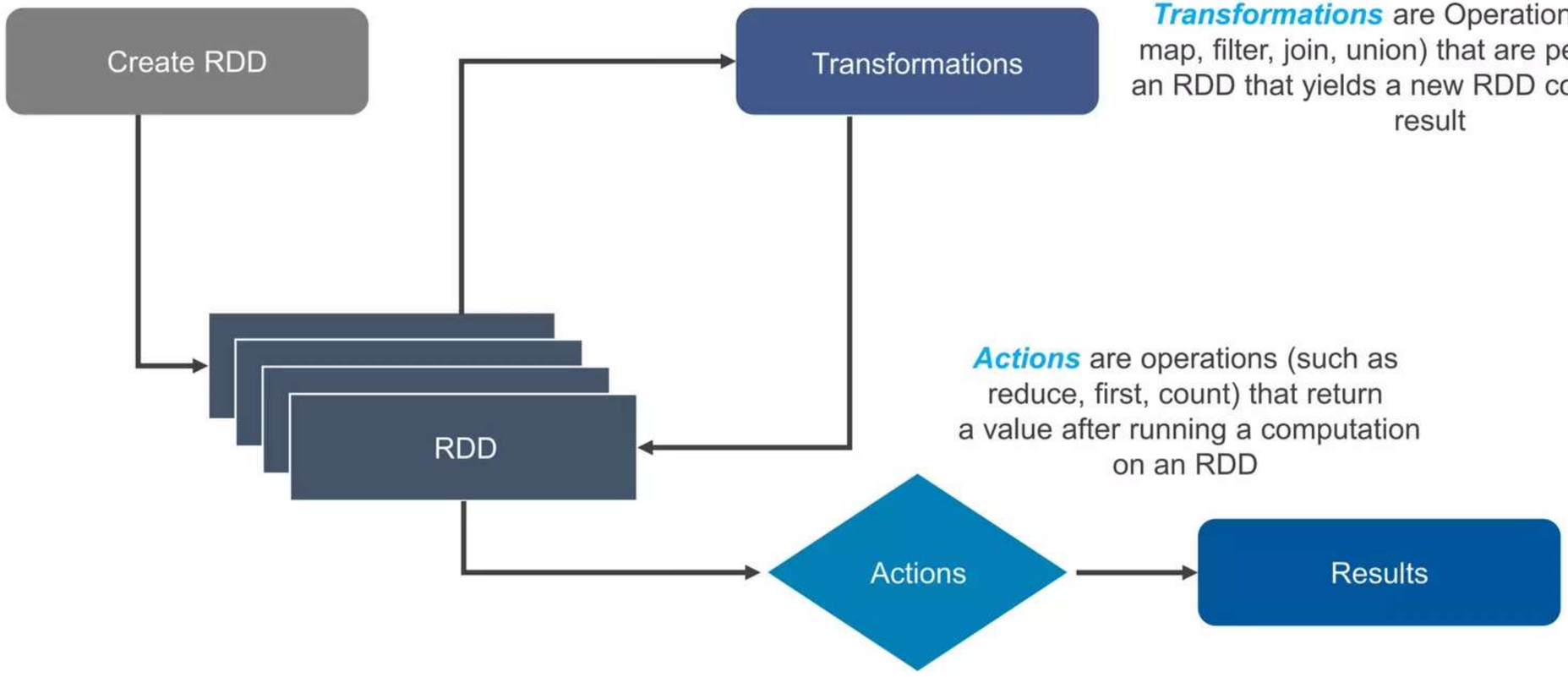
Memory management and fault recovery

Scheduling, distributing and monitoring jobs on a cluster

Interacting with storage system

Spark RDD

***Resilient Distributed Datasets* (RDDs) are the building blocks of any Spark application**



Transformations are Operations (such as map, filter, join, union) that are performed on an RDD that yields a new RDD containing the result

Actions are operations (such as reduce, first, count) that return a value after running a computation on an RDD

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Spark SQL

Spark SQL is Apache Spark's module for working with structured data

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Spark SQL features

Integrated

You can integrate Spark SQL with Spark programs and query structured data inside Spark programs

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You can run unmodified Hive queries on existing warehouses in Spark SQL. With existing Hive data, queries and UDFs, Spark SQL offers full compatibility

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Standard Connectivity

You can easily connect Spark SQL with JDBC or ODBC. For connectivity for business intelligence tools, both turned as industry norms

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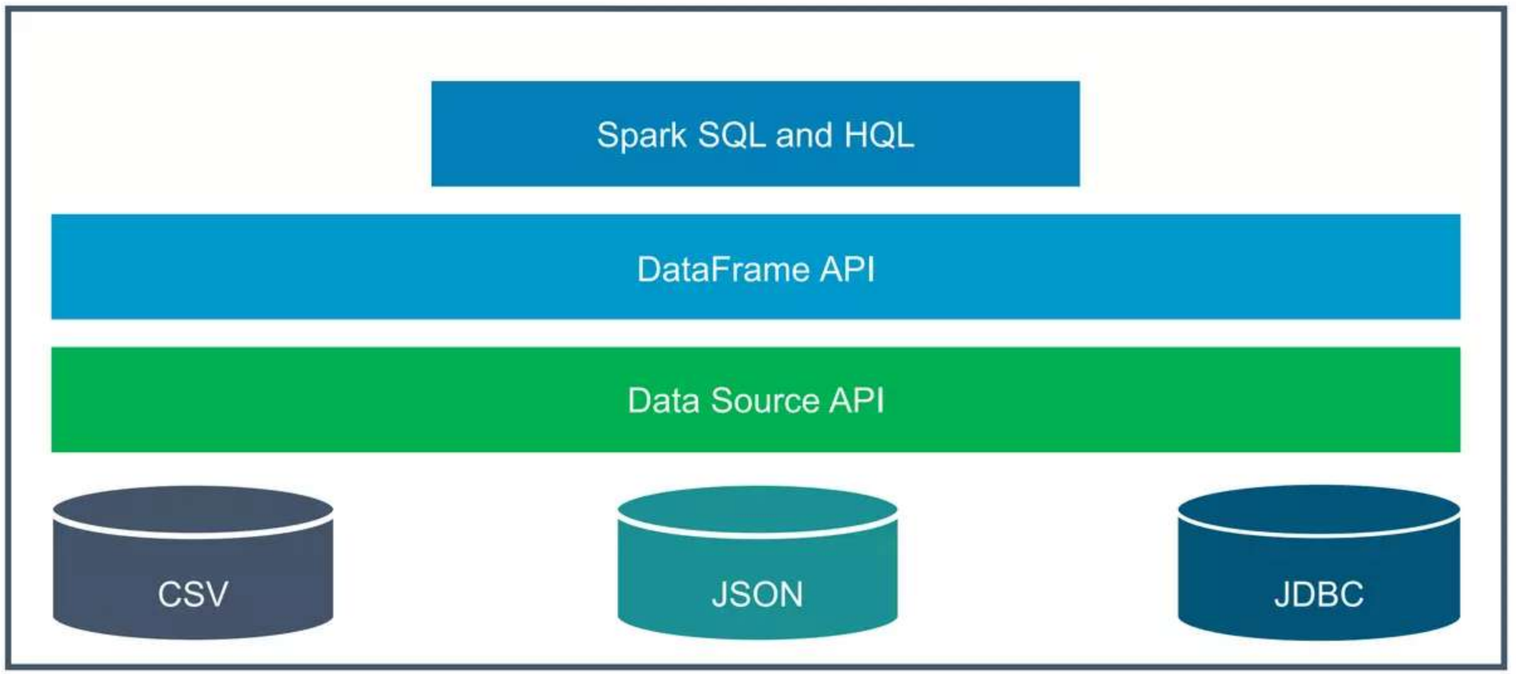
SQL Architecture



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Spark SQL has three main layers

Language API	SchemaRDD	Data Sources
Spark is compatible and even supported by the languages like Python, HiveQL, Scala, and Java	As Spark SQL works on schema, tables, and records, you can use SchemaRDD or data frame as a temporary table	Data sources for Spark SQL are different like JSON document, HIVE tables, and Cassandra database

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Spark SQL

Spark allows you to define custom SQL functions called **User Defined Functions** (UDFs)

UDF that removes all the whitespace and lowercases all the characters in a string

```
def lowerRemoveAllWhiteSpaces(s: String): String = {
    s.tolowerCase().replace("\\S", "")
}

val lowerRemoveAllWhiteSpacesUDF = udf[String, String]
(lowerRemoveAllWhiteSpaces)

val sourceDF = spark.createDF(
   List(
     (" WELCOME    ")
     (" SpaRk SqL    ")
  ), List(
  ("text", StringType, true)
  )
)

sourceDF.select(
  lowerRemoveAllWhiteSpacesUDF(col("text")).as("clean_text")
).show()
```

Output

clean_text
welcome
sparksql

Spark Streaming

Spark Streaming an extension of the core Spark API that enables scalable, high-throughput, fault-tolerant stream processing of live data streams

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Streaming data sources

Static data sources

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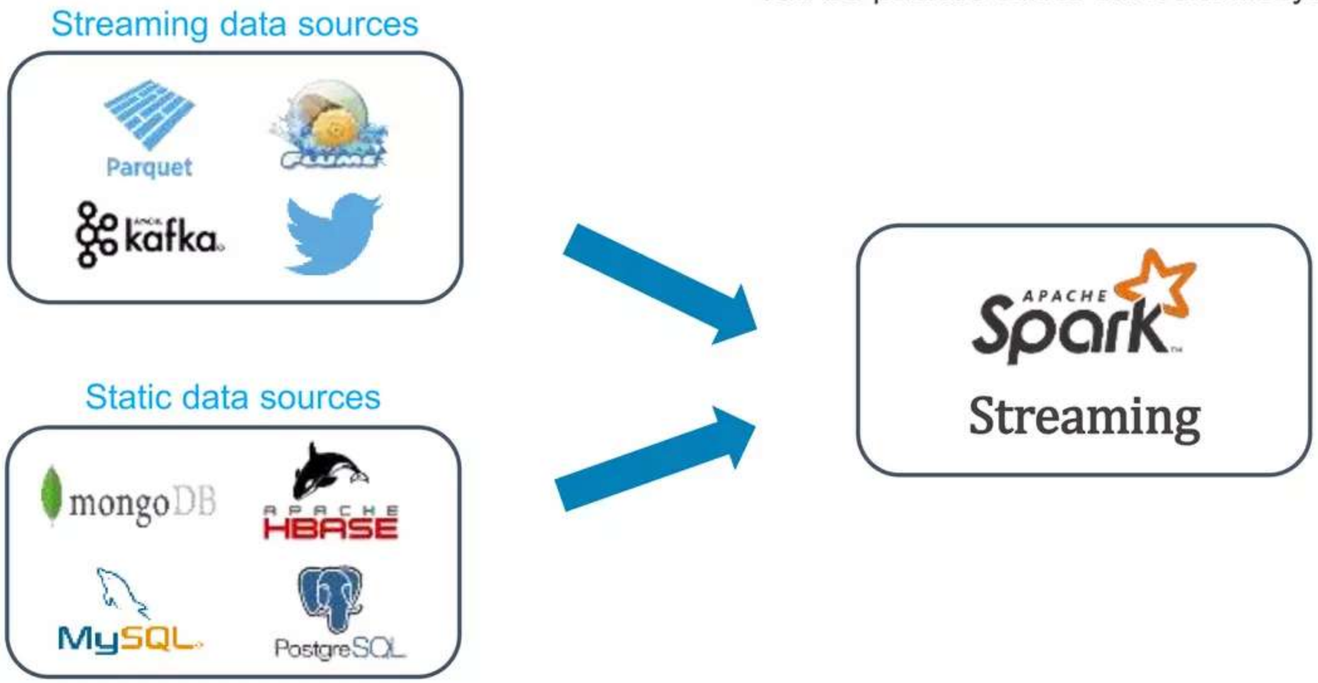

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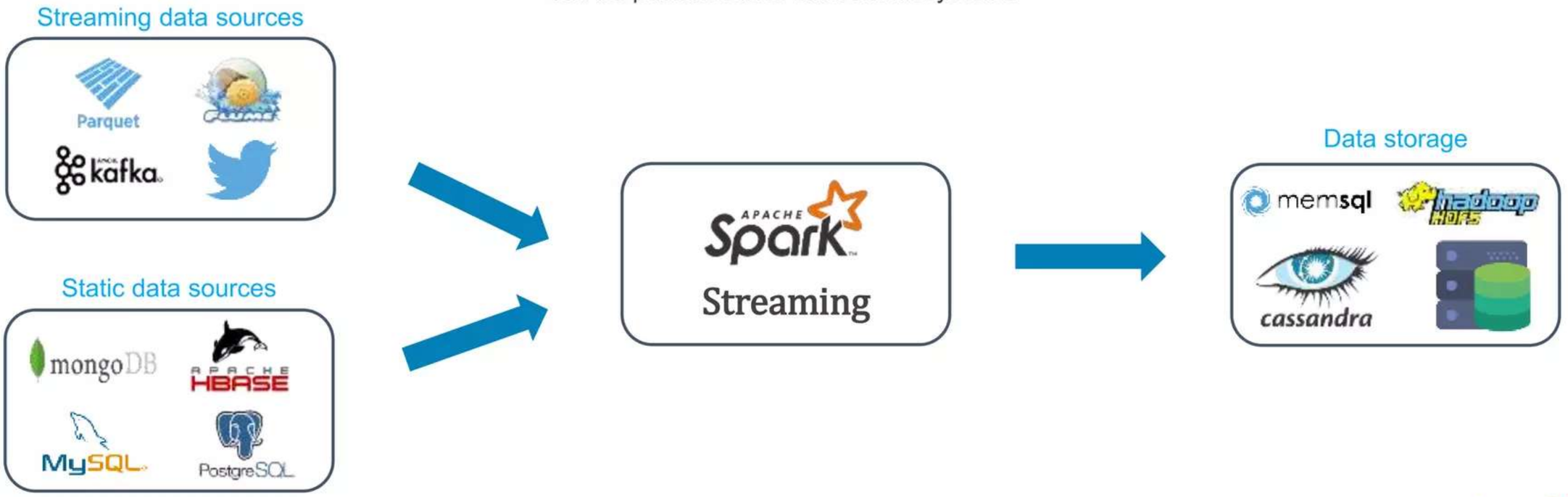

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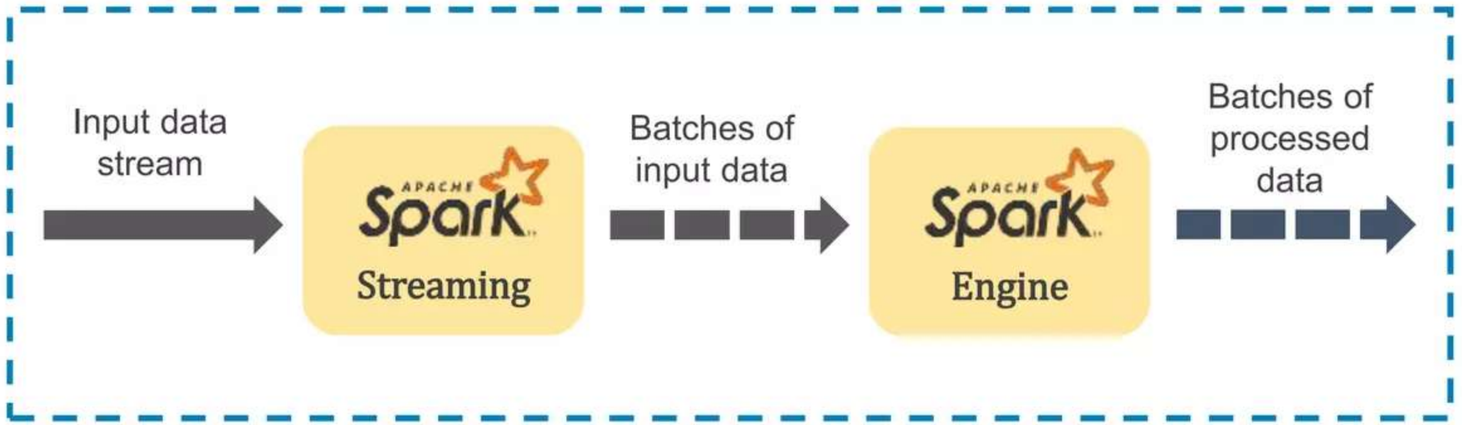
Spark Streaming receives live input data streams and divides the data into batches, which are then processed by the Spark engine to generate the final stream of results in batches



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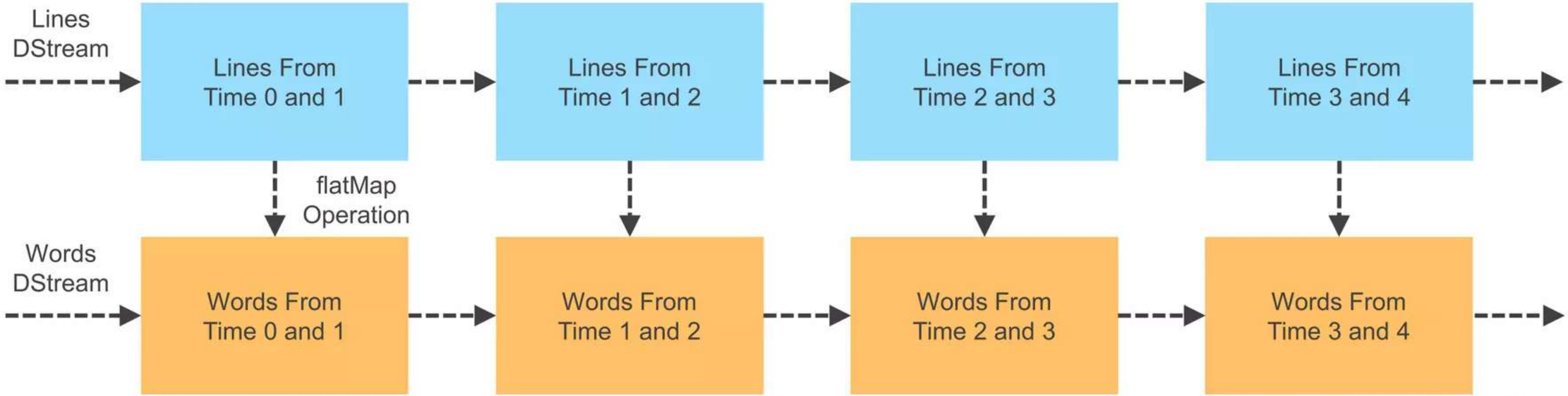
Here is an example of a basic RDD operation to extract individual words from lines of text in an input data stream



Spark MLlib

MLlib

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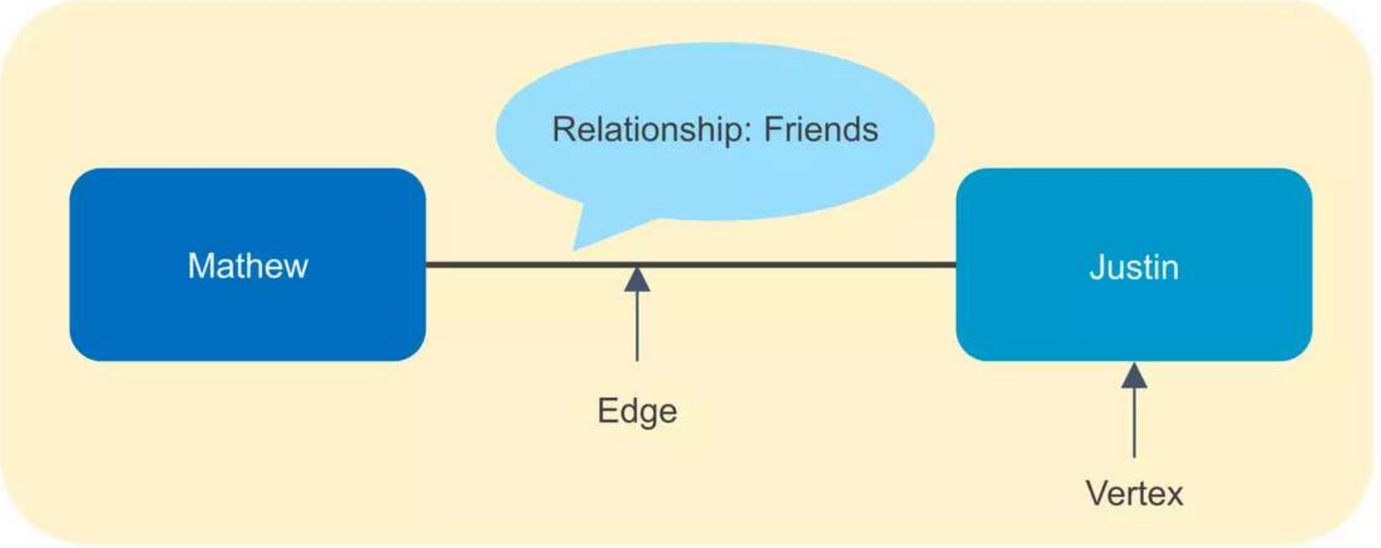
- Pipelines: tools for constructing, evaluating, and tuning ML pipelines
- Utilities: linear algebra, statistics, data handling

GraphX

GraphX is a component in Spark for graphs and graph-parallel computation

GraphX is used to model relations between objects. A graph has vertices (objects) and edges (relationships).



GraphX

GraphX is a component in Spark for graphs and graph-parallel computation

Provides a uniform tool for ETL

Exploratory data analysis

Interactive graph computations

GraphX

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Following are the applications of GraphX

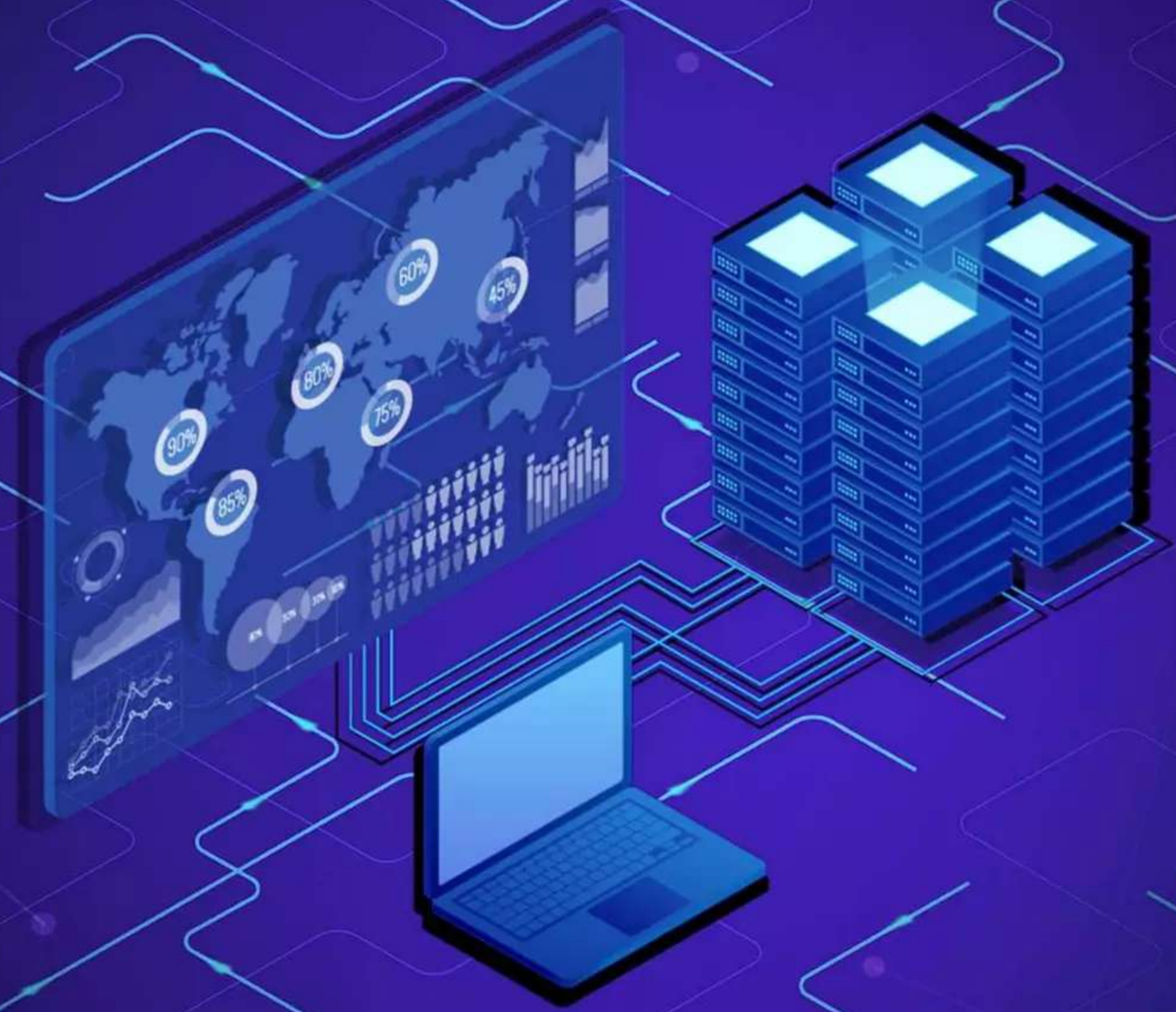
Page Rank

Fraud Detection

Geographic information system

Disaster management

Spark Architecture



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Spark Architecture

Spark Architecture is based on 2 important abstractions

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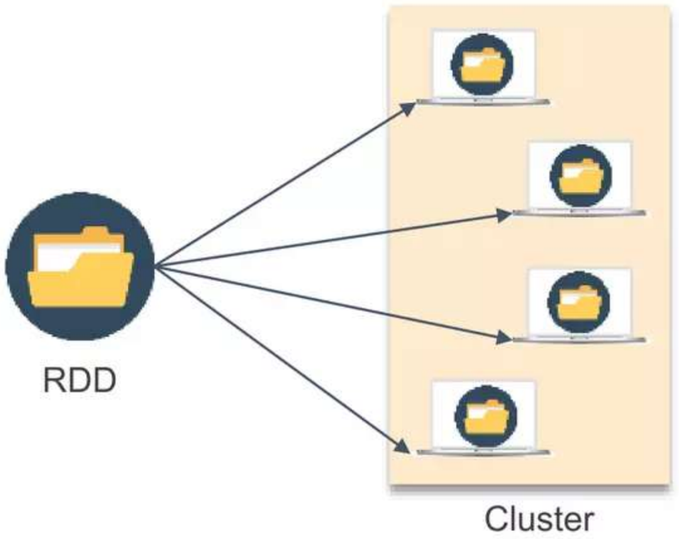
Resilient Distributed Dataset (RDD)

RDD's are the fundamental units of data in Apache Spark that are split into partitions and can be executed on different nodes of a cluster



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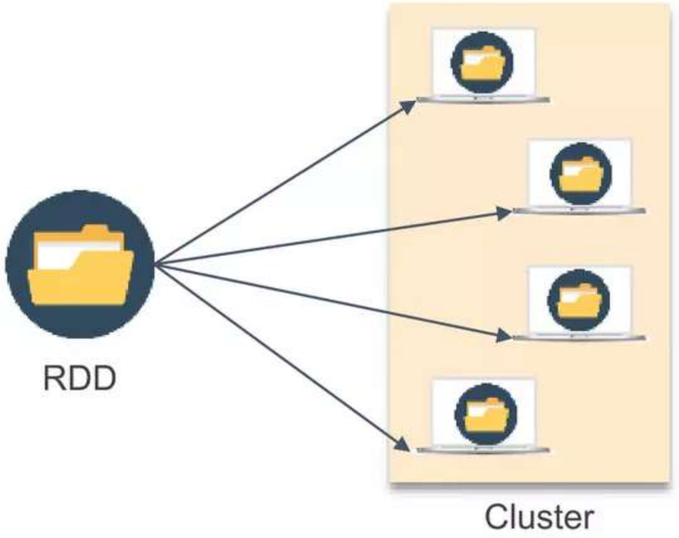
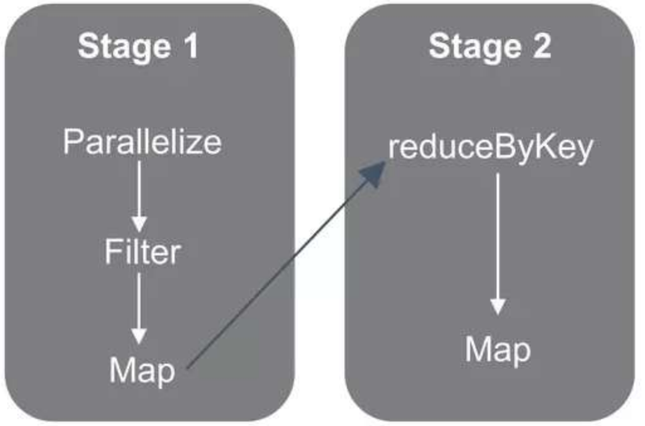


Directed Acyclic Graph (DAG)

DAG is the scheduling layer of the Spark Architecture that implements stage-oriented scheduling and eliminates the Hadoop MapReduce multistage execution model



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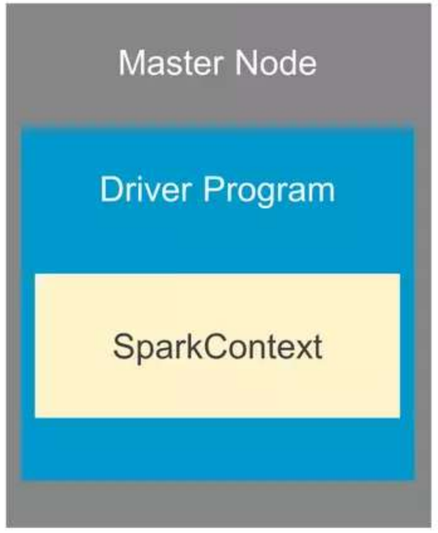
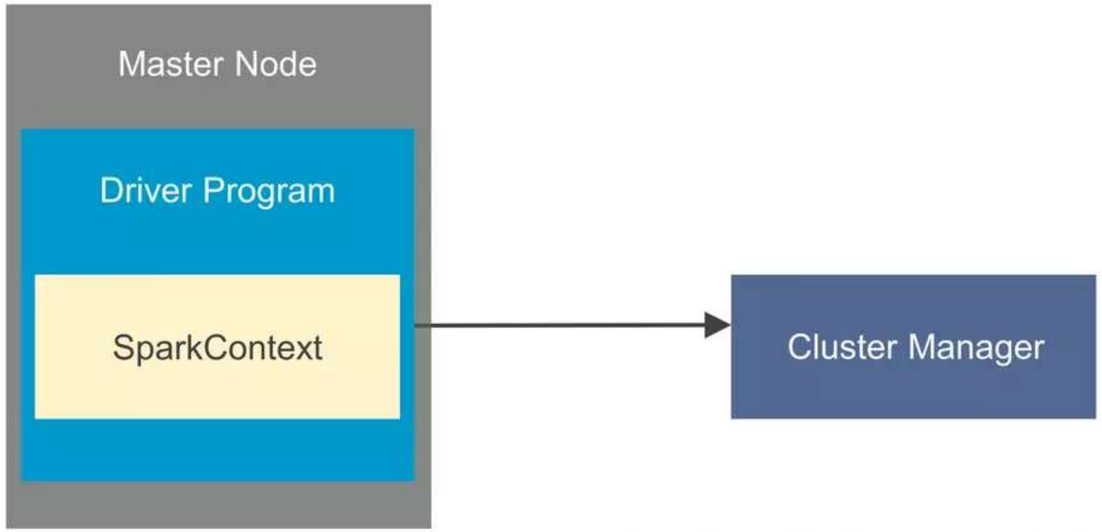
Spark Architecture

Apache Spark uses a master-slave architecture that consists of a driver, that runs on a master node, and multiple executors which run across the worker nodes in the cluster



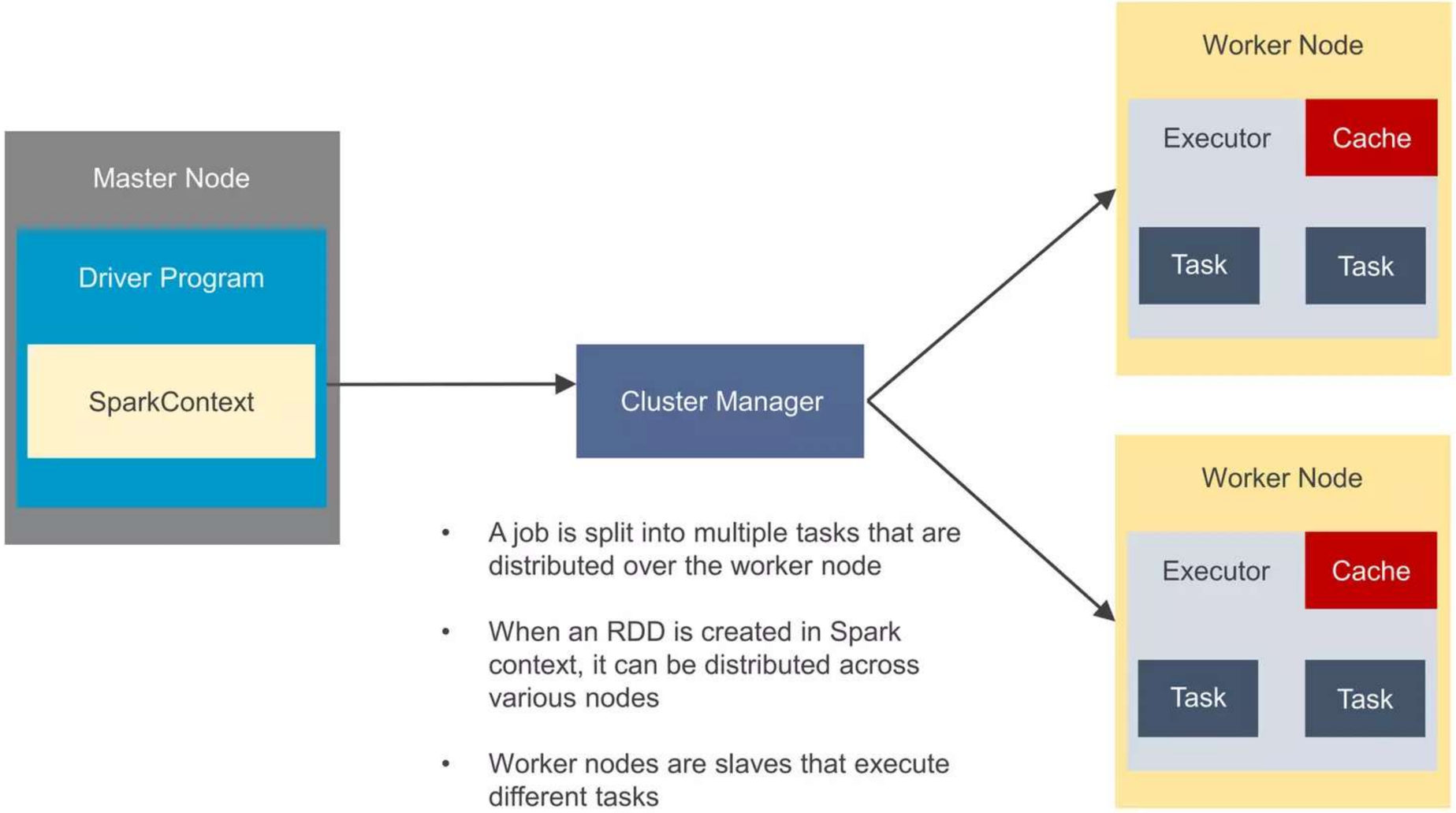
- Master Node has a Driver Program
- The Spark code behaves as a driver program and creates a SparkContext which is a gateway to all the Spark functionalities

Spark Architecture



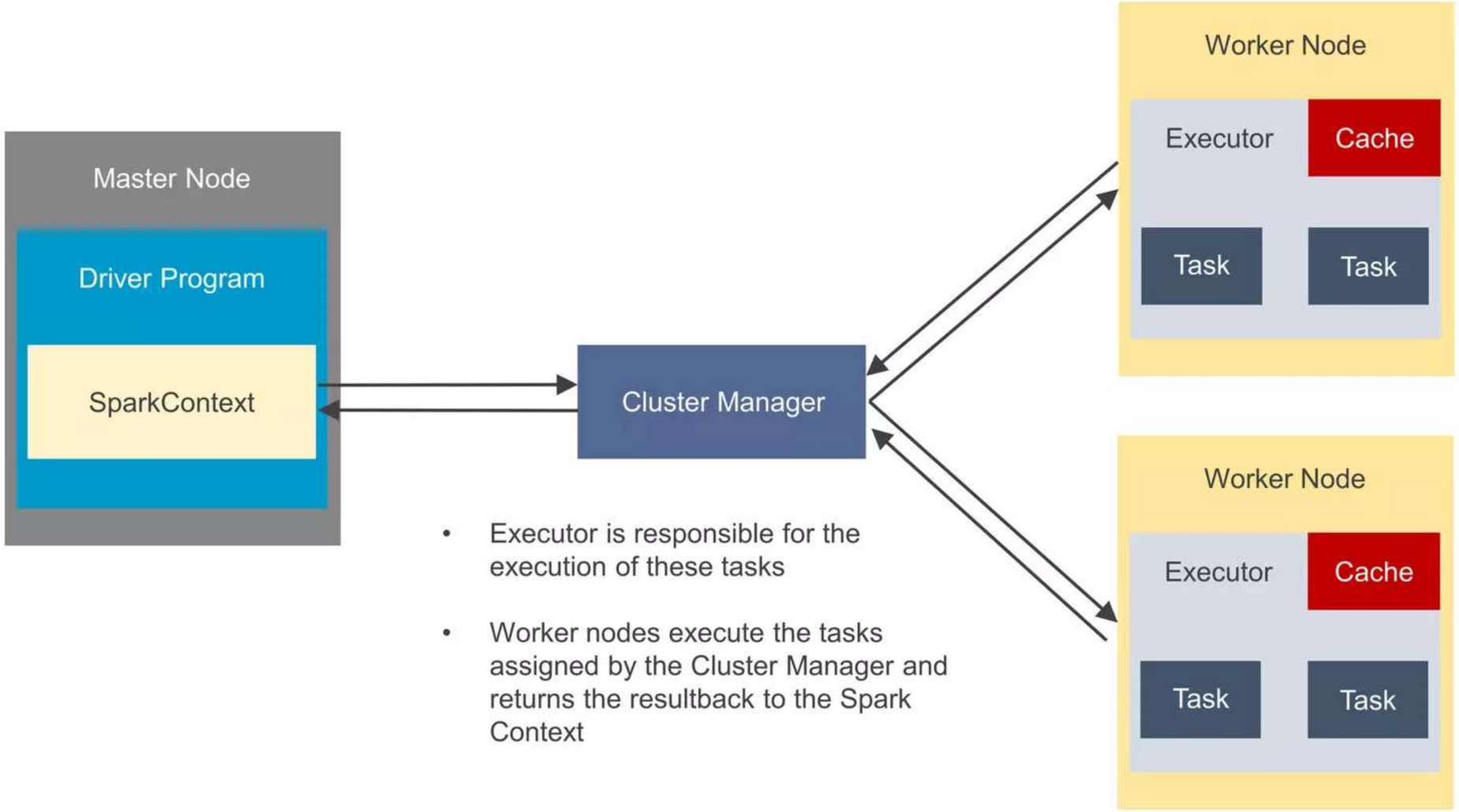
- Spark applications run as independent sets of processes on a cluster
- The driver program & Spark context takes care of the job execution within the cluster

Spark Architecture



- A job is split into multiple tasks that are distributed over the worker node
- When an RDD is created in Spark context, it can be distributed across various nodes
- Worker nodes are slaves that execute different tasks

Spark Architecture



- Executor is responsible for the execution of these tasks
- Worker nodes execute the tasks assigned by the Cluster Manager and returns the resultback to the Spark Context

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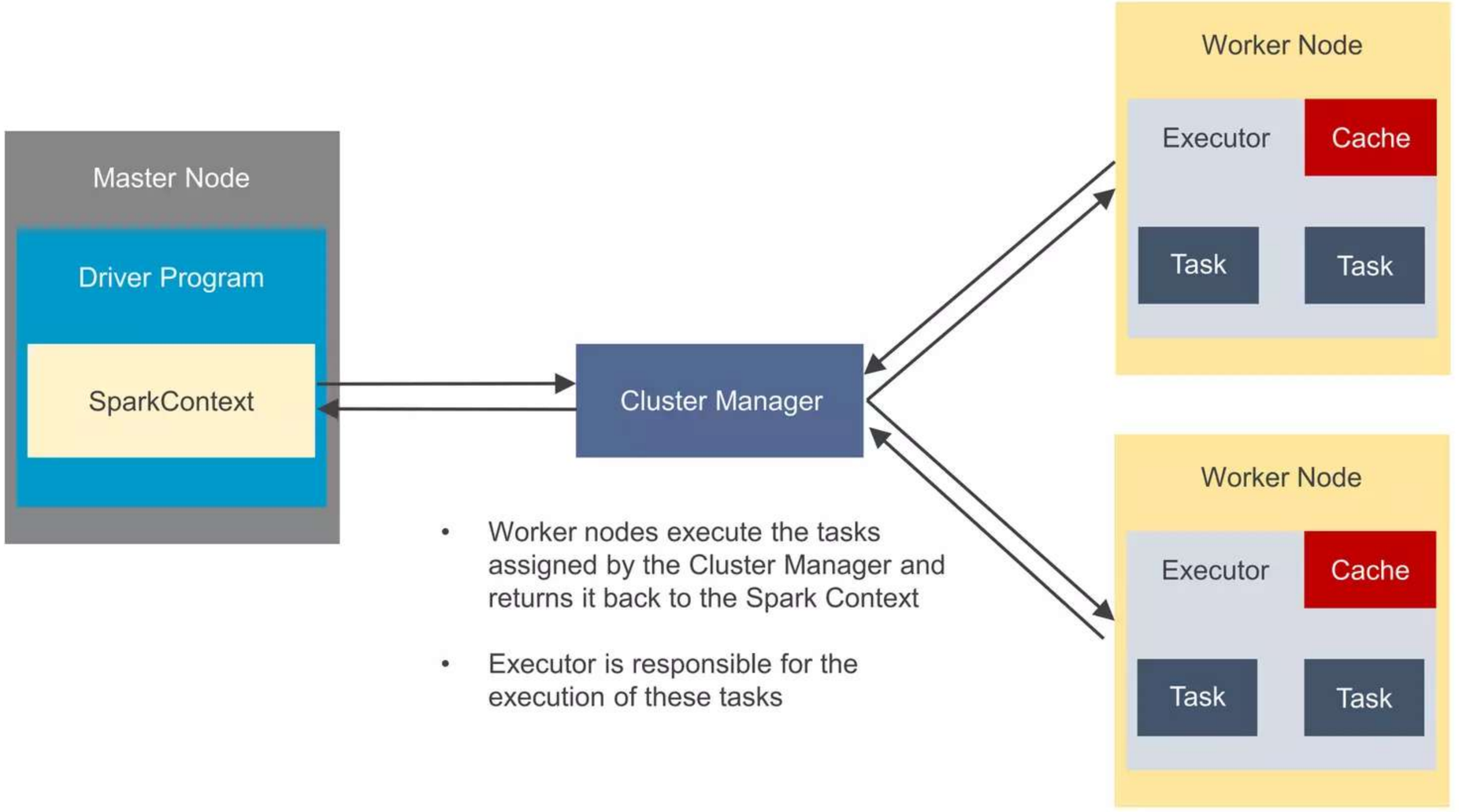
Spark Architecture



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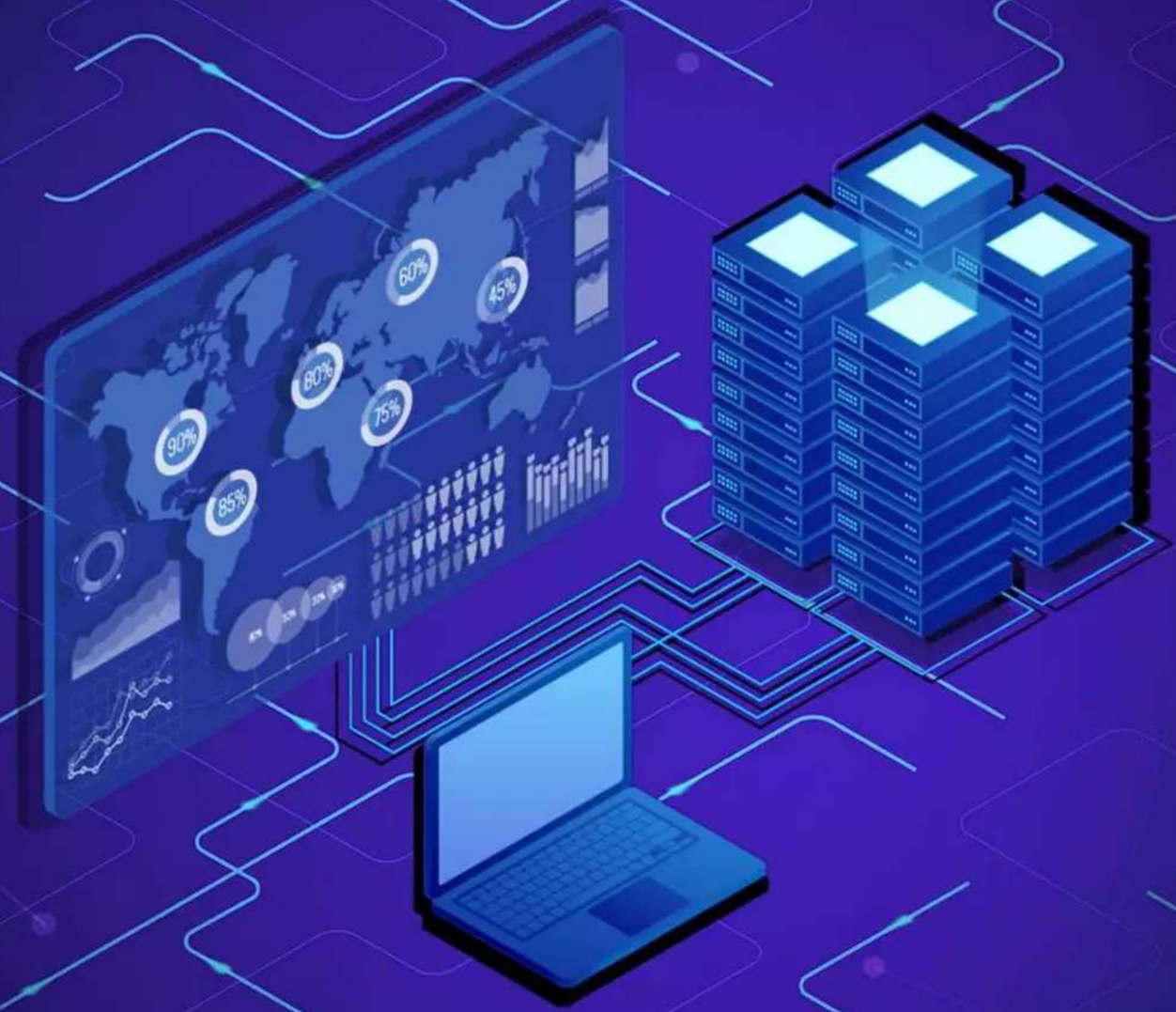
Running a Spark Application



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How a Spark application runs on a cluster?

Spark applications run as independent processes, coordinated by the SparkSession object in the driver program

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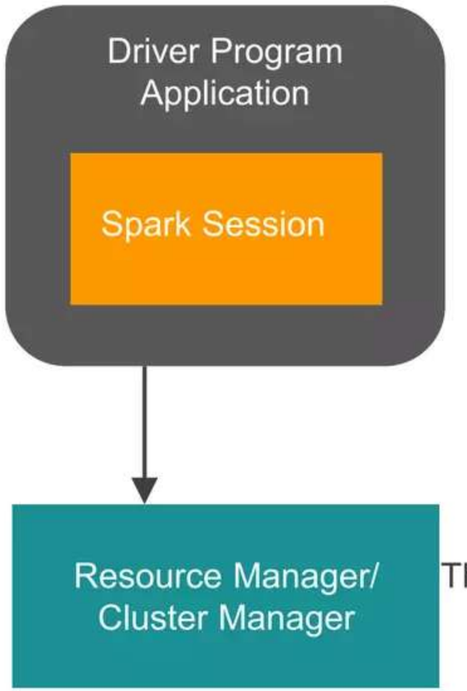

The resource or cluster manager assigns tasks to workers, one task per partition

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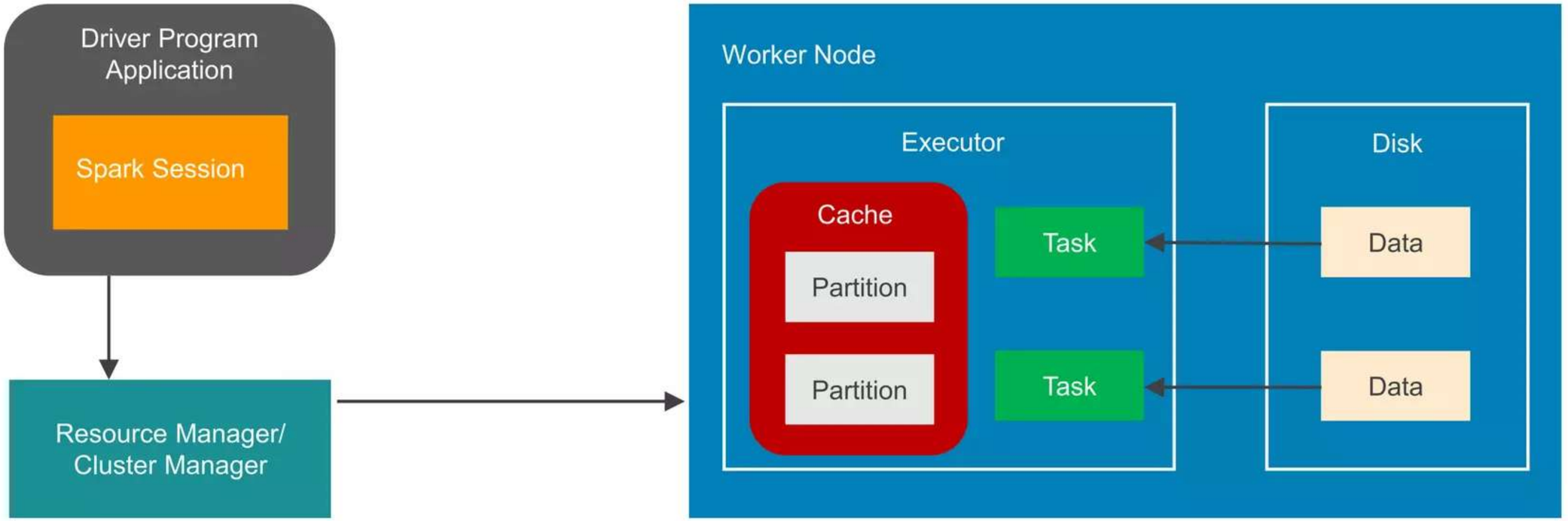
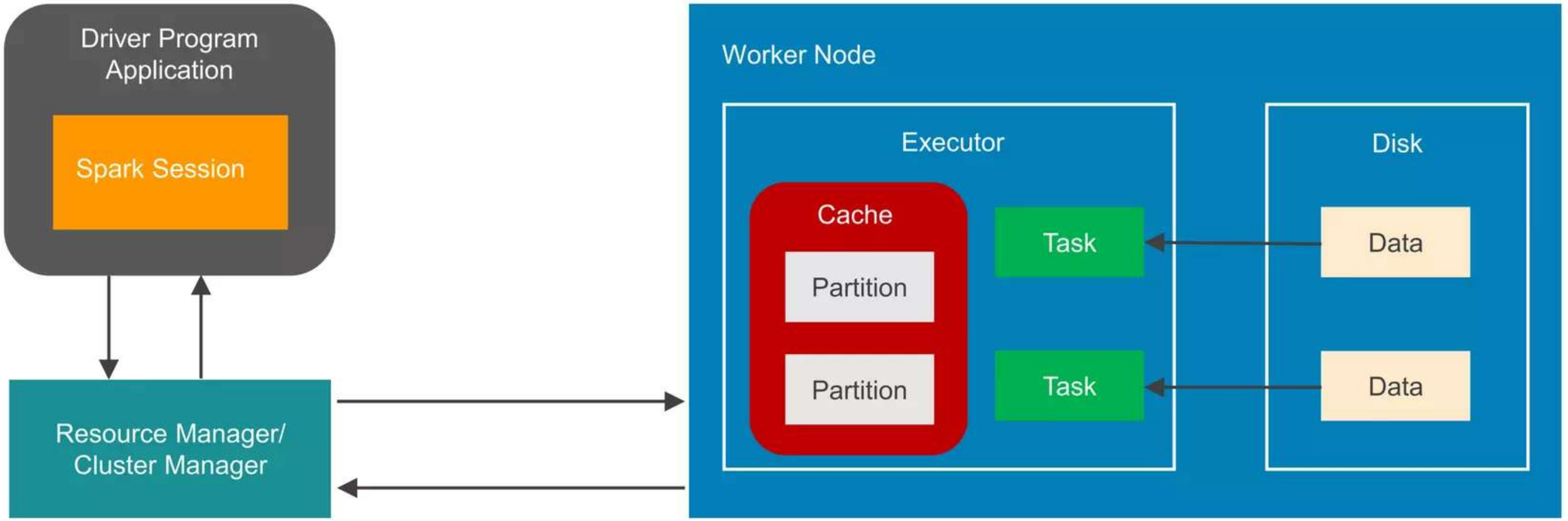


- A task applies its unit of work to the dataset in its partition and outputs a new partition dataset
- Because iterative algorithms apply operations repeatedly to data, they benefit from caching datasets across iterations

How a Spark application runs on a cluster?



Results are sent back to the driver application or can be saved to disk


THANK YOU
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