Amirkabir University of Technology
(Tehran Polytechnic)

Cloud Computing

Spark Architecture and Useful Links

Seyyed Ahmad Javadi

sajavadi@aut.ac.ir

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Course Logistics

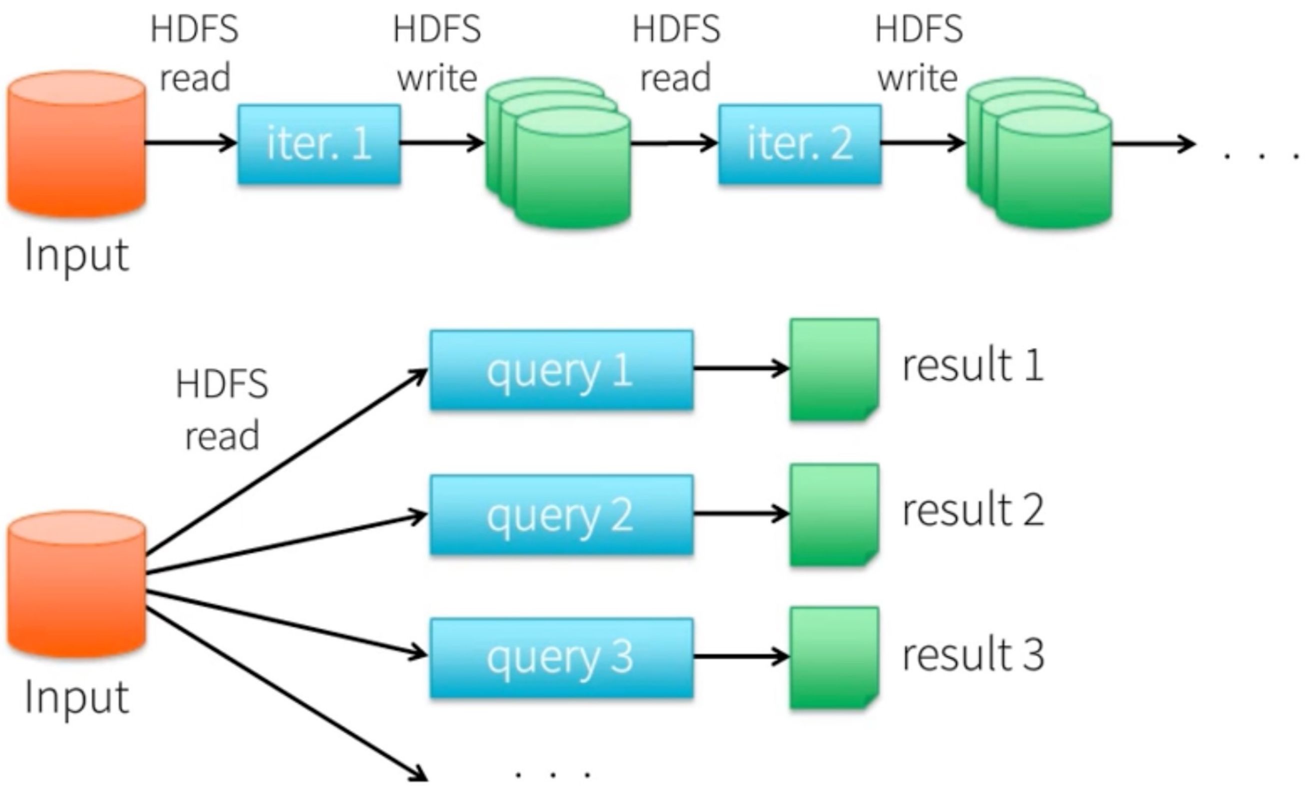
- HW2 presentation
  - Last three days of the week

A Quick Review

Few slides from Mr. Zahari’s presentation available in the link below:

https://www.youtube.com/watch?v=d9D-Z3-44F8&t=206s

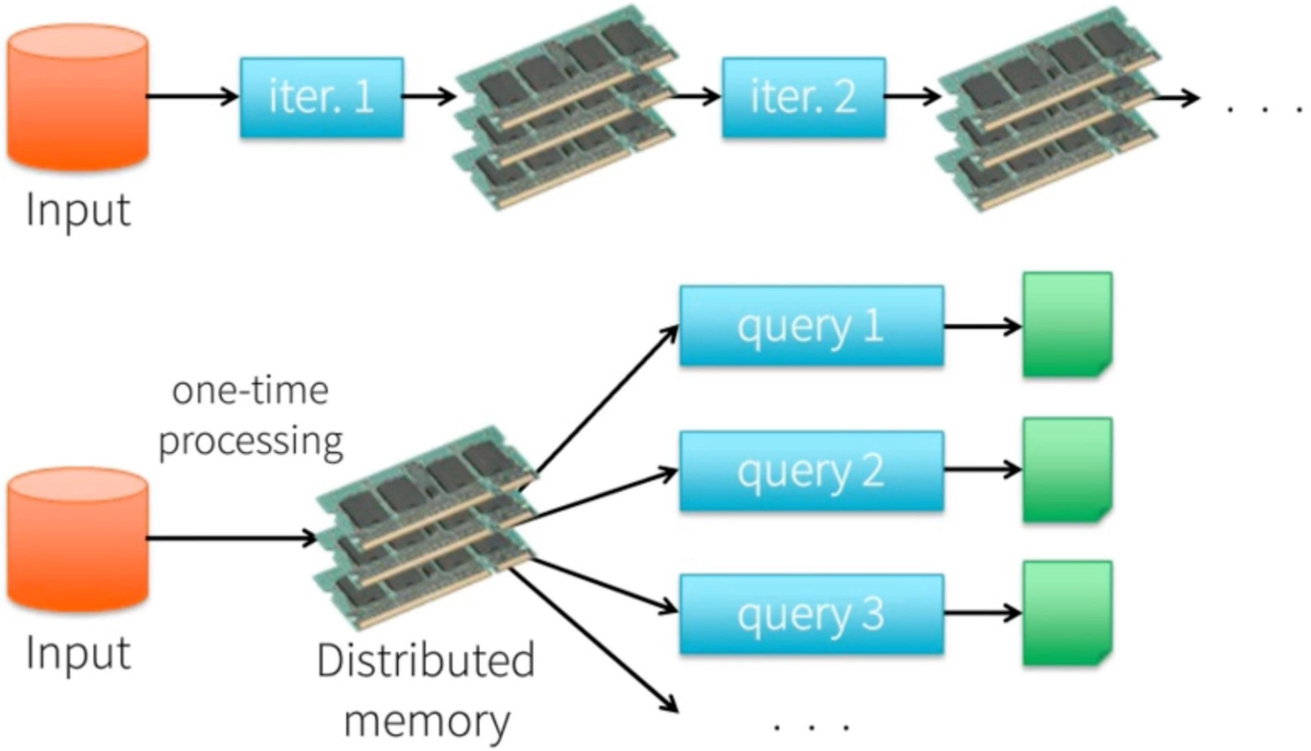
Data Sharing in MapReduce



Slow due to replication and disk I/O

Source: Matei Zaharia's persentatioin

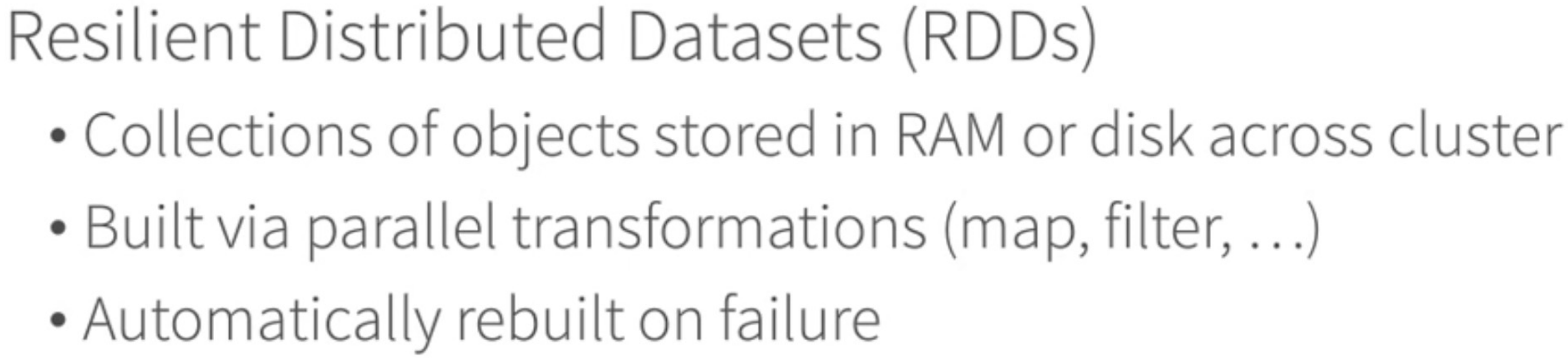
What We’d Like



10-100x faster than network and disk

Source: Matei Zaharia’s persentatioin

Spark Programming Model

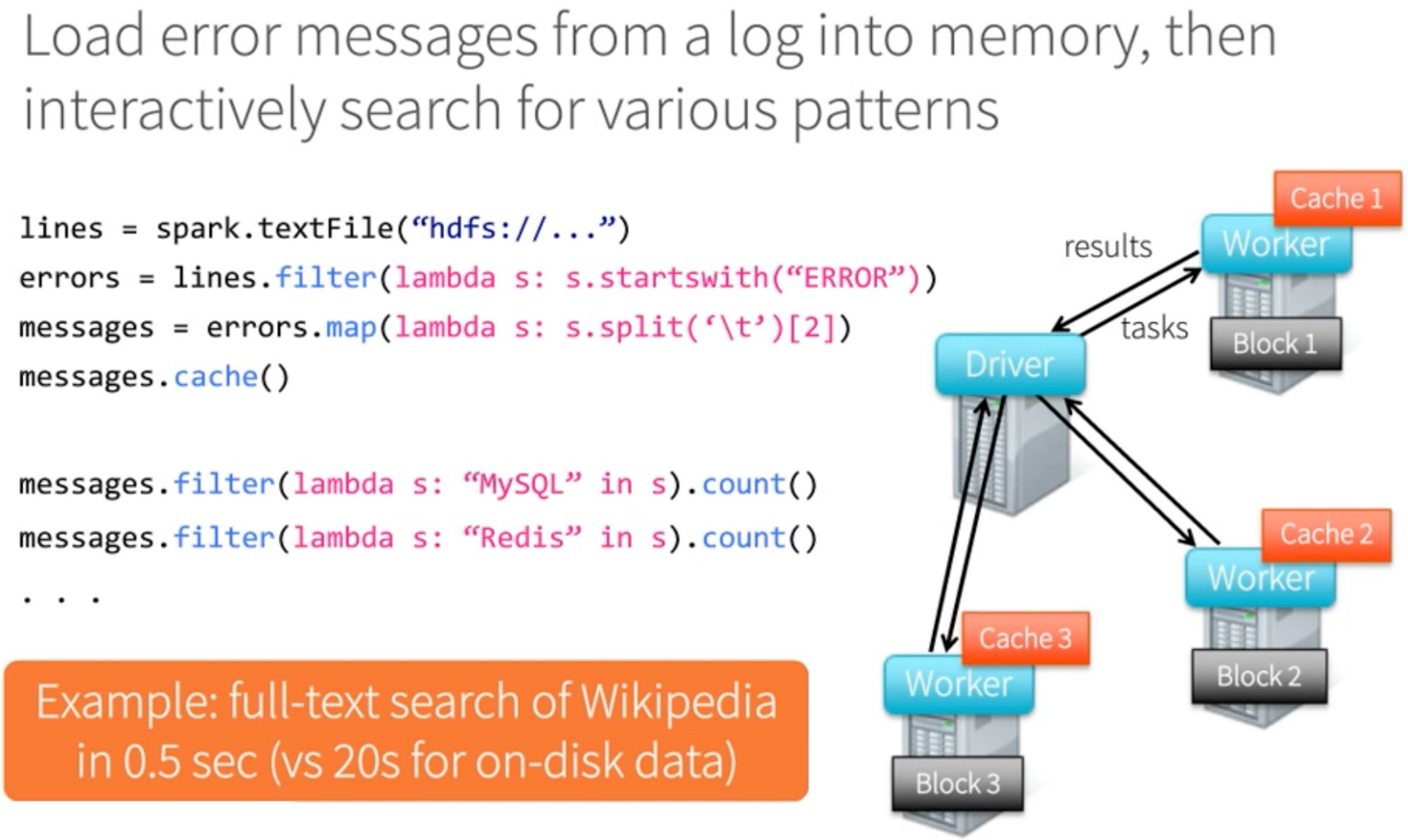


Resilient Distributed Datasets (RDDs)

- Collections of objects stored in RAM or disk across cluster
- Built via parallel transformations (map, filter, …)
- Automatically rebuilt on failure

Source: Matei Zaharia’s persentatioin

Example: Log Mining



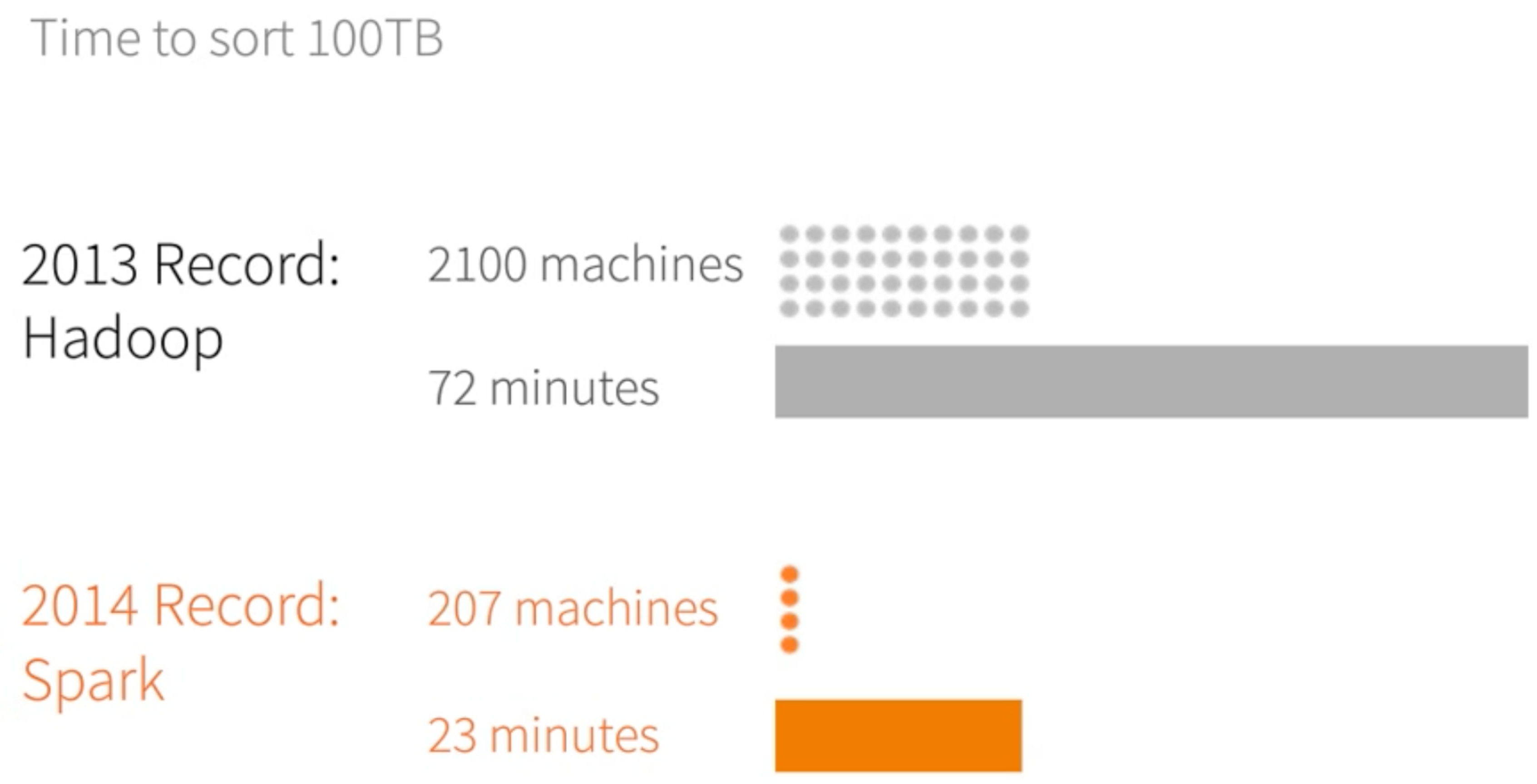
Load error messages from a log into memory, then interactively search for various patterns

```
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: “Redis” in s).count()
. . .
```

Example: full-text search of Wikipedia in 0.5 sec (vs 20s for on-disk data)

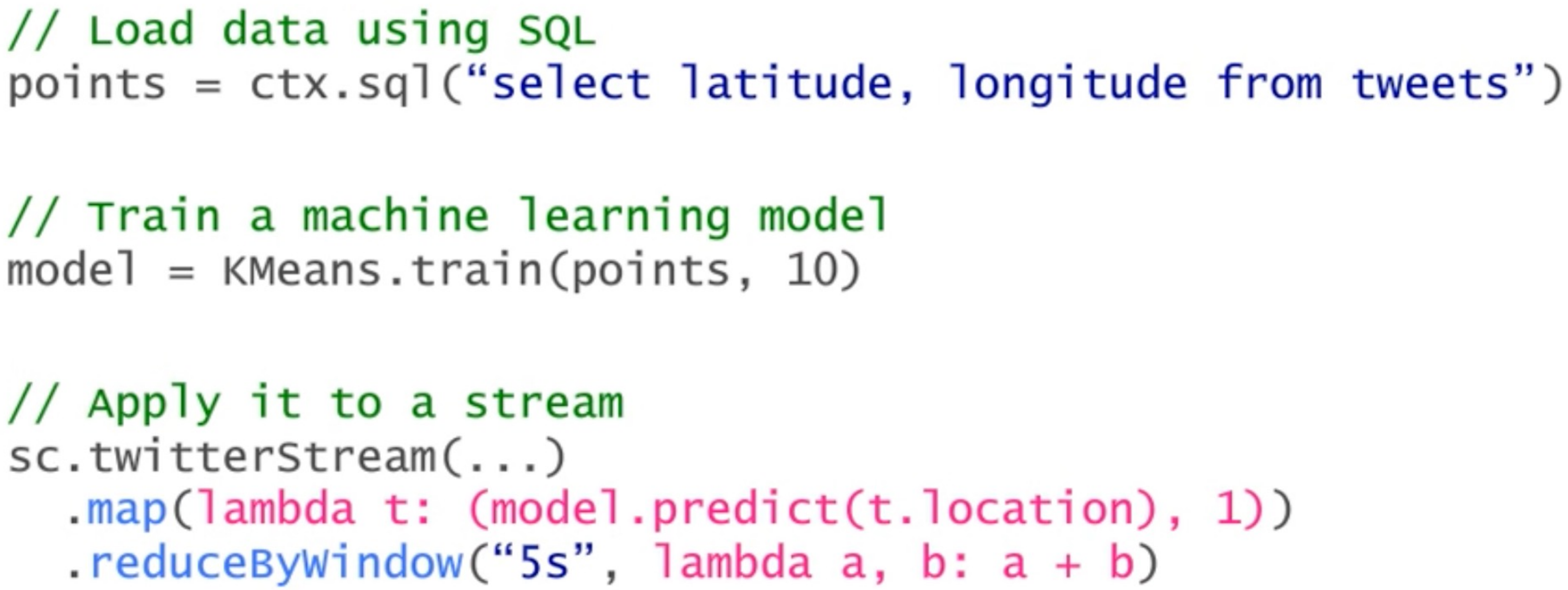
Source: Matei Zaharia’s persentatioin

On-Disk Performance



Source: Matei Zaharia’s persentatioin

Combining Processing Types

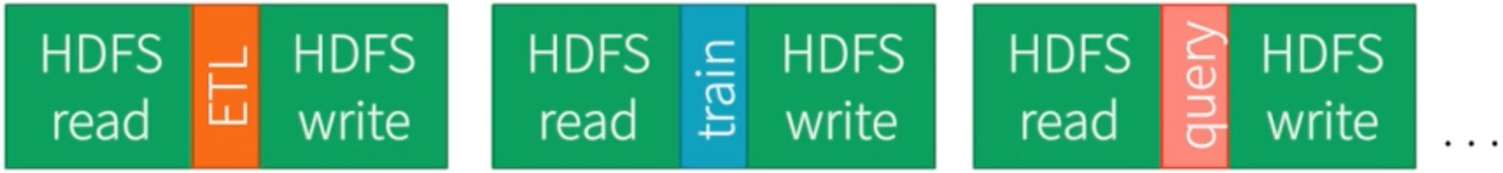


```
// Load data using SQL
points = ctx.sql(“select latitude, longitude from tweets”)

// Train a machine learning model
model = KMeans.train(points, 10)

// Apply it to a stream
sc.twitterStream(...)
  .map(lambda t: (model.predict(t.location), 1))
  .reduceByWindow(“5s”, lambda a, b: a + b)
```

Source: Matei Zaharia’s persentatioin

Combining Processing Types

Separate systems:



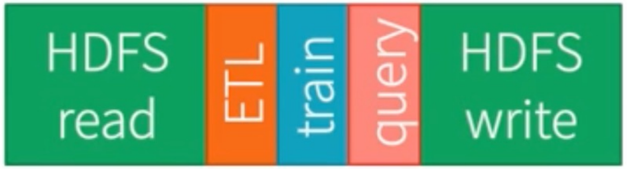
HDFS read | ETL | HDFS write

HDFS read | train | HDFS write

HDFS read | query | HDFS write

. . .

Spark:

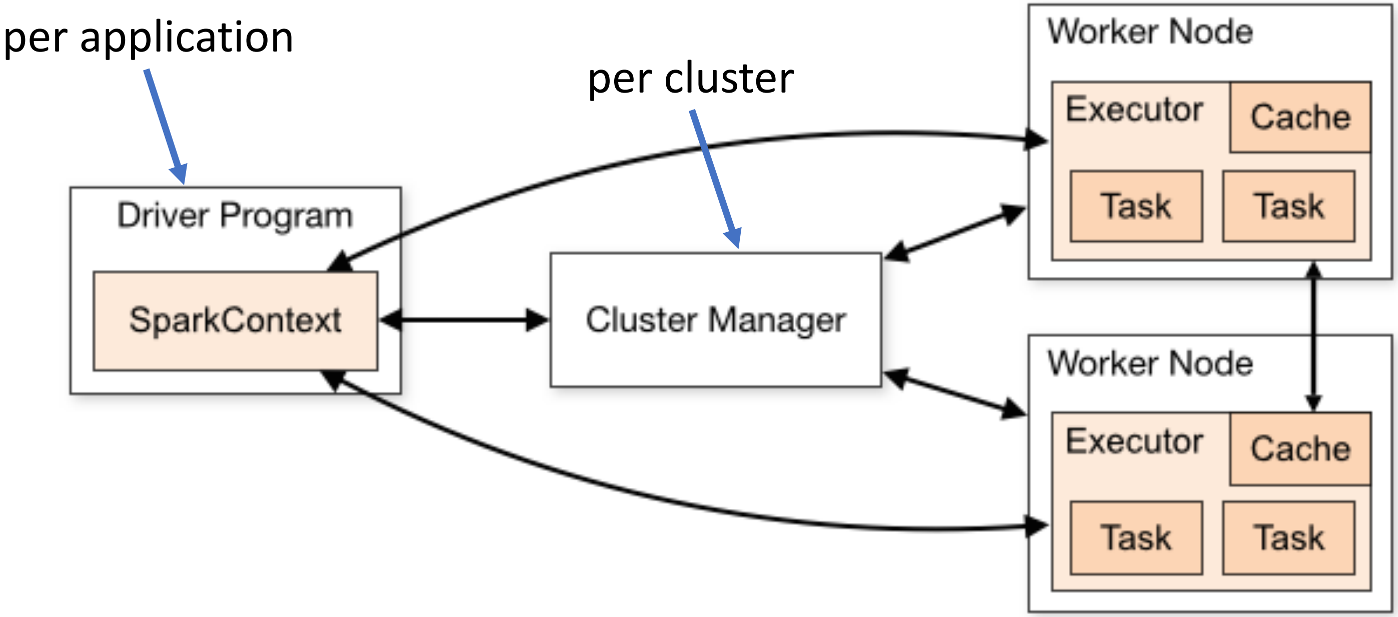


HDFS read | ETL | train | query | HDFS write

Source: Matei Zaharia’s persentatioin

Spark Architeture

Cluster Mode Overview

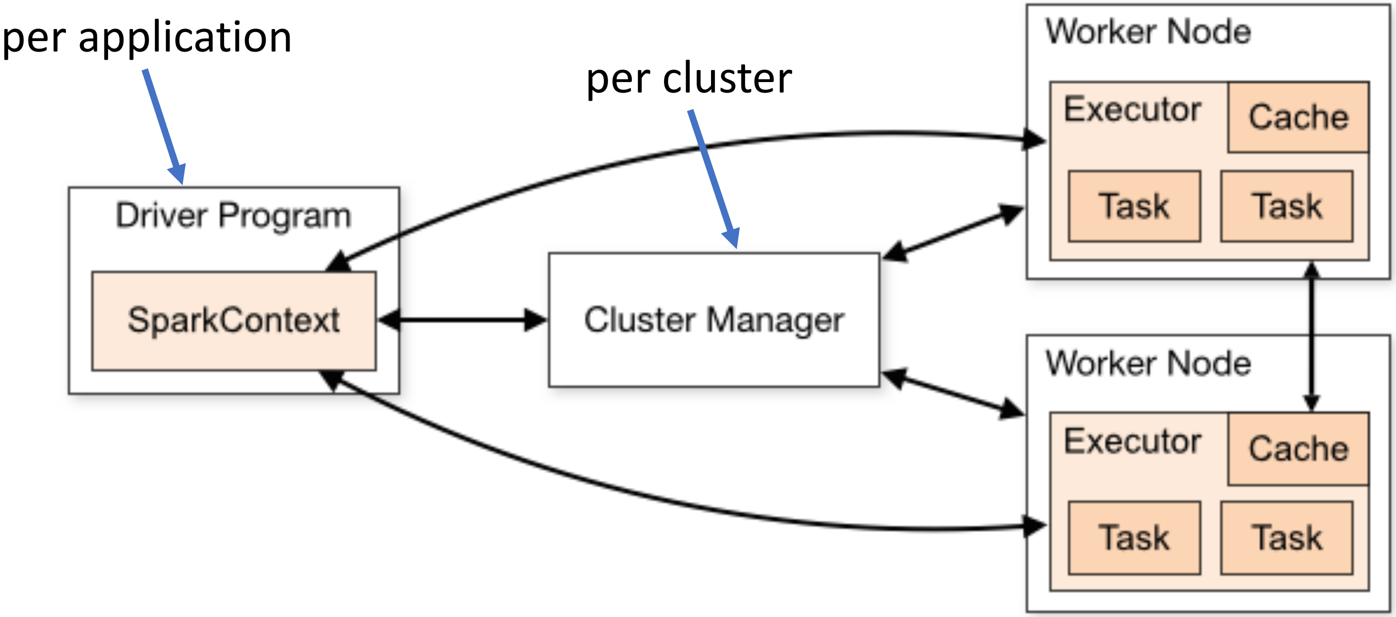

per application

per cluster

https://spark.apache.org/docs/latest/cluster-overview.html

- SparkContext can connect to several types of *cluster managers:*
  - Spark's own standalone cluster manager,
  - Mesos,
  - YARN or
  - Kubernetes
- Cluster manager allocates resources across applications.

Cluster Mode Overview (cont.)



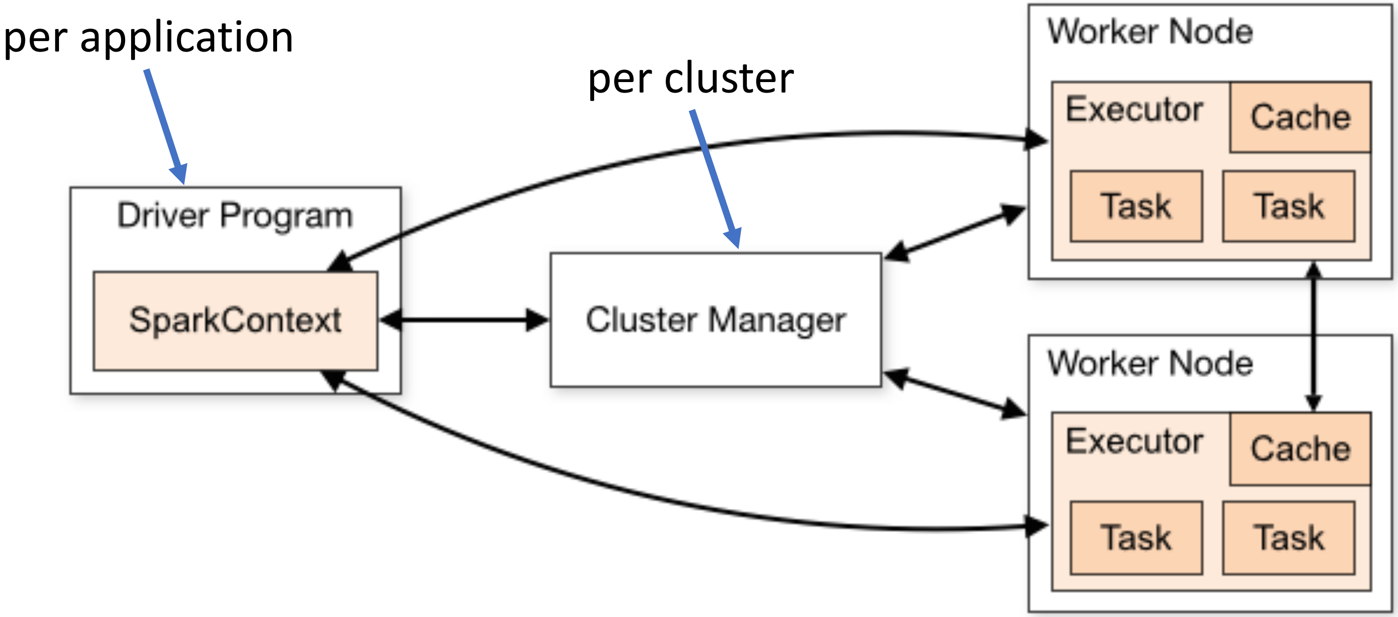
per application

per cluster

https://spark.apache.org/docs/latest/cluster-overview.html

- Each application gets its own executor processes.
  - Executor processes run tasks in multiple threads
  - Benefit: isolating applications from each other
  - Challenge: ***data cannot*** be shared across different Spark applications without writing it to an external storage system.

Cluster Mode Overview (cont.)



per application

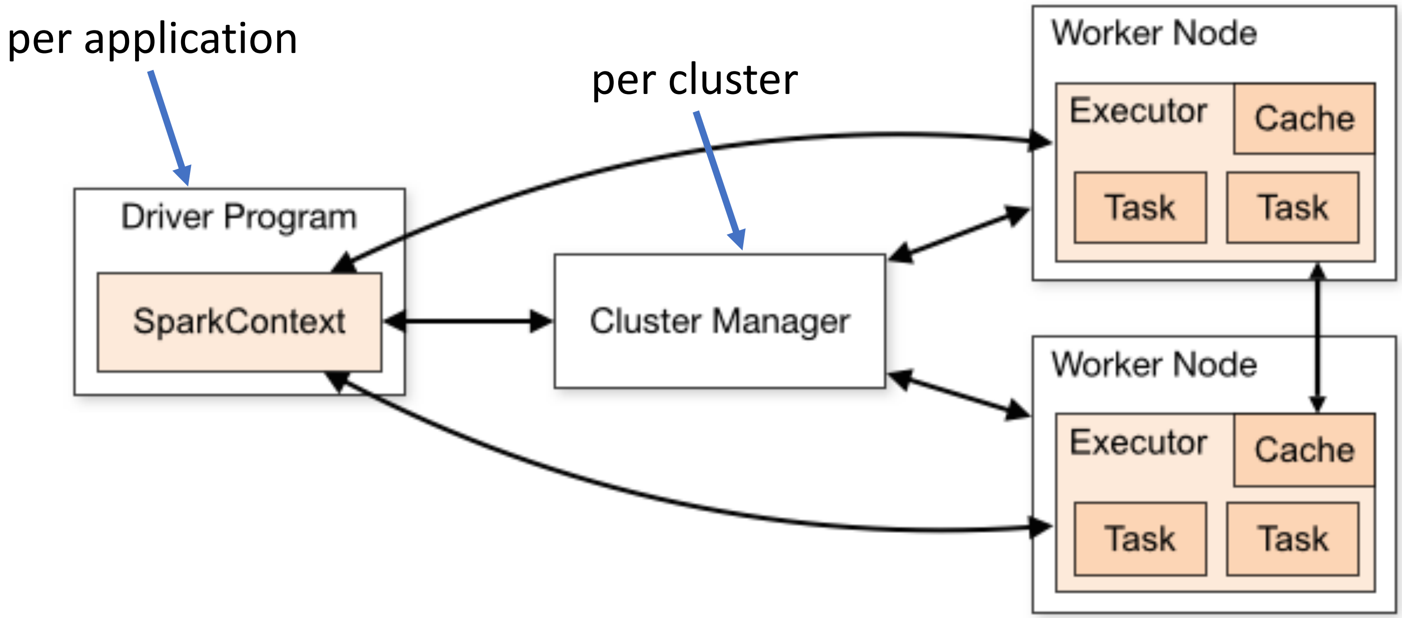
per cluster

https://spark.apache.org/docs/latest/cluster-overview.html

- Spark is agnostic to the underlying cluster manager.
  - As long as Spark can acquire executor processes & these communicate with each other.

Apache MESOS™ APACHE hadoop kubernetes

Cluster Mode Overview (cont.)


per application

per cluster

https://spark.apache.org/docs/latest/cluster-overview.html

- The driver program must listen for and accept incoming connections from its executors throughout its lifetime.
- As such, the driver program must be network addressable from the worker nodes.

Cluster Manager Types

- Standalone
  - A simple cluster manager included with Spark making it easy to set up a cluster.
- Apache Mesos
  - A general cluster manager that can also run Hadoop MapReduce and service applications. (Deprecated)
- Hadoop YARN
  - The resource manager in Hadoop 2.
- Kubernetes
  - An open-source system for automating deployment, scaling, and management of containerized applications.