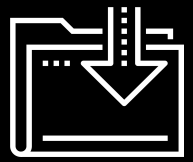
Introduction to Big Data

Data Boot Camp

Lesson 22.1



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WELCOME

Class Objectives

By the end of this lesson, you will be able to:

Identify the parts of the Hadoop ecosystem.

Write a Python script that implements the MapReduce programming model.

Identify the differences between the Hadoop and Spark environments.

Create a DataFrame by using PySpark.

Filter and order a DataFrame by using Spark.

Intro to Big Data

Instructor Demonstration

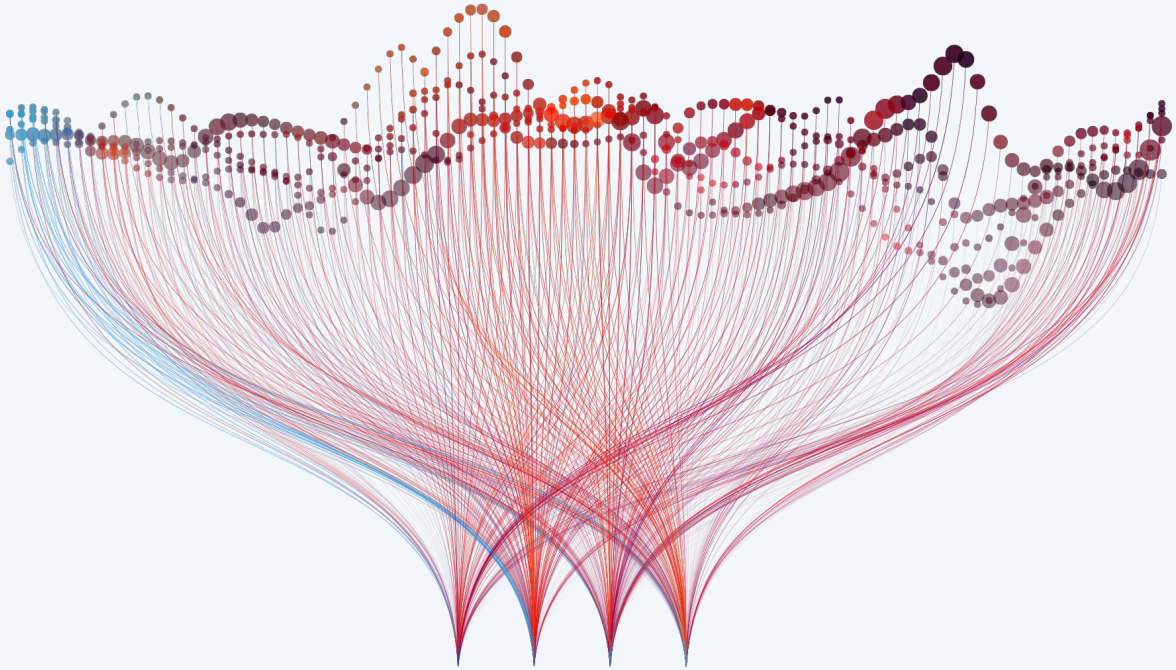
Intro to Big Data

Big data refers to a large amount of structured, unstructured, or semistructured data that’s received at a fast rate, that’s received with the utmost accuracy, and that needs to be processed at a high capacity.

Large datasets have been on the rise since the inception of the internet. But, what's a large dataset? And, just how big is big data?

Big Data: History

In the late 1990s, the term “big data” referred to any information that filled more than a gigabyte. Today, big data can range from hundreds of gigabytes to exabytes of data.



How Big Is Big Data?

To give us an idea of just how big these amounts are, the following table lists data sizes along with an example of what each size might contain:

Size	Example
One kilobyte (KB)	A paragraph in a text document
One megabyte (MB)	A small novel
One gigabyte (GB)	Either about 10,000 rows in a CSV file or one low-definition streamed movie
One terabyte (TB)	About 500 hours worth of videos on the internet
One petabyte (PB)	About 11,000 high-definition movies
One exabyte (EB)	About 11 million high definition movies

NETFLIX **has about 100 petabytes worth of stored videos across the world.**

Generally, we consider a dataset to be big data if it's too large for an operational database.

An **operational database** allows users to modify, retrieve, and manage data in real time.

The Four Vs of Big Data

01 **Volume:** The size of the data.

02 **Velocity:** The rate at which the data is received.

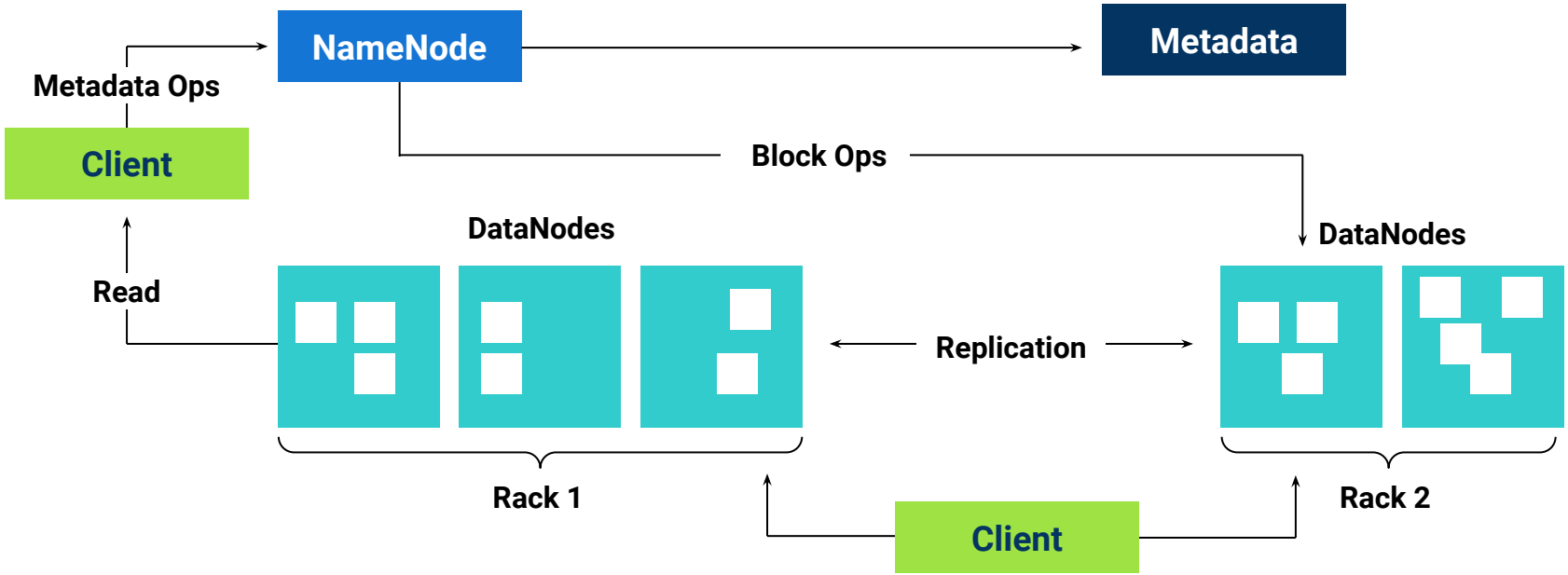
03 **Variety:** The diversity of the data: structured, unstructured, or semistructured.

04 **Veracity:** The uncertainty of the data. That is, how accurate is the data? Does it include errors, abnormalities, or biases?

Hadoop is an open-source framework for big data.
It consists of several components.

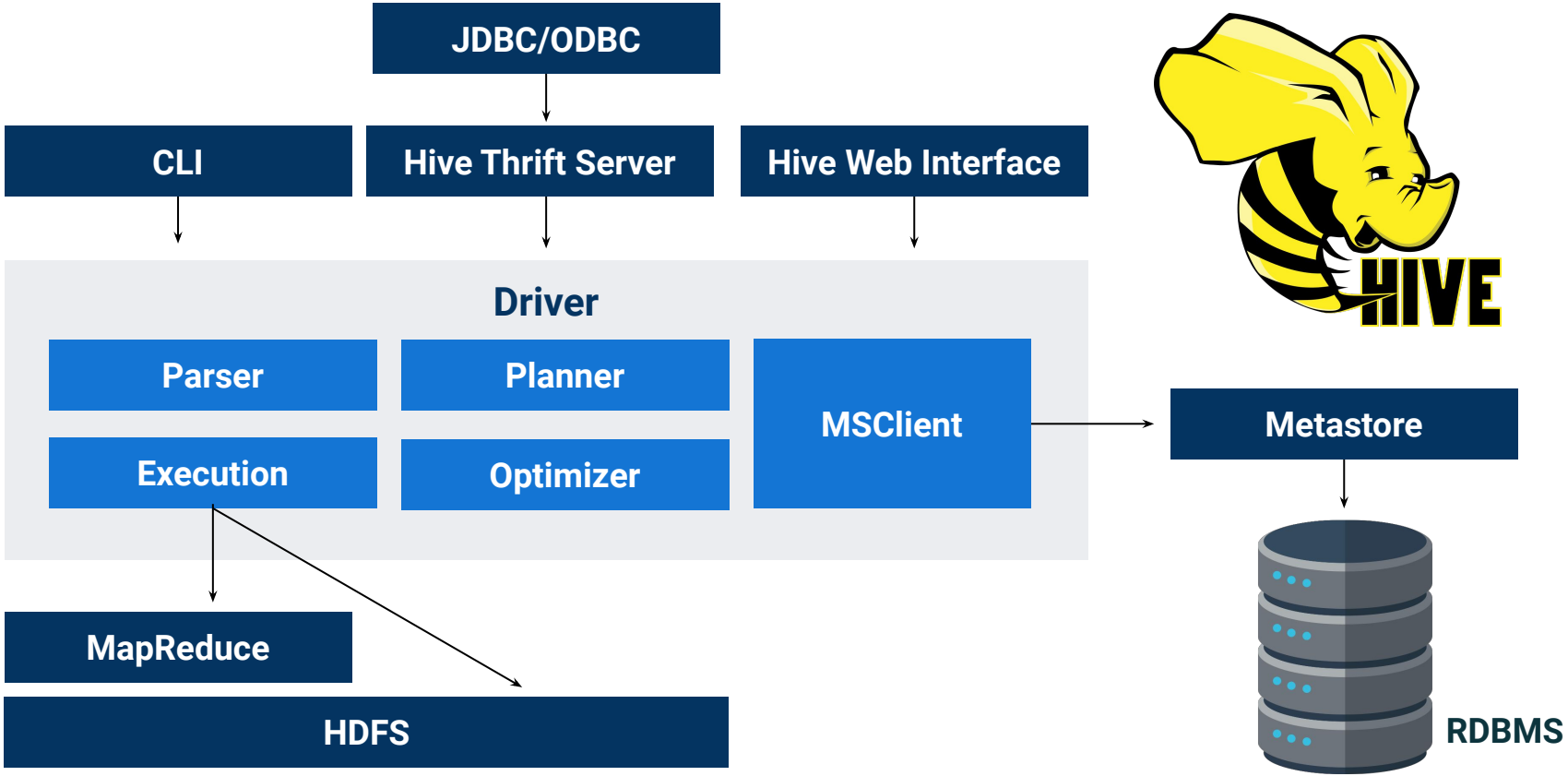
Hadoop Distributed File System

The **Hadoop Distributed File System (HDFS)** enables the efficient and cheap storage of large quantities of data across multiple servers while minimizing the risk of data loss.



Hive is a SQL-like query tool for big data.

Hive Architecture



MapReduce simultaneously processes vast amounts of multi-terabyte datasets in large clusters, or on multiple servers, in a fault-tolerant manner.

Questions?

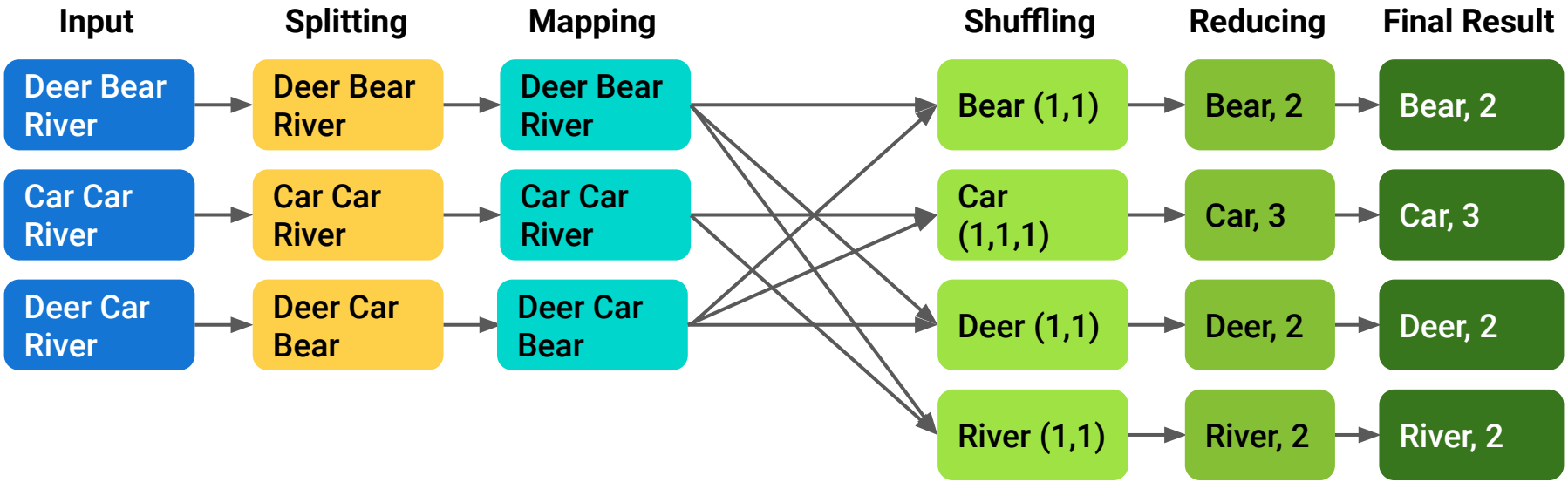
MapReduce with MRJob

Instructor Demonstration

MapReduce with MRJob

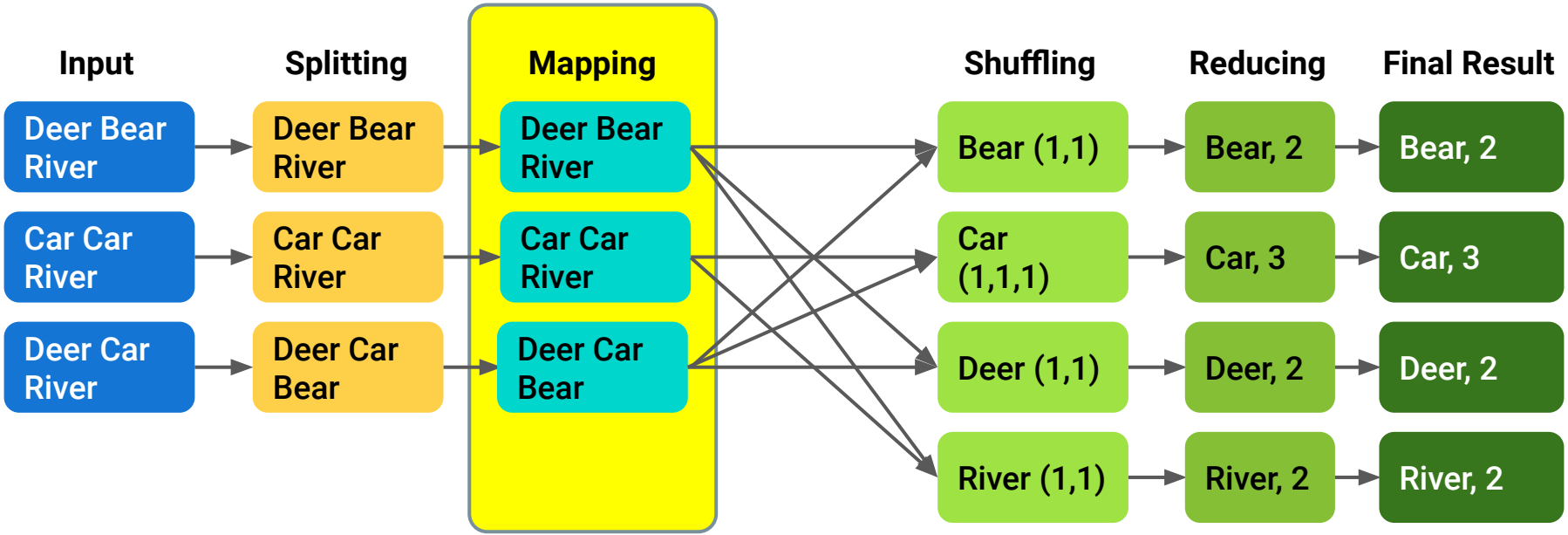
MapReduce with MRJob (1 of 3)

Google created MapReduce with the initial purpose of indexing all the information on the internet. Now, people use MapReduce as a way to distribute and process the data in a cluster. Basically, a MapReduce job divides the input data into chunks, which the map tasks process in a parallel manner.



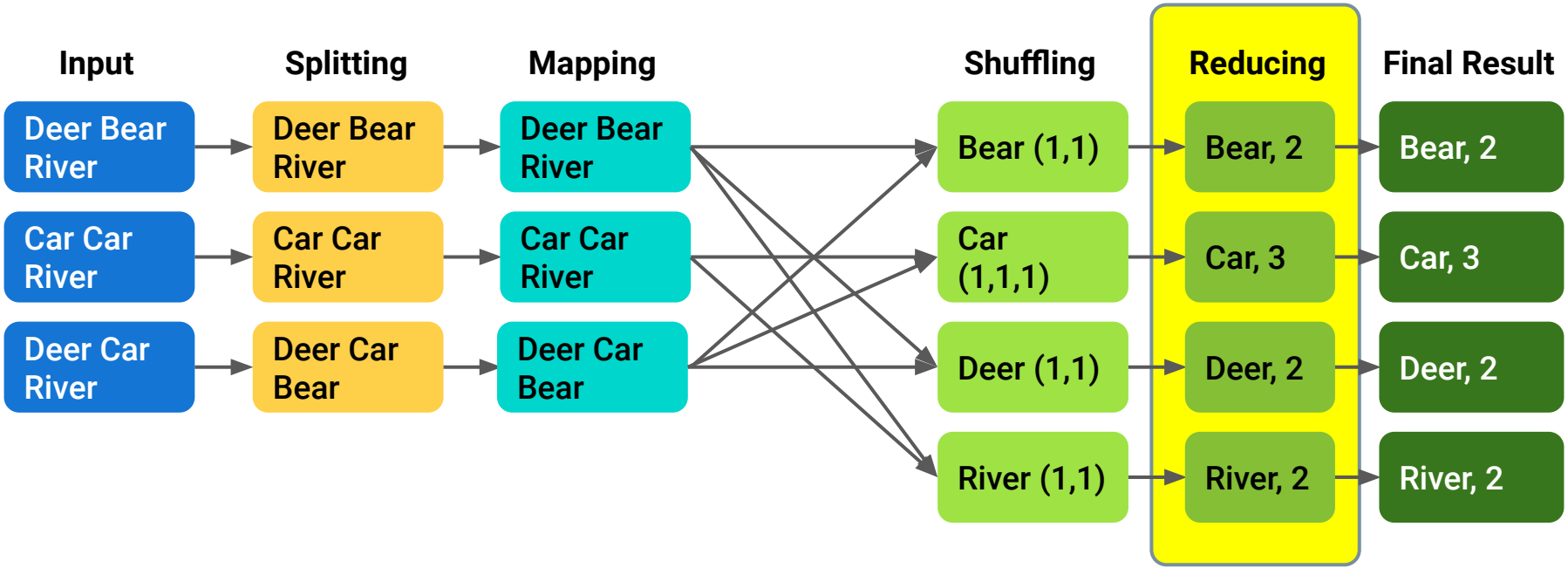
MapReduce with MRJob (2 of 3)

Mapping means splitting up data, preprocessing it, and then converting it into key-value pairs.



MapReduce with MRJob (3 of 3)

Reducing means aggregating the results.



MapReduce: An Example Use Case

Imagine that our organization collects temperature data every day of the year for a city in the United States.

We can use MapReduce to find many aggregations.

But, one example is the average maximum temperature for each day over all the days in the dataset.

```
"2017-08-11"    97.5
"2017-08-12"    97.75
"2017-08-13"    98.5
"2017-08-14"    98.25
"2017-08-15"    97.25
"2017-08-16"    98.75
"2017-08-17"    99.0
"2017-08-18"    99.0
"2017-08-19"    99.0
"2017-08-20"    99.25
"2017-08-21"    97.25
"2017-08-22"    97.5
"2017-08-23"    98.75
"2017-08-24"    96.75
"2017-08-25"    91.25
"2017-08-26"    81.5
"2017-08-27"    74.25
"2017-08-28"    77.75
"2017-08-29"    86.0
"2017-08-30"    89.0
"2017-08-31"    91.25
"2017-09-01"    92.0
"2017-09-02"    92.5
```

Questions?

Activity: MapReduce Use Cases

In this activity, you'll find common use cases for MapReduce. The ability to research and learn about common use cases is an important skill to have in your career.

Suggested Time:

10 minutes

Time’s Up! Let’s Review.

Questions?

MRJob with Python

MapReduce is intended to distribute an
process large data files.

MRJob is a Python package that we can use to locally test our MapReduce code on our own computers.

Group Programming Activity:

MRJob with a CSV File

In this activity, you'll use MRJob with a CSV file to count the number of hot days in Austin, Texas.

Suggested Time:

15 Minutes

Questions?

Activity: Snow in Austin

In this activity, you'll use MRJob to return the days when it snowed in Austin, Texas.

Suggested Time:

15 minutes

Time's Up! Let's Review.

Questions?

Break

Spark Overview and Spark Installation Check

Instructor Demonstration

Spark Overview

Spark: The Beginning

MapReduce was an amazing leap forward for handling massive amounts of data, but it was still slow.

So, the AMPLab at UC Berkeley came up with the idea of storing data in Resilient Distributed Datasets (RDDs) and using memory instead of disk space.

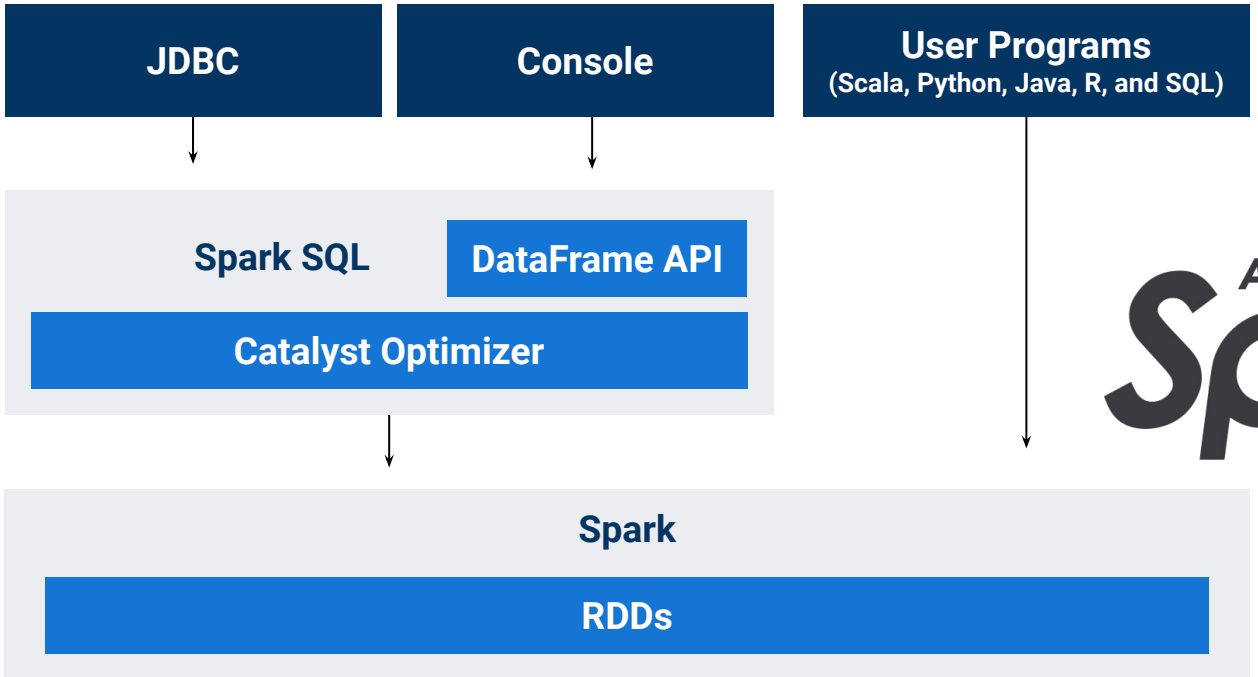
That improved the speed by 100 times.

Although AMPLab developed Spark, they later donated it to the Apache Software Foundation—which now maintains it.

That's why you might find it called Apache Spark, just like you might find Hadoop called Apache Hadoop.

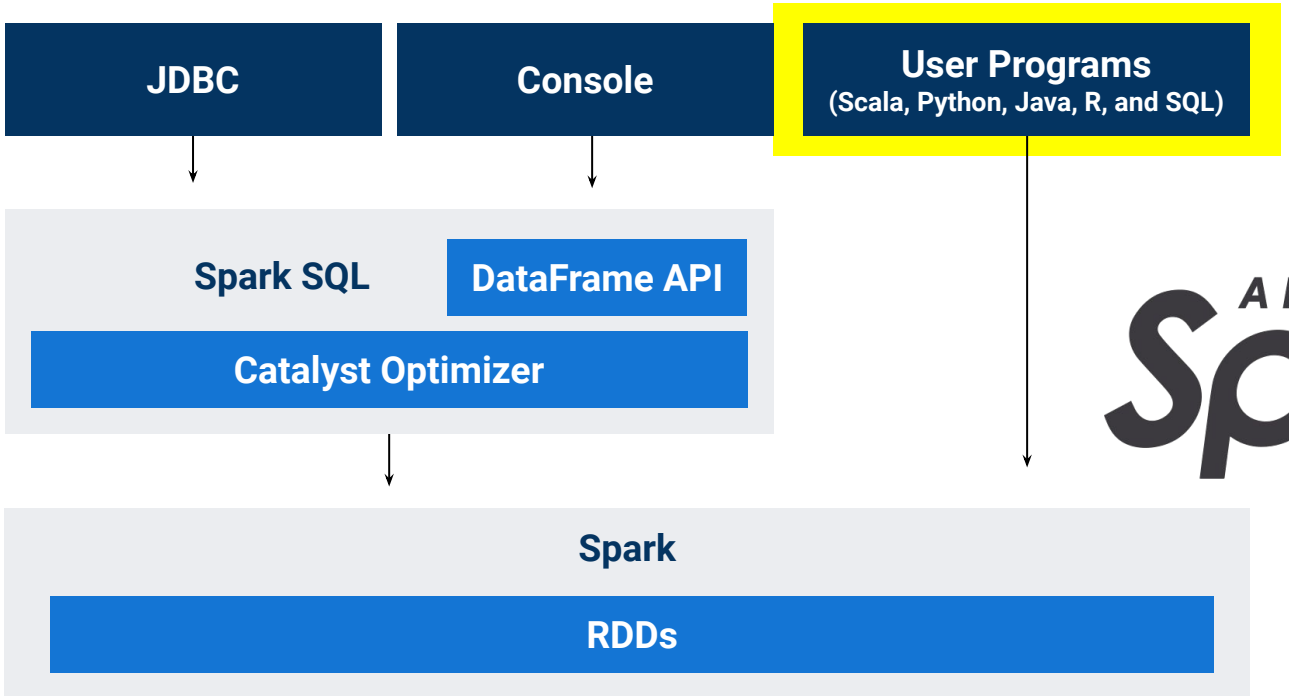
Spark: The Evolution

As Spark evolved to its current version, 3.x, the direct use of RDDs was simplified by the use of datasets and DataFrames.



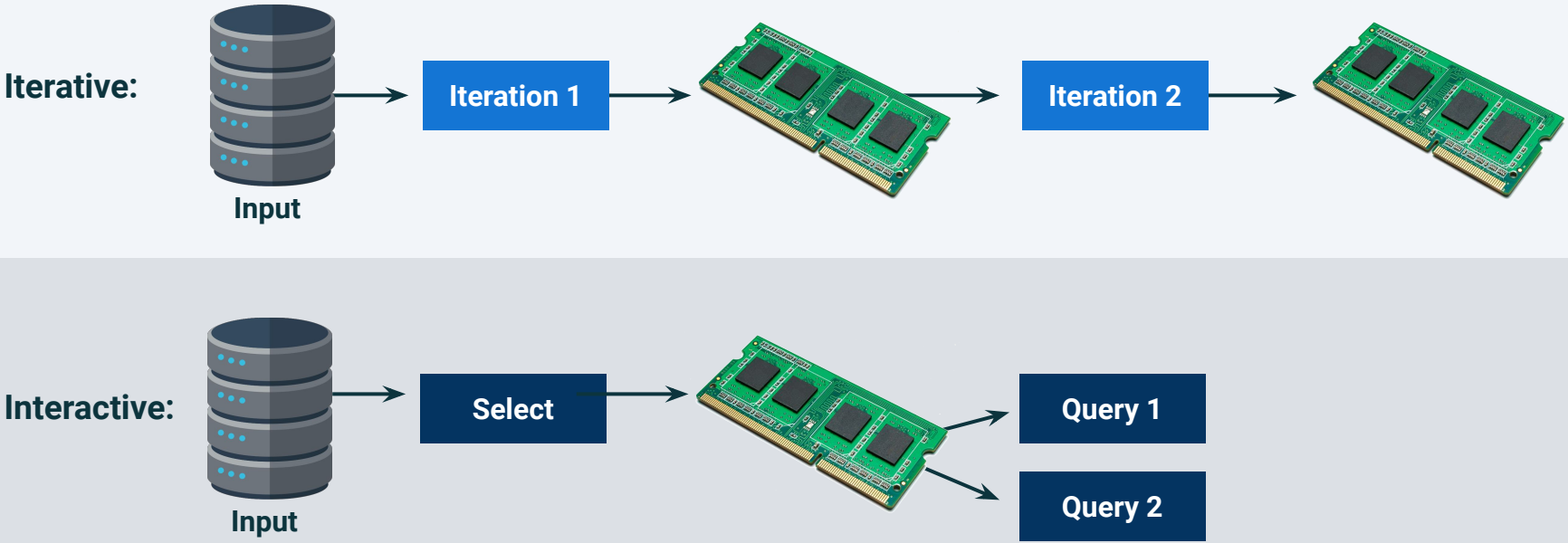
Spark: Supported Languages and More

Spark can be programmed in Scala, Python, Java, R, and SQL.
It has a rich ecosystem and is very scalable.



Spark: In-Memory Computation

Spark uses in-memory computation instead of a disk-based solution.
That means it has a limited need to read or write data from disks.



Questions?

Group Activity:

Spark Installation Check

In this activity, you'll check to make sure you have installed your dependencies to run PySpark in Jupyter notebook.

Suggested Time:

10 Minutes

Questions?

PySpark DataFrame Basics

Instructor Demonstration

PySpark DataFrame Basics

Questions?

Activity: Demographic DataFrame Basics

In this activity, you'll use PySpark DataFrame basics to analyze demographic data.

Suggested Time:

20 minutes

Time's Up! Let's Review.

Questions?

PySpark Filtering

Instructor Demonstration

PySpark Demographic Filtering

Questions?

Activity: PySpark Demographic Filtering

In this activity, you'll use the PySpark filtering functions to filter through the demographic dataset.

Suggested Time:

15 minutes

Time's Up! Let's Review.

Questions?

The End