Agenda

- Spark Platform
- Spark Core
- Spark Extensions
- Using Apache Spark

About me

eleks®

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Eleks

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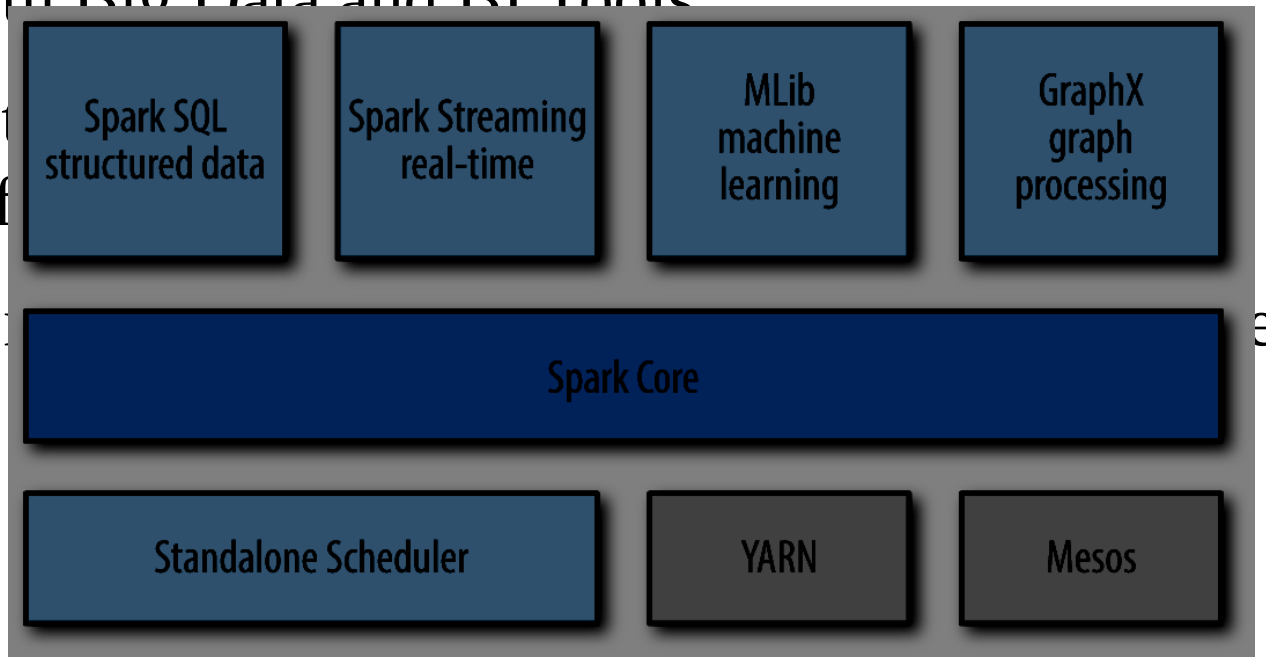
20 years in software development

9+ years of developing for MS SQL

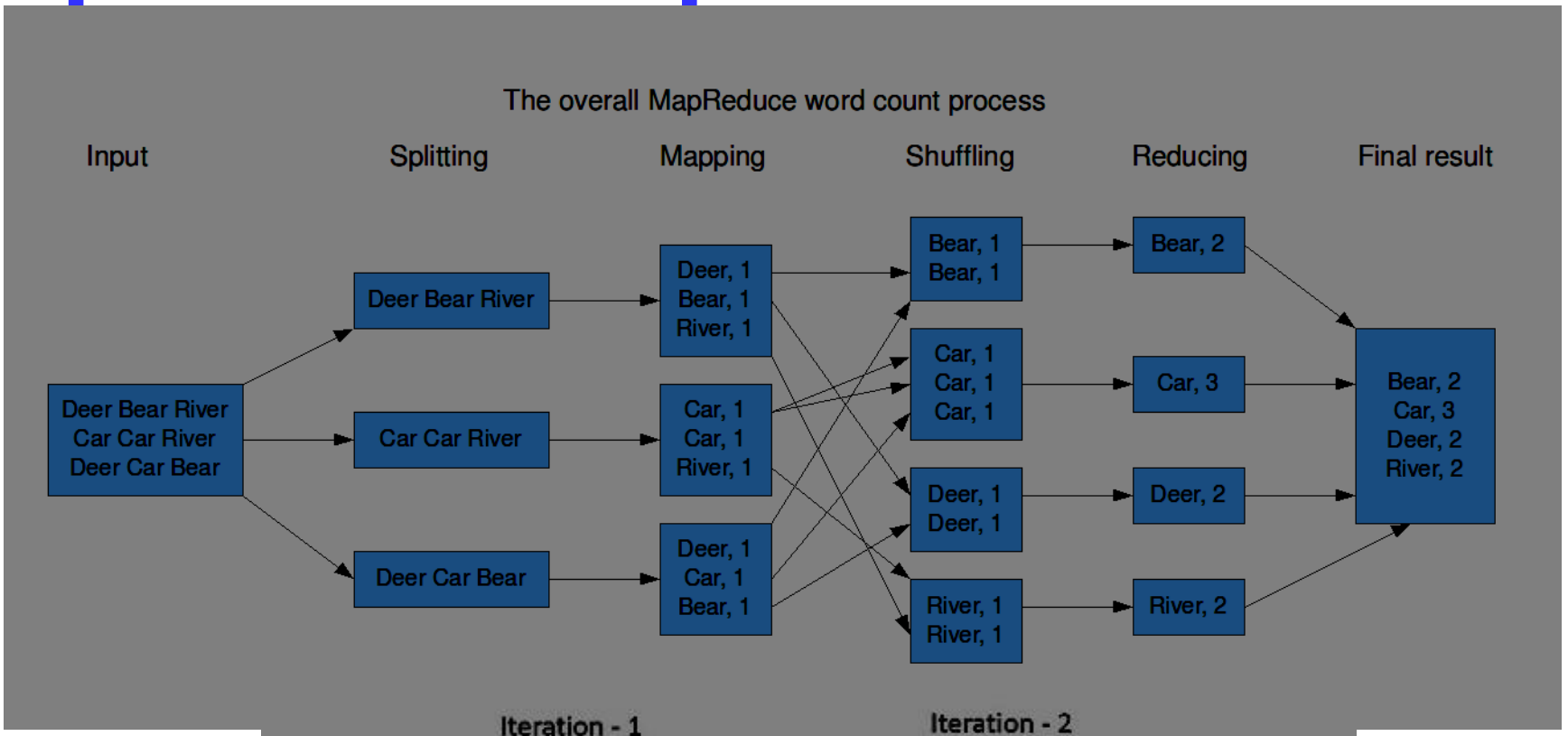
3+ years of architecting Big Data So

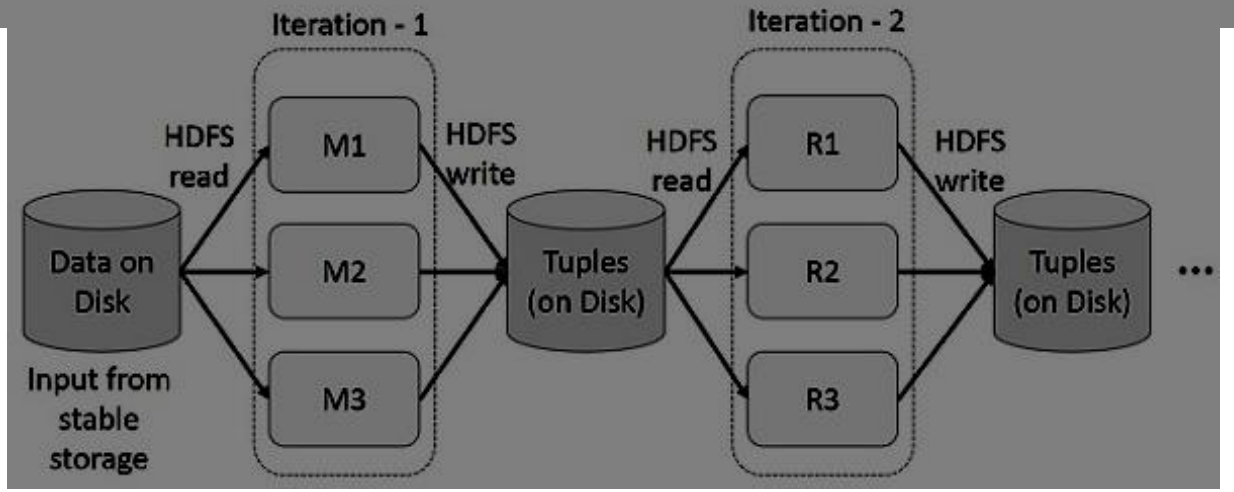
Spark Stack

- Clustered computing platform
- Designed to be fast and general purpose
- Integrated with distributed systems
- API for Python, Scala, Java, clear and understandable code
- Integrated wit
- Integrated wit like Cassanda, Kaf
- First Apache ed

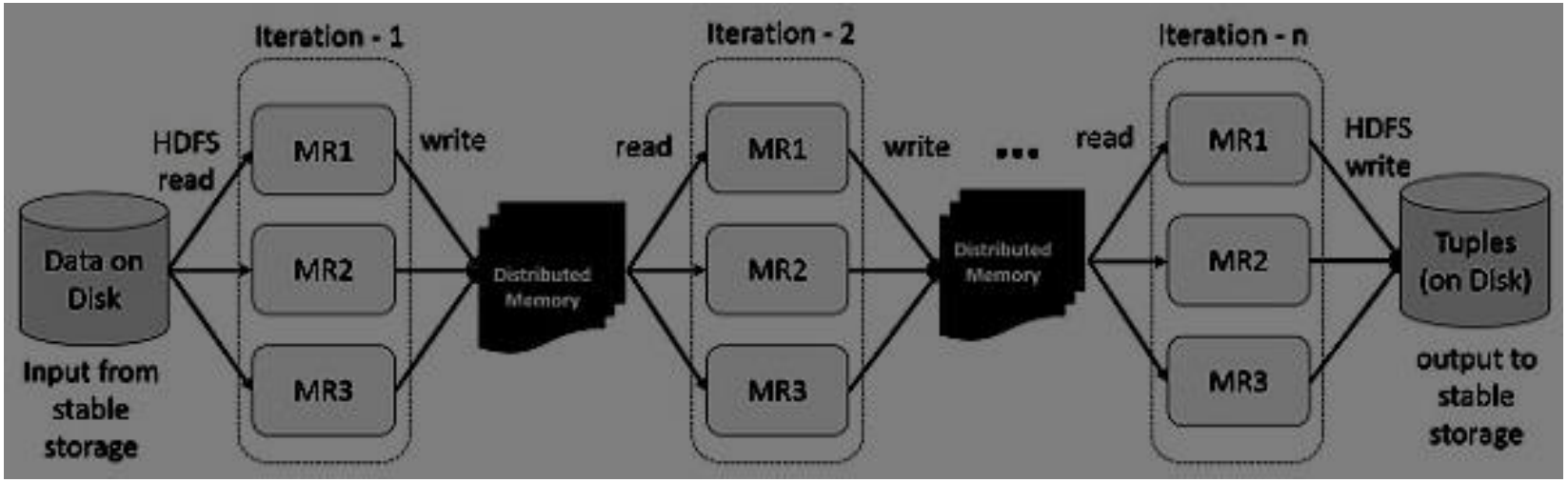


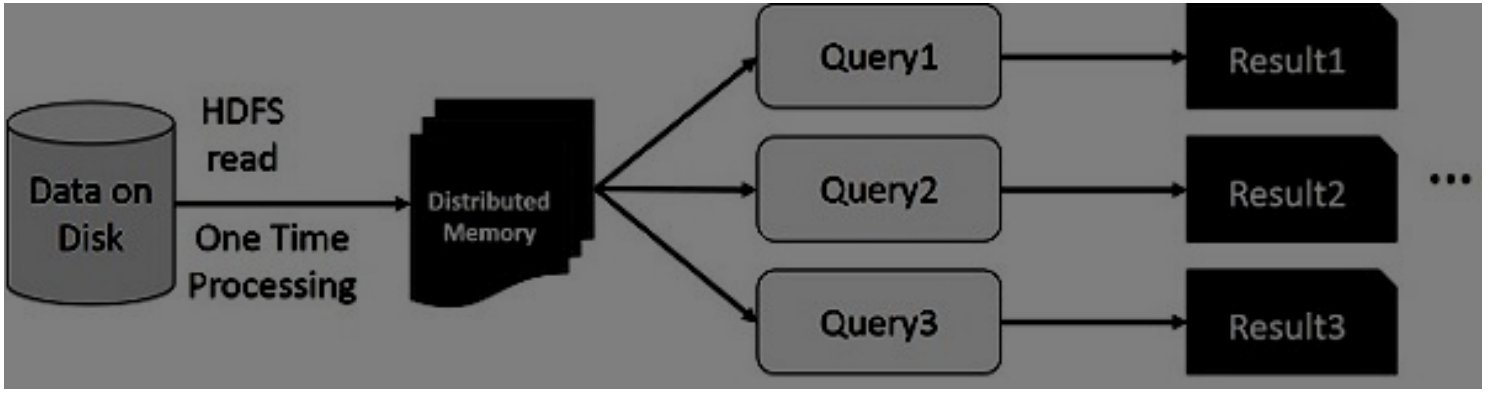
Map-reduce computations





In-memory map-reduce





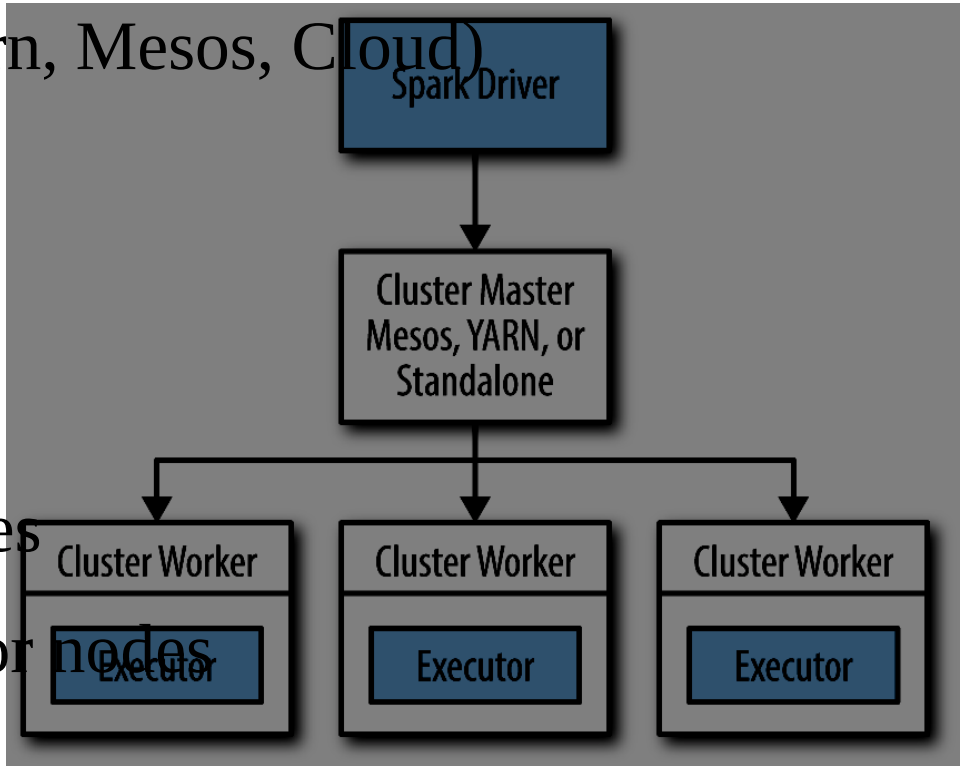
Execution Model

Spark Execution

- Shells and Standalone application
- Local and Cluster (Standalone, Yarn, Mesos, Cloud)

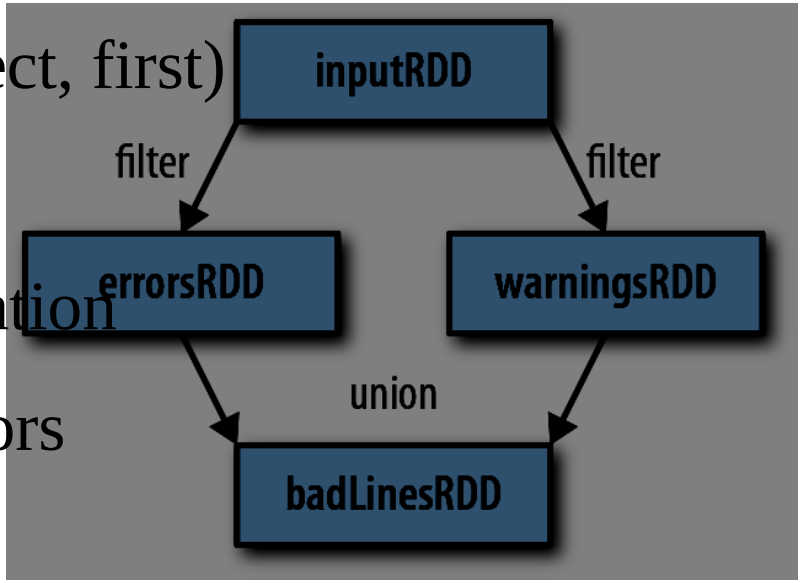
Spark Cluster Architecture

- Master / Cluster manager
- Cluster allocates resources on nodes
- Master sends app code and tasks to nodes
- Executers run tasks and cache data



RDD: resilient distributed dataset

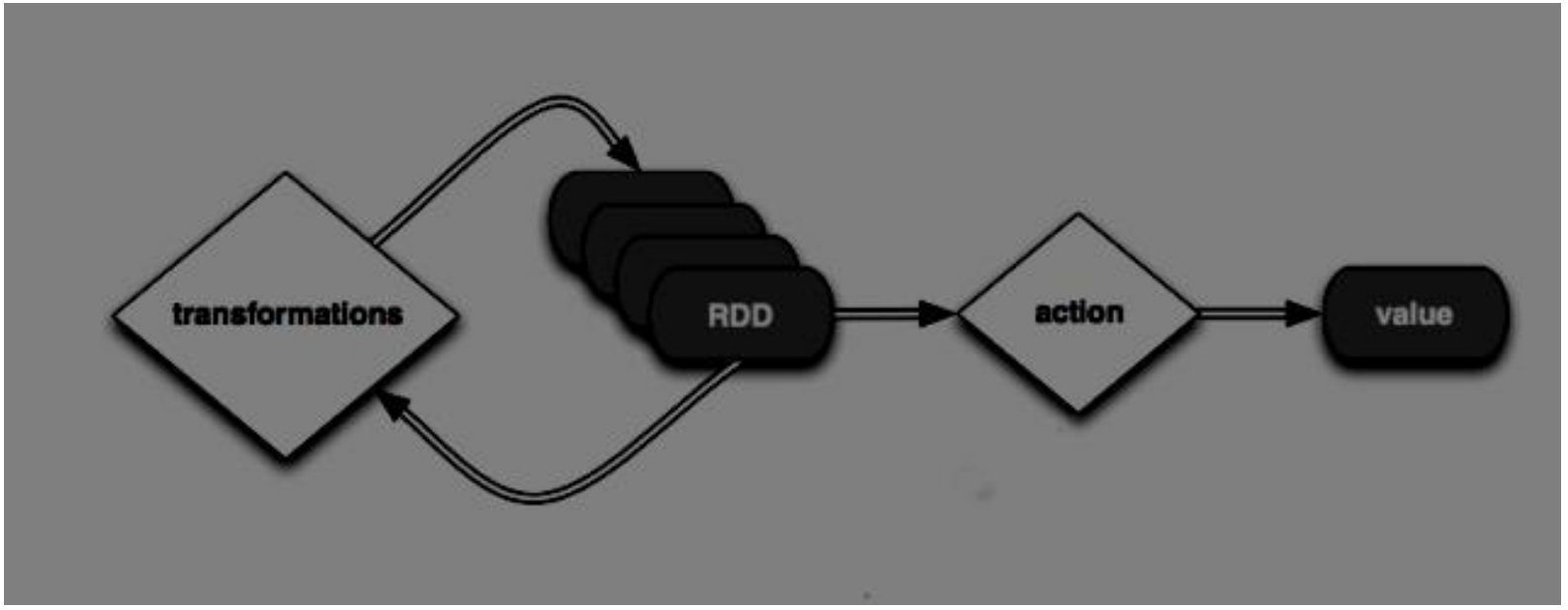
- Parallelized collections with fault-tolerant (Hadoop datasets)
- **Transformations** set new RDDs (filter, map, distinct, union, subtract, etc)
- **Actions** call to calculations (count, collect, first)
- Transformations are lazy
- Actions trigger transformations computation
- Broadcast Variables send data to executors
- Accumulators collect data on driver




```
from pyspart import SparkContext as sc

inputRDD = sc.textFile("log.txt")

errorsRDD = inputRDD.filter(lambda x: "error" in x)

warningsRDD = inputRDD.filter(lambda x: "warning" in x)

badLinesRDD = errorsRDD.union(warningsRDD)

print "Input had " + badLinesRDD.count() + " concerning lines"
```

Spark program scenario

- Create RDD (loading external datasets, parallelizing a collection on driver)
- Transform
- Persist intermediate RDDs as results
- Launch actions



Transformations (1)

Function name	Purpose	Example	Result
`map()`	Apply a function to each element in the RDD and return an RDD of the result.	`rdd.map(x => x + 1)`	`{2, 3, 4, 4}`
`flatMap()`	Apply a function to each element in the RDD and return an RDD of the contents of the iterators returned. Often used to extract words.	`rdd.flatMap(x => x.to(3))`	`{1, 2, 3, 2, 3, 3, 3}`
`filter()`	Return an RDD consisting of only elements that pass the condition passed to filter().	`rdd.filter(x => x != 1)`	`{2, 3, 3}`
`distinct()`	Remove duplicates.	`rdd.distinct()`	`{1, 2, 3}`

Transformations (2)

Function name	Purpose	Example	Result
`union()`	Produce an RDD containing elements from both RDDs.	`rdd.union(other)`	`{1, 2, 3, 3, 4, 5}`
`intersection()`	RDD containing only elements found in both RDDs.	`rdd.intersection(other)`	`{3}`
`subtract()`	Remove the contents of one RDD (e.g., remove training data).	`rdd.subtract(other)`	`{1, 2}`
`cartesian()`	Cartesian product with the other RDD.	`rdd.cartesian(other)`	`{(1, 3), (1, 4), … (3,5)}`

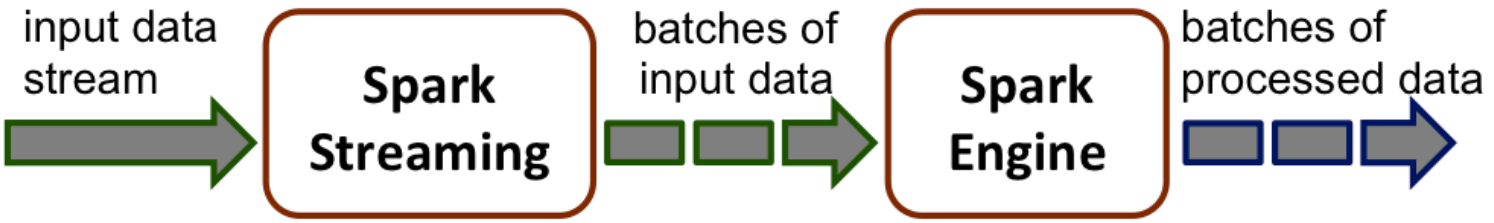
Actions (1)

Function name	Purpose	Example	Result
`collect()`	Return all elements from the RDD.	`rdd.collect()`	`{1, 2, 3, 3}`
`count()`	Number of elements in the RDD.	`rdd.count()`	`4`
`countByValue()`	Number of times each element occurs in the RDD.	`rdd.countByValue()`	`{(1, 1), (2, 1), (3, 2)}`
`take(num)`	Return numelements from the RDD.	`rdd.take(2)`	`{1, 2}`
`top(num)`	Return the top numelements the RDD.	`rdd.top(2)`	`{3, 3}`

Actions (2)

`takeOrdered(num)(ordering)`	Return numelements based on provided ordering.	`rdd.takeOrdered(2)(myOrdering)`	`{3, 3}`
`reduce(func)`	Combine the elements of the RDD together in parallel (e.g.,sum).	`rdd.reduce((x, y) => x + y)`	`9`
`fold(zero)(func)`	Same as `reduce()` but with the provided zero value.	`rdd.fold(0)((x, y) => x + y)`	`9`
`aggregate(zeroValue)(seqOp, combOp)`	Similar to `reduce()` but used to return a different type.	`rdd.aggregate((0, 0))((x, y) =>(x._1 + y, x._2 + 1), (x, y) => (x._1 + y._1, x._2 + y._2))`	`(9, 4)`

Spark Streaming Architecture



- Micro-batch architecture
- SparkStreaming Concext
- Batch interval from 500ms
- Transformation on Spark Engine
- Outup operations instead of Actions
- Different sources and outputs

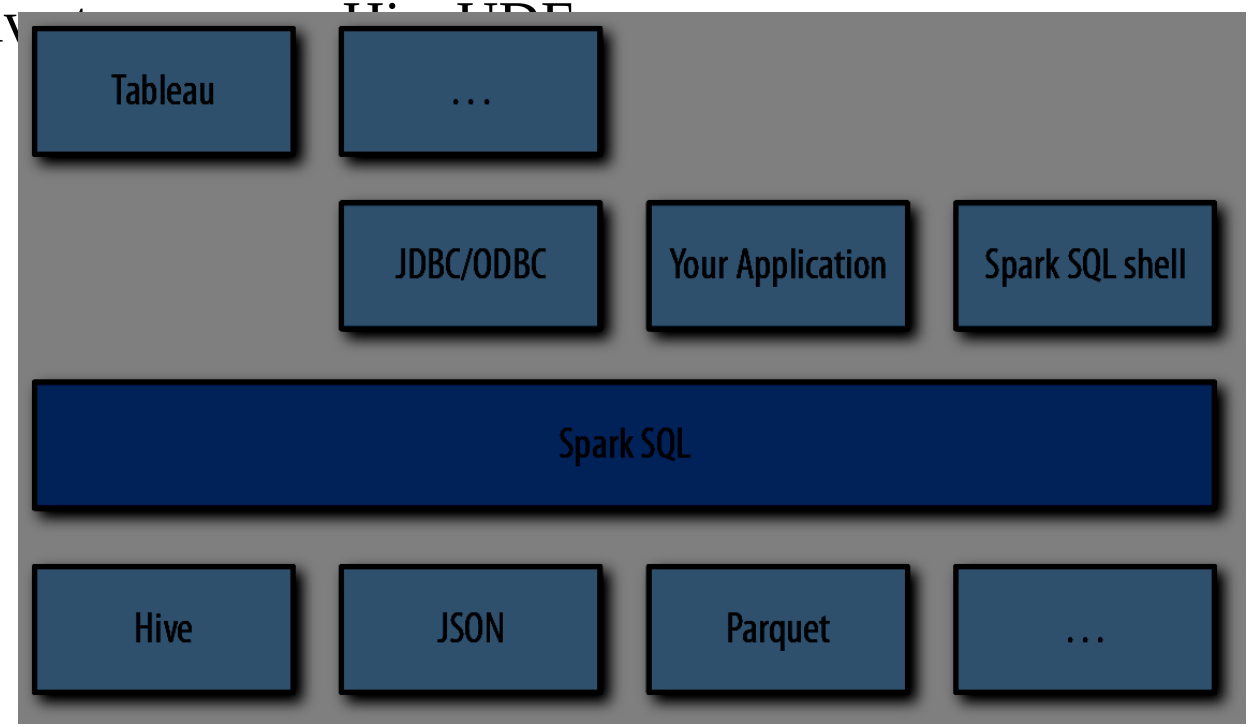
Spark Streaming Example

```
from pyspark.streaming import StreamingContext

ssc = StreamingContext(sc, 1)

input_stream = ssc.textFileStream("sampleTextDir")

word_pairs = input_stream.flatMap(
    lambda l:l.split(" ")).map(lambda w: (w,1))

counts = word_pairs.reduceByKey(lambda x,y: x + y)

counts.print()

ssc.start()

ssc.awaitTermination()
```

- Process RDDs in batches
- Start after ssc.start()
- Output to console on Driver
- Awaiting termination

Spark SQL

- SparkSQL interface for working with structured data by SQL
- Works with Hive tables and HiveQL
- Works with files (Json, Parquet etc) with defined schema
- JDBC/ODBC connectors for BI tools
- Integrated with Hive and Hiv
- DataFrame abstraction



Spark DataFrames

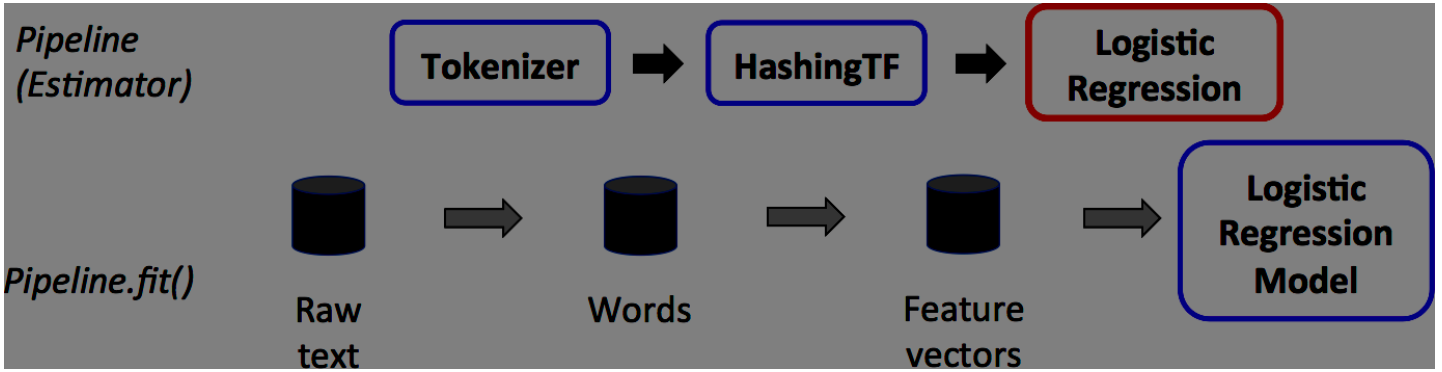
```
# Import Spark SQLfrom pyspark.sql
import HiveContext, Row

# Or if you can't include the hive requirementsfrom pyspark.sql
import SQLContext, Row

sc = new SparkContext(...)
hiveCtx = HiveContext(sc)
sqlContext = SQLContext(sc)

input = hiveCtx.jsonFile(inputFile)

# Register the input schema RDD
input.registerTempTable("tweets")

# Select tweets based on the retweet
CounttopTweets = hiveCtx.sql("""SELECT text, retweetCount  FROM  tweets ORDER BY retweetCount LIMIT 10""")
```

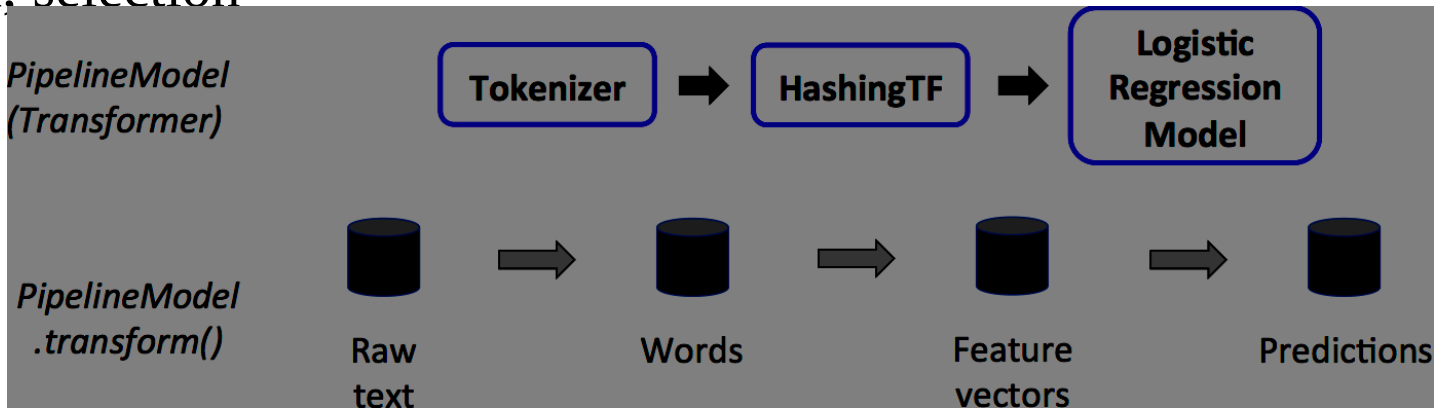
- hiveCtx.cacheTable("tableName"), in-memory, column-store, while driver is alive
- df.show()
- df.select(“name”, df(“age”)+1)
- df.filtr(df(“age”) > 19)

Spark ML

Spark ML

- Classification
- Regression
- Clustering
- Recommendation
- Feature transformation, selection
- Statistics
- Linear algebra
- Data mining tools





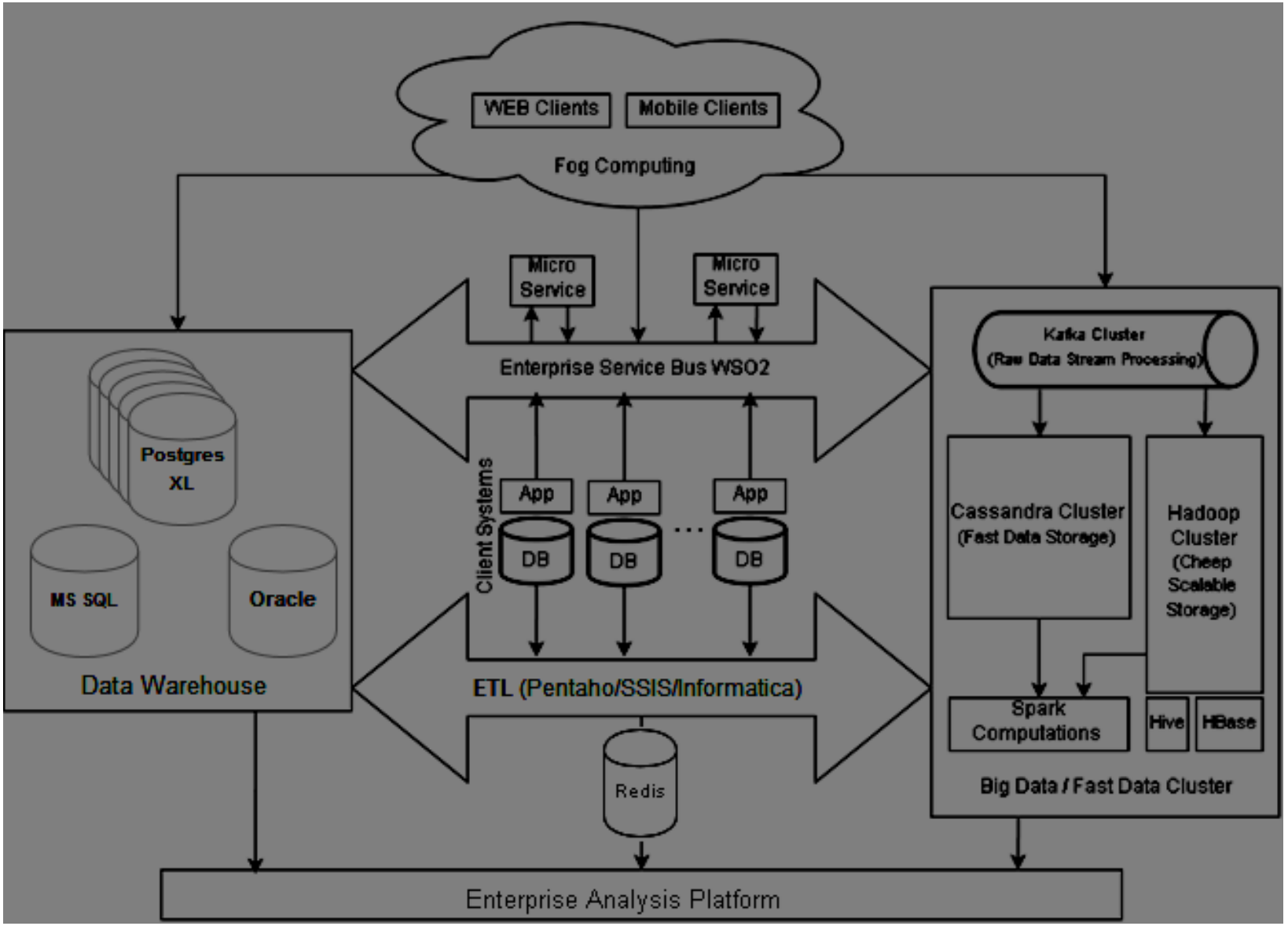
Pipeline Cmponents

- DataFrame

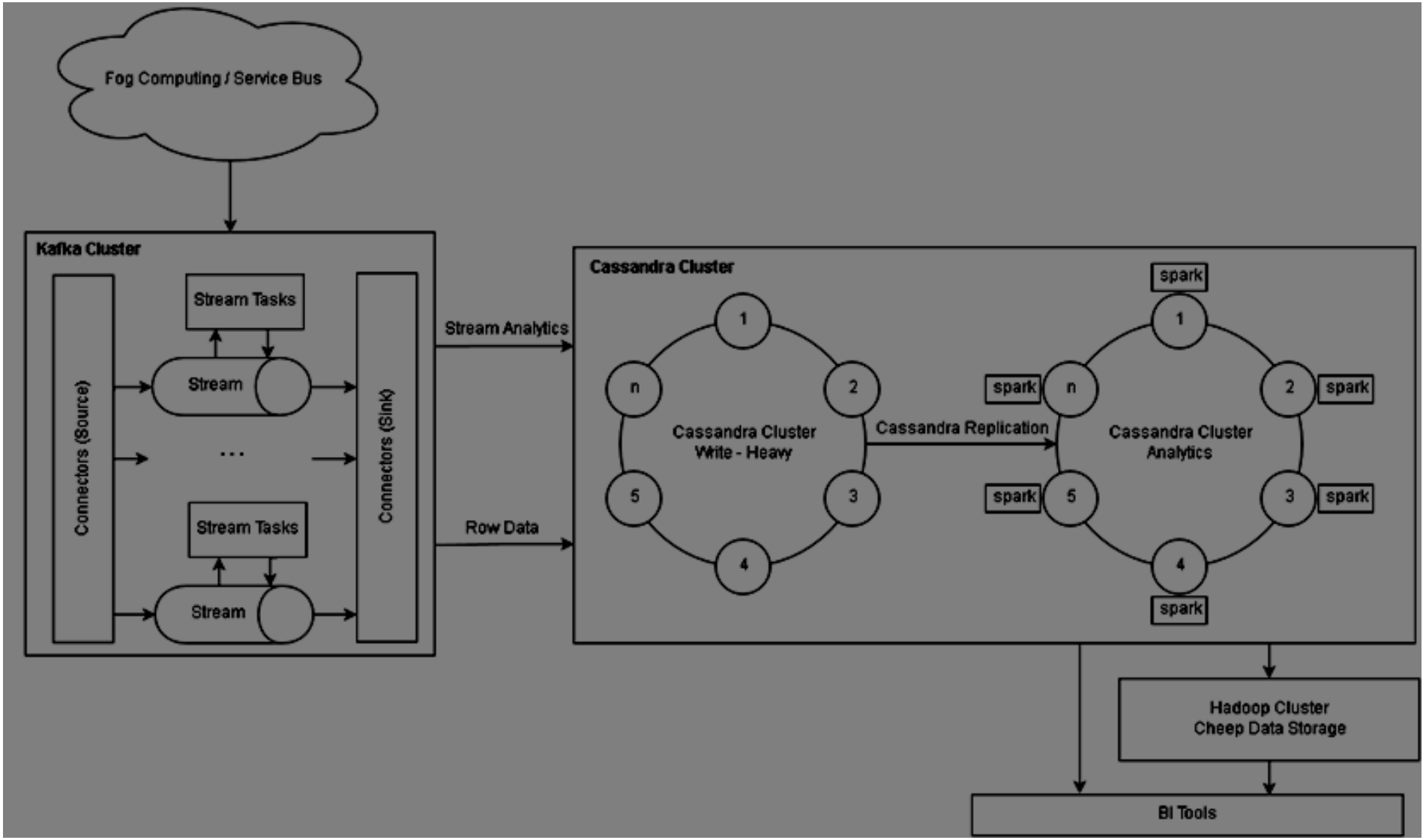
DEMO: Spark

- Local Spark installation
- Shells and Notebook
- Spark Examples
- HDInsight Spark Cluster
- SSH connection to Spark in Azure
- Jupyter Notebook connected to HDInsight Spark
- Transformations
- ActionsSimple SparkSQL querying
- Data Frames
- Data exploration with SparkSQL
- Connect from BI
- Training a model

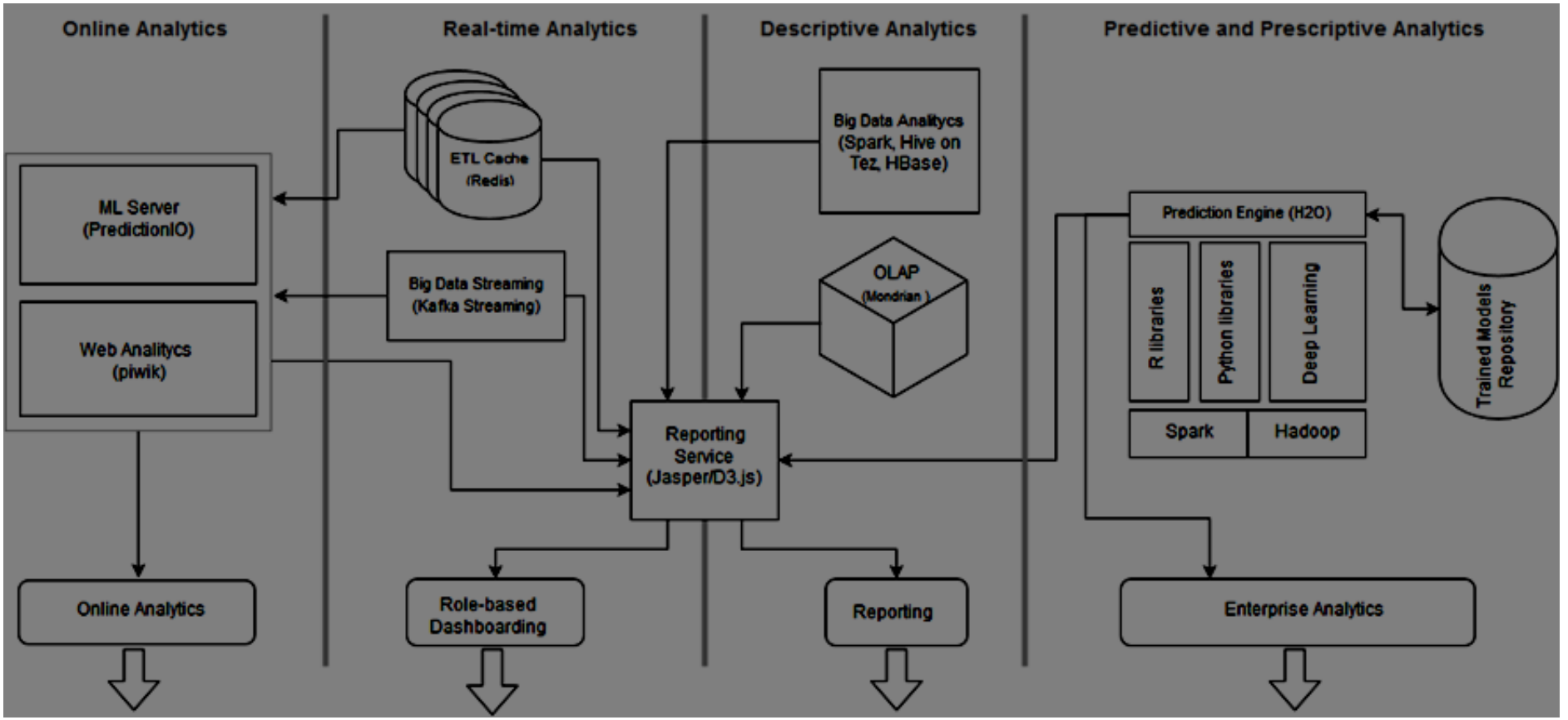
Eleks Enterprice Platform



Fast Data Processing



BI / DS Platform



Using Spark

1.Visual data exploration and interactive analysis (HDFS)

2.Spark with NoSQL (HBase and Cassandra)

3.Spark with Data Lake

4.Spark with Data Warehouse

5.Machine Learning using R Server, Mllib

6.Putting it all together in a notebook experience

7.Using BI with Spark

8.Spark Environmens

- On-Premis, Cloudera, Hortonworks, DataBricks
- HDInsight, AWS, DataBriks Cloud
- Sparkling Water (H2O), prediction.io

Q&A