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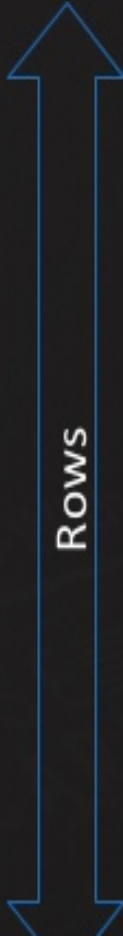
Heterogeneous Workflows with Spark at Netflix

Antony Arokiasamy | Kedar Sadekar | Personalization Infrastructure

Help members find content to **watch** and **enjoy** to
maximize member **satisfaction** and **retention**

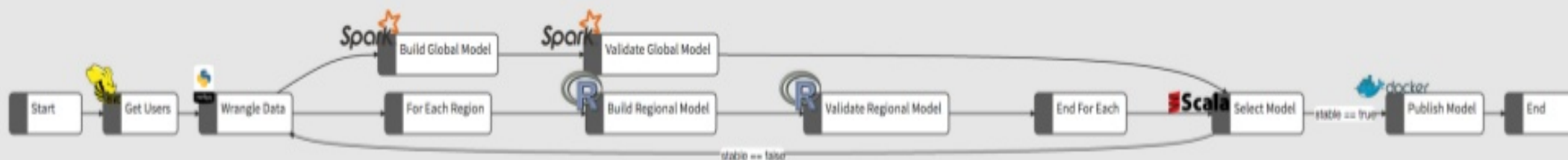
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Ranking



**Recommendations
are driven by
Machine Learning**

Machine Learning Pipeline



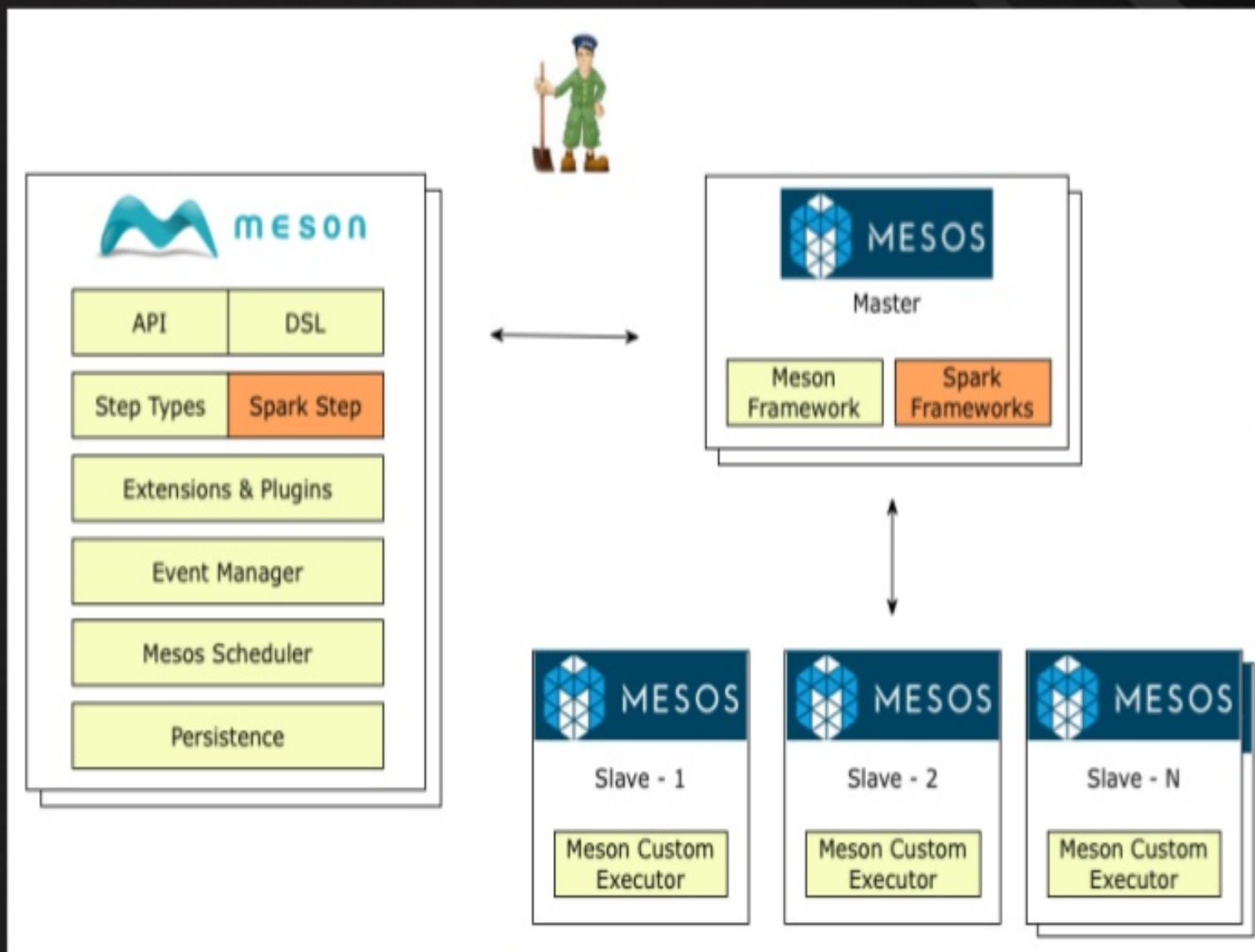
Machine Learning Pipeline Challenges

- Innovation
 - Heterogeneous Environments
- Spark
 - Native Support
- Separate Orchestration and Execution
- Multi Tenancy
- Machine Learning Constructs
 - Parameter Sweep – 30k Dockers

Meson Workflow System

- General Purpose Workflow Orchestration and Scheduling framework
 - Delegates execution to resource managers like Mesos
- Optimized for Machine Learning Pipelines and Visualization
- Checkout the Blog
 - <http://bit.ly/mesonws> or techblog.netflix.com
- Plan to Open Sourced soon

Meson Architecture



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Standard and Custom Step Types

Type

Select a step type

Run Genie (V2) Job

Run Hive/Pig Query

Run On Titan

Scala Command

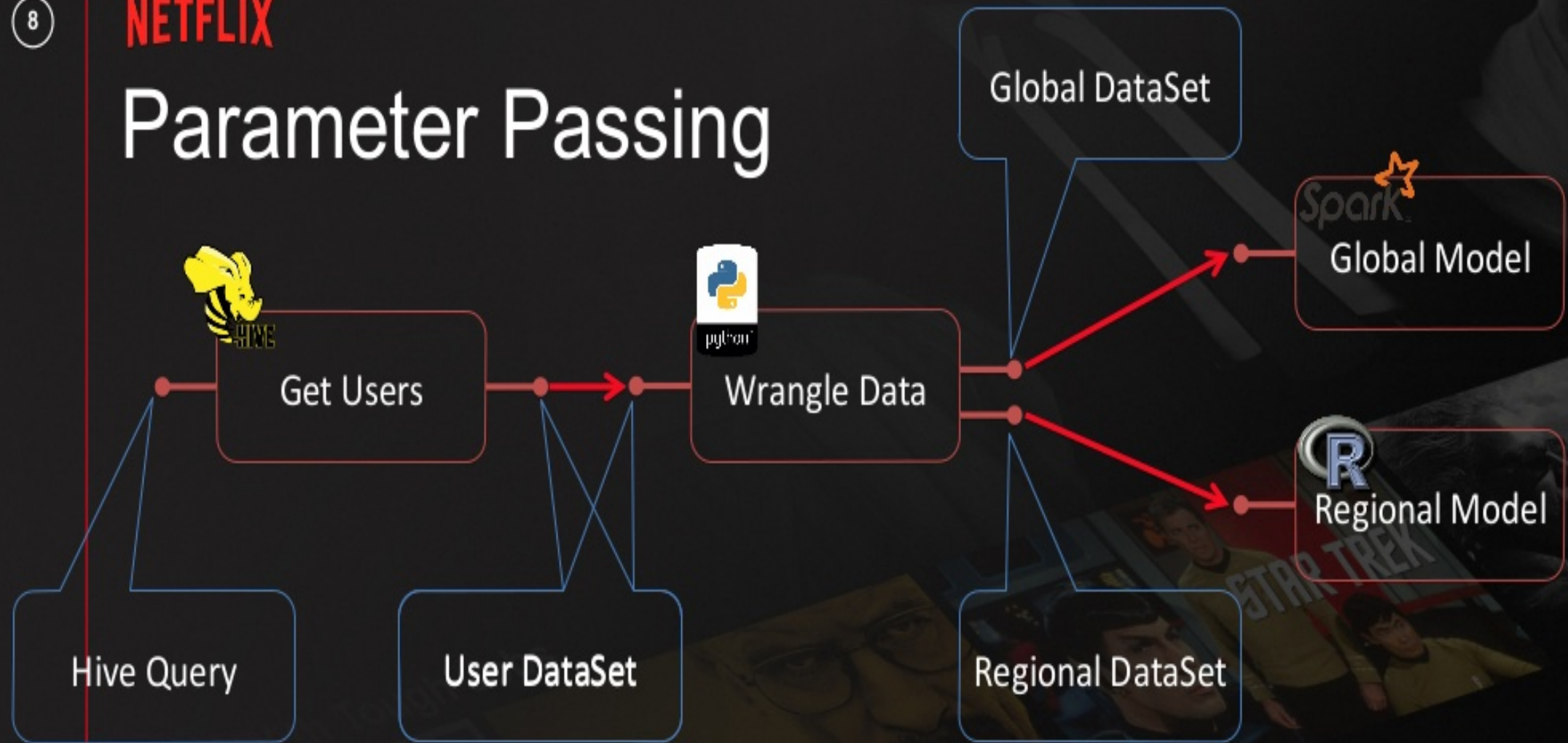
Spark Job

Spark Submit

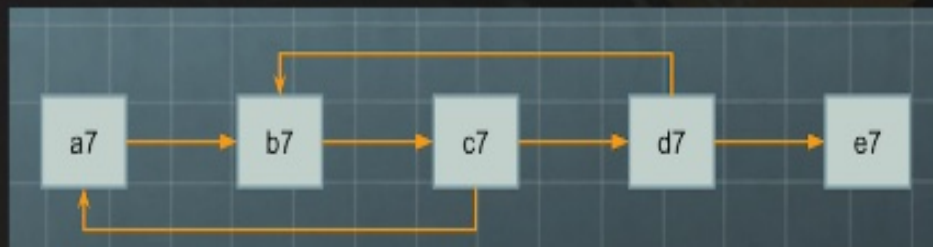
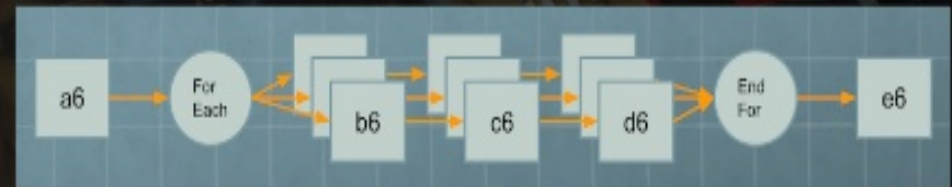
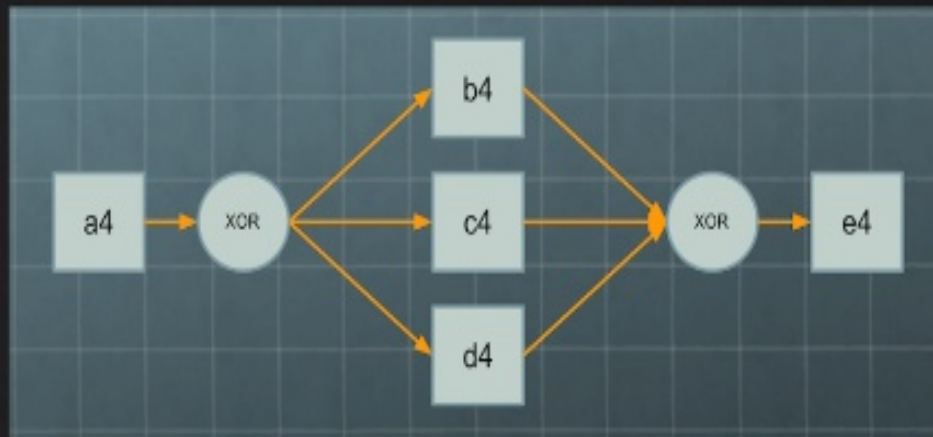
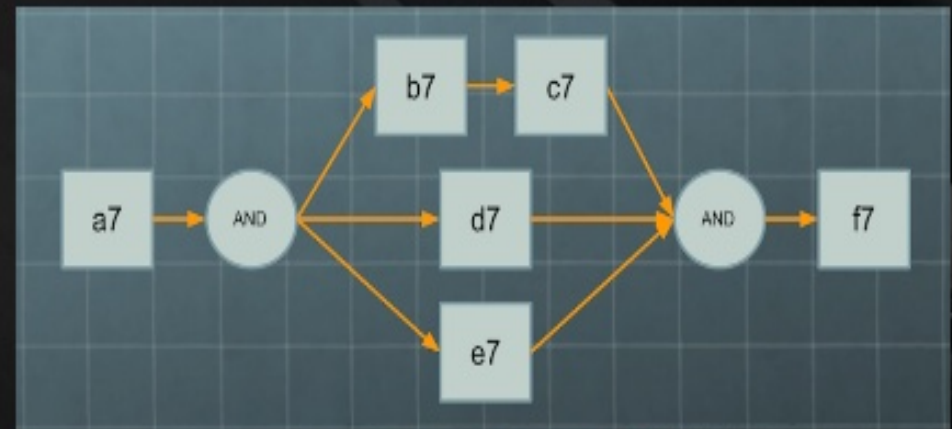
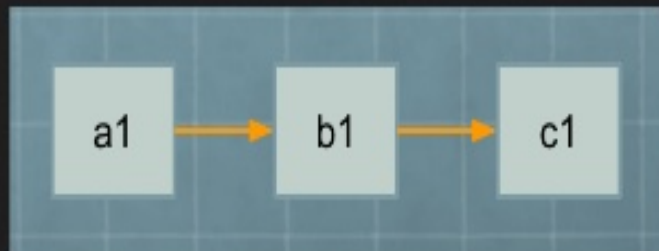
Start Sub Workflow

Wait For Action

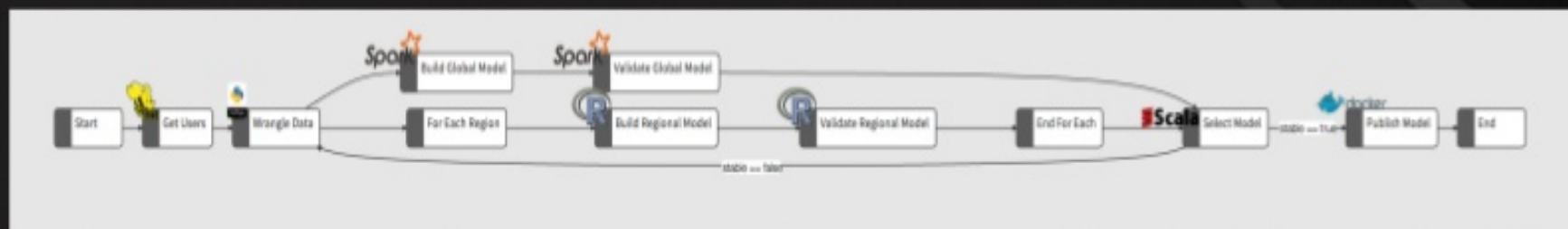
Parameter Passing



Structured Constructs



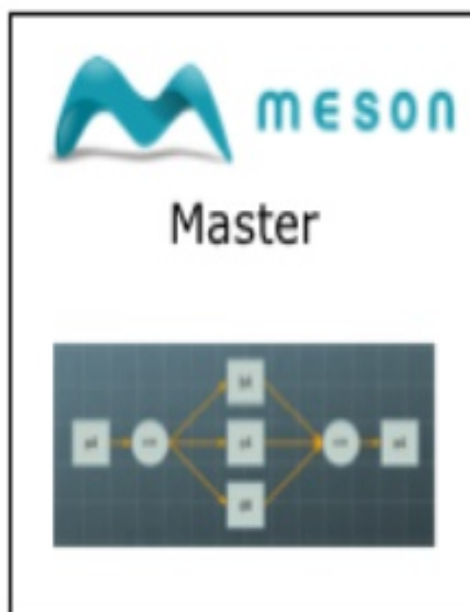
Top Down or Bottom Up



```

val getUsers = Step("Get Users", ...)
val wrangleData = Step("Wrangle Data", ...)
...
val regionSplit = Step("For Each Region", ...)
val regionJoin = Step("End For Each", ...)
val regions = Seq("US", "Canada", "UK_Ireland", "LatAm", ...)
val wf = start -> getUsers -> wrangleData ==> (
  trainGlobalModel -> validateGlobalModel,
  regionSplit ** (reg = regions) --< (trainRegModel, validateRegModel) >-- regionJoin
) >== selectModel -> validateModel -> end
  
```


Two Way Communication



← Message Bus →



Spark Step

Logs: stdout

```

1 /apps/mesos-0.22.1/libexec/mesos/mesos-fetcher: /lib/x86_64-linux-gnu/libnsl-3.so.200: no version information available (required)
2 /apps/mesos-0.22.1/libexec/mesos/mesos-fetcher: /lib/x86_64-linux-gnu/libnsl-3.so.200: no version information available (required)
3 /apps/mesos-0.22.1/libexec/mesos/mesos-fetcher: /lib/x86_64-linux-gnu/libnsl-3.so.200: no version information available (required)
4 W0517 22:42:23.790077 6319 logging.cpp:172] WARNING level logging started!
5 W0517 22:42:37.777552 7066 logging.cpp:172] WARNING level logging started!
6 Warning: Local jar /apps/spark-common/lib/mysql-connector-java-5.1.33-bin.jar:/apps/spark-common/lib/spectator-ext-spark-0.27.0-
7 log4j:WARN No such property [datePattern] in org.apache.log4j.RollingFileAppender.
8 16/05/17 22:42:45 ERROR SparkContext: Jar not found at file:/apps/spark-common/lib/mysql-connector-java-5.1.33-bin.jar:/apps/spa
9 W0517 22:42:46.306296 7429 logging.cpp:172] WARNING level logging started!
10 2016-05-17 22:42:46,319:7289(0x7ff87b7fe700):ZOO_INFO@log_env@712: Client environment:zookeeper.version=zookeeper C client 3.4.
11 2016-05-17 22:42:46,320:7289(0x7ff87b7fe700):ZOO_INFO@log_env@716: Client environment:host.name=quark-slavenohdfs-i-7fa958e5
12 2016-05-17 22:42:46,321:7289(0x7ff87b7fe700):ZOO_INFO@log_env@723: Client environment:os.name=Linux
13 2016-05-17 22:42:46,321:7289(0x7ff87b7fe700):ZOO_INFO@log_env@724: Client environment:os.arch=3.13.0-76-generic
14 2016-05-17 22:42:46,323:7289(0x7ff87b7fe700):ZOO_INFO@log_env@725: Client environment:os.version=#120-Ubuntu SMP Mon Jan 18 15:
15 2016-05-17 22:42:46,338:7289(0x7ff87b7fe700):ZOO_INFO@log_env@733: Client environment:user.name=(null)
16 2016-05-17 22:42:46,341:7289(0x7ff87b7fe700):ZOO_INFO@log_env@741: Client environment:user.home=/home/quarkprod
17 2016-05-17 22:42:46,342:7289(0x7ff87b7fe700):ZOO_INFO@log_env@753: Client environment:user.dir=/mnt/data/mesos/slaves/20160505-
57/runs/b1bbd65e-209d-4da7-b541-3e352630a411
18 2016-05-17 22:42:46,342:7289(0x7ff87b7fe700):ZOO_INFO@zookeeper_init@706: Initiating client connection, host=ec2-104-73-159-205
107-20-175-174.compute-1.amazonaws.com:2181,ec2-107-20-175-190.compute-1.amazonaws.com:2181 sessionTimeout=10000 watcher=0x7ff80865
19 2016-05-17 22:42:46,386:7289(0x7ff87a7fc700):ZOO_INFO@check_events@1703: initiated connection to server [10.65.142.185:2181]
20 2016-05-17 22:42:46,389:7289(0x7ff87a7fc700):ZOO_INFO@check_events@1750: session establishment complete on server [10.65.142.18
21
22 [Stage 0:> (0 + 0) / 8]

```

Close

Artifacts

JOB_URL : 28160:209960


<http://trion.4080/history/73097992-1dc5-4ea5-901f-8563ba1fa178-2957/jobs/>

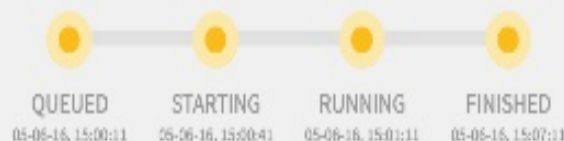
RECORD COUNT : 28160:209960

206,081,150

USER_DATASET : 28160:209960

<s3n://us-east-1/cw/2016-06-05/>

 MILESTONE : 25372:190998



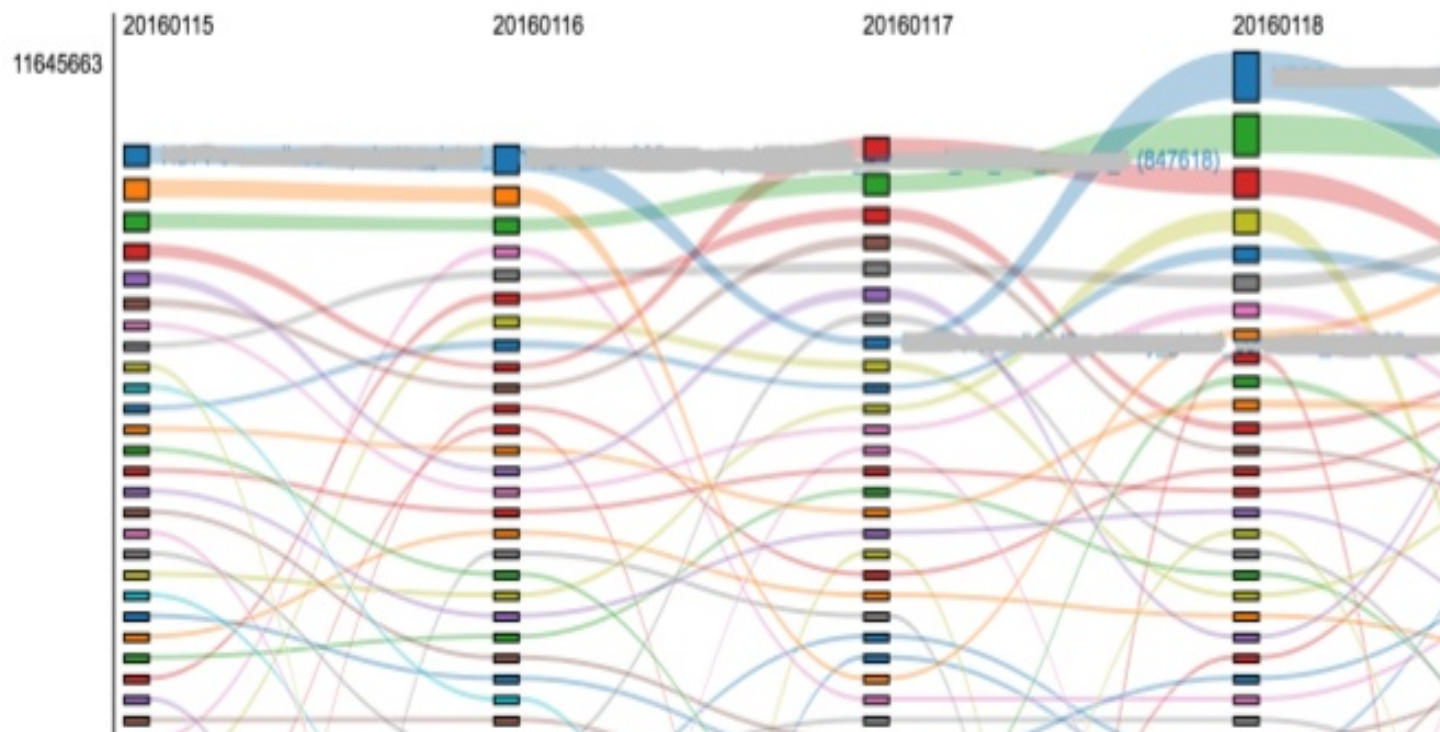
Artifacts

- Step outputs tracked as Artifacts
- Visualization
- Memoization

Feature Importance as Function of Date

Thickness at each node is proportional to the absolute value of the predictionDecrease from that feature on that date.

The total height is proportional to the sum of predictionDecrease from all features on that date.



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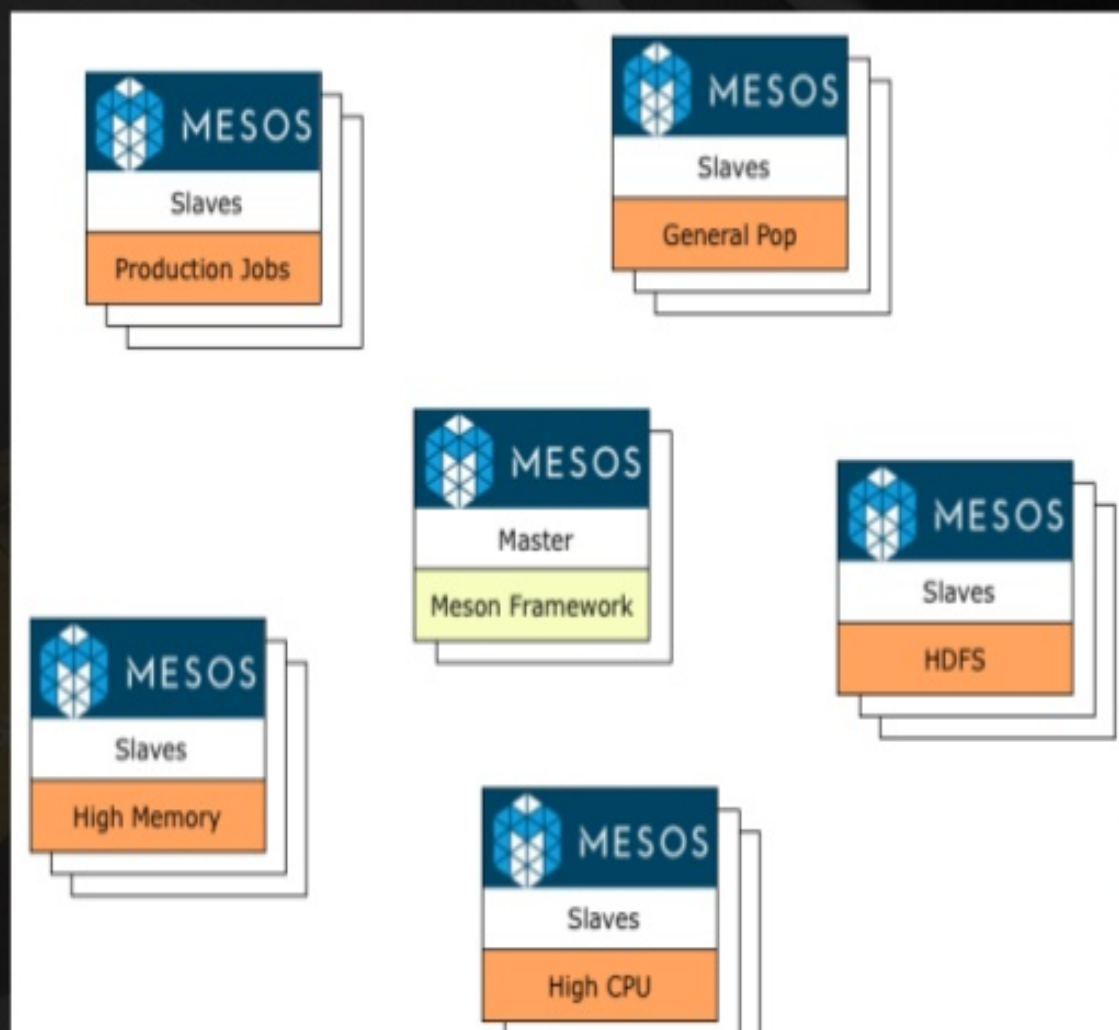
Multi Tenancy



- Resource Attributes
 - `spark.cores.max`
 - `spark.executor.memory`
 - `spark.mesos.constraints`
 - Dynamic Resource Allocation

Cluster Management

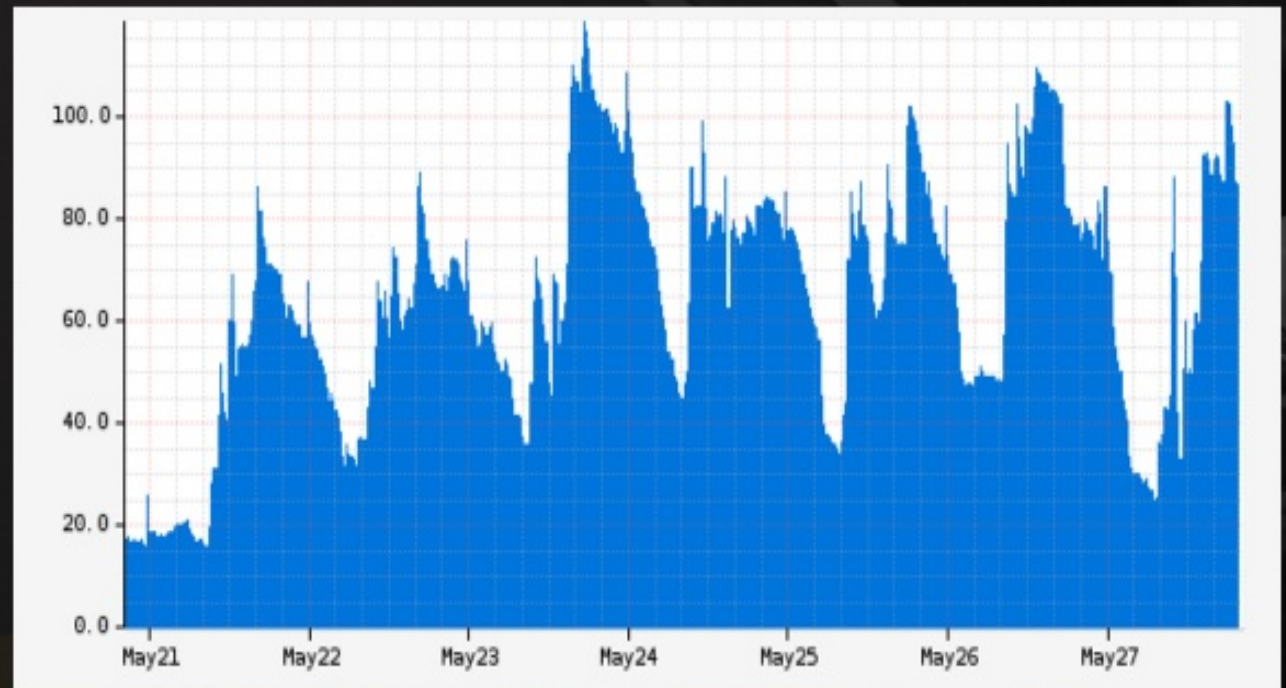
- Red-Black software updates
- Scale up/Scale down



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Meson/Spark Cluster

- 100s of Concurrent Jobs
- 700 Nodes
- 5000 Cores
- 25 TB Memory
- Apps: Meson Workflow System, Spark and Dockers
- Few smaller clusters



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