Introduction to Apache Spark

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What is Spark?

Fast and **Expressive** Cluster Computing Engine Compatible with Apache Hadoop

Up to **10×** faster on disk, **100×** in memory

Efficient

- General execution graphs
- In-memory storage

2-5× less code

Usable

- Rich APIs in Java, Scala, Python
- Interactive shell

Spark Programming Model

Key Concept: RDD's

Write programs in terms of **operations** on **distributed datasets**

Resilient Distributed Datasets

- Collections of objects spread across a cluster, stored in RAM or on Disk
- Built through parallel transformations
- Automatically rebuilt on failure

Operations

- Transformations (e.g. map, filter, groupBy)
- Actions (e.g. count, collect, save)

Example: Log Mining

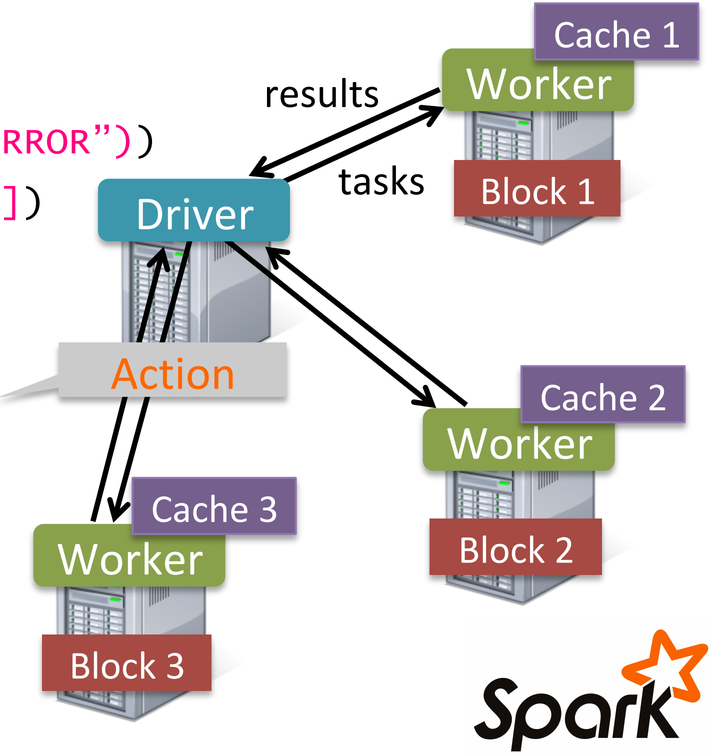
Load error messages from a log into memory, then interactively search for various patterns

B Transformed RDD

```
lines = spark.textFile(“hdfs://...”)
errors = lines.filter(lambda s: s.startswith(“ERROR”))
messages = errors.map(lambda s: s.split(“\t”)[2])
messages.cache()


messages.filter(lambda s: “mysql” in s).count()
messages.filter(lambda s: “php” in s).count()
. . .
```

Action



Full-text search of Wikipedia

- 60GB on 20 EC2 machine
- 0.5 sec vs. 20s for on-disk

More RDD Operators

- map
- filter
- groupBy
- sort
- union
- join
- leftOuterJoin
- rightOuterJoin

- reduce
- count
- fold
- reduceByKey
- groupByKey
- cogroup
- cross
- zip

sample

take

first

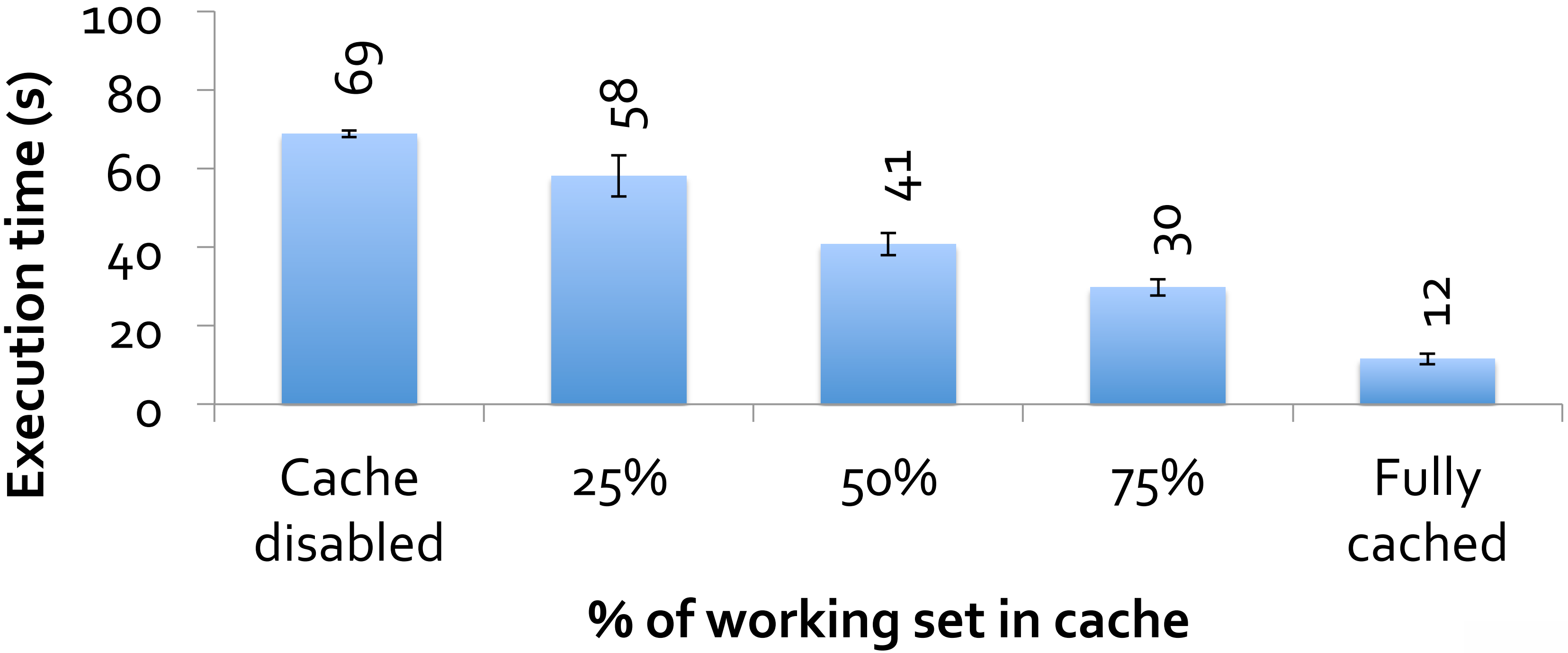
partitionBy

mapWith

pipe

save ...

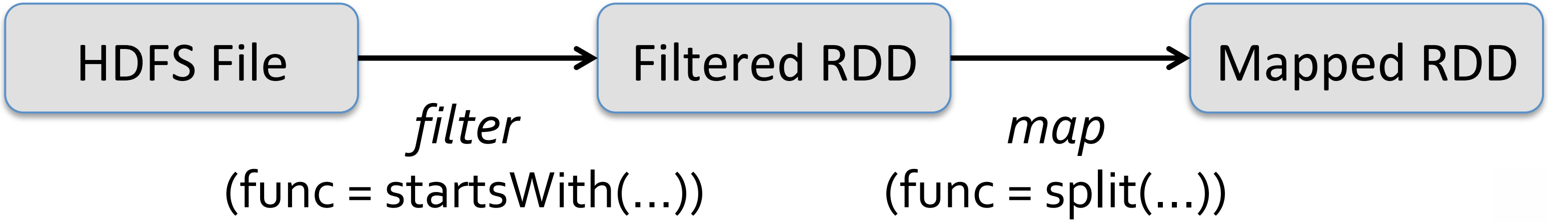
Scaling Down



Fault Recovery

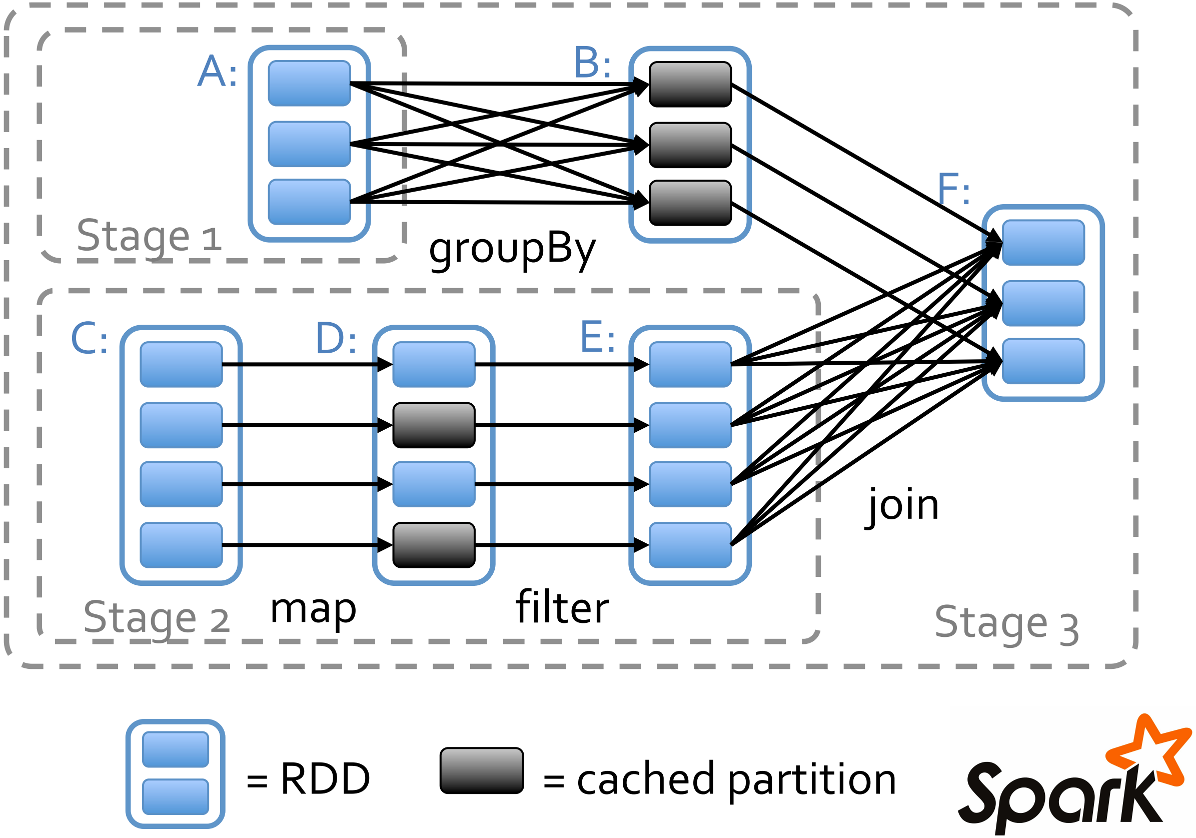
RDDs track *lineage* information that can be used to efficiently recompute lost data

```
msgs = textFile.filter(lambda s: s.startsWith(“ERROR”))
               .map(lambda s: s.split(“\t”)[2])
```



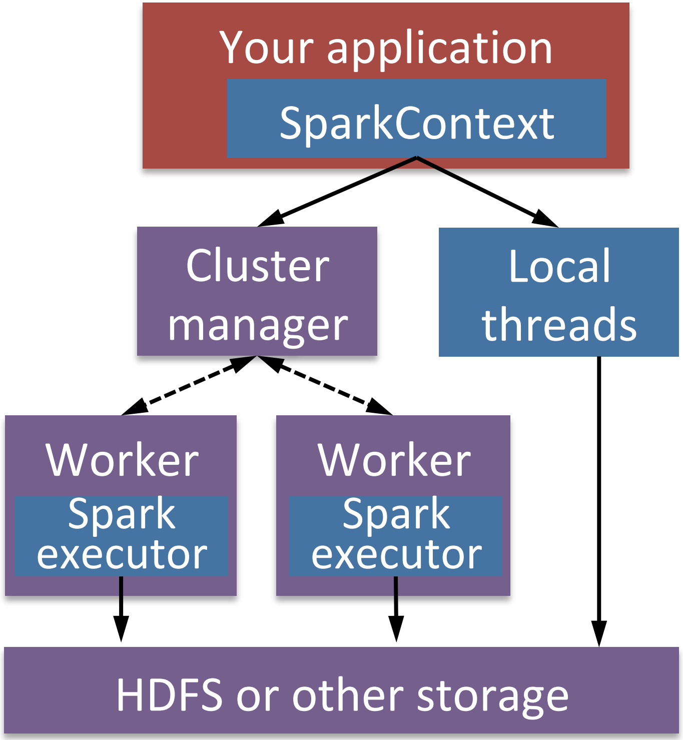
Under The Hood: DAG Scheduler

- General task graphs
- Automatically pipelines functions
- Data locality aware
- Partitioning aware to avoid shuffles



Software Components

- Spark runs as a library in your program (1 instance per app)
- Runs tasks locally or on cluster
  - Mesos, YARN or standalone mode
- Accesses storage systems via Hadoop InputFormat API
  - Can use HBase, HDFS, S3, …



CONCLUSION

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- Spark offers a rich API to make data analytics *fast*: both fast to write and fast to run
- Achieves 100x speedups in real applications
- Growing community with 25+ companies contributing