Big Data

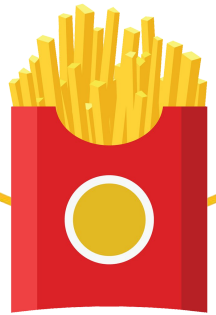
Data Boot Camp

Lesson 22.1

Big Data, Big Problems

Financial Industry Regulatory Authority (FINRA):
Needs to store 37 records daily in the financial market and analyze trends over a period of days, weeks, and months

McDonald's:
Collects transactional data as it serves 69 million people each day in 188 countries



Netflix:
Collects ratings, searches, watch dates, device information, pause and skip data, repeat views, and more for 100+ million subscribers

Class Objectives:

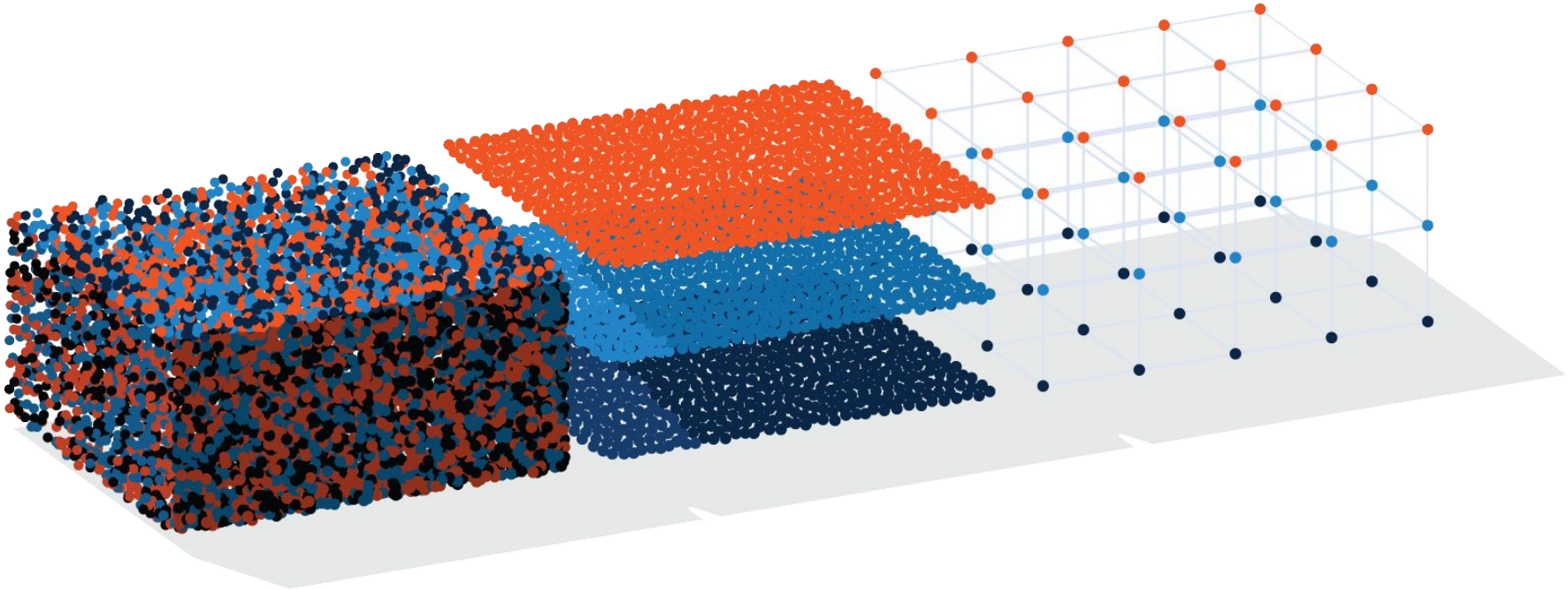
By the end of today's class you will:

Articulate the different components in the Hadoop ecosystem and their primary use cases.

Run MapReduce jobs.

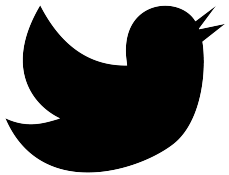
Use Spark DataFrames to process large datasets.

What Is Big Data?



What Is Big Data?

Big data includes stock exchange data, emails, and social media posts such as Facebook statuses and tweets.



It also includes lesser known things like supply chains, barcodes, and cell towers.

Big data has always existed, there just hasn't been a way to gather and analyze it.

Four Vs of Big Data

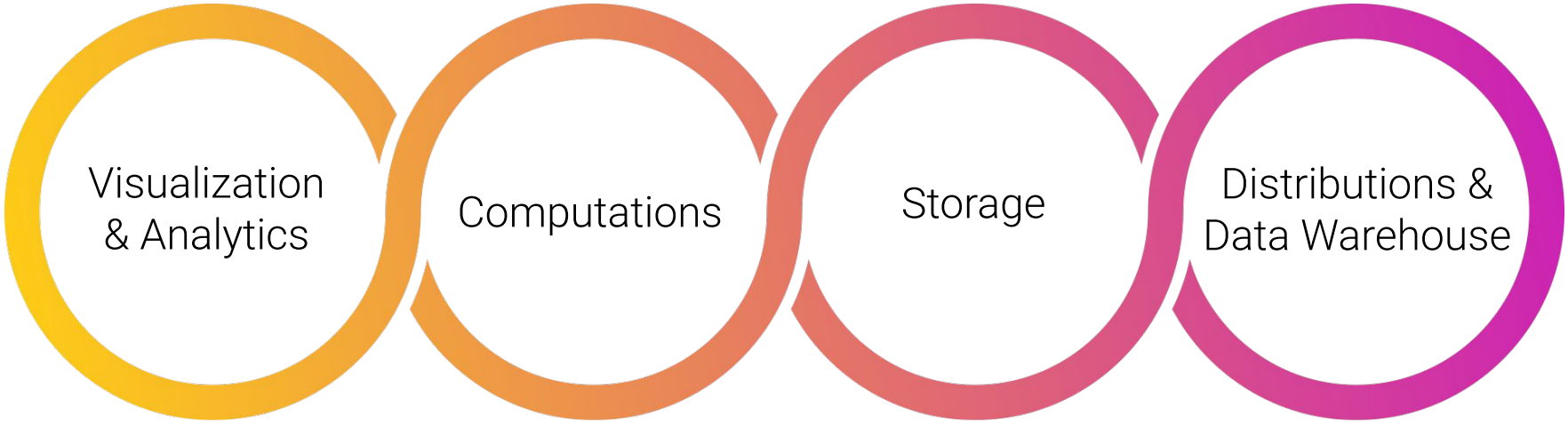
01 **Volume: Size of the data** (terabytes of stock data)

02 **Velocity: How quickly data is coming in** (car sensors sending information every second)

03 **Variety: Different forms of data** (social media posts, comments, photos, etc.)

04 **Veracity: Uncertainty of data** (social media data may not be precise, come from bots, etc.)

Big Data Overview



Visualization & Analytics	Computations	Storage	Distributions & Data Warehouse
IBM Cognos	Hadoop MapReduce	IBM GPFS	Pivotal
SAP Business Objects	HIVE	Hadoop	Oracle EXADATA
MicroStrategy	TEZ	MAPR Tables	TERADATA
ZoomData	Apache Drill	Apache HBASE	GreenPlum
Qlik	Apache Storm	KUDU	MAPR
PowerBI	Google BigQuery	MEMSQL	NETEZZA
Tableau	Flink		HortonWorks
	Spark Streaming		Cloudera
	Kafka		Azure HDInsight
			Amazon EMR

What are some issues that you might encounter when dealing with extremely large datasets?

Extremely Large Datasets

Issues you might encounter when dealing with extremely large datasets:

Need a place to store massive amounts of data

Need a way to access data quickly

Need backups for hardware failure

Need ways to analyze data quickly

Hadoop Overview

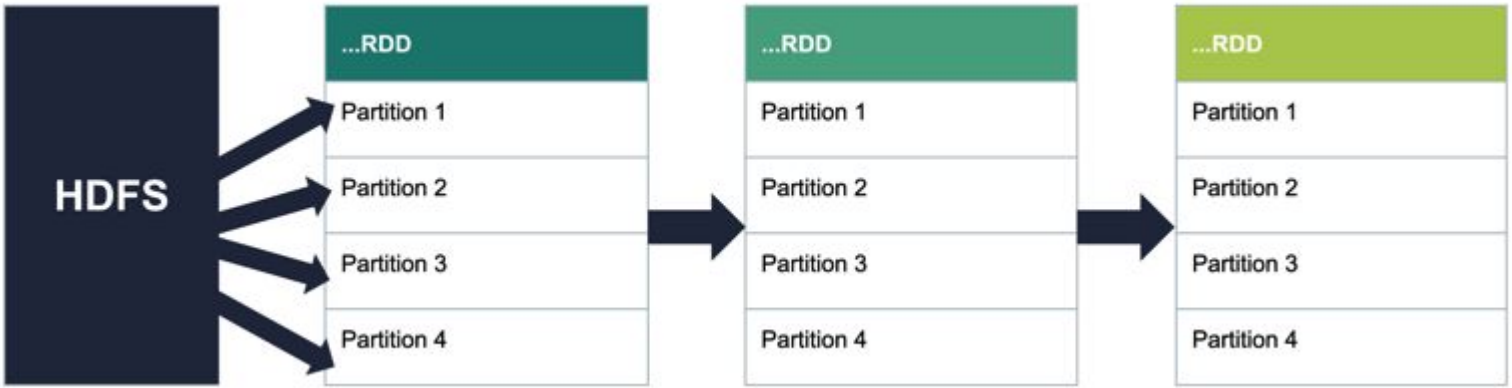
What is Hadoop?

> The Apache Hadoop software library is a framework that allows for the distributed processing of large data sets across clusters of computers using simple programming models. It is designed to scale up from single servers to thousands of machines, each offering local computation and storage. Rather than rely on hardware to deliver high-availability, the library itself is designed to detect and handle failures at the application layer, so delivering a highly-available service on top of a cluster of computers, each of which may be prone to failures.
>
> *—Hadoop website*

Hadoop was named after a stuffed yellow elephant belonging to the son of Doug Cutting, the Hadoop creator.

Hadoop Distributed File System (HDFS)

HDFS is a file system that is used to store data across server clusters, and is **scalable, fault-tolerant,** and **distributed.**



Fundamentals

01

MapReduce

02

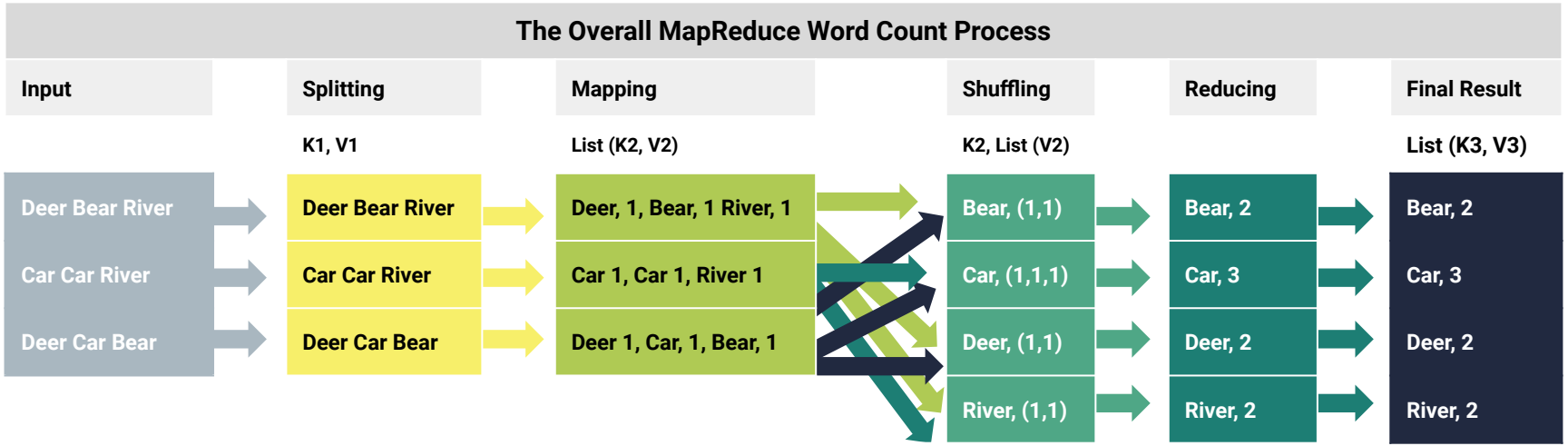
Hadoop Distributed File System (HDFS)

03

Yet Another Resource Negotiator (YARN)

MapReduce

Classic Word Count Example



MapReduce History

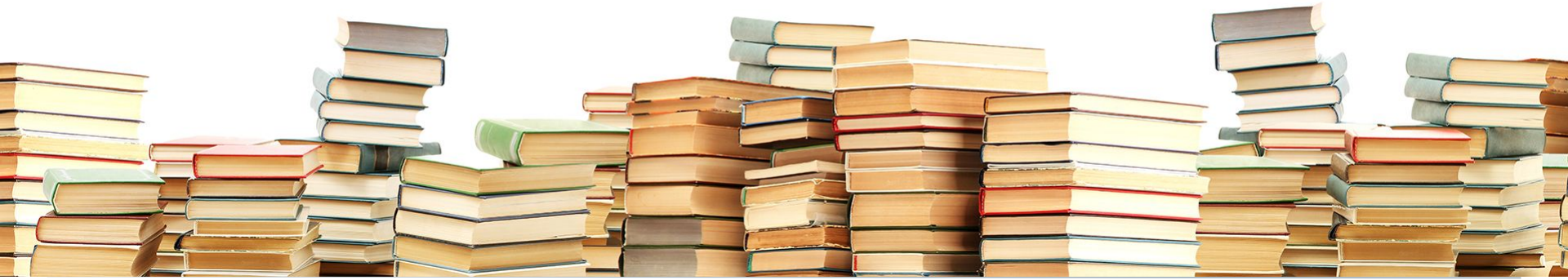
It was originally the product of research done by Google.

Designed to solve a single problem: how to index all the information on the Internet

Example: Counting the Number of Books in a Library

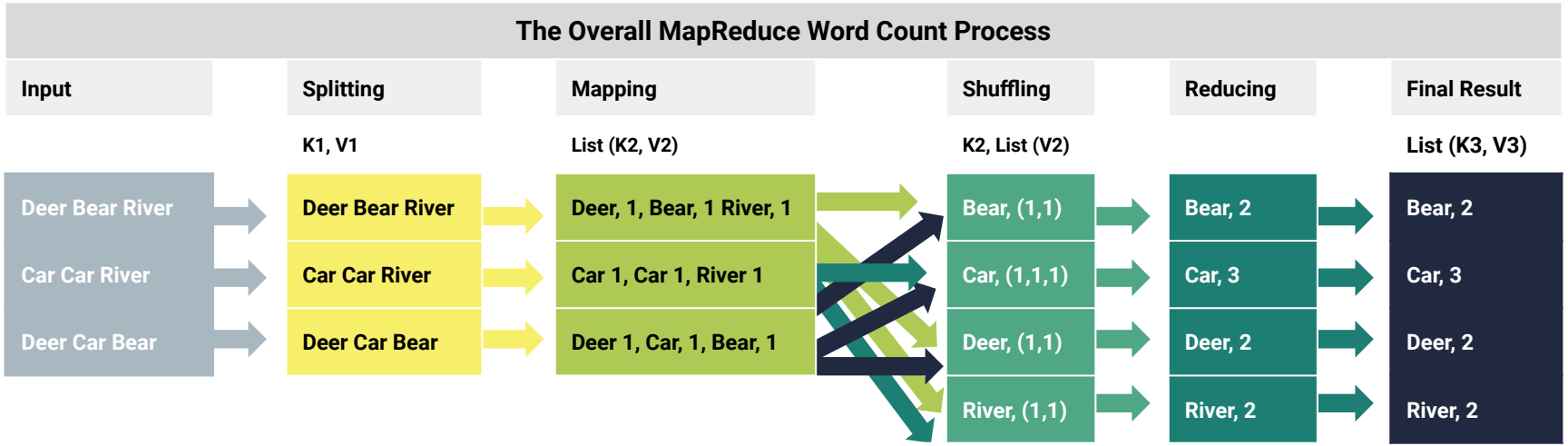
Map: You count this half of the library, and I'll count the other.

Reduce: We get together and add up our counts.



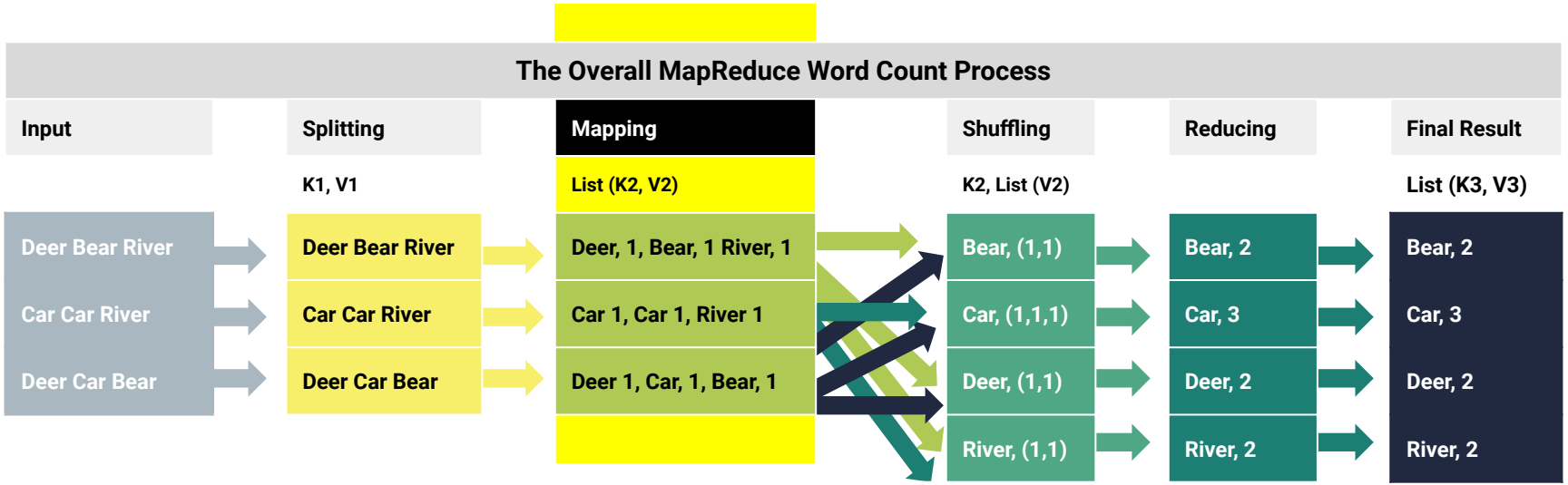
The Map Part of MapReduce

- Execute the `Map()` function on data.
- Execute on each node.
- Output `<key, value>` pairs on each node.



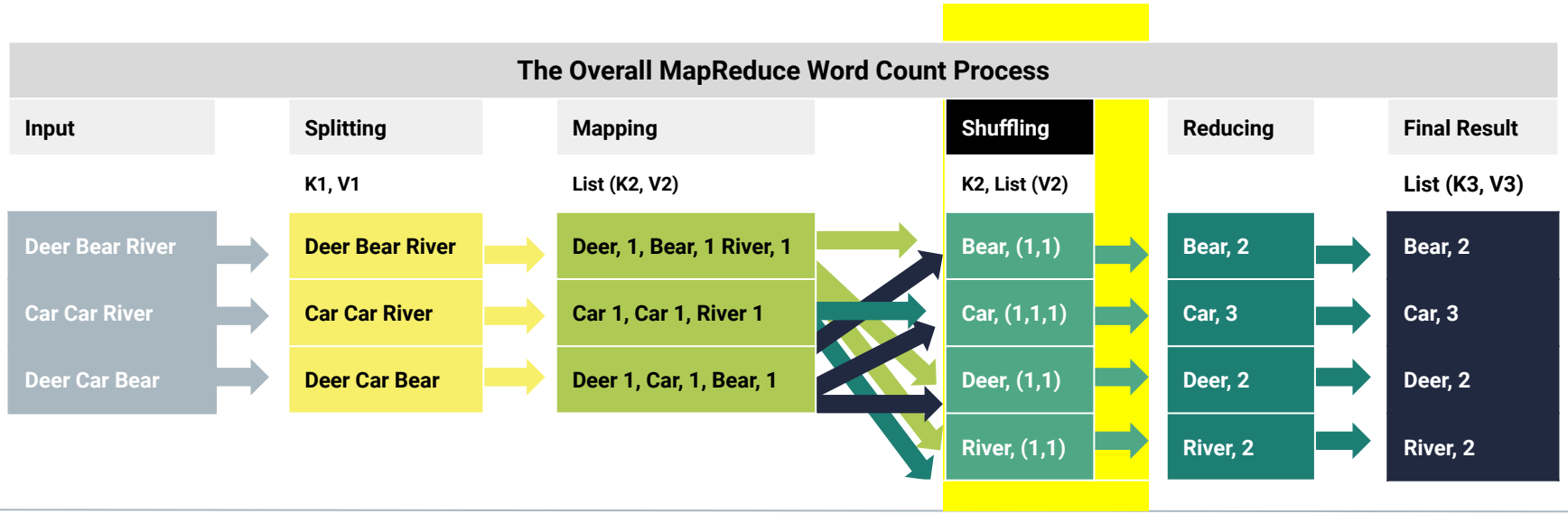
The Map in MapReduce

The mapping step takes a small piece of the input and maps the data to key-value pairs. A common example is sending a line of text to a mapper function, and the mapper generates a key-value pair for each word. The values will be added up later in the reducing step.



The Shuffle in MapReduce

The shuffle step groups the keys together. Each value found for a key is appended to the list of values.



What Is a Job?

- A job is defined by a class that inherits from `MRjob`.
- This class contains methods that define the steps of your job.
- Can translate the job and run it locally or on a Hadoop cluster.
- Note: the shuffle step is handled behind the scenes

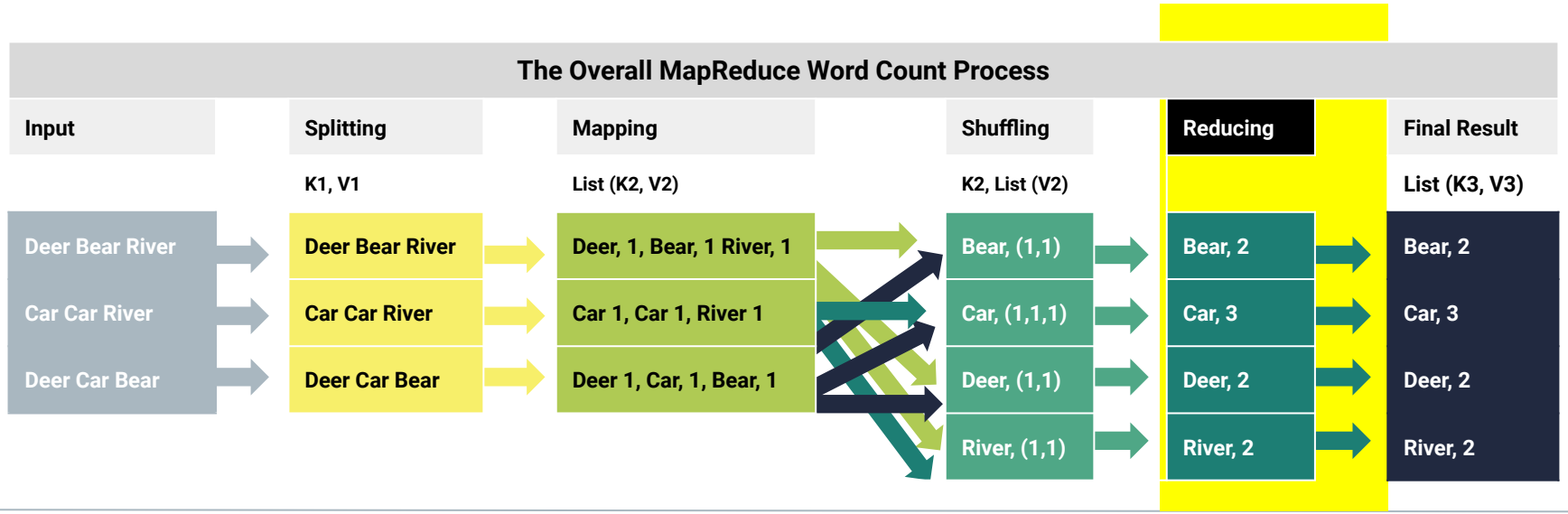
```
from mrjob.job import MRJob

class WordCounter(MRJob):
```

The Reduce Part of MapReduce

- Execute the `Reduce()` function on data.
- Execute on some node.
- Aggregate sets of `<key, value>` pairs on some nodes.
- Output a combined list.

The Reduce in MapReduce

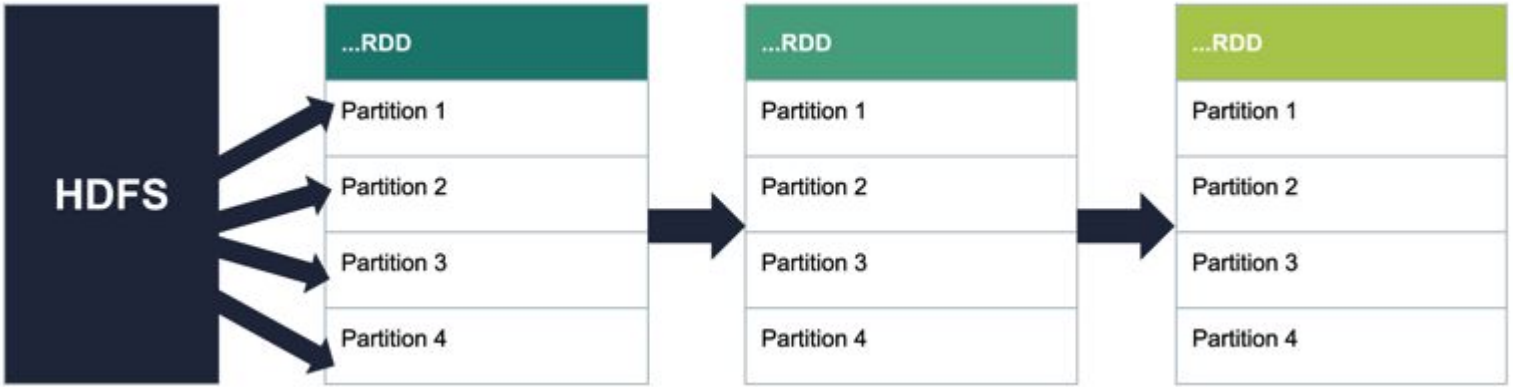
The reducing step reduces the list of the values for a key to a single value. Tin this example, the values are added to get the count of each word.



Hadoop Distributed File System

Hadoop Distributed File System (HDFS)

- Partitioned large data sets
- Store files across a network of machines
- Evolved from the GFS, or Google File System



Hadoop Distributed File System (HDFS)

Pros

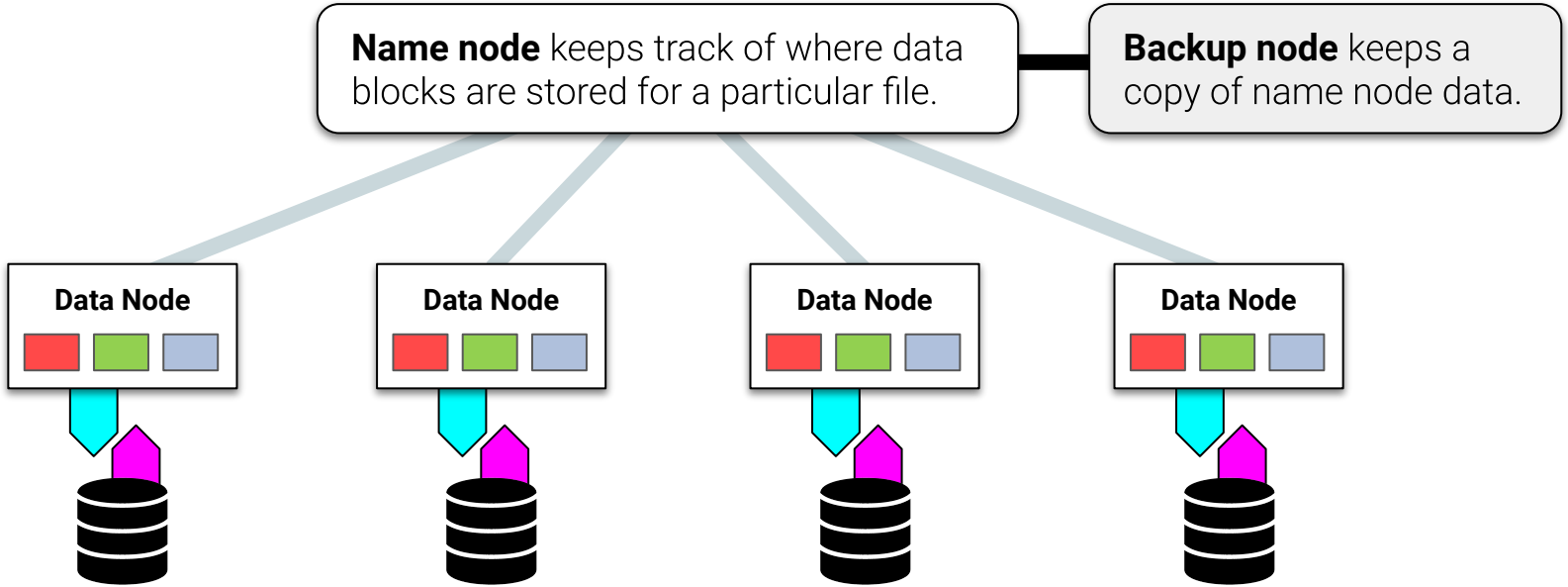
1. Handles terabytes of data
2. Write once, read many times
3. Uses commodity hardware

Cons

1. Not good to low latency access
2. Bad for lots of small files
3. Not for multiple writers

Node

The client will request data through the name node. The name node will locate that data across its data node, and then return data back to the client.



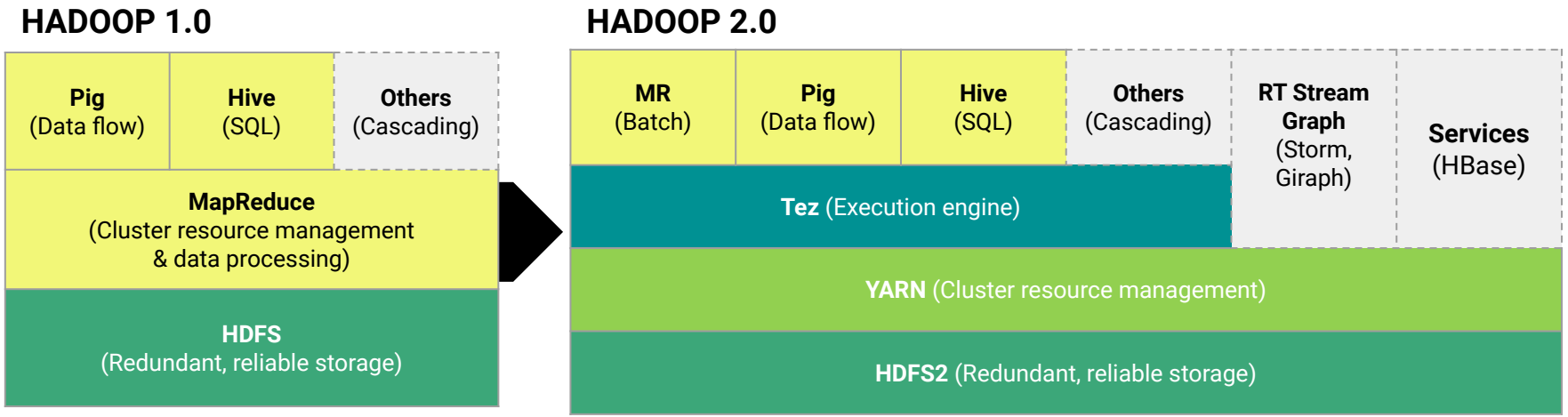
Data nodes store the data and return it on request.

Yet Another Resource Manager (YARN)

YARN Overview

Apache Hadoop YARN (Yet Another Resource Negotiator) is a cluster management technology.

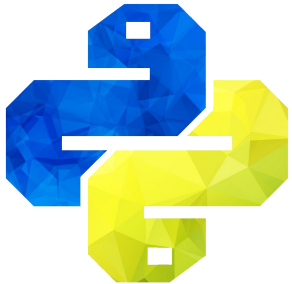
YARN is one of the key features in the second-generation Hadoop 2 version of the Apache Software Foundation's open-source distributed processing framework.



mrjob

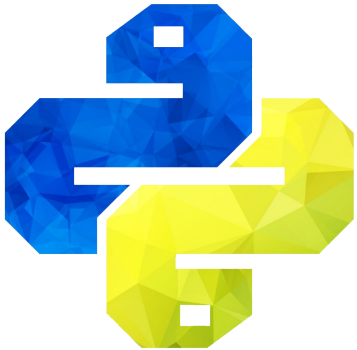
What Is MRjob?

- mrjob is a Python library built by Yelp.
- It lets you write MapReduce jobs in Python and run them on different platforms.
- It also lets you stay in Python while making it easier to process and analyze big data.



What Will We Use mrjob For?

Writing MapReduce jobs in pure Python



Running jobs on our Hadoop cluster

mrjob fundamentals

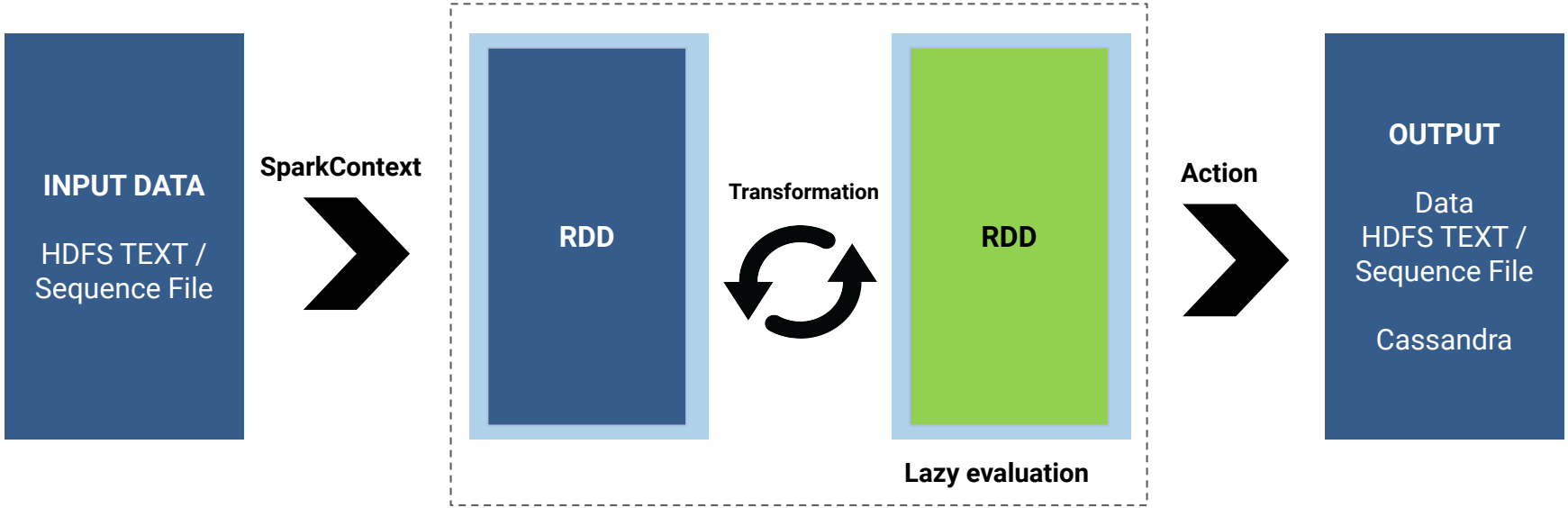
Basic Example

```
from MRJob.job import MRJob

class WordCounter(MrJob):
    def mapper(self, _, line):
        """Maps every word in a line."""
        for word in line.split():
            yield word, 1

    def reducer(self, word, values):
        """Reduces the list of values."""
        yield word, sum(values)
```

Spark (PySpark)

What Is Spark?

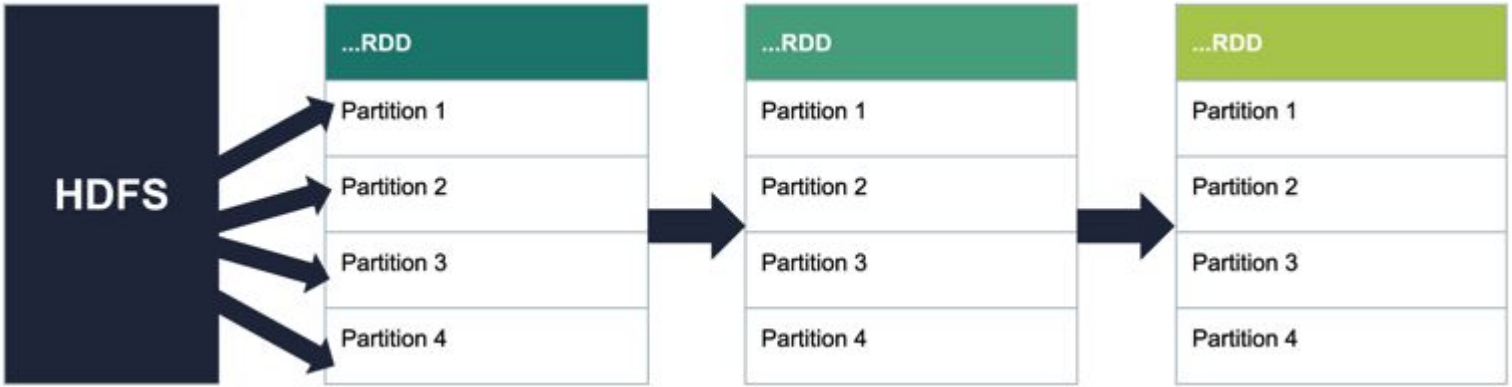
Apache Spark is a unified analytics engine for large-scale data processing.
It lets you write applications in Java, Scala, Python, R, and SQL and runs on Hadoop, stand-alone, or in the cloud (and many other platforms).
Spark can be 100 times faster than Hadoop.



Resilient Distributed Dataset

A resilient distributed dataset (RDD) is the basic abstraction in Spark.

It represents an immutable, partitioned collection of elements that can be operated on in parallel.



Spark DataFrames

- Spark DataFrames are similar to Pandas.
- They hold data in a column and row format.
- Each column represents a variable or feature.
- Each row represents one data point.

Unlike Pandas, Spark DataFrames can scale to handle petabytes of data on clusters of servers or in the cloud.