Let's Break Apache Spark Workshop (using docker)

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VIRTUSLAB

Requirements

Let's Break
Apache Spark
Workshop
(using docker)

A laptop with:

- at least 10GB disk space free, 4 cores, 8GB of free RAM
- installed Docker Community Edition https://docs.docker.com/engine/installation/
- installed Docker Compose https://docs.docker.com/compose/install/
- installed git (https://gist.github.com/derhuerst/1b15ff4652a867391f03)

Run:

- ❑ docker pull dimajix/jupyter-spark
- ❑ git clone https://github.com/dimajix/docker-jupyter-spark.git

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ABOUT ME

Grzegorz Gawron
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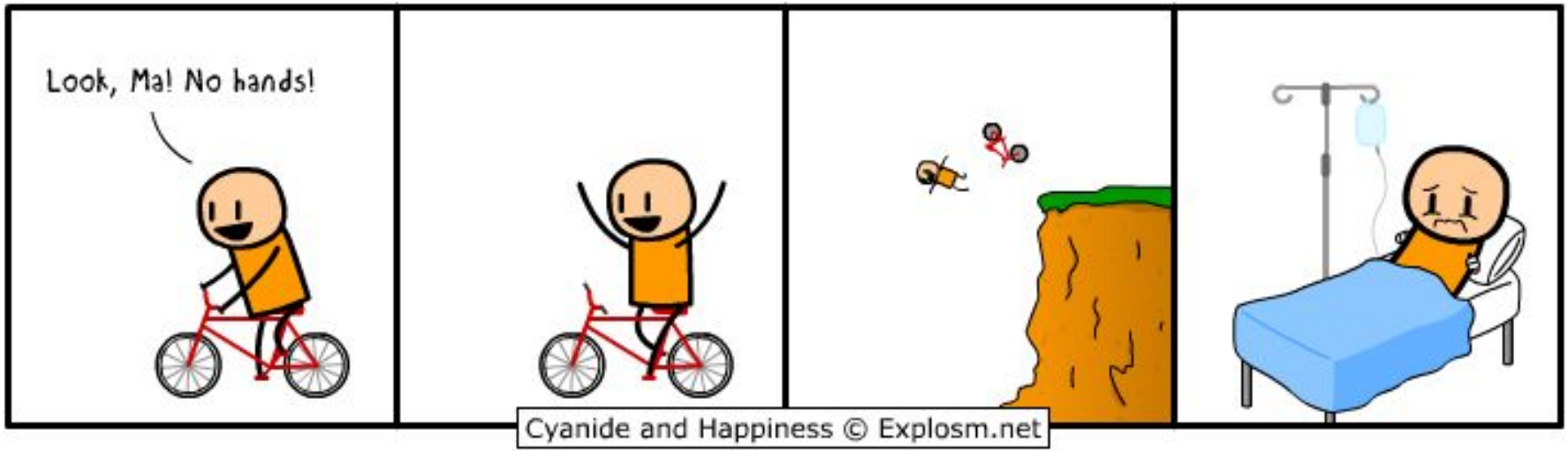
- currently running a large data engineering project for a global retailer
- greenishfield
  - Spark ML pipelines (forecasting, recommendation)
  - Spark Streaming
- large hadoop cluster (1000s cores + TBs RAM)
- spark, scala, python

Motivation: KIDS



Agenda

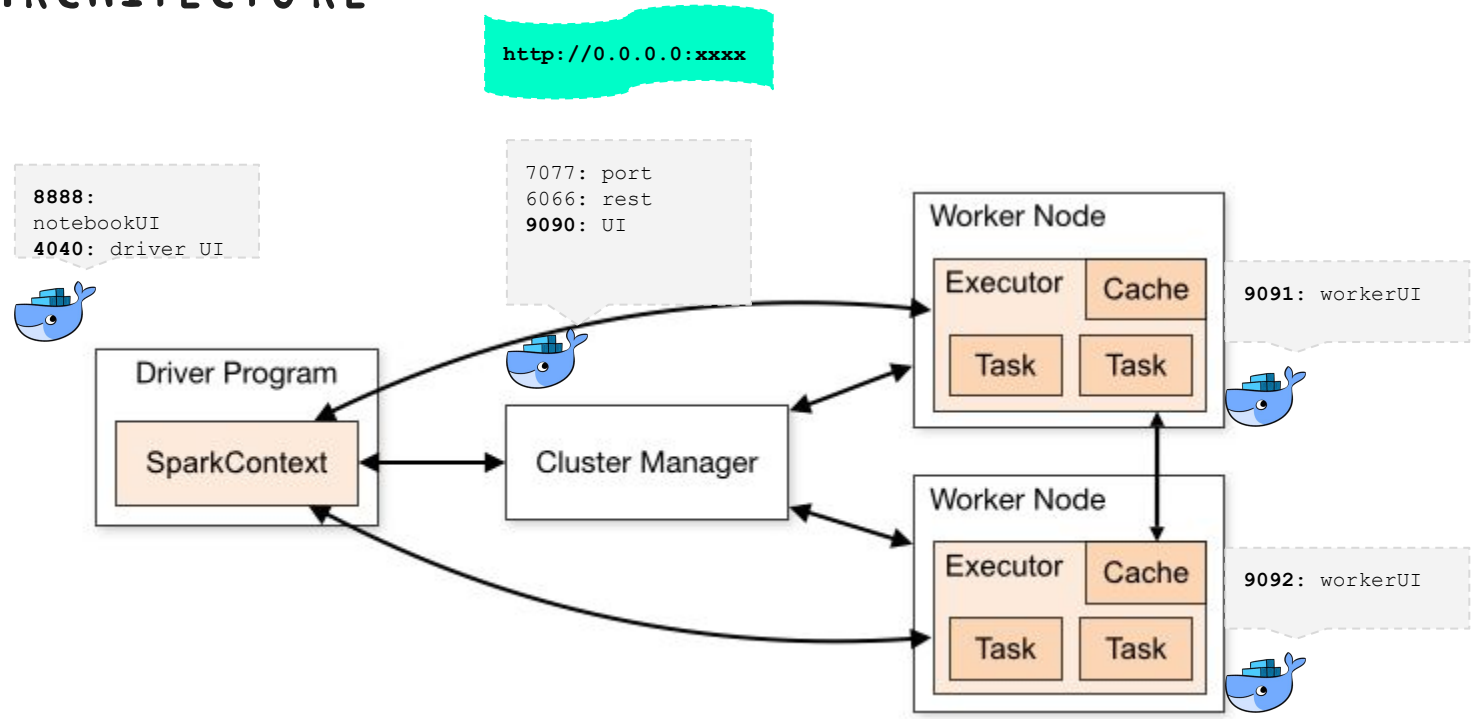
- run a simple distributed python spark app in jupyter notebook and via shell
- see it running healthily on spark UIs
- repeat the **break-and-feel** cycle multiple times

Questions we'll be asking

- healthy system
  - what does it look like?
- how to
  - make a spark job hang temporarily
  - … or hang it for good?
  - get a spark job live-locked?
- what happens if
  - you kill the master? slaves? master and slaves?
  - ! the slaves/master come back?
  - the notebook kernel dies?

Architecture

Spark Architecture



Other ways of running spark

Out of Scope

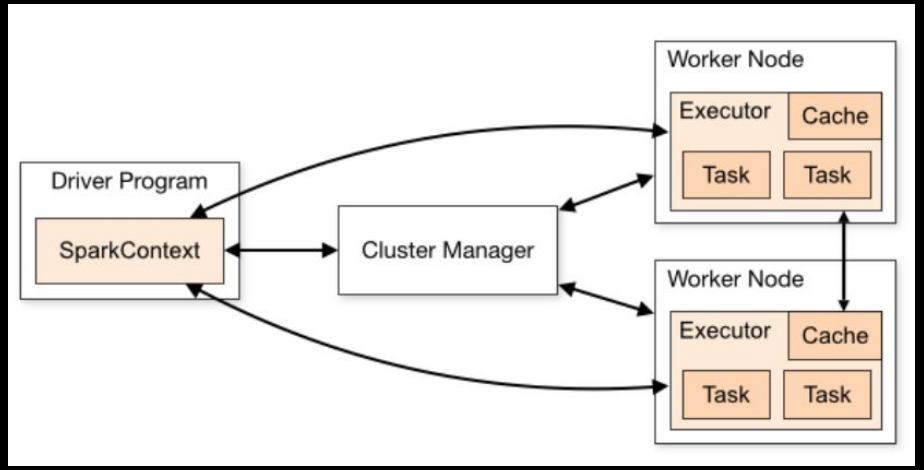
- mesos
- yarn
- kubernetes

Configs: docker-compose.yml

```
Machito:docker gregaw$ cat docker-jupyter-spark/docker-compose.yml
version: "3"

services:

  jupyter-notebook:
    hostname: jupyter-notebook
    container_name: jupyter-notebook
    image: dimajix/jupyter-spark:latest
    command: notebook
    build:
      context:  .
      args:
        http_proxy: ${http_proxy}
        https_proxy: ${https_proxy}
    env_file:
      - docker-compose.env
    environment:
      - http_proxy=${http_proxy}
      - https_proxy=${https_proxy}
    expose:
      - 8888
    ports:
      - 8888:8888
      - 4040:4040
    volumes:
        - ./:/shared

  spark-master:
    hostname: spark-master
```

Configs: docker-compose.env

```
Machito:docker gregaw$ cat docker-jupyter-spark/docker-compose.env
#...

SPARK_MASTER_HOST=spark-master
SPARK_MASTER_PORT=7077
SPARK_WEBUI_PORT=9090
SPARK_WORKER_CORES=2
SPARK_WORKER_MEMORY=2G
SPARK_LOCAL_DIRS=/tmp
SPARK_WORKER_DIR=/tmp

SPARK_MASTER=spark://spark-master:7077

# Additional Spark variables used by notebook
SPARK_DRIVER_MEMORY=1G
SPARK_EXECUTOR_MEMORY=1G
SPARK_EXECUTOR_CORES=1
SPARK_NUM_EXECUTORS=4

# AWS S3 Configuration
#S3_ENDPOINT=s3.eu-central-1.amazonaws.com
#S3_PROXY_HOST=<your-proxy-host>
#S3_PROXY_PORT=<your-proxy-port>

#AWS_ACCESS_KEY_ID=<your-aws-access-key>
#AWS_SECRET_ACCESS_KEY=<your-aws-access-secret>
```



Configs [optional]: kernel.json

```
Machito:docker gregaw$ cat docker-jupyter-spark/conf/jupyter-kernels/PySpark/kernel.json
{
  "display_name": "PySpark 2.1 (Python 3.5)",
  "language": "python",
  "argv": [
    "[% ANACONDA_HOME %]/bin/python3",
    "-m", "ipykernel",
    "-f", "{connection_file}"
  ],
  "env": {
    "TZ": "UTC",
    "SPARK_MAJOR_VERSION": "${SPARK_MAJOR_VERSION}",
    "SPARK_HOME": "[% SPARK_HOME %]",
    "PYTHONPATH": "[% SPARK_HOME %]/python/:[% SPARK_HOME %]/python/lib/py4j-0.10.4-src.zip",
    "PYTHONSTARTUP": "[% SPARK_HOME %]/python/pyspark/shell.py",
    "PYTHONHASHSEED": "0",
    "SPARK_YARN_USER_ENV": "PYTHONHASHSEED=0",
    "PYSPARK_PYTHON": "[% ANACONDA_HOME %]/bin/python3",
    "PYSPARK_SUBMIT_ARGS": "--master [% SPARK_MASTER %] --driver-memory=[% SPARK_DRIVER_MEMORY %] --executor-cores=[%
SPARK_EXECUTOR_CORES %] --executor-memory=[% SPARK_EXECUTOR_MEMORY %] --num-executors=[% SPARK_NUM_EXECUTORS %]
pyspark-shell"
  }
}
```

Healthy system

The Toolbox

> cd docker-jupyter-spark

> docker network create dimajix

> docker-compose up

> docker-compose down

> docker ps

> docker inspect jupyter-notebook

> docker images

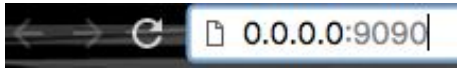
> docker stop jupyter-spark-master

> docker start jupyter-spark-master

Show Some logs

```
> docker exec -it jupyter-spark-master tail -f
/opt/spark/logs/spark--org.apache.spark.deploy.master.Master-1-spark-master.out

> docker exec -it jupyter-spark-slave-1 tail -f
/opt/spark/logs/spark--org.apache.spark.deploy.worker.Worker-1-spark-slave-1.out

> docker exec -it jupyter-spark-slave-2 tail -f
/opt/spark/logs/spark--org.apache.spark.deploy.worker.Worker-2-spark-slave-2.out
```

Spark Master



Spark Master at spark://spark-master:7077

2.2.0

URL: spark://spark-master:7077
REST URL: spark://spark-master:6066 *(cluster mode)*
Alive Workers: 2
Cores in use: 4 Total, 0 Used
Memory in use: 8.0 GB Total, 0.0 B Used
Applications: 0 Running, 13 Completed
Drivers: 0 Running, 0 Completed
Status: ALIVE

Workers

Worker Id	Address	State	Cores	Memory
worker-20171023065727-172.18.0.2-39315	172.18.0.2:39315	ALIVE	2 (0 Used)	4.0 GB (0.0 B Used)
worker-20171023065728-172.18.0.3-43191	172.18.0.3:43191	ALIVE	2 (0 Used)	4.0 GB (0.0 B Used)

Spark Worker

Spark Worker at 172.18.0.3:43191

ID: worker-20171023065728-172.18.0.3-43191
Master URL: spark://spark-master:7077
Cores: 2 (0 Used)
Memory: 4.0 GB (0.0 B Used)

Back to Master

Running Executors (0)

ExecutorID	Cores	State	Memory	Job Details	Logs

Finished Executors (12)

ExecutorID	Cores	State	Memory	Job Details	Logs
0	1	KILLED	2.0 GB	**ID:** app-20171023073418-0000 **Name:** pyspark-shell **User:** root	stdout stderr
1	1	KILLED	2.0 GB	**ID:** app-20171023073418-0000 **Name:** pyspark-shell **User:** root	stdout stderr

Spark Driver

Spark 2.2.0 | Jobs | Stages | Storage | Environment | Executors | SQL | pyspark-shell appl

Spark Jobs (?)

User: root
Total Uptime: 16 min
Scheduling Mode: FIFO
Active Jobs: 1
Completed Jobs: 11

▸ Event Timeline

Active Jobs (1)

Job Id	Description	Submitted	Duration	Stages: Succeeded/Total	Tasks (for all stages): Succeeded/Total
11	reduce at <ipython-input-12-fec2a75ec3fb>:14 (kill)	2017/10/23 14:30:44	5.7 min	0/1	0/10

Completed Jobs (11)

Job Id	Description	Submitted	Duration	Stages: Succeeded/Total	Tasks (for all stages): Succeeded/Total
10	reduce at <ipython-input-11-fec2a75ec3fb>:14	2017/10/23 14:29:17	2 s	1/1	10/10
9	reduce at <ipython-input-10-fec2a75ec3fb>:14	2017/10/23 14:28:45	2 s	1/1	10/10

Jupyter Notebook

jupyter

Files Running Clusters Conda

Select items to perform actions on them.

Upload New

Text File
Folder
Terminal

Notebooks
PySpark 2.1 (Python 3.5)
Python 3.5
Python [conda root]
Python [default]

spark-warehouse
Untitled.ipynb
Untitled1.ipynb

Drivers

Use spark-submit

```
> docker exec -it jupyter-notebook bash

# cd /opt/spark-2.2.0-bin-without-hadoop/

# bin/spark-submit --executor-memory=1G --conf "spark.driver.memory=1G" --conf
"spark.cores.max=10" --conf "spark.executor.cores=2" --master
spark://spark-master:7077 examples/src/main/python/pi.py
```

Use jupyter notebook

```
# based on pyspark standard example
from random import random
from operator import add

def within_circle_quarter (_):
    # x, y in [0,1)
    x, y = random(), random()
    return 1 if x**2 + y**2 <= 1.0 else 0

spark = SparkSession.builder.appName( 'breakit').getOrCreate()
spark.sparkContext.setLogLevel( "INFO")
n = 10000000
partitions = 10
quarter_count = spark.sparkContext.parallelize( range(n), partitions).map(within_circle_quarter).reduce(add)

pi = 4.0 * quarter_count / n

print("pi={}".format(pi))
```

GET FAMILIAR WITH RUNNING JOBS, PLAY WITH PARAMS

(SPARK-SUBMIT)

GET FAMILIAR WITH TWEAKING YOUR CLUSTER

(DOCKER-COMPOSE.ENV + DOCKER-COMPOSE UP)

GET FAMILIAR WITH INTRODUCING HAVOC

(DOCKER STOP <CONTAINER-NAME>)

Make a job Hang

Make a job Hang for Good

Get a Spark job Live-Locked

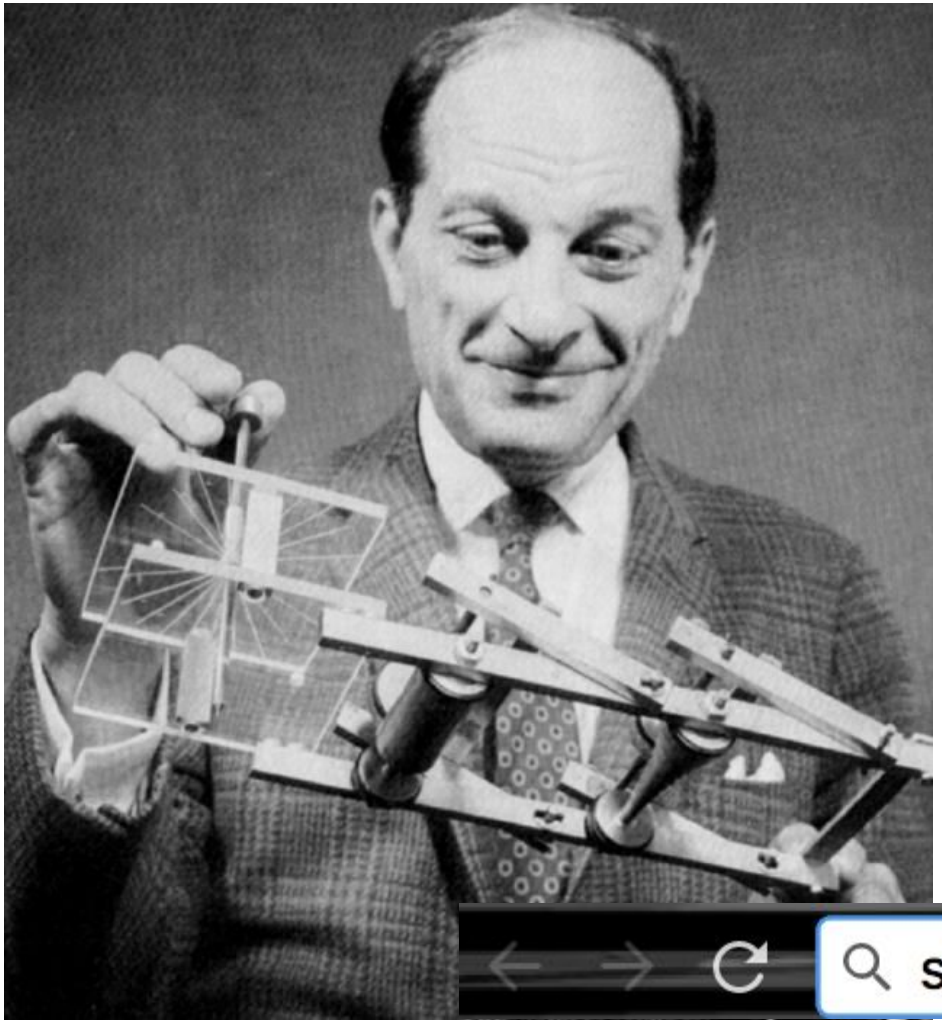
What if... you kill the Master?

What if...workers are too greedy?

What if... your driver gets too little memory?

How to Fix the LIVELOCK problem

Implement Solitaire Success Probability Estimation using Monte Carlo in SPARK

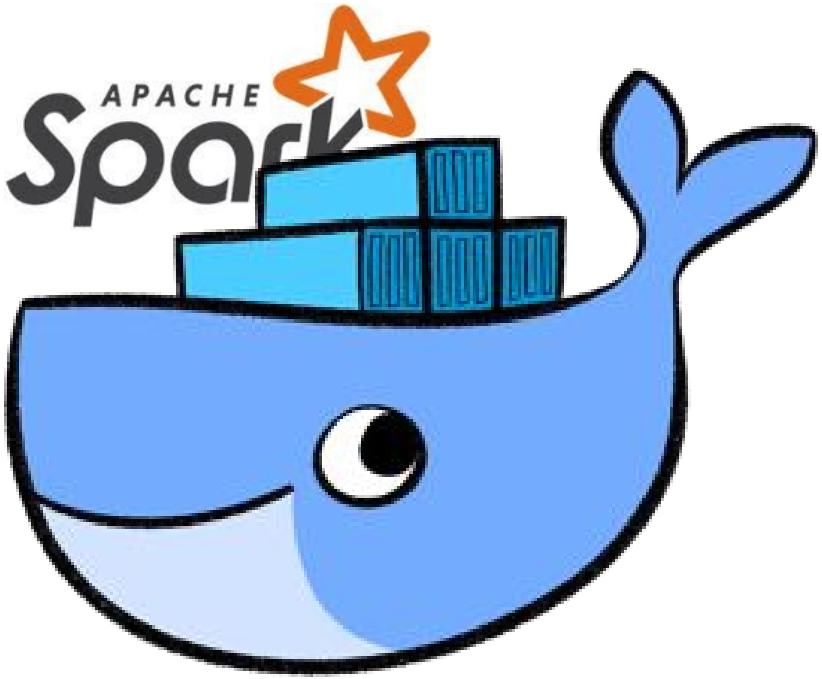


STAN ULAM, JOHN VON NEUMANN, *and the* MONTE CARLO METHOD

by Roger Eckhardt

stanislaw ulam solitaire monte carlo

Come up with your own Task



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