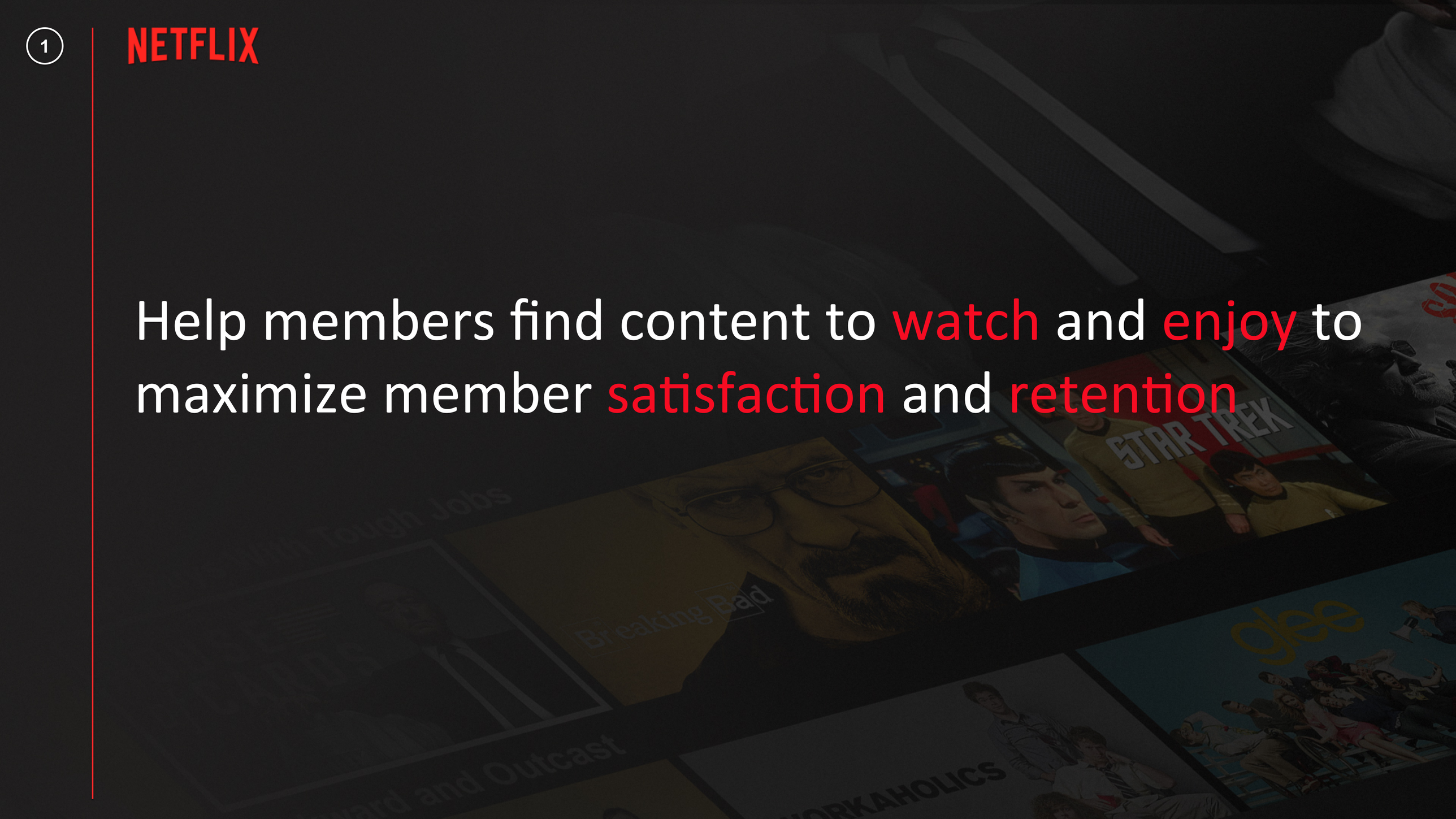
NETFLIX

Heterogeneous Workflows with Spark at Netflix

Antony Arokiasamy | Kedar Sadekar | Personalization Infrastructure

NETFLIX

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

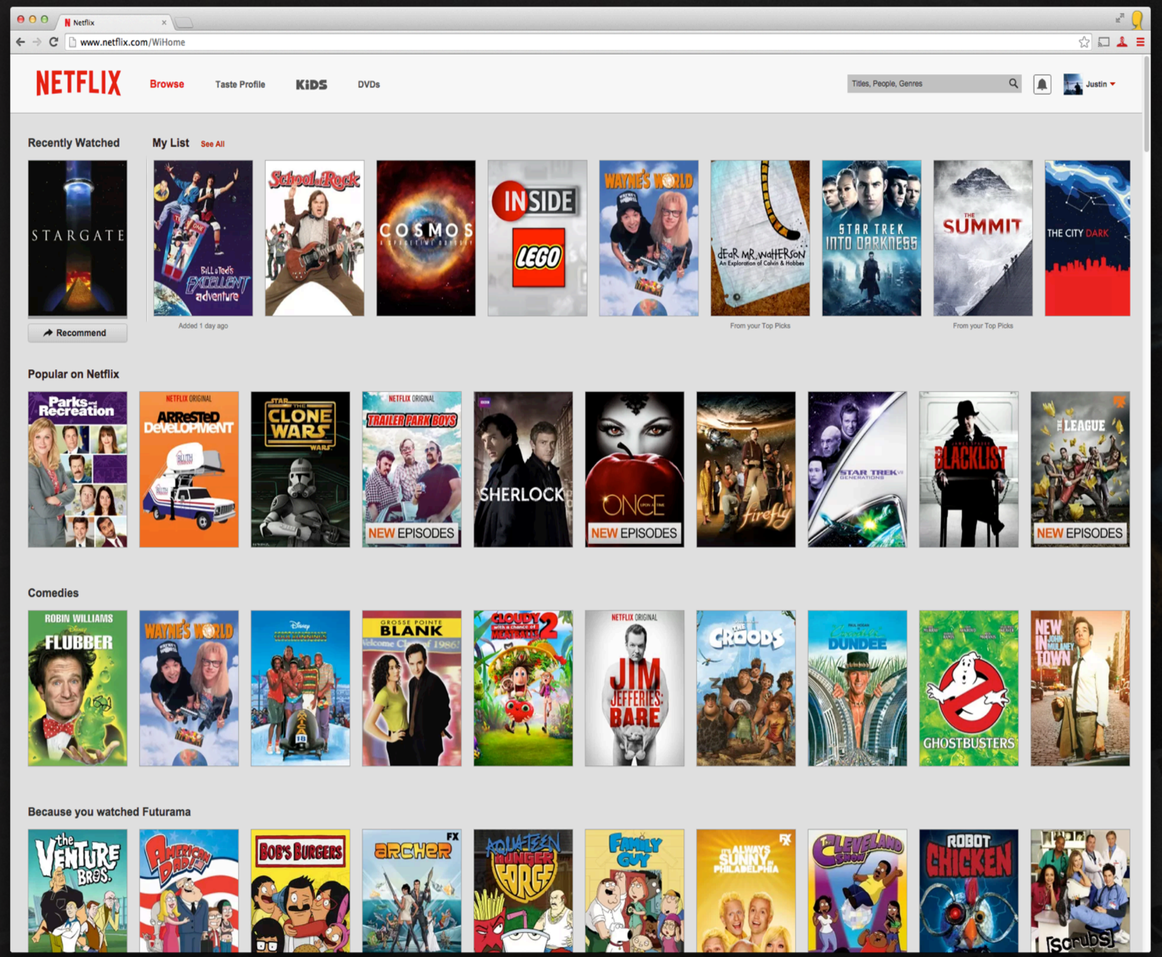


NETFLIX

Everything is a Recommendation

Ranking

Rows

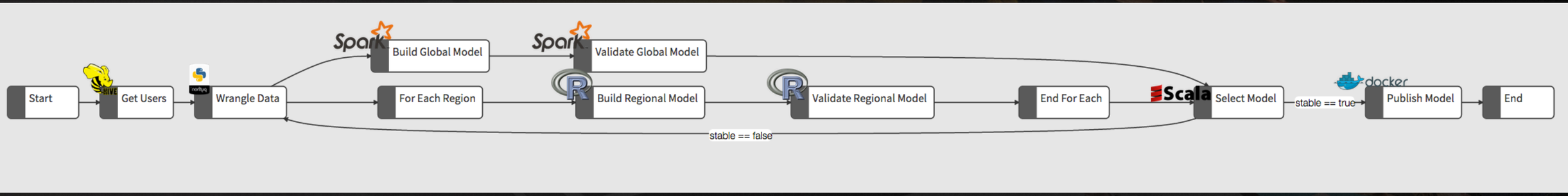


Recommendations are driven by Machine Learning

NETFLIX

Machine Learning Pipeline

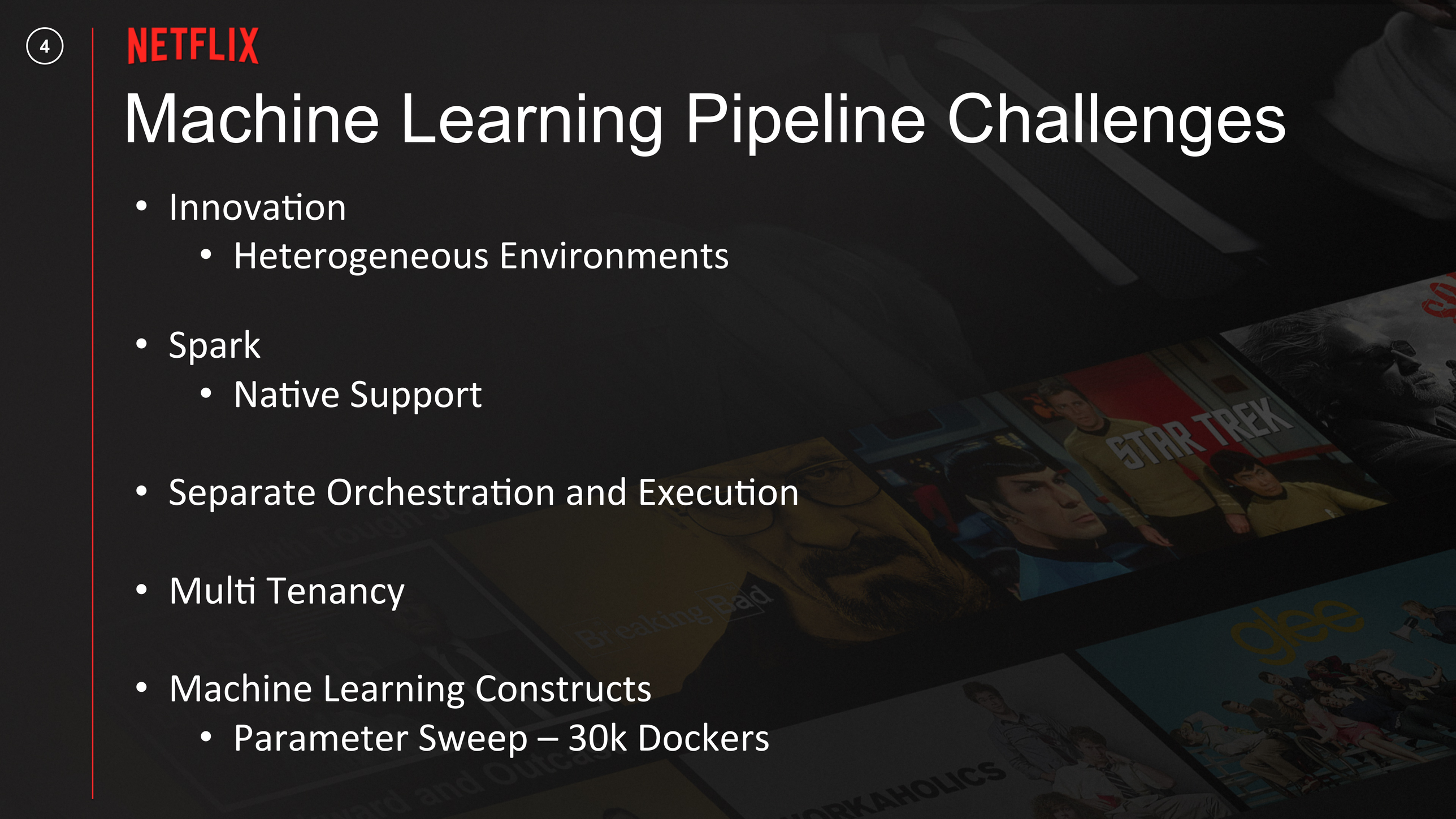
User Selection → Feature Generation → Model Training → Model Validation → Publish Model



NETFLIX

Machine Learning Pipeline Challenges

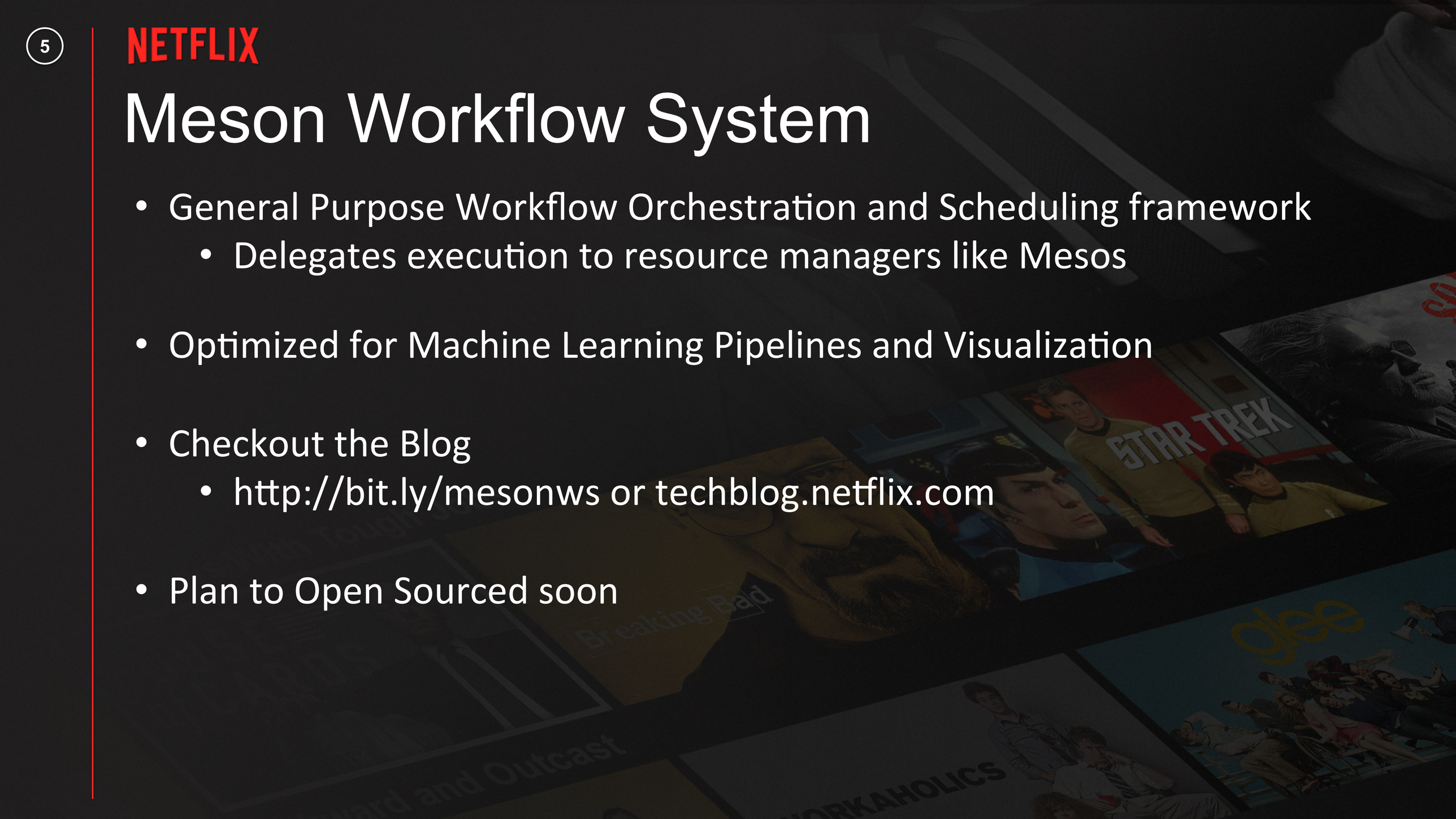
- Innovation
  - Heterogeneous Environments
- Spark
  - Native Support
- Separate Orchestration and Execution
- Multi Tenancy
- Machine Learning Constructs
  - Parameter Sweep – 30k Dockers



NETFLIX

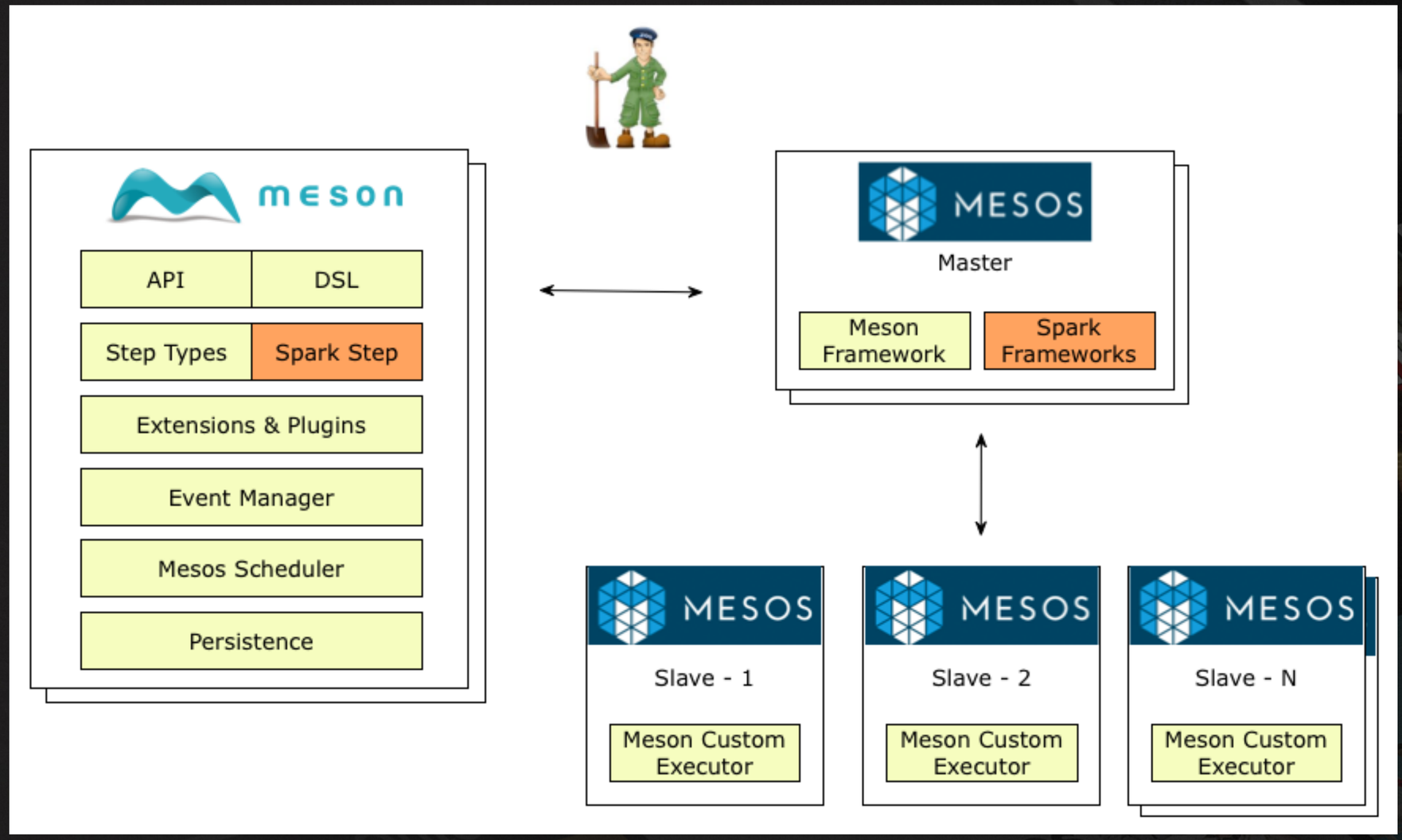
Meson Workflow System

- 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



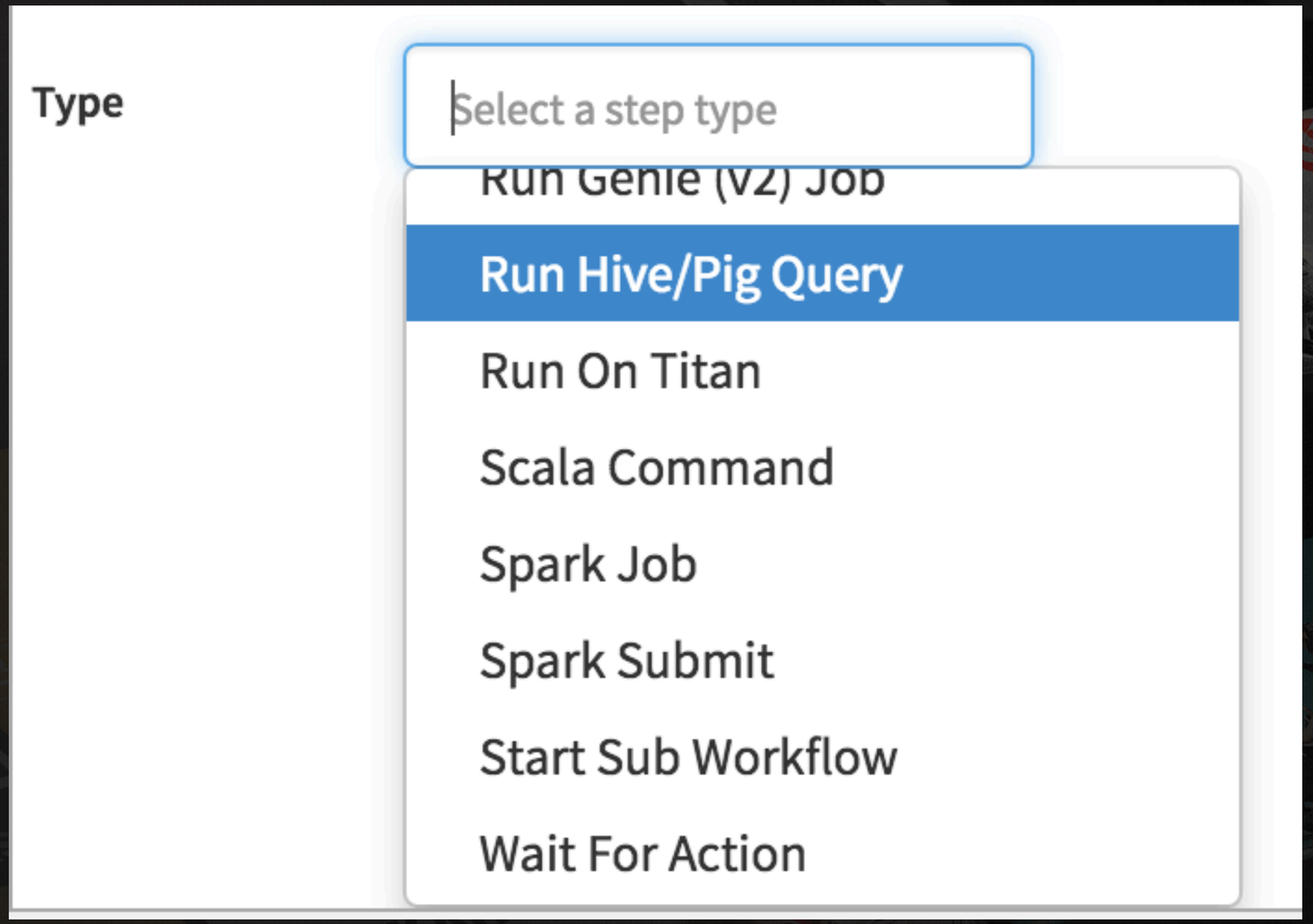
NETFLIX

Meson Architecture



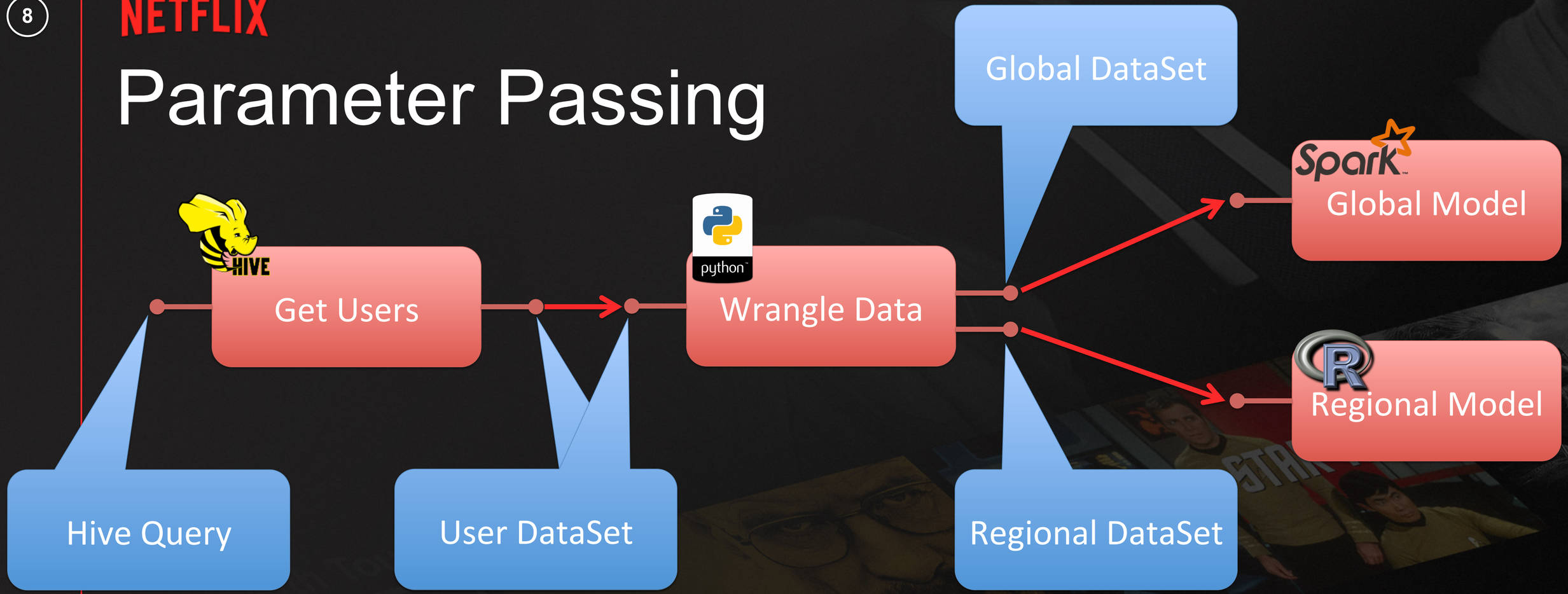
NETFLIX

Standard and Custom Step Types



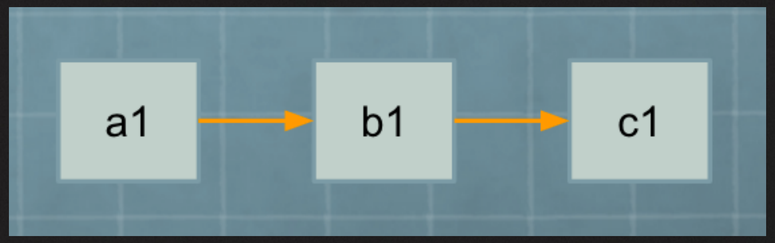
NETFLIX

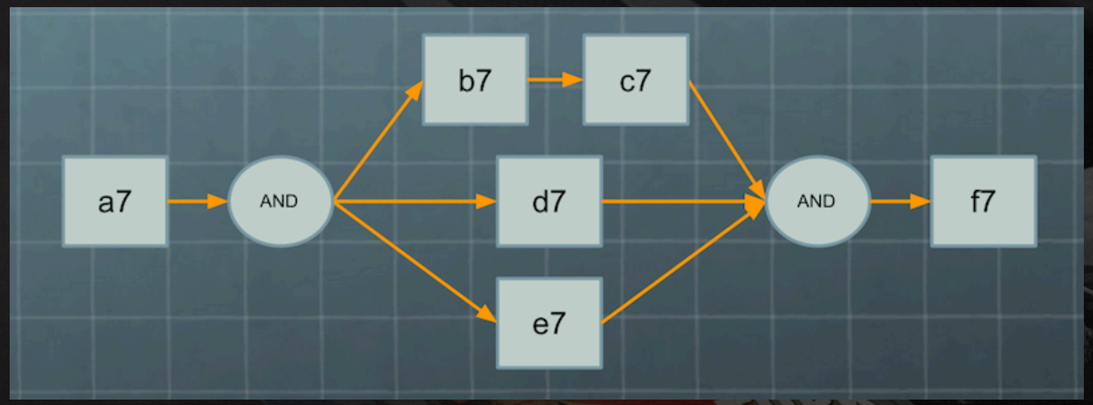
Parameter Passing

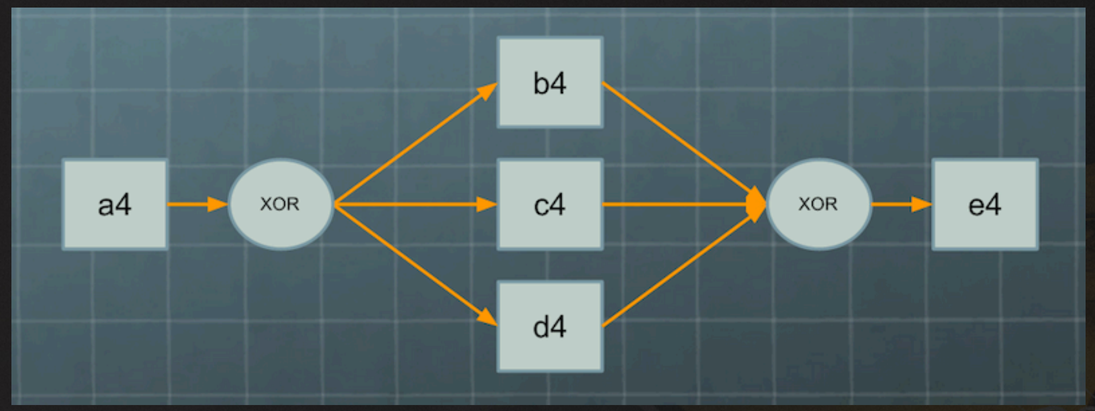


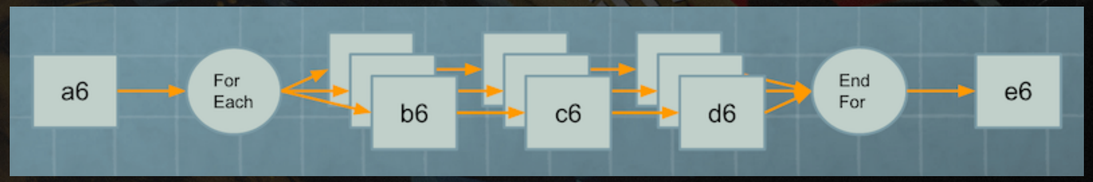
NETFLIX

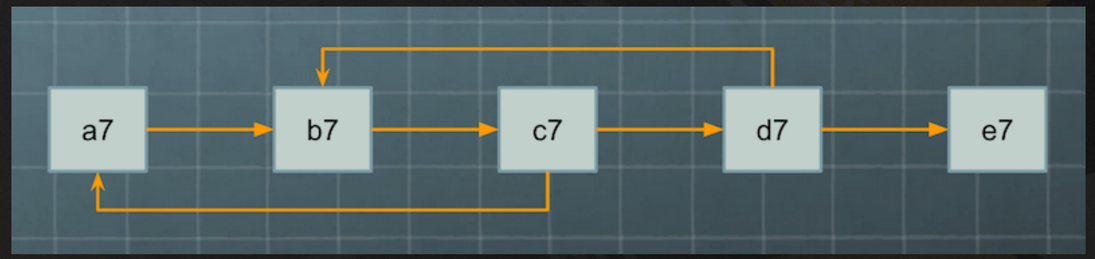
Structured Constructs





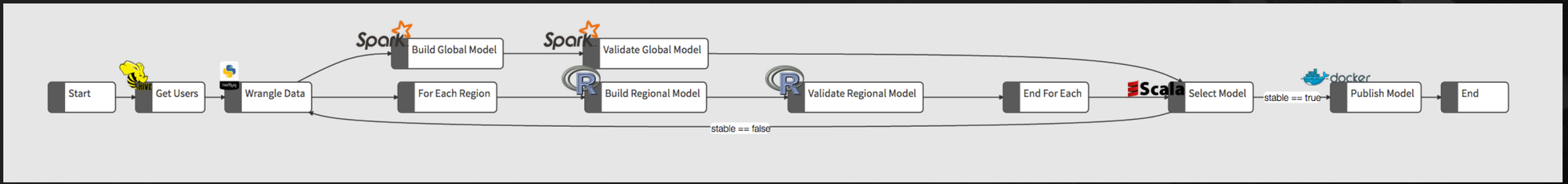






NETFLIX

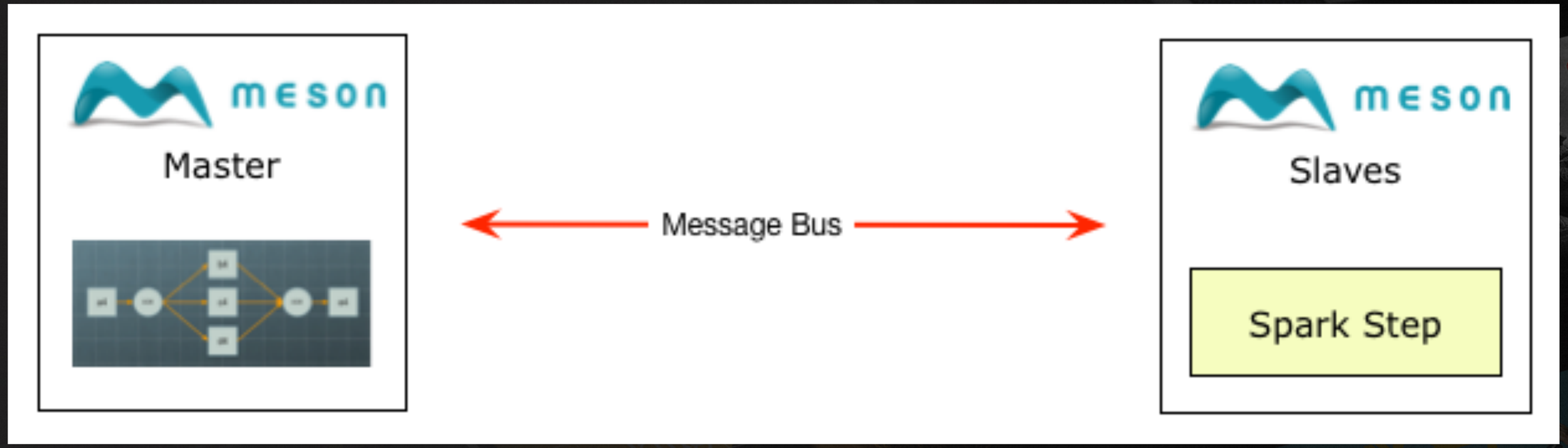
Top Down or Bottom Up




```
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
```

NETFLIX

Two Way Communication



NETFLIX

Spark Step

Logs: stdout

```
1  /apps/mesos-0.22.1/libexec/mesos/mesos-fetcher: /lib/x86_64-linux-gnu/libnl-3.so.200: no version information available (required
2  /apps/mesos-0.22.1/libexec/mesos/mesos-fetcher: /lib/x86_64-linux-gnu/libnl-3.so.200: no version information available (required
3  /apps/mesos-0.22.1/libexec/mesos/mesos-fetcher: /lib/x86_64-linux-gnu/libnl-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-289d-4da7-b541-3e352638a411
18  2016-05-17 22:42:46,342:7289(0x7ff87b7fe700):ZOO_INFO@zookeeper_init@786: Initiating client connection, host=ec2-184-73-159-205
107-20-175-174.compute-1.amazonaws.com:2181,ec2-107-20-175-190.compute-1.amazonaws.com:2181 sessionTimeout=10000 watcher=0x7ff88659
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.[redacted]:8080/history/73097992-1dc6-4ea5-901f-8563ba1fa178-2957/jobs/

RECORD COUNT : 28160:209960

206,081,150

USER_DATASET : 28160:209960

s3n://us-east-1[redacted]/cw/2016-06-05/

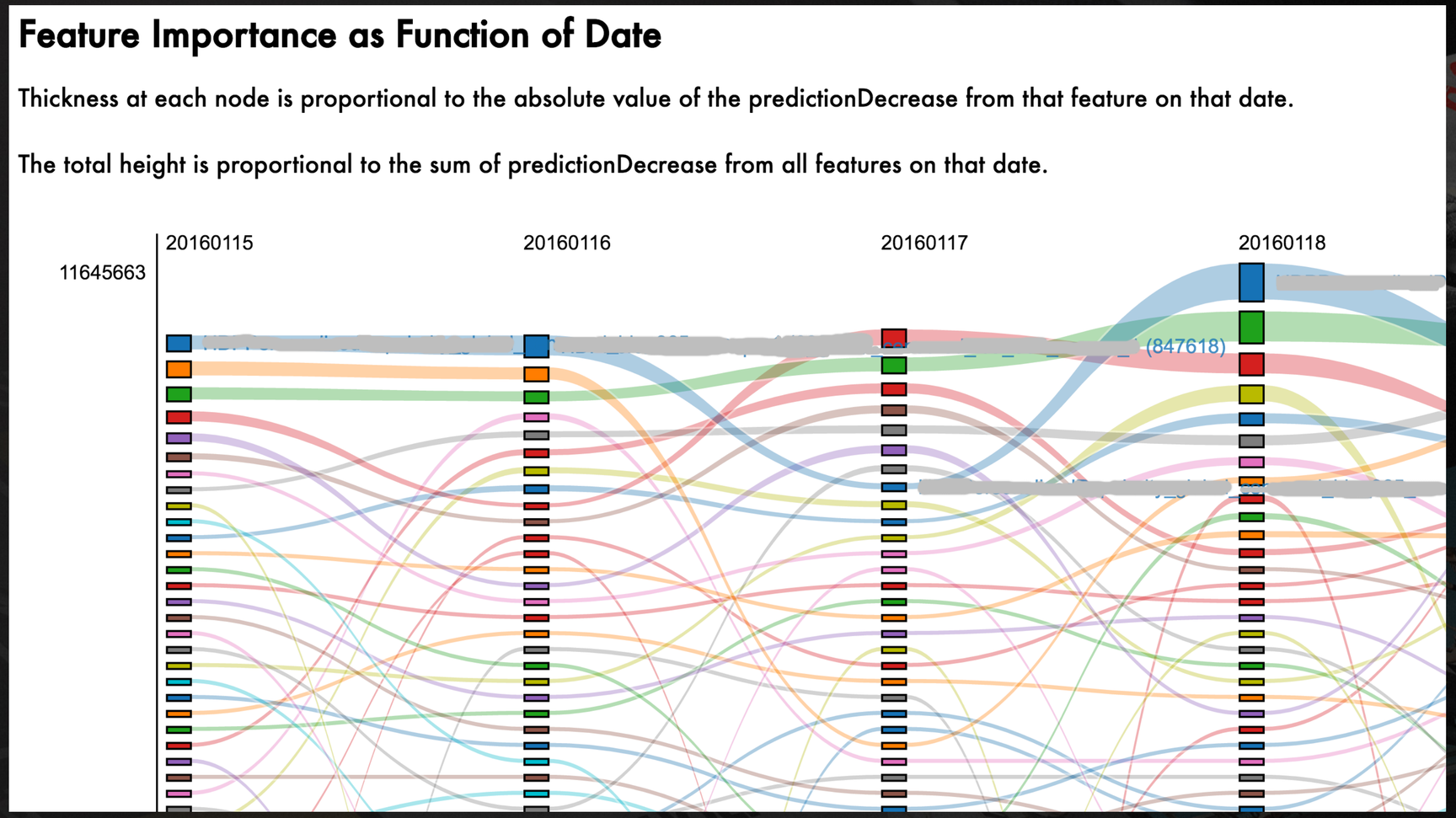
MILESTONE : 25372:190998

QUEUED	STARTING	RUNNING	FINISHED
05-06-16, 15:00:11	05-06-16, 15:00:41	05-06-16, 15:01:11	05-06-16, 15:07:11

NETFLIX

Artifacts

- Step outputs tracked as Artifacts
- Visualization
- Memoization



NETFLIX

Multi Tenancy

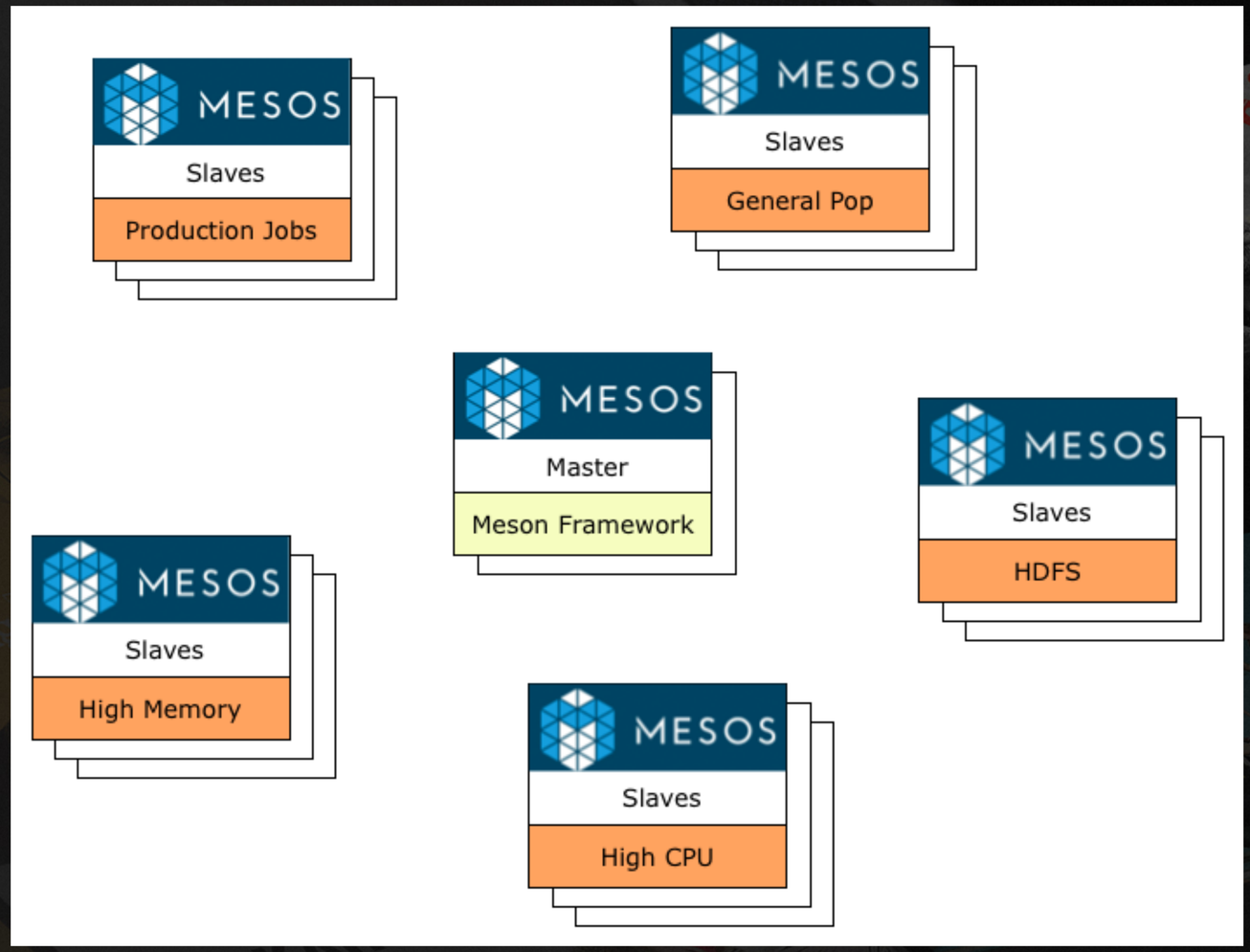
- Resource Attributes

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

NETFLIX

Cluster Management

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



NETFLIX

Meson/Spark Cluster

- 100s of Concurrent Jobs
- 700 Nodes
- 5000 Cores
- 25 TB Memory

- Apps: Meson Workflow System, Spark and Dockers
- Few smaller clusters

NETFLIX

Antony Arokiasamy

@aasamy

/aasamy

aarokiasamy@netflix.com

Kedar Sadekar

@kedar_sadekar

/kedar-sadekar

ksadekar@netflix.com