



The Institute  
for Quantitative Social Science  
*at Harvard University*



# Apache Spark Now Runs on Kubernetes!

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University

# Agenda

- Who we are/Why we are excited about Spark on Kubernetes
- Spark Intro
- Overview of Cluster Managers - advantages of using Kubernetes vs Other Managers
- Kubernetes Overview
- Spark on Kubernetes - how does it work?
  - Basics
  - Auto-scaling
- Getting Started with Spark on Kubernetes (how to build, deploy, etc)
- Demo - building and deploying Spark App on Kubernetes minikube
- Demo - autoscaling Spark App on Kubernetes (Azure Cluster)
- What's next with Spark/Kubernetes - Spark 2.4 features

# Consilience: Text Analysis Tool for Researchers

Consilience **Beta**

## Upload Document Set

### Set Name

Wine Reviews Demo

### Description

Reviews from Wine Spectator

### Documents ZIP/CSV File

wine\_reviews500.csv *Uploaded*

### Text Analysis

Select at least one column that will be used for text analysis.

text

### Metadata Landmarks (Optional)

Optionally select one or more columns to create clusterings based on your metadata.

country, points, price

Save Changes



Consilience **Beta**

Document Sets > Set Preview

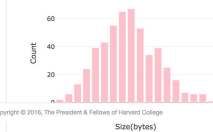
Wine Reviews 501 Documents description

## Document Set Summary

### Term Frequency Cloud



### Document Size Distribution

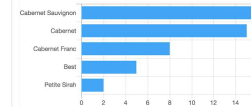


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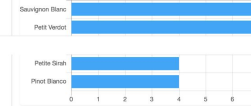
### Most Frequent Entities



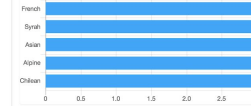
### ORGANIZATION



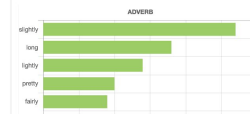
### PERSON



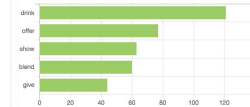
### MSG



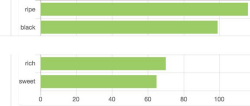
### Most Frequent Parts of Speech



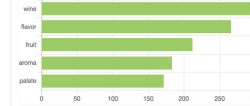
### VERB



### ADJECTIVE



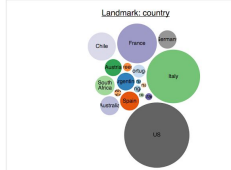
### NOUN



## Sample Classifications

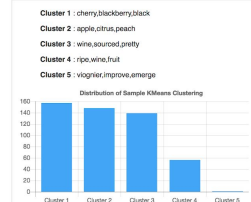
### Metadata Clustering Landmark

Explore



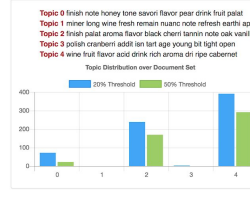
### KMeans Clustering Landmark

Explore

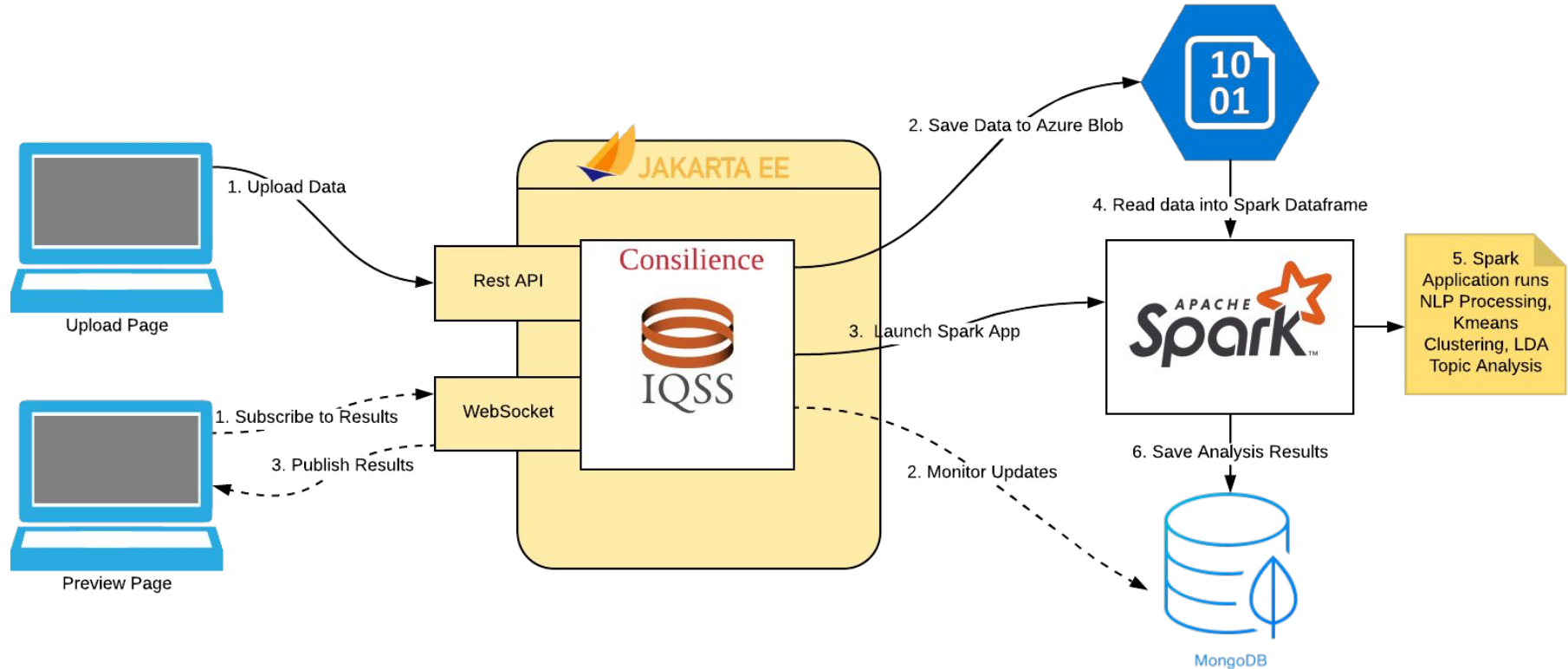


### LDA: 5 Topics

Explore



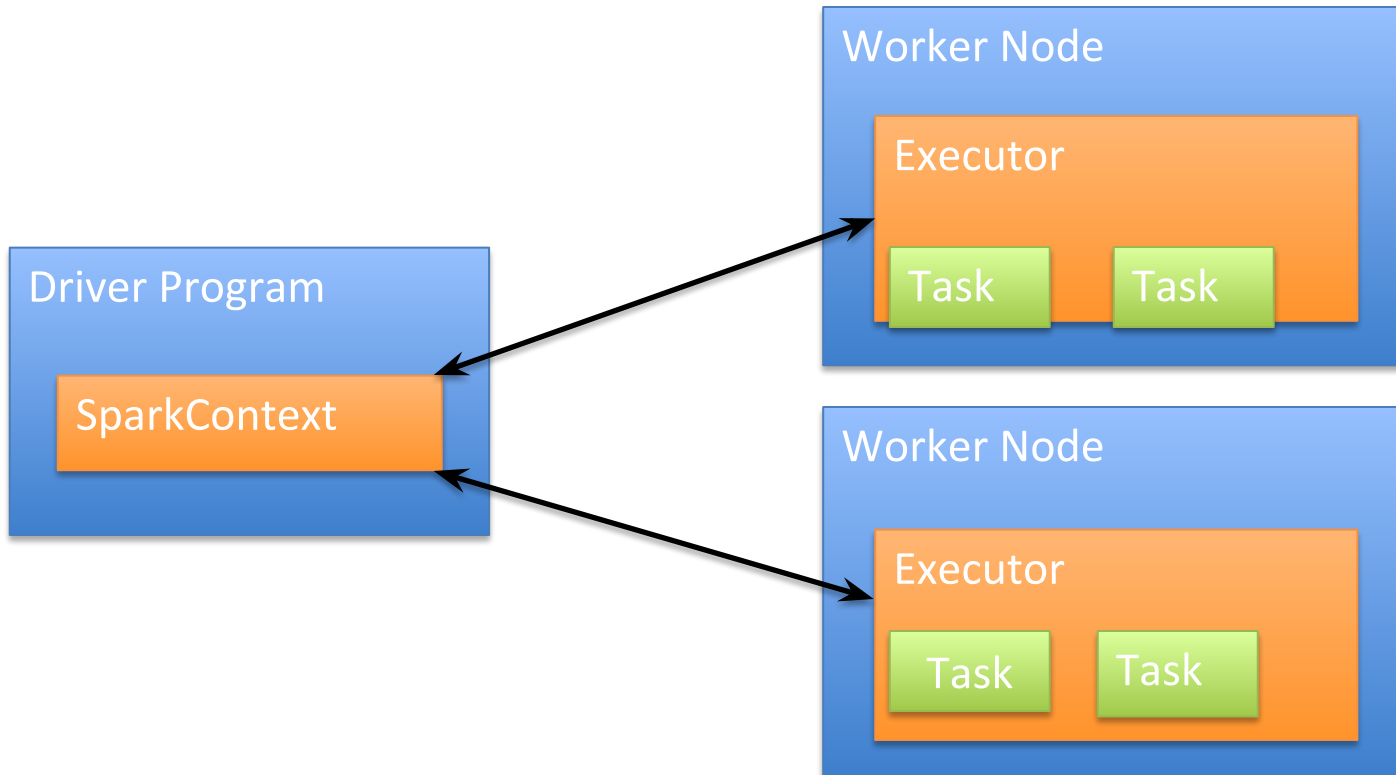
# Consilience: Data Processing Workflow



# Apache Spark

- A fast and general engine for large scale data processing
- Latest version 2.3.2 - k8s support
- 100x faster than Hadoop MapReduce in memory, 10x faster in disk
  - Resilient Distributed Dataset/Directed Acyclic Graph
  - DataFrame/DataSet

# Cluster execution



# Spark Components

Spark SQL

Spark  
Streaming

MLlib

GraphX

Spark Core

Standalone Cluster

YARN

Mesos

Kubernetes

# Kubernetes

- Container-orchestration
- Operating system for clusters
  - Simplifies application deployment
  - Improves utilization of resources
- Standard for running distributed applications
  - Cloud
  - On -premise
- Containers
  - Docker
  - Rkt, others



# Kubernetes Tools

kubectl

CLI client

Kubernetes dashboard

Web UI

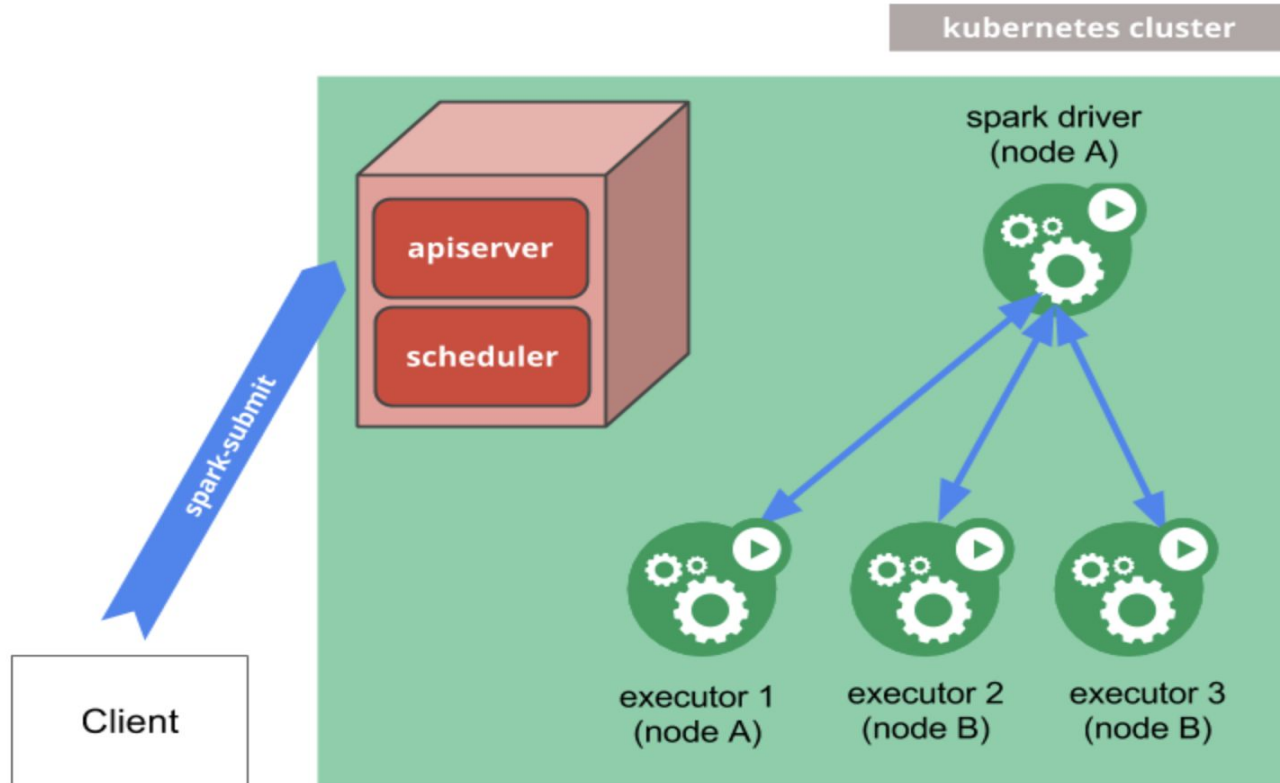
# Kubernetes Automatic Scaling

- Google Kubernetes Engine
- Google Compute Engine
- Amazon Web Services
- Azure

# Spark Kubernetes

- Spark v 2.3+
- Kubernetes 1.6+
- Docker

# Spark on Kubernetes



# Deploy to Kubernetes with spark-submit

```
bin/spark-submit --master
```

```
k8s://https://iqcodeone-73142460.hcp.eastus.azmk8s.io:443 --deploy-mode
```

```
cluster --name spark-pi --class org.apache.spark.examples.SparkPi --conf
```

```
spark.executor.instances=5 --conf
```

```
spark.kubernetes.container.image=bobtreacy/text-analysis --conf
```

```
spark.kubernetes.authenticate.driver.serviceAccountName=spark
```

```
local:///opt/spark/examples/jars/spark-examples_2.11-2.3.2.jar 50000
```

# Docker for Spark

- Spark-provided Dockerfile in `kubernetes/dockerfiles` directory
- `bin/docker-image-tool.sh`
  - `./bin/docker-image-tool.sh -r <repo> -t my-tag build`
  - `./bin/docker-image-tool.sh -r <repo> -t my-tag push`

# kubectl CLI

- Stream logs
  - `kubectl -n=<namespace> logs -f <driver-pod-name>`
- Driver UI
  - `kubectl port-forward <driver-pod-name> 4040:4040`
- debug
  - `kubectl describe pod <spark-driver-pod>`
  - `kubectl logs <spark-driver-pod>`

# minikube

- Run kubernetes locally on a laptop
- Single-node Kubernetes cluster in a VM
- Minimum requirements
  - 3 CPU
  - 4g



# Spark & RBAC

If RBAC is enabled, the Spark driver pod needs permission to create and watch Spark executor pods:

```
$ kubectl create serviceaccount spark
```

```
$ kubectl create clusterrolebinding spark-role --clusterrole=edit  
--serviceaccount=default:spark --namespace=default
```

# Demo

# Spark 2.4 and beyond

- PySpark
- R
- Client deploy mode
- Dynamic Executor Scaling
- Local File Dependency Management
- Spark Application Management
- Job Queues and Resource Management

# Related Presentations

- DEV6238 – Big Data Exploration with Spark SQL and Java \*
- DEV5009 – Firefighting Java Big Data Problems \*
- DEV5212 – Getting Started with Spark \*
- DEV5168 – Spark Streaming Versus Kafka Streams \*
- DEV5355 – Location Based Tracking of Moving Objects with Apache Spark
- CON4998 – Java EE 7 with Apache Spark for the World's Largest Credit Card Core Systems

# More Related Presentations

- DEV5080 – Effective Docker and Kubernetes for Java EE Developers
- DEV5369 – Kube Me This! Kubernetes Ideas and Best Practices
- DEV5432 – Writing Kubernetes Controllers with Java SE and CDI
- DEV4854 – A Day in a Java Developer's Life with a Taste of Kubernetes
- DEV6568 - Kubernetes: Your Next Java Application Server

# Thank you!

- Demo on Github:

<https://github.com/ekraffmiller/CodeOne2018>

- Questions?