BLACKROCK®

sbt-spark-submit

Straight-through Build to Spark Analytics

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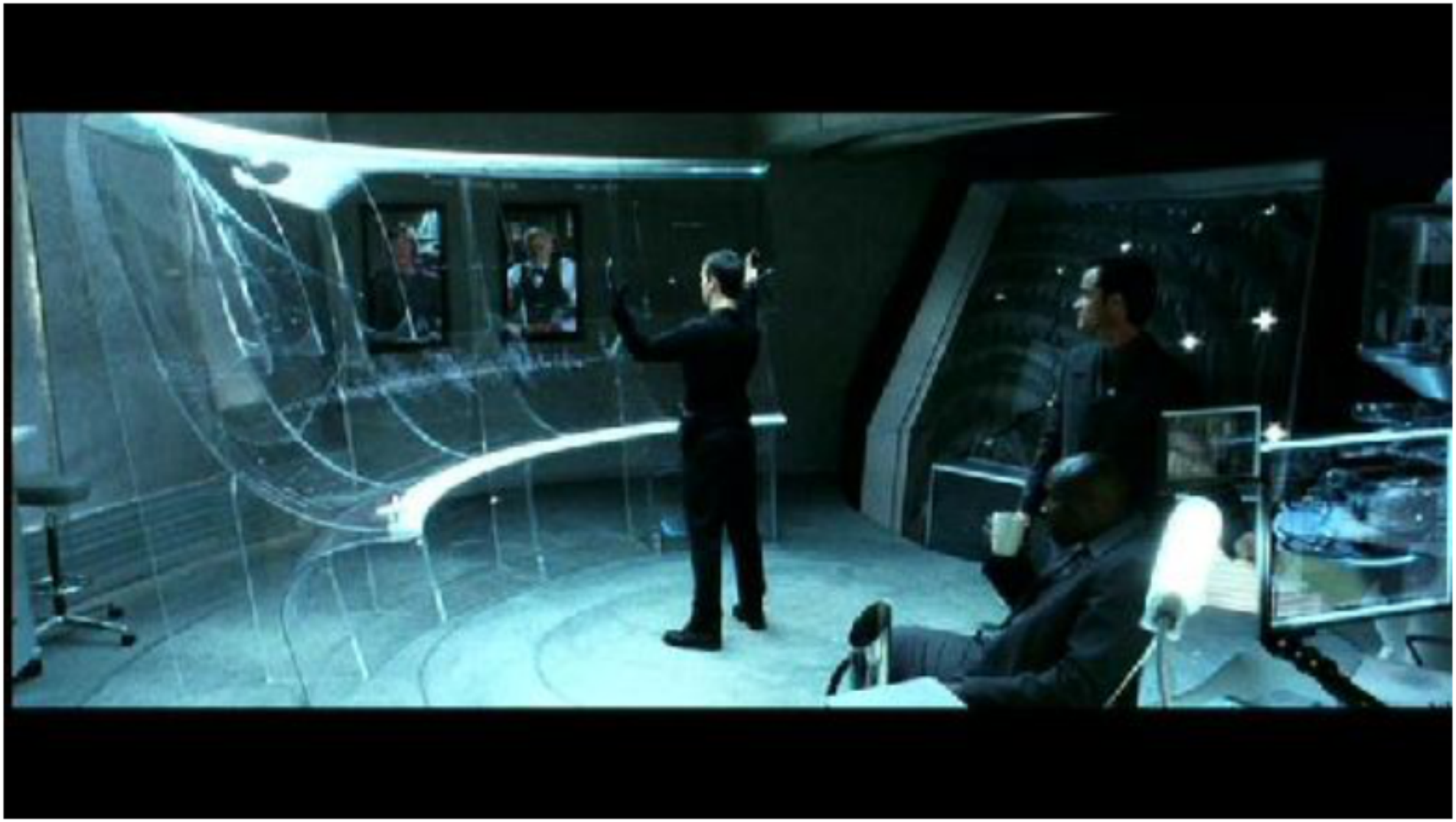
Financial Modeling Group - Advanced Data Analytics

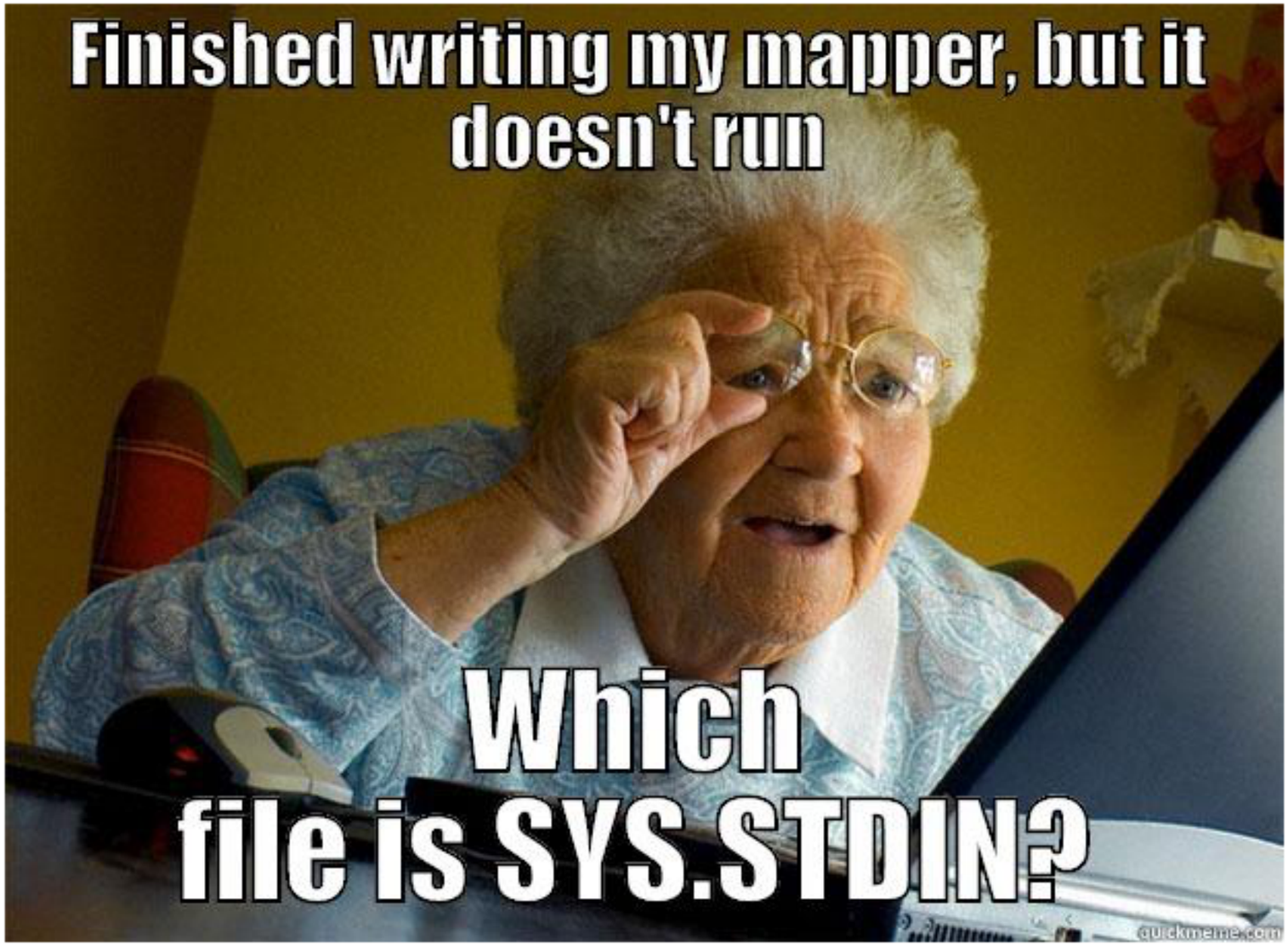
2015-09-24

What People Think We Do



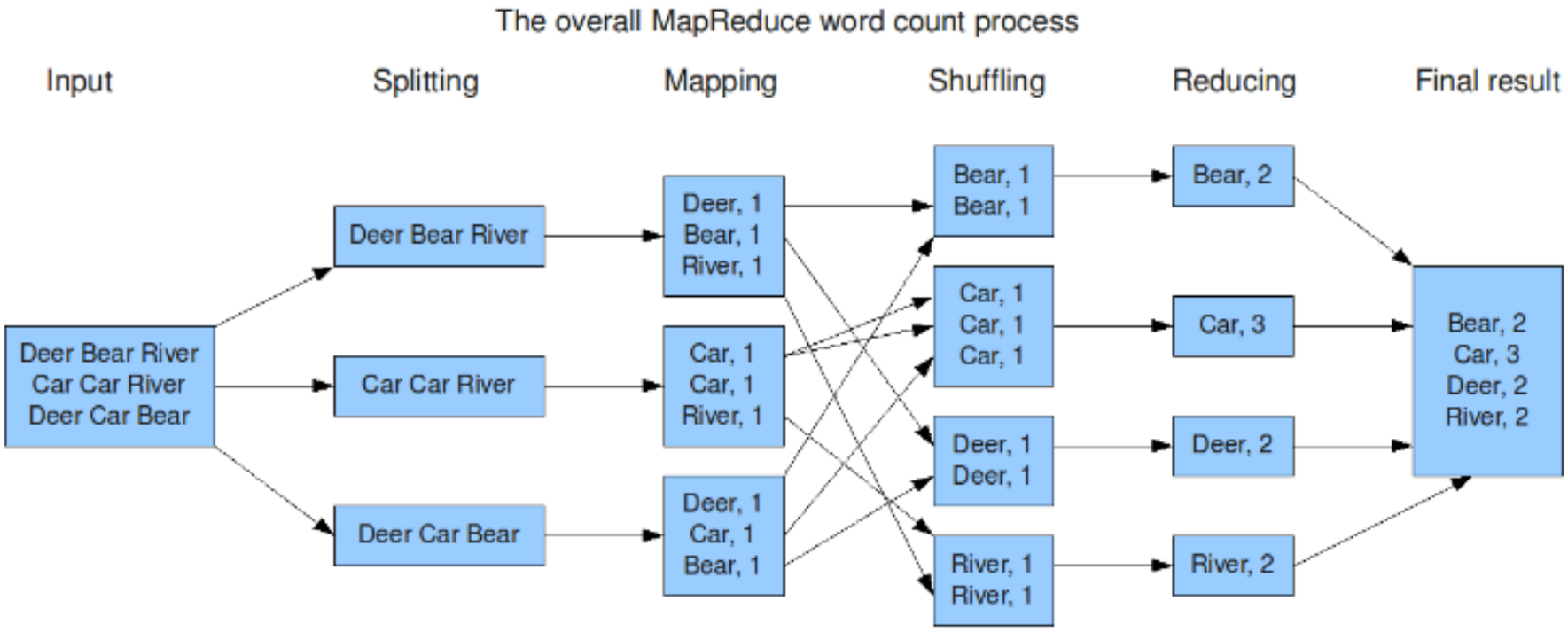
Source: https://99designs.com/designer-blog/2013/07/19/fantasy-user-interfaces/

What We Really Do



Source: http://www.quickmeme.com/p/3vovpz

Word Count



"

Source: http://www.milanor.net/blog/?p=853

Word Count So Easy!

```
import java.io.BufferedReader;
import java.io.FileReader;
import java.io.IOException;
import java.net.URI;
import java.util.ArrayList;
import java.util.HashSet;
import java.util.List;
import java.util.Set;
import java.util.StringTokenizer;

import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.mapreduce.Counter;
import org.apache.hadoop.util.GenericOptionsParser;
import org.apache.hadoop.util.StringUtils;
```

Source: http://hadoop.apache.org/docs/current/hadoop-mapreduce-client/hadoop-mapreduce-client-core/MapReduceTutorial.html#Example:_WordCount_v2.0

Word Count So Easy!

```
public class WordCount2 {

  public static class TokenizerMapper
       extends Mapper<Object, Text, Text, IntWritable>{

    static enum CountersEnum { INPUT_WORDS }

    private final static IntWritable one = new IntWritable(1);
    private Text word = new Text();

    private boolean caseSensitive;
    private Set<String> patternsToSkip = new HashSet<String>();

    private Configuration conf;
    private BufferedReader fis;

    @Override
    public void setup(Context context) throws IOException,
        InterruptedException {
      conf = context.getConfiguration();
      caseSensitive = conf.getBoolean("wordcount.case.sensitive", true);
      if (conf.getBoolean("wordcount.skip.patterns", true)) {
        URI[] patternsURIs = Job.getInstance(conf).getCacheFiles();
        for (URI patternsURI : patternsURIs) {
          Path patternsPath = new Path(patternsURI.getPath());
          String patternsFileName = patternsPath.getName().toString();
          parseSkipFile(patternsFileName);
        }
      }
    }
```

Word Count So Easy!

```
  private void parseSkipFile(String fileName) {
    try {
      fis = new BufferedReader(new FileReader(fileName));
      String pattern = null;
      while ((pattern = fis.readLine()) != null) {
        patternsToSkip.add(pattern);
      }
    } catch (IOException ioe) {
      System.err.println("Caught exception while parsing the cached file '"
          + StringUtils.stringifyException(ioe));
    }
  }

  @Override
  public void map(Object key, Text value, Context context
                  ) throws IOException, InterruptedException {
    String line = (caseSensitive) ?
        value.toString() : value.toString().toLowerCase();
    for (String pattern : patternsToSkip) {
      line = line.replaceAll(pattern, "");
    }
    StringTokenizer itr = new StringTokenizer(line);
    while (itr.hasMoreTokens()) {
      word.set(itr.nextToken());
      context.write(word, one);
      Counter counter = context.getCounter(CountersEnum.class.getName(),
          CountersEnum.INPUT_WORDS.toString());
      counter.increment(1);
    }
  }
}
```

Word Count So Easy!

```
public static class IntSumReducer
    extends Reducer<Text,IntWritable,Text,IntWritable> {
  private IntWritable result = new IntWritable();

  public void reduce(Text key, Iterable<IntWritable> values,
                     Context context
                     ) throws IOException, InterruptedException {
    int sum = 0;
    for (IntWritable val : values) {
      sum += val.get();
    }
    result.set(sum);
    context.write(key, result);
  }
}

public static void main(String[] args) throws Exception {
  Configuration conf = new Configuration();
  GenericOptionsParser optionParser = new GenericOptionsParser(conf, args);
  String[] remainingArgs = optionParser.getRemainingArgs();
  if (!(remainingArgs.length != 2 || remainingArgs.length != 4)) {
    System.err.println("Usage: wordcount <in> <out> [-skip skipPatternFile]");
    System.exit(2);
  }
  Job job = Job.getInstance(conf, "word count");
  job.setJarByClass(WordCount2.class);
  job.setMapperClass(TokenizerMapper.class);
  job.setCombinerClass(IntSumReducer.class);
  job.setReducerClass(IntSumReducer.class);
  job.setOutputKeyClass(Text.class);
  job.setOutputValueClass(IntWritable.class);

  List<String> otherArgs = new ArrayList<String>();
  for (int i=0; i < remainingArgs.length; ++i) {
    if ("-skip".equals(remainingArgs[i])) {
      job.addCacheFile(new Path(remainingArgs[++i]).toUri());
      job.getConfiguration().setBoolean("wordcount.skip.patterns", true);
    } else {
      otherArgs.add(remainingArgs[i]);
    }
  }
  FileInputFormat.addInputPath(job, new Path(otherArgs.get(0)));
  FileOutputFormat.setOutputPath(job, new Path(otherArgs.get(1)));

  System.exit(job.waitForCompletion(true) ? 0 : 1);
 }
}
```

Word Count So Easy!

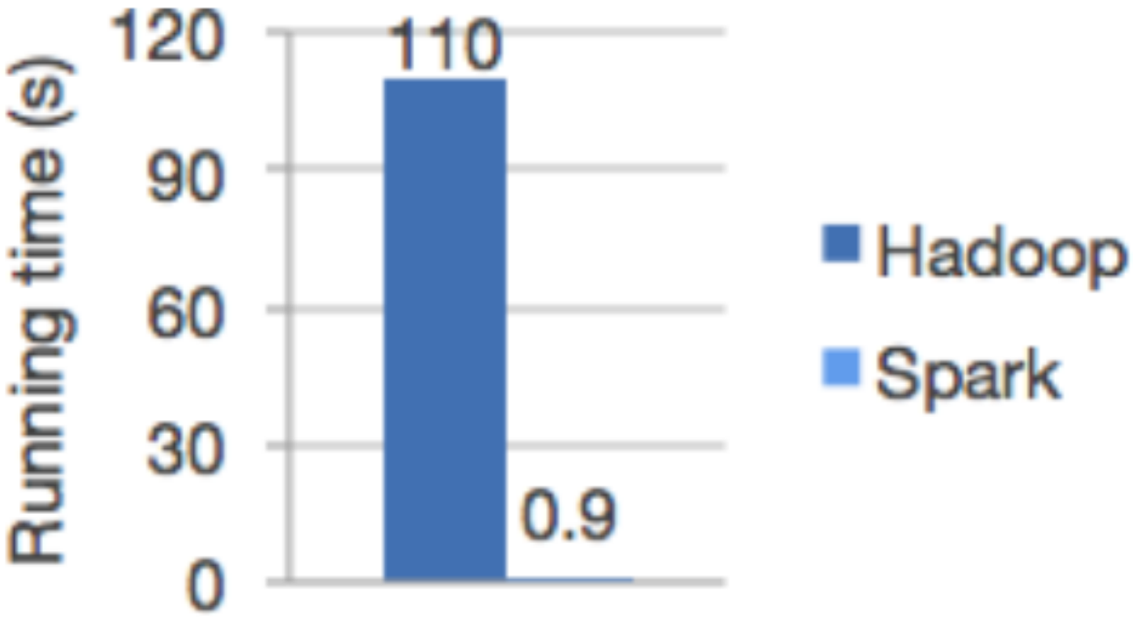
Source: http://knowledgespeakswisdomlistens.blogspot.com/2013/01/am-i-sheldon-cooper.html

We Do Big Data

Source: http://i.imgur.com/OF87Yiw.jpg

Until Spark Came Along

```
val textFile= spark.textFile("hdfs://...")
val counts= textFile.flatMap(line => line.split(" "))
                 .map(word => (word, 1))
                 .reduceByKey(_ + _)
counts.saveAsTextFile("hdfs://...")
```



Source: http://www.dispuutcirce.nl/leden/img_2426/ http://spark.apache.org/

Spark First World Problem

Source: https://i.imgflip.com/r4xnp.jpg

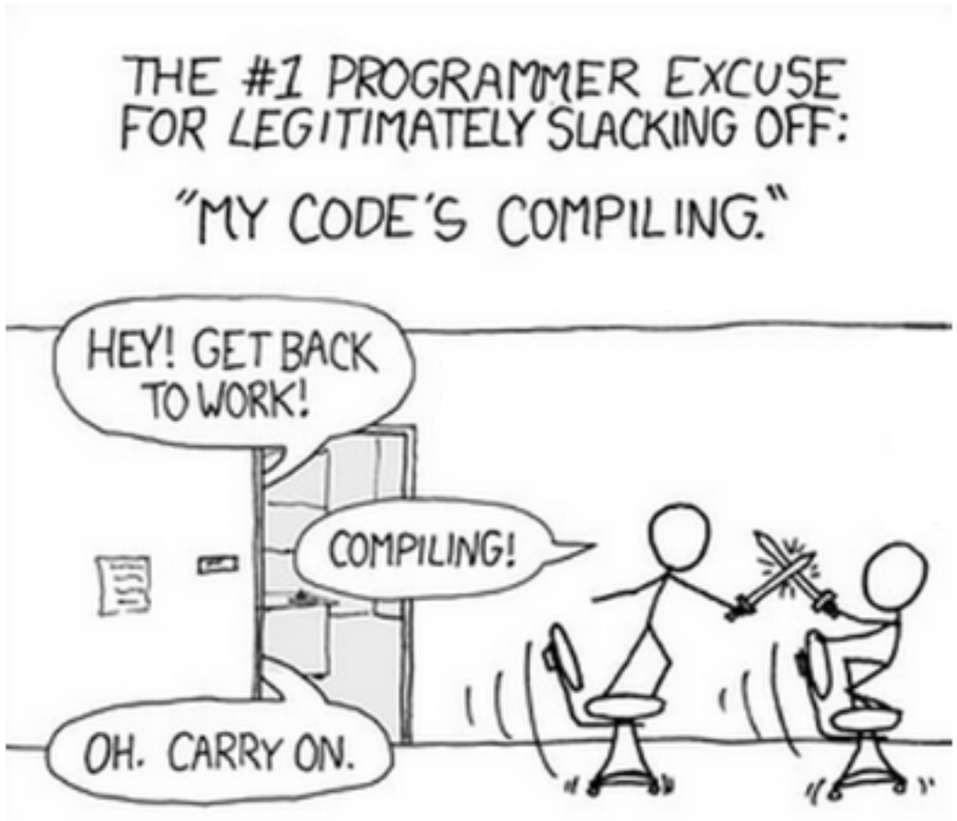
Submit Spark Application

Create application JAR

```
sbt vis/assembly
```

Upload JAR to cluster

```
scp vis/target/scala-2.10/vis-assembly-x.y.z-SNAPSHOT.jar my-awesome-spark-cluster:
```



Source: https://xkcd.com/303/

Submit Spark Application

The *spark-submit* script in Sparkâ€™s bin directory is used to launch applications on a cluster.

```
# Run application locally on 8 cores
$SPARK_HOME/bin/spark-submit \
  --class org.apache.spark.examples.SparkPi \
  --master local[8] \
  /path/to/examples.jar \
  100

# Run on a Spark Standalone cluster in client deploy mode
$SPARK_HOME/bin/spark-submit \
  --class org.apache.spark.examples.SparkPi \
  --master spark://207.184.161.138:7077 \
  --executor-memory 20G \
  --total-executor-cores 100 \
  /path/to/examples.jar \
  1000
```

- Commands difficult to remember
- No easy way to store different pairs of arguments

Source: http://spark.apache.org/docs/latest/submitting-applications.html

Bash Scripting Rocks!

```
#!/bin/bash

PROJECT_VER=SNAPSHOT
PROJECT_ML_JAR=${PROJECT_DIR}/project-ml-assembly-${PROJECT_VER}.jar

PREFIX=kmeans
HBASE_KEYPREFIX=${PREFIX}_${SUFFIX}
HBASE_CLASSPATH=/etc/hbase/conf:/usr/lib/hbase/lib/hbase-client.jar:/usr/lib/hbase/lib/hbase-

OUTPUT_HDFS_DIR=${PREFIX}/${SUFFIX}

time \
    spark-submit \
    --master yarn-cluster \
    --num-executors 1000 \
    --class com.awesome.ml.KMClustering \
    --driver-class-path ${HBASE_CLASSPATH} \
    --driver-memory=3g --executor-memory=3g \
    --conf="spark.executor.extraClassPath=${HBASE_CLASSPATH}" \
    --conf="spark.yarn.jar=hdfs:///proj/share/spark/spark-assembly-1.5.0-hadoop2.6.0.jar" \
    ${PROJECT_ML_JAR} \
    -output=${OUTPUT_HDFS_DIR} -input=my_awesome_big_dataset \
    -k=10 -partitions=10 -runs=10 \
    -hbase=${HBASE_KEYPREFIX}
```

Bash Scripting Rocks!

Source: http://memegenerator.net/instance/37544999

Bash Scripting Rocks?

- Environment isolation difficult to achieve (repeatability)
- Weak abstraction and encapsulation (code reuse)
- Runtime exception only (reliability)

Source: http://animatedmeme.blogspot.com/2013/06/peter-griffin-vs-blinds.html

Spark Development Challenges

- Multiple non-instantaneous steps
  - Build, Upload, Submit
- Multiple main classes
  - Exploratory Analysis, Model Training, Model Evaluation, et. al.
- Multiple projects
  - Core, Batch ETL, ML, Streaming, Visualization, et. al.
- Multiple configurations
  - Different Datasets, Parameters and etc
- Multiple deployment locations
  - local, yarn, EC2, et. al.

Scala!

Source: http://memegenerator.net/instance/58038541

sbt-spark-submit Plugin to Rescue

Demo: SparkPi Submission for Local and YARN

What is *sbt*

The interactive build tool

Use Scala to define your tasks. Then run them in parallel from the shell.

- *build.sbt* uses an elegant Scala DSL for build definition
- *project/*.scala* use full power of Scala to configure the build and create custom tasks

Source: http://www.scala-sbt.org/

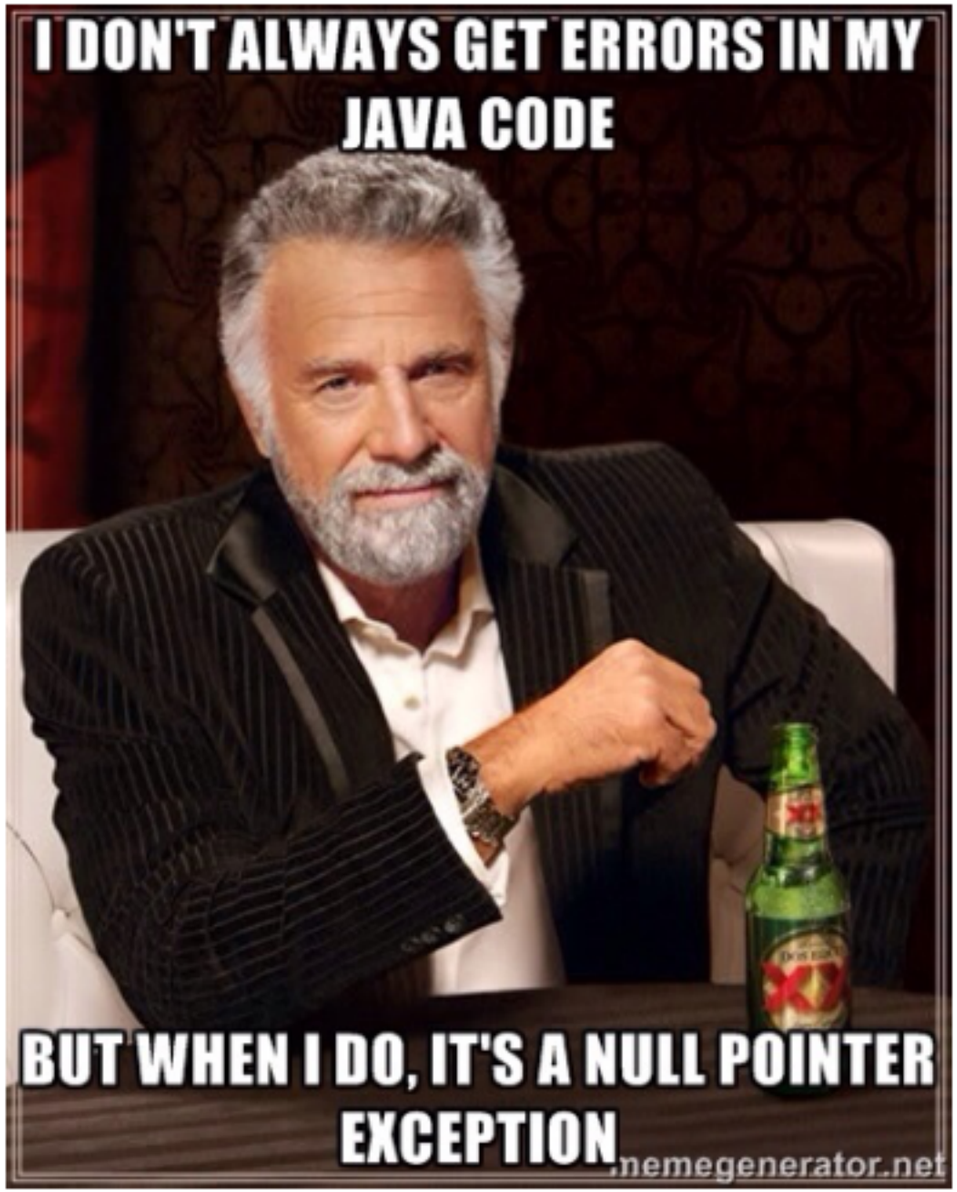
Why *sbt*

- Fast incremental build
- Continous compilation/testing
- Concise and powerful configuration
- Built-in auto-complete
- IDE highlights compile time exception

Scala!

Source: http://www.iamprogrammer.net/

Scala!



Source: http://imgur.com/r/programmingmemes/ju1CgAo

Multi-project Build

Demo

sbt Multi-project Build

- Create tasks specific to each project
- Common settings/tasks are automatically deduplicated
- Tasks are executed in parallel

It's extensible!

Demo: Deploy on *AWS EC2*

sbt-spark-submit Recap

- Streamline build, upload and submit into single task
- Codify *spark-submit* command into settings
- Integrate well for multi-project
- Extensible

Thank you

Slides and code

https://github.com/saurfang/nyc-spark-meetup

sbt-spark-submit

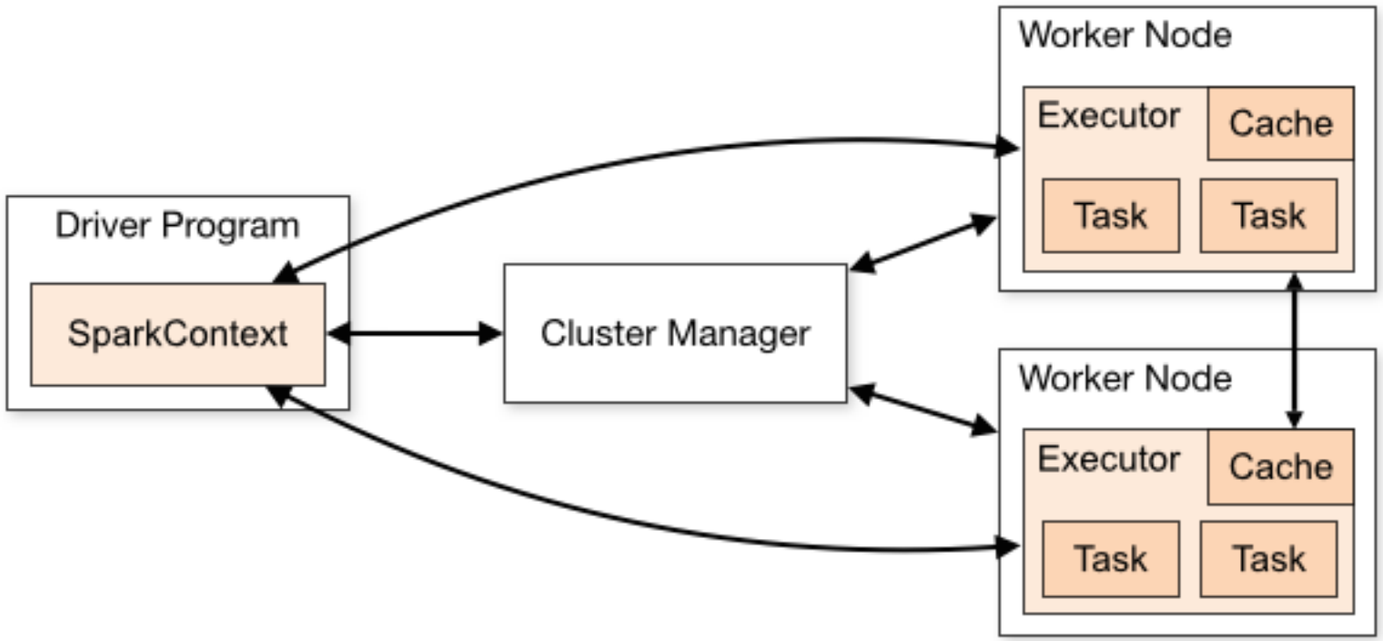
https://github.com/saurfang/sbt-spark-submit

Source: http://www.blankchapters.com/2012/12/22/big-data-is-not-always-the-solution-to-all-our-problems

Appendix

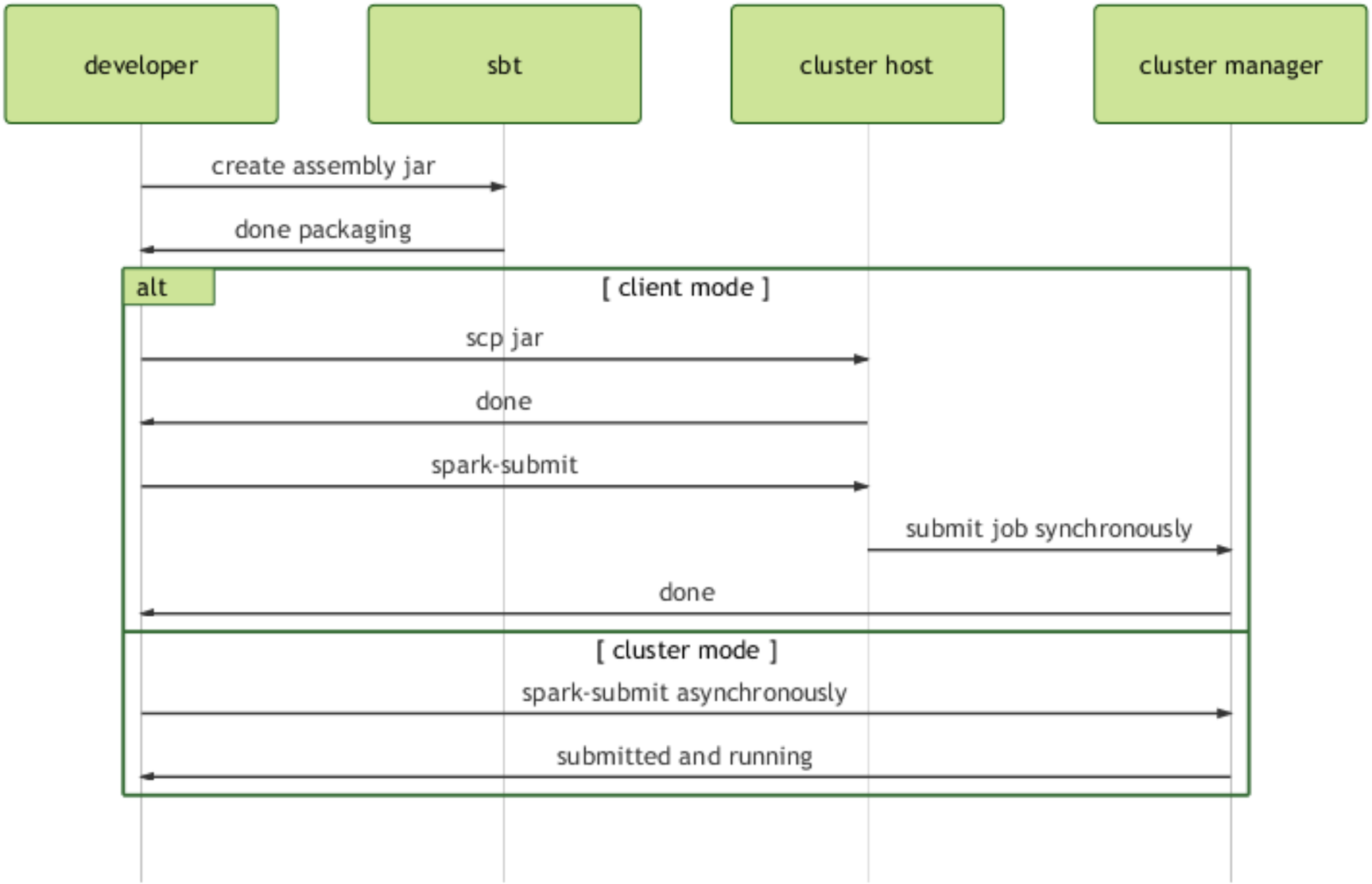
Spark Cluster Mode Overview

- Driver Program
- Executors (worker, slave, container)

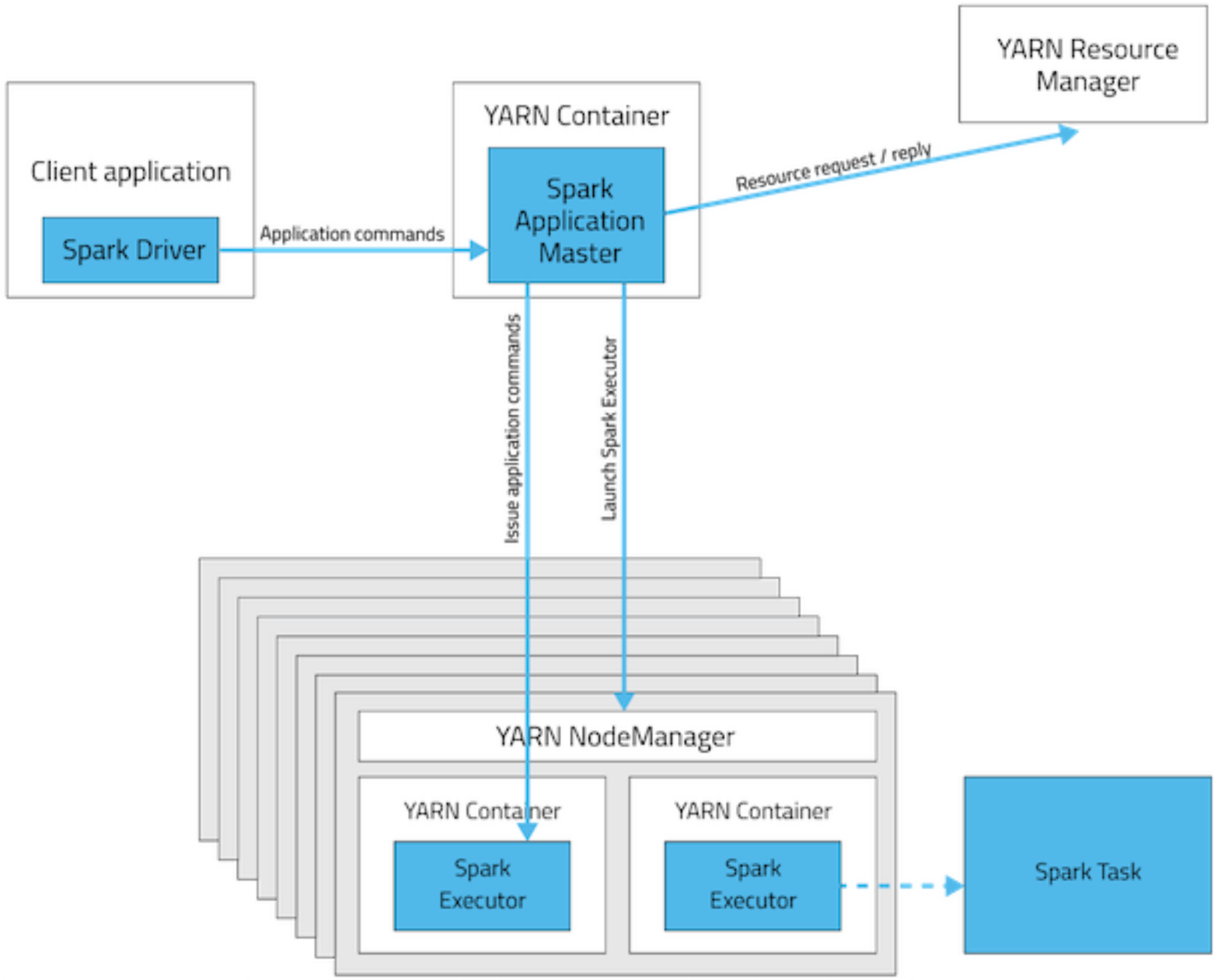


Source: http://spark.apache.org/docs/latest/cluster-overview.html

Submit Spark Application

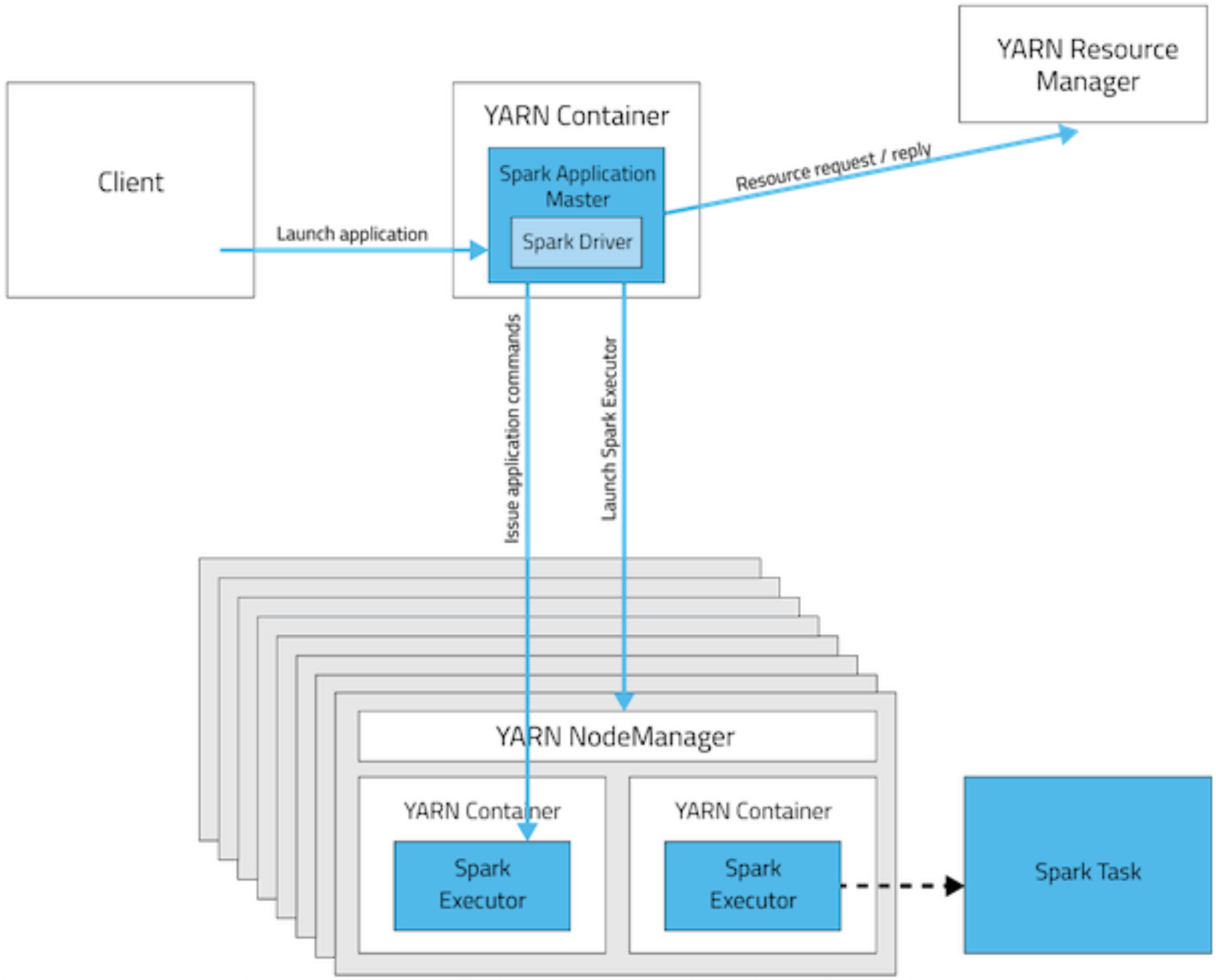


Client Deployment Mode



Source: http://www.cloudera.com/content/cloudera/en/documentation/core/latest/topics/cdh_ig_running_spark_on_yarn.html

Cluster Deployment Mode



Source: http://www.cloudera.com/content/cloudera/en/documentation/core/latest/topics/cdh_ig_running_spark_on_yarn.html