Python + Spark

Lightning Fast Cluster Computing

Jyotiska NK

Data Engineer

DataWeave

What is Spark ?

In-memory cluster computing framework for large-scale data processing

Some facts about Apache Spark

- Started in 2009 by AMP Lab at UC Berkeley.
- Graduated from Apache Incubator earlier this year.
- Close to 300 contributors on Github.
- Developed using Scala, with Java and Python APIs.
- Can sit on an existing Hadoop cluster.
- Processes data up to 100x faster than Hadoop Map-Reduce in memory or up to 10x faster in disk.

Who are using Spark?

Alibaba	eBay Inc.	Rocketfuel
Amazon	Guavus	Shazam
Autodesk	IBM Almaden	Shopify
Baidu	NASA JPL	Stratio
Conviva	Nokia S&N	Yahoo!
Databricks	Ooyala	Yandex

Full list at: `https://cwiki.apache.org/confluence/display/SPARK/Powered+By+Spark`

Few misconceptions around Spark

Misconception #1

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*** Spark Streaming coming soon!**

PySpark

PySpark

About PySpark

- Python API for Spark using Py4j.
- Provides interactive shell for processing data from command line.
- 2x to 10x less code than standalone programs.
- Can be used from iPython shell or notebook.
- Full support for Spark SQL (previously Shark).
- Spark Streaming coming soon… (version 1.2.0)

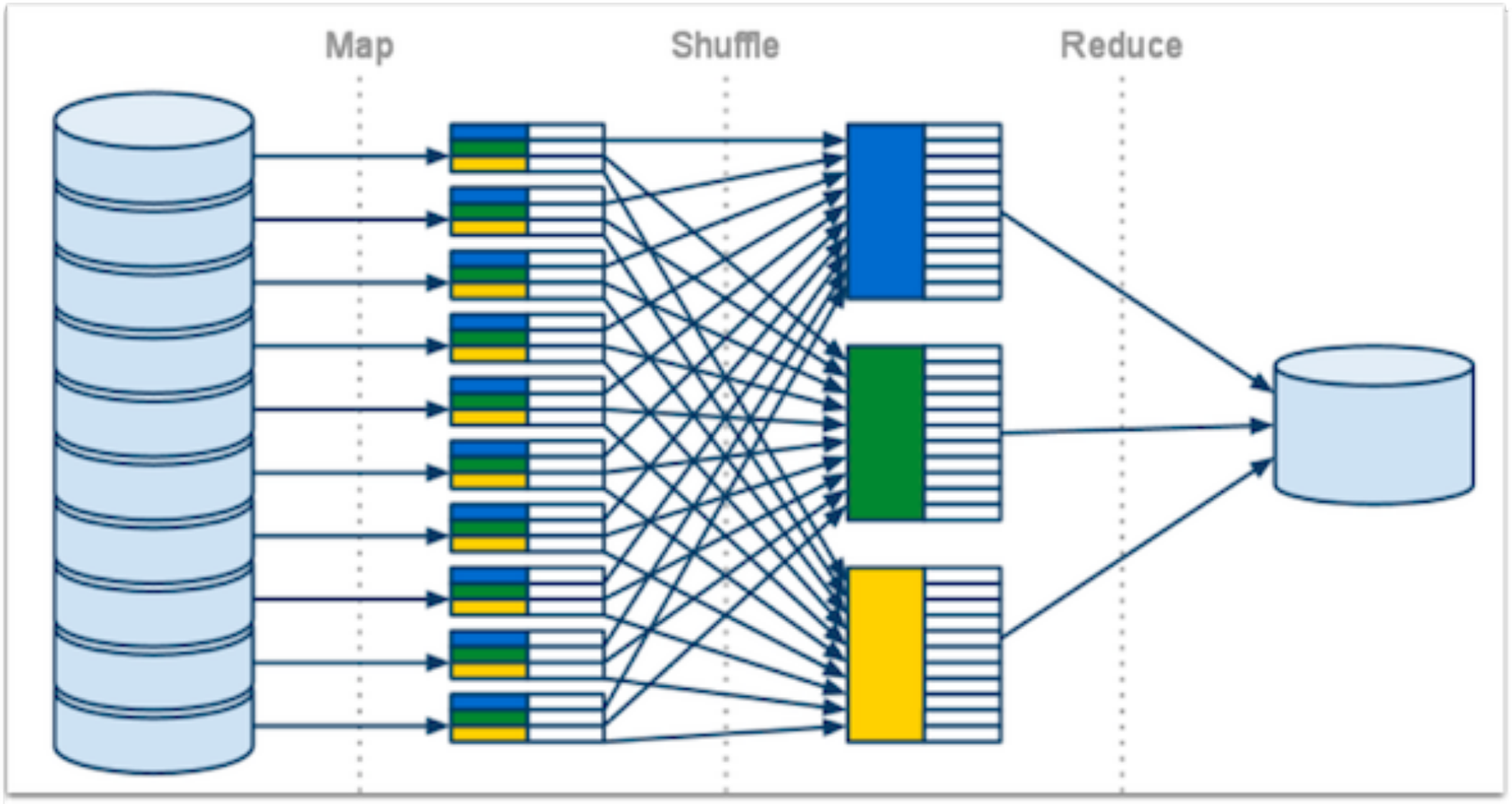
Who can benefit from PySpark?

Data Scientists

- Rich, scalable machine learning libraries (MLlib)
  - Statistics - Correlation, sampling, hypothesis testing
  - ML - Classification, Regression, Collaborative filtering, Clustering, Dimensionality Reduction etc.
- Seamless integration of Numpy, Matplotlib and Pandas for data wrangling and visualizations.
- Advantage of in-memory processing for iterative tasks

Spark vs. Hadoop Map-Reduce

Hadoop Map-Reduce



- A programming paradigm for batch processing.
- Data loaded and read from disk for each iteration and finally written to disk.
- Fault tolerance achieved through data replication on data nodes.
- Each Pig/Hive query spawns a separate Map-Reduce job and reads from disk.

What is different in Spark?

- Data is cached in RAM from disk for iterative processing.
- If data is too large for memory, rest is spilled into disk.
- Interactive processing of datasets without having to reload in the memory.
- Dataset is represented as RDD (Resilient Distributed Dataset) when loaded into Spark Context.
- Fault tolerance achieved through RDD and lineage graphs.

RDD (Resilient Distributed Dataset)

What is RDD?

- A read-only collection of objects, partitioned across a set of machines.

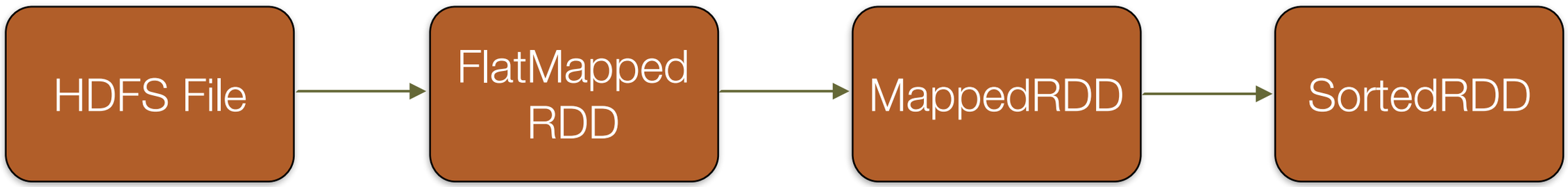
- RDDs can be re-built if a partition is lost through **lineage**: an RDD has information about how it was derived from other RDDs to be reconstructed.

- RDDs can be cached and reused in multiple Map-Reduce like parallel operations.

- RDDs are lazy and ephemeral.

RDD Lineage

```
lines = sc.textFile("hdfs://...")
sortedCount = lines.flatMap(lambda x: x.split(' ')) \
                   .map(lambda x: (int(x), 1)) \
                   .sortByKey(lambda x: x)
```



RDD Operations

Transformations	map, filter, flatmap, sort
Actions	reduce, count, collect, save

Map

Returns a new RDD by applying a function to each element of this RDD

```
from pyspark.context import SparkContext

sc = SparkContext('local[2]', 'map_example')

rdd = sc.parallelize(["banana", "apple",
“watermelon"])
sorted(rdd.map(lambda x: (x, len(x))).collect())

[('apple', 5), ('banana', 6), ('watermelon',
10)]
```

FlatMap

Return a new RDD by first applying a function to all elements of this RDD, and then flattening the results.

```
from pyspark.context import SparkContext
sc = SparkContext('local[2]', 'flatmap_example')

rdd = sc.parallelize(["this is you", "you are here",
"how do you feel about this"])
sorted(rdd.flatMap(lambda x: x.split()).collect())

['about', 'are', 'do', 'feel', 'here', 'how', 'is',
'this', 'this', 'you', 'you', 'you']
```

Filter

Returns a new RDD containing only the elements that satisfy a predicate.

```
from pyspark.context import SparkContext
sc = SparkContext('local[2]', 'filter_example')

rdd = sc.parallelize([1, 2, 3, 4, 5])
rdd.filter(lambda x: x % 2 == 0).collect()

[2, 4]
```

Reduce

Reduces the elements of this RDD using the specified commutative and associative binary operator. Currently reduces partitions locally.

```
from operator import add
from pyspark.context import SparkContext

sc = SparkContext('local[2]', 'reduce_example')

num_list = [num for num in xrange(1000000)]
sc.parallelize(num_list).reduce(add)

499999500000
```

Count

Return the number of elements in this RDD.

```
from pyspark.context import SparkContext

sc = SparkContext('local[2]', 'count_example')

file = sc.textFile("hdfs://...")
file.flatMap(lambda line: line.split()).count()

4929075
```

SaveAsTextFile

Save this RDD as a text file, using string representations of elements.

```
from pyspark.context import SparkContext
sc = SparkContext('local[2]', 'filter_example')

file = sc.textFile(“hdfs://...")

file.flatMap(lambda line: line.split())
    .saveAsTextFile(“output_dir”)
```

Live Demo

- Word count to compute top 5 words by frequency
- Processing a HTTP log to find number of errors in a day
- Logistic Regression
- Processing JSON using Spark SQL

Contribute to Spark

Submit a Pull Request on Github

github.com/apache/spark

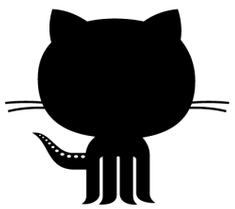
Report a bug or suggestions on Apache Spark JIRA

issues.apache.org/jira/browse/SPARK

Join the Apache Spark mailing list

spark.apache.org/mailing-lists.html

Contact Me



github.com/jyotiska

in.linkedin.com/in/jyotiskank/

jyotiska@dataweave.in