Algorithms and Applications of Data Mining - Introduction to Spark

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Thanks for source slide and material to: Dr. Heather Miller
https://www.coursera.org/learn/scala-spark-big-data/home/welcome

Why Need MapReduce

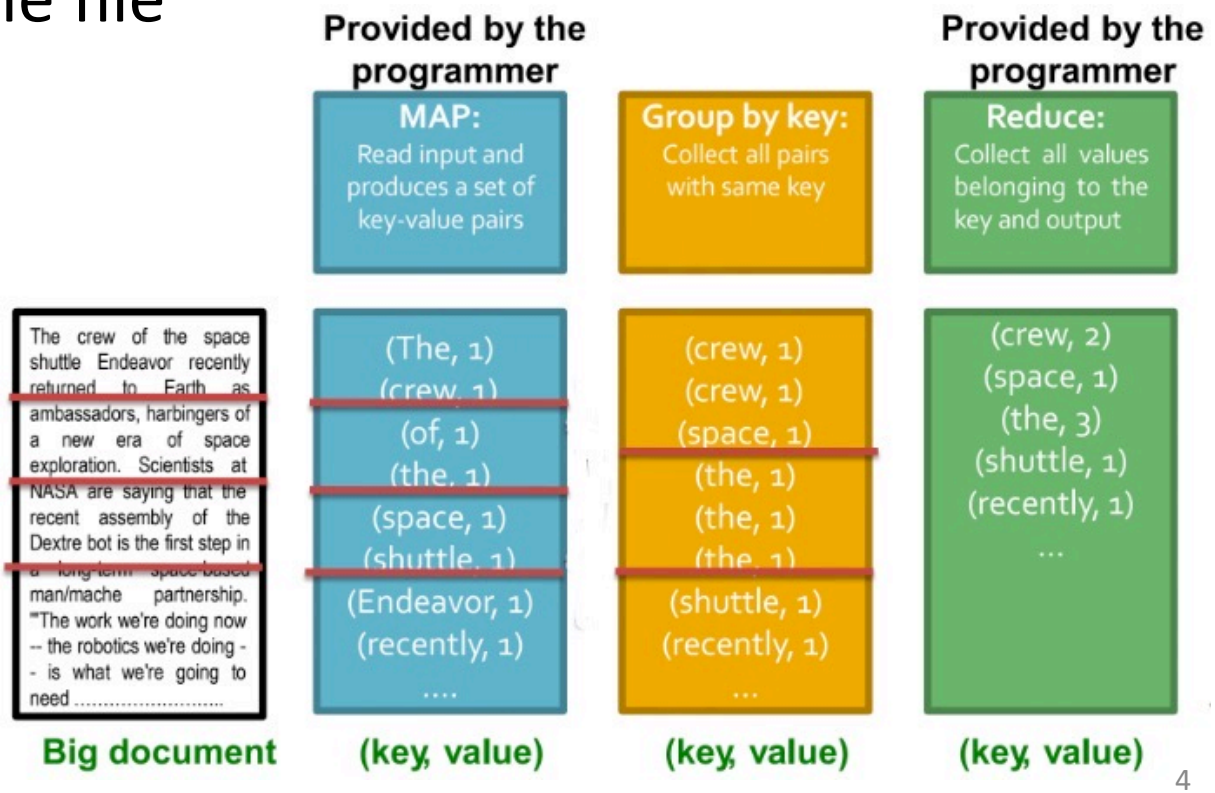
- Challenges in large-scale computing
  - How to distribute computation (moving data around is time-consuming)
  - How to make it easy to write distributed programs
  - How to handle machine failures

What Is MapReduce

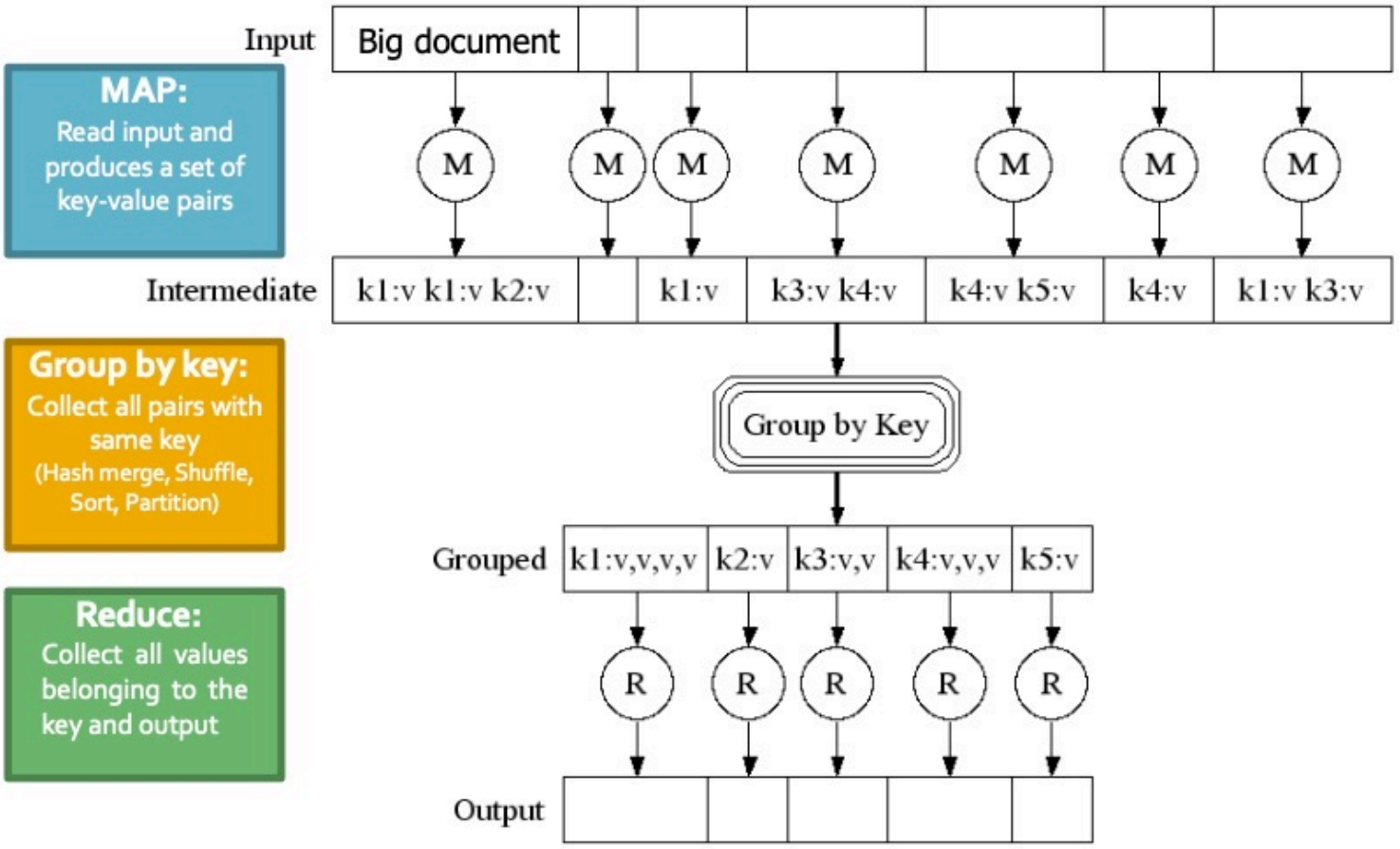
- MapReduce addresses these problems
  - Master Node: Coordinate worker nodes
  - Map worker/node: Extract something you care about, usually data are represented as (key, value) pairs
  - Reduce worker/node: Aggregate, summarize, ...

MapReduce: Word Count

- Task: We have a huge text document, and we want to count the number of times each distinct word appears in the file

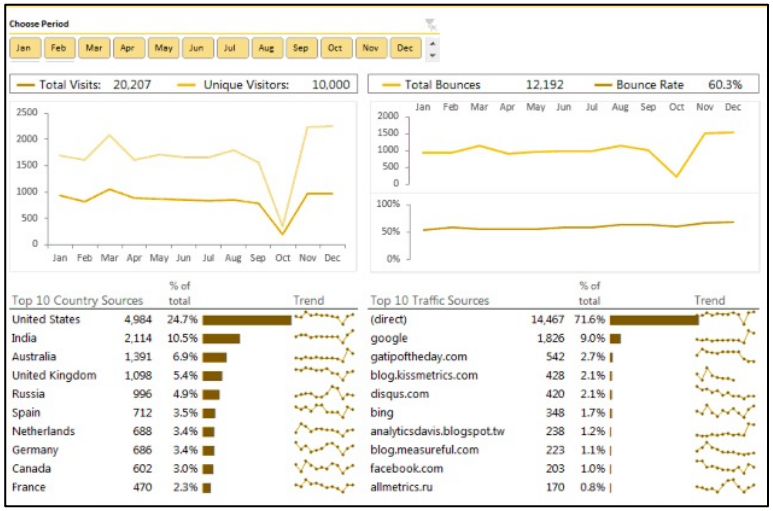


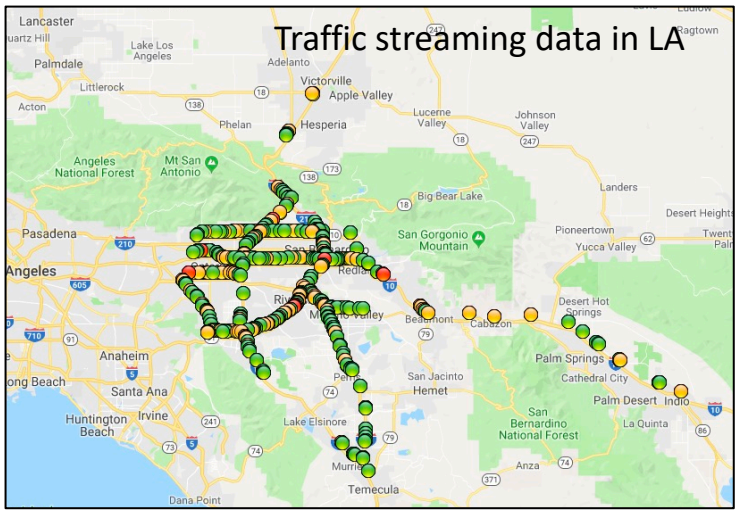
MapReduce: The Diagram



What Is Spark

- **Apache Spark** is an open-source cluster-computing framework for large-scale data processing

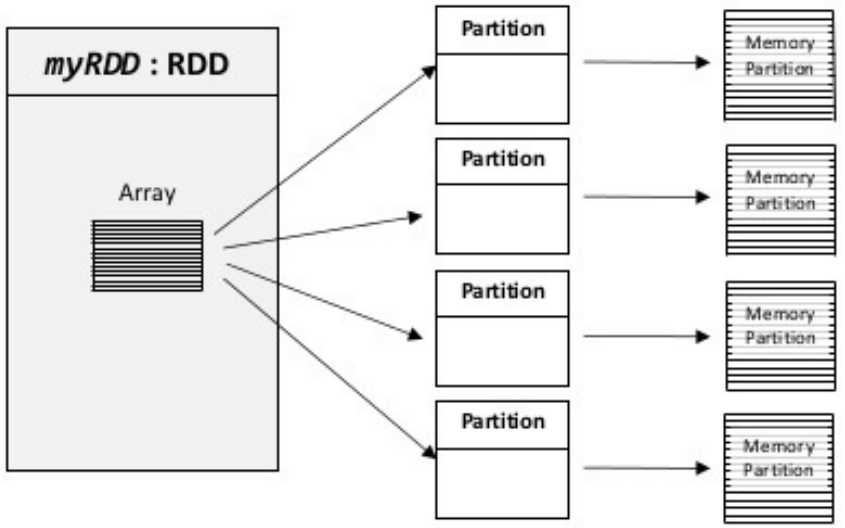




How Does Spark Work?

- Resilient Distributed Datasets (RDDs)
- An **immutable**, **in-memory collection** of objects
- Each RDD can be split into multiple partitions, which in turn are computed on different nodes of the cluster

- RDDs are like collections
  - RDD[T] and List[T]



SparkContext Object

- Create a SparkContext Object to start
  - Can be thought as your handle to the Spark Cluster

```
if __name__ == '__main__':

    sc_conf = pyspark.SparkConf() \
        .setAppName('task1') \
        .setMaster('local[*]') \
        .set('spark.driver.memory', '8g') \
        .set('spark.executor.memory', '4g')

    sc = pyspark.SparkContext(conf=sc_conf)
    sc.setLogLevel("OFF")
```

How To Create An RDD

- Create from a SparkContext object
  - **Parallelize:** convert a local Scala collection to an RDD

```
a_list = ['you', 'jump', 'I', 'jump', '']
a_rdd = sc.parallelize(a_list)  # RDD[String]
```

  - **TextFile**: read a file from HDFS or local file system

```
input_file = 'work-count-sample-doc.txt'
text_rdd = sc.textFile(input_file)
```

How To Create An RDD (Cont.)

- Transform from an existing RDD
  - E.g., calling a *map operation* on an existing RDD, it will return a new RDD

```
# call a map operation on an RDD
length_rdd = word_rdd.map(lambda x: len(x))  # RDD[Int]
```

RDD Operations

- Transformations:
  - E.g., map, filter, ...

```
# call a map operation on an RDD
length_rdd = word_rdd.map(lambda x: len(x))  # RDD[Int]
```

- Actions:
  - E.g., collect, reduce, ...

```
a_coll = a_rdd.collect()  # RDD -> collection
print(a_coll)  # ['you', 'jump', 'I', 'jump', '']
```

Transformations VS. Actions

- Transformations
  - Return new RDDs as results
  - They are **lazy**, the result RDD is **not immediately** computed

```
# call a map operation on an RDD
length_rdd = word_rdd.map(lambda x: len(x))  # RDD[Int]
```

- Actions
  - Compute a result based on an RDD, and returned
  - They are **eager**, the result is **immediately computed**

```
a_coll = a_rdd.collect()  # RDD -> collection
print(a_coll)  # ['you', 'jump', 'I', 'jump', '']
```

Word Count Example

- Let’s start!

If You Want To Learn More

- Official documentation
  - http://spark.apache.org/docs/latest/
- Coursera: Big Data Analysis with Scala and Spark
- Books
  - Learning Spark, O' Reilly
  - Advanced Analytics with Spark: Patterns for Learning from Data at Scale, O' Reilly
  - Machine Learning with Spark, Packt