HU Extension   Assignment 03   E63 Big Data Analytics

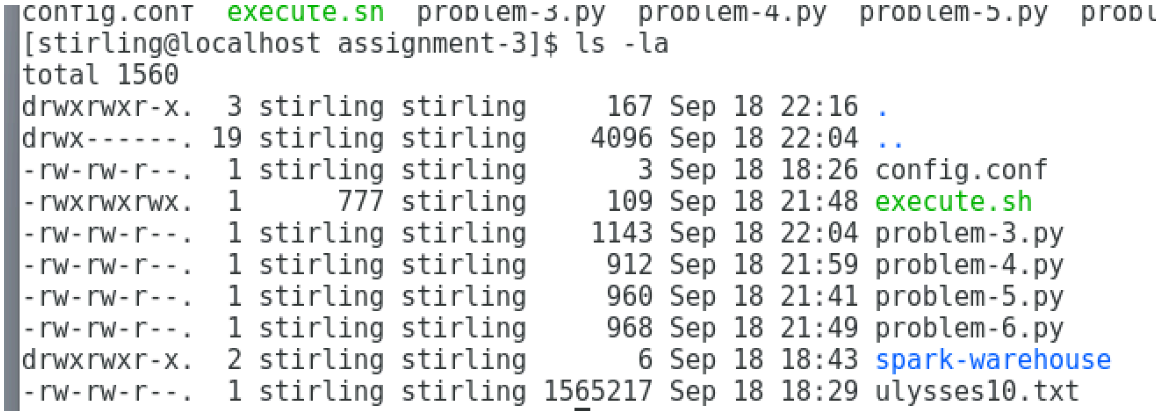
Handed out: 09/15/2017   Due by 11:59 AM EST on Saturday, 09/23/2017

Use either VMWare Workstation or VMWare Fusion
https://e5.onthehub.com/WebStore/Welcome.aspx?ws=4185a0dc-d0d1-e511-9416-b8ca3a5db7a1&vsro=8
If you feel comfortable with a virtualization technology different from VMWare, please be free to use it. Rather than creating a VM with CentOS, you can create the VM with a different flavor of Linux you more familiar with or consider better.

Problem 1. Create your own Virtual Machine with a Linux operating system. The lecture notes speak about CentOS. You are welcome to work with another Linux OS. When creating the VM, create an administrative user. Call that user whatever you feel like. Please record the password of the new user. Once the VM is created transfer the attached text file Ulysses10.txt to the home of new user. You can do it using scp (secure copy command) or email. Examine the version of Java, Python and Scala on your VM. If any of those versions is below requirements for Spark 2.2 install proper version. Set JAVA_HOME environmental variable. Set your PATH environmental variable properly, so that you can invoke: `java, sbt` and `python` commands from any directory on your system. [20%]

```
/opt2/spark-2.2.0-bin-hadoop2.7/sbin/start-master.sh
/opt2/spark-2.2.0-bin-hadoop2.7/bin/spark-submit
```

```
# Set everything to be logged to the console
log4j.rootCategory=ERROR, console
log4j.appender.console=org.apache.log4j.ConsoleAppender
log4j.appender.console.target=System.err
log4j.appender.console.layout=org.apache.log4j.PatternLayout
log4j.appender.console.layout.ConversionPattern=%d{yy/MM/dd HH:mm:ss} %p
%c{1}: %m%n
```



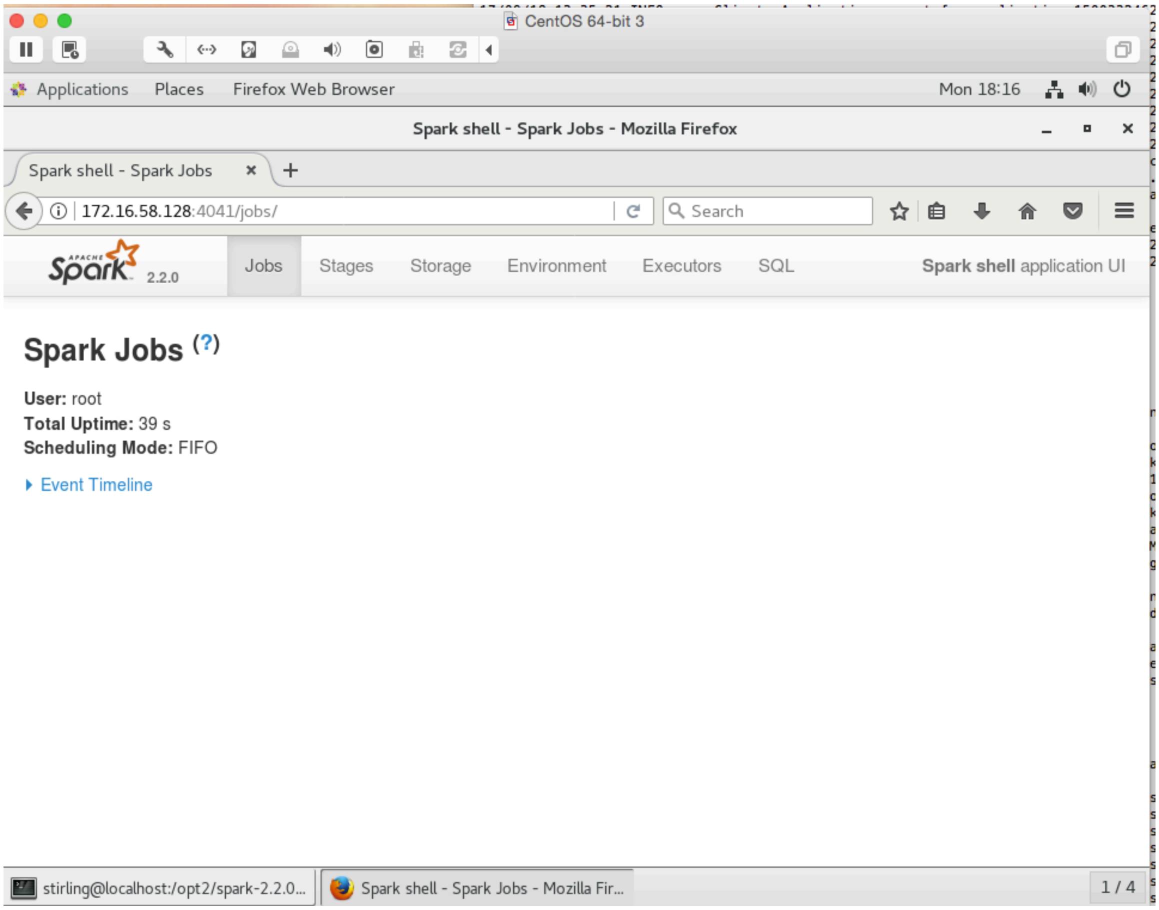
```
config.conf  execute.sh  problem-3.py  problem-4.py  problem-5.py  probl
[stirling@localhost assignment-3]$ ls -la
total 1560
drwxrwxr-x.  3 stirling stirling     167 Sep 18 22:16 .
drwx------. 19 stirling stirling    4096 Sep 18 22:04 ..
-rw-rw-r--.  1 stirling stirling       3 Sep 18 18:26 config.conf
-rwxrwxrwx.  1      777 stirling     109 Sep 18 21:48 execute.sh
-rw-rw-r--.  1 stirling stirling    1143 Sep 18 22:04 problem-3.py
-rw-rw-r--.  1 stirling stirling     912 Sep 18 21:59 problem-4.py
-rw-rw-r--.  1 stirling stirling     960 Sep 18 21:41 problem-5.py
-rw-rw-r--.  1 stirling stirling     968 Sep 18 21:49 problem-6.py
drwxrwxr-x.  2 stirling stirling       6 Sep 18 18:43 spark-warehouse
-rw-rw-r--.  1 stirling stirling 1565217 Sep 18 18:29 ulysses10.txt
```

Problem 2. Install Spark 2.2 on your VM. Make sure that `pyspark` is also installed. Demonstrate that you can successfully open `spark-shell` and that you can eliminate most of WARNing messages. [15%]

```
[stirling@localhost sbin]$ sudo spark-shell
Using Spark's default log4j profile: org/apache/spark/log4j-defaults.properties
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use
setLogLevel(newLevel).
17/09/18 18:09:56 WARN NativeCodeLoader: Unable to load native-hadoop library for
your platform... using builtin-java classes where applicable
17/09/18 18:09:57 WARN Utils: Your hostname, localhost.localdomain resolves to a
loopback address: 127.0.0.1; using 172.16.58.128 instead (on interface ens33)
17/09/18 18:09:57 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another
address
17/09/18 18:09:57 WARN Utils: Service 'SparkUI' could not bind on port 4040.
Attempting port 4041.
17/09/18 18:10:01 WARN ObjectStore: Version information not found in metastore.
hive.metastore.schema.verification is not enabled so recording the schema version 1.2.0
17/09/18 18:10:01 WARN ObjectStore: Failed to get database default, returning
NoSuchObjectException
17/09/18 18:10:02 WARN ObjectStore: Failed to get database global_temp, returning
NoSuchObjectException
Spark context Web UI available at http://172.16.58.128:4041
Spark context available as 'sc' (master = local[*], app id = local-1505772597695).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.2.0
      /_/

Using Scala version 2.11.8 (OpenJDK 64-Bit Server VM, Java 1.8.0_144)
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```



Spark Jobs (?)

User: root
Total Uptime: 39 s
Scheduling Mode: FIFO

Event Timeline

Problem 3. Find the number of lines in the text file `ulysses10.txt` that contain word "afternoon" or "night" or "morning". In this problem use RDD API. Do this in two ways, first create a lambda function which will test whether a line contains any one of those 3 words. Second, create a named function in the language of choice that returns TRUE if a line passed to it contains any one of those three words. Demonstrate that the count is the same. Use `pyspark` and Spark Python API. If convenient you are welcome to implement this problem in any other language: Scala, Java or R. [15%]

# create a lambda function which will test whether a line contains any one of those 3 words.

```
lines = sc.textFile("file:////home/stirling/assignment-3/ulysses10.txt")
wordLines = lines.filter(lambda line: "afternoon" in line or "night" in line or "morning" in line)
print(wordLines.count())
```

Answer

> 418

# Second, create a named function in the language of choice that returns TRUE if a line passed to it contains any one of those three words. Demonstrate that the count is the same.

```
def hasWords(line):
      return "afternoon" in line or "night" in line or "morning" in line

lines = sc.textFile("file:////home/stirling/assignment-3/ulysses10.txt")
wordLines = lines.filter(hasWords)
print(wordLines.count())
```

ANSWER

```
> 418
```

Problem 4. Implement the above task, finding the number of lines with one of those three words in file ulysses10.txt using Dataset/DataFrame API. Again, use the language of your choice. [20%]

```
dset = spark.read.text("file:////home/stirling/assignment-3/ulysses10.txt")
print(dset.count())
wordLines = dset.filter(dset.value.contains('afternoon') | dset.value.contains('night') |
dset.value.contains('morning'))
print(wordLines.count())
```

ANSWER

```
> 418
```

Problem 5. Create a standalone Python script that will count all words in file `ulysses10.txt`. You are expected to produce a single number. Do it using RDD API. If convenient, you are welcome to implement this problem in other languages: Scala, Java or R. [%15]

```
from pyspark import SparkConf, SparkContext, SQLContext
from pyspark.sql import SQLContext, SparkSession, Row
from pyspark.sql.types import *
from pyspark.sql.functions import *

conf = (
        SparkConf()
        .setAppName("assignment-3")
        .set("spark.executor.instances", 1)
        .set("spark.executor.cores", 1)
        .set("spark.shuffle.compress", "true")
        .set("spark.io.compression.codec", "snappy")
        .set("spark.executor.memory", "4g")
)

sc = SparkContext().getOrCreate(conf = conf)
sc.setLogLevel("ERROR")
sqlContext = SQLContext(sc)
spark = SparkSession.builder.appName("spark play").getOrCreate()

word_file = sc.textFile("file:////home/stirling/assignment-3/ulysses10.txt")
word_count = word_file.flatMap(lambda x: "".join(x).encode("utf-8",
"ignore").strip().split()).map(lambda x: (x,1)).reduceByKey(lambda a,b:
a+b).values().sum()
print("Total Word Count: {0}".format(str(word_count)))
```

Answer

```
> Total Word Count: 267,832
```

Problem 6. Create a standalone Python script that will count all words in file `ulysses10.txt`. You are expected to produce a single number. Do it using Dataset/DataFrame API. If convenient, you are welcome to implement this problem in other languages: Scala, Java or R. [%15]

```
from pyspark import SparkConf, SparkContext, SQLContext
from pyspark.sql import SQLContext, SparkSession, Row
from pyspark.sql.types import *
from pyspark.sql.functions import *

conf = (
        SparkConf()
        .setAppName("assignment-3")
        .set("spark.executor.instances", 1)
        .set("spark.executor.cores", 1)
        .set("spark.shuffle.compress", "true")
        .set("spark.io.compression.codec", "snappy")
        .set("spark.executor.memory", "4g")
)

sc = SparkContext().getOrCreate(conf = conf)
sc.setLogLevel("ERROR")
sqlContext = SQLContext(sc)
spark = SparkSession.builder.appName("spark play").getOrCreate()

word_file = spark.read.text("file:////home/stirling/assignment-3/ulysses10.txt")

word_count = word_file.rdd.flatMap(lambda x: "".join(x).encode("utf-8",
"ignore").strip().split()).map(lambda x: (x,1)).reduceByKey(lambda a,b:
a+b).values().sum()
print("Total Word Count: {0}".format(str(word_count)))
```

Answer

```
> Total Word Count: 267,832
```

Please, describe every step of your work and present all intermediate and final results in a Word document. Please, copy past text version of all essential command and snippets of results into the Word document with explanations of the purpose of those commands. We cannot retype text that is in JPG images. Please, always submit a separate copy of the original, working scripts and/or class files you used. Sometimes we need to run your code and retyping is too costly. Please include in your MS Word document only relevant portions of the console output or output files. Sometime either console output or the result file is too long and including it into the MS Word document makes that document too hard to read. PLEASE COPY Snippets of your Code but DO NOT EMBED files into your MS Word document. For issues and comments visit the class Discussion Board on Piazza.