MSDS610 Week 6 Spark Assignment - Nathan Worsham

I installed the latest Spark and chose to download the package that was prebuilt for Hadoop 2.6 and later. Then as usual, unpacked it, and created a sym link.

```
spark-1.6.0-bin-hadoop2.6/examples/src/main/resources/people.txt
spark-1.6.0-bin-hadoop2.6/examples/src/main/resources/full_user.avsc
spark-1.6.0-bin-hadoop2.6/examples/src/main/resources/users.parquet
spark-1.6.0-bin-hadoop2.6/examples/src/main/resources/users.avro
spark-1.6.0-bin-hadoop2.6/examples/src/main/resources/people.json
spark-1.6.0-bin-hadoop2.6/examples/src/main/resources/user.avsc
spark-1.6.0-bin-hadoop2.6/NOTICE
spark-1.6.0-bin-hadoop2.6/RELEASE
[hadoop@week1 ~]$ ls
apache-hive-1.2.1-bin  hadoopdata   hive          ml-100k.zip  pig_1455010061684.log  pigtutorial.tar.g
derby.log              hbase        metastore_db  pig          pig_test               scripts
hadoop                 hbase-1.1.2  ml-100k       pig-0.15.0   pigtmp                 shakespeareoutput
[hadoop@week1 ~]$ ln -s /home/hadoop/spark-1.6.0-bin-hadoop2.6 /home/hadoop/spark
[hadoop@week1 ~]$ ls -l
total 302280
drwxr-xr-x.  8 hadoop hadoop      4096 Feb  1 21:53 apache-hive-1.2.1-bin
-rw-rw-r--.  1 hadoop hadoop     21058 Feb  3 22:31 derby.log
drwxr-xr-x. 10 hadoop hadoop      4096 Feb  9 02:14 hadoop
drwxrwxr-x.  3 hadoop hadoop        17 Jan 12 17:44 hadoopdata
drwxrwxr-x.  8 hadoop hadoop      4096 Jan 25 19:36 hbase
drwxr-xr-x.  8 hadoop hadoop      4096 Jan 25 19:12 hbase-1.1.2
lrwxrwxrwx.  1 root   root          34 Feb  1 21:54 hive -> /home/hadoop/apache-hive-1.2.1-bin
drwxrwxr-x.  5 hadoop hadoop      4096 Feb  3 22:31 metastore_db
drwxr-x---.  2 hadoop hadoop      4096 Jan 29 13:26 ml-100k
-rw-rw-r--.  1 hadoop hadoop   4924029 Jan 29 13:28 ml-100k.zip
lrwxrwxrwx.  1 hadoop hadoop        23 Feb  8 21:48 pig -> /home/hadoop/pig-0.15.0
drwxr-xr-x. 16 hadoop hadoop      4096 Jun  1  2015 pig-0.15.0
-rw-rw-r--.  1 hadoop hadoop      5230 Feb  9 02:37 pig_1455010061684.log
drwxr-xr-x. 18 hadoop hadoop      4096 Feb  9 07:01 pig_test
drwxr-xr-x.  4 hadoop hadoop      4096 Feb 10 09:56 pigtmp
-rw-rw-r--.  1 hadoop hadoop  10467367 Feb  9 07:16 pigtutorial.tar.gz
drwxrwxr-x.  2 hadoop hadoop        30 Feb  2 21:41 scripts
-rw-r--r--.  1 hadoop hadoop    356409 Jan 12 20:04 shakespeareoutput.txt
-rw-rw-r--.  1 hadoop hadoop   4538523 Aug 16  2011 shakespeare.txt
lrwxrwxrwx.  1 hadoop hadoop        38 Feb 15 12:03 spark -> /home/hadoop/spark-1.6.0-bin-hadoop2.6
drwxr-xr-x. 12 hadoop hadoop      4096 Dec 21 19:22 spark-1.6.0-bin-hadoop2.6
-rw-rw-r--.  1 hadoop hadoop 289160984 Dec 28 16:21 spark-1.6.0-bin-hadoop2.6.tgz
drwxrwxr-x.  4 hadoop hadoop        51 Jan 25 22:38 zookeeper
[hadoop@week1 ~]$
```

As far as configuration went, it seemed just a couple of environmental variables needed to be set. HADOOP_CONF_DIR was already set from last week, so I just set SPARK_DIST_CLASSPATH–to $HADOOP_HOME–and SPARK_LOCAL_IP to 10.0.2.15. By the end of the assignment I realized I needed/wanted one last environmental variable because I was once again getting a similar warning to week 1–

```
Unable to load native-hadoop library for your platform... using builtin-java classes
where applicable
```

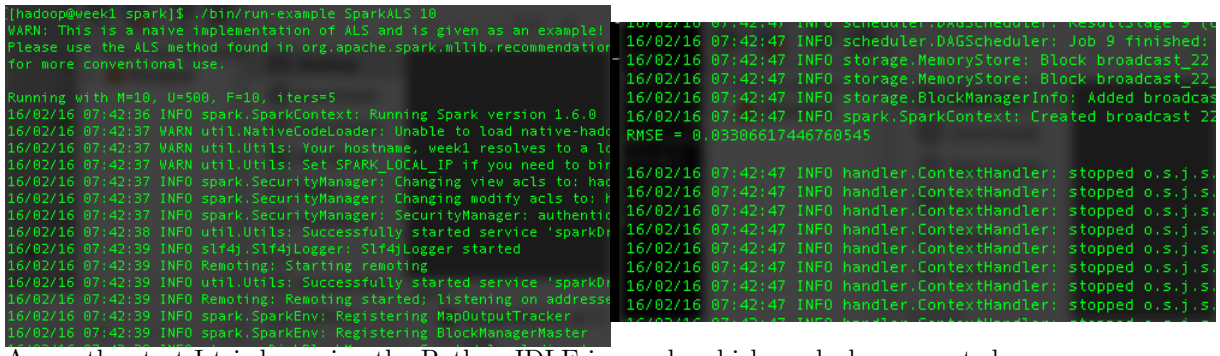
in week 1 I ended up setting the JAVA_LIBRARY_PATH, which was still set but not fixing the problem. I ended up setthing the following to fix it:

```
export LD_LIBRARY_PATH=$HADOOP_HOME/lib/native:$LD_LIBRARY_PATH
```

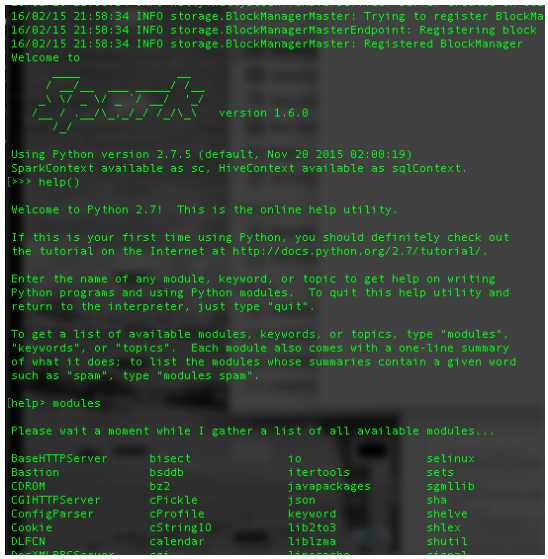
I then ran the example Scala command it gave of `./bin/run-example SparkPi 10`. Even after scanning the output I wasn't sure what I was supposed to look for or what the script even did. After looking through the actual script, I realized that somewhere in the mash of text that it was supposed to output "Pi is roughly..." and that really is all the example script does is calculate Pi, though I ran the script several times and each time the output is slightly different. I seems that number at the end of the command tells Spark how many processes or threads to split the job into.

```
16/02/15 16:05:51 INFO executor.Executor: Finished task 9.0 in stage 0.0 (TID 9). 1031 bytes result sent to driver
16/02/15 16:05:51 INFO scheduler.TaskSetManager: Finished task 9.0 in stage 0.0 (TID 9) in 58 ms on localhost (10/10)
16/02/15 16:05:51 INFO scheduler.DAGScheduler: ResultStage 0 (reduce at SparkPi.scala:36) finished in 2.152 s
16/02/15 16:05:51 INFO scheduler.TaskSchedulerImpl: Removed TaskSet 0.0, whose tasks have all completed, from pool
16/02/15 16:05:51 INFO scheduler.DAGScheduler: Job 0 finished: reduce at SparkPi.scala:36, took 2.750919 s
Pi is roughly 3.142512
16/02/15 16:05:51 INFO handler.ContextHandler: stopped o.s.j.s.ServletContextHandler{/metrics/json,null}
16/02/15 16:05:51 INFO handler.ContextHandler: stopped o.s.j.s.ServletContextHandler{/stages/stage/kill,null}
16/02/15 16:05:51 INFO handler.ContextHandler: stopped o.s.j.s.ServletContextHandler{/api,null}
16/02/15 16:05:51 INFO handler.ContextHandler: stopped o.s.j.s.ServletContextHandler{/,null}
```

I went ahead an looked through the scala examples directory but wasn't really sure how to use all of these examples. I did go ahead and try running the SplarkALS example in the same manner as the SparkPi example. This did seem to work, it outputted an RMSE (root-mean-square-error) value from 5 iterations. Though I'm not sure what the values indicate.



As another test I tried running the Python IDLE in spark, which worked as expected.



Scala Shell

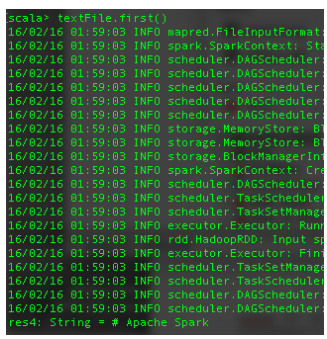
I connected to the Scala shell as directed and it worked as expected. I am not familiar with scala, but looking it up on the internet seems it is a programming language whose name means "scalable language" (scala-lang.org, 2016). Continuing on, it appears that `val` must set a variable or object and I successfully set the readme file to the `textFile` object. However when I tried the next line to count the words in the file I received and error about the input path not existing in the HDFS.

I went ahead and using `copyFromLocal`, copied the file to the HDFS but again received the same error. I came across a stackoverflow.com (2014) thread that had a very similar problem, the solution was to use `"file:///home/hadoop/spark/README.md"` instead of just `"README.md"`. I went ahead and tried this but the first time I did not put enough forward slashes and received an error message of

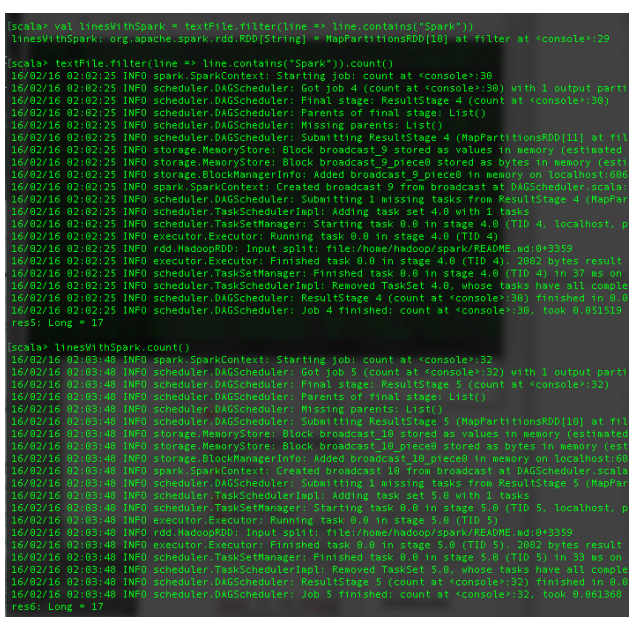
```
Wrong FS: file://home/hadoop/spark/README.md, expected: file:///
```

After I did it correctly, this time I received the correct output. Although the number for "Long" I received was 95 and not 126 like the example stated. I decided one way to confirm this was correct was to run the python version it provides and sure enough I received 95 as well.

Next I confirmed that "Apache Spark" is the first item.



The remaining portion of the "Basics" section did not make a lot of sense to me. First it asks you to create a variable or value with the text file filtered with lines that contain "Spark"–which worked fine. But in the following command it ignores the variable just created and uses the filter again then `.count()` on the end. I went ahead and did it their way first, which returned 17 as an answer, but then I tried it as `linesWithSpark.count()` which returned the same value.



For the "More on RDD Operations" section, I received the answer of line 14 being the longest, however I found it fairly tough trying to understand the command they gave. I even took a look at the Python version–since I am more familiar with Python–but that seemed even more cryptic. The exercise goes on to say to make the command "easier" to understand it uses the `Math.max()`function but again I'm not familiar with it, so it doesn't clear up much for me but does confirm the same output of 14. That being said, looking at the Python version of the example, it shows it using a custom function instead and the function is much easier to read.

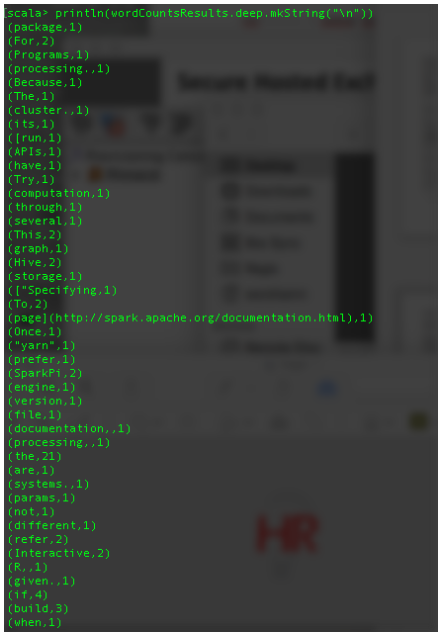
```
scala> textFile.map(line => line.split(" ").size).reduce((a, b) => if (a > b) a else b)
16/02/16 02:18:59 INFO spark.SparkContext: Starting job: reduce at <console>:30
16/02/16 02:18:59 INFO scheduler.DAGScheduler: Got job 7 (reduce at <console>:30) with 1
16/02/16 02:18:59 INFO scheduler.DAGScheduler: Final stage: ResultStage 7 (reduce at <co
16/02/16 02:18:59 INFO scheduler.DAGScheduler: Parents of final stage: List()
16/02/16 02:18:59 INFO scheduler.DAGScheduler: Missing parents: List()
16/02/16 02:18:59 INFO scheduler.DAGScheduler: Submitting ResultStage 7 (MapPartitionsRD
16/02/16 02:18:59 INFO storage.MemoryStore: Block broadcast_12 stored as values in memor
16/02/16 02:18:59 INFO storage.MemoryStore: Block broadcast_12_piece0 stored as bytes in
16/02/16 02:18:59 INFO storage.BlockManagerInfo: Added broadcast_12_piece0 in memory on
16/02/16 02:18:59 INFO spark.SparkContext: Created broadcast 12 from broadcast at DAGSch
16/02/16 02:18:59 INFO scheduler.DAGScheduler: Submitting 1 missing tasks from ResultSta
16/02/16 02:18:59 INFO scheduler.TaskSchedulerImpl: Adding task set 7.0 with 1 tasks
16/02/16 02:18:59 INFO scheduler.TaskSetManager: Starting task 0.0 in stage 7.0 (TID 7,
16/02/16 02:18:59 INFO executor.Executor: Running task 0.0 in stage 7.0 (TID 7)
16/02/16 02:18:59 INFO rdd.HadoopRDD: Input split: file:/home/hadoop/spark/README.md:0+3
16/02/16 02:18:59 INFO executor.Executor: Finished task 0.0 in stage 7.0 (TID 7). 2160 b
16/02/16 02:18:59 INFO scheduler.TaskSetManager: Finished task 0.0 in stage 7.0 (TID 7)
16/02/16 02:18:59 INFO scheduler.TaskSchedulerImpl: Removed TaskSet 7.0, whose tasks hav
16/02/16 02:18:59 INFO scheduler.DAGScheduler: ResultStage 7 (reduce at <console>:30) fi
16/02/16 02:18:59 INFO scheduler.DAGScheduler: Job 7 finished: reduce at <console>:30, t
res11: Int = 14
```

```
scala> import java.lang.Math
import java.lang.Math

scala> textFile.map(line => line.split(" ").size).reduce((a, b) => Math.max(a, b))
16/02/16 02:31:01 INFO spark.SparkContext: Starting job: reduce at <console>:31
16/02/16 02:31:01 INFO scheduler.DAGScheduler: Got job 8 (reduce at <console>:31) w
16/02/16 02:31:01 INFO scheduler.DAGScheduler: Final stage: ResultStage 8 (reduce a
16/02/16 02:31:01 INFO scheduler.DAGScheduler: Parents of final stage: List()
16/02/16 02:31:01 INFO scheduler.DAGScheduler: Missing parents: List()
16/02/16 02:31:01 INFO scheduler.DAGScheduler: Submitting ResultStage 8 (MapPartiti
16/02/16 02:31:01 INFO storage.MemoryStore: Block broadcast_13 stored as values in
16/02/16 02:31:01 INFO storage.MemoryStore: Block broadcast_13_piece0 stored as byt
16/02/16 02:31:01 INFO storage.BlockManagerInfo: Added broadcast_13_piece0 in memor
16/02/16 02:31:01 INFO spark.SparkContext: Created broadcast 13 from broadcast at D
16/02/16 02:31:01 INFO scheduler.DAGScheduler: Submitting 1 missing tasks from Resu
16/02/16 02:31:01 INFO scheduler.TaskSchedulerImpl: Adding task set 8.0 with 1 task
16/02/16 02:31:01 INFO scheduler.TaskSetManager: Starting task 0.0 in stage 8.0 (TI
16/02/16 02:31:01 INFO executor.Executor: Running task 0.0 in stage 8.0 (TID 8)
16/02/16 02:31:01 INFO rdd.HadoopRDD: Input split: file:/home/hadoop/spark/README.m
16/02/16 02:31:01 INFO executor.Executor: Finished task 0.0 in stage 8.0 (TID 8). 2
16/02/16 02:31:01 INFO scheduler.TaskSetManager: Finished task 0.0 in stage 8.0 (TI
16/02/16 02:31:01 INFO scheduler.TaskSchedulerImpl: Removed TaskSet 8.0, whose task
16/02/16 02:31:01 INFO scheduler.DAGScheduler: ResultStage 8 (reduce at <console>:3
16/02/16 02:31:01 INFO scheduler.DAGScheduler: Job 8 finished: reduce at <console>:
res12: Int = 14
```

Finally I did the per-word counts as directed. I found it strange that the output was cut off.

```
scala> val wordCounts = textFile.flatMap(line => line.split(" ")).map(word => (word, 1)).reduceByKey((a, b) => a + b)
wordCounts: org.apache.spark.rdd.RDD[(String, Int)] = ShuffledRDD[16] at reduceByKey at <console>:30

scala> wordCounts.collect()
16/02/16 02:39:36 INFO spark.SparkContext: Starting job: collect at <console>:33
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Registering RDD 15 (map at <console>:30)
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Got job 9 (collect at <console>:33) with 1 output partitions
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Final stage: ResultStage 10 (collect at <console>:33)
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Parents of final stage: List(ShuffleMapStage 9)
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Missing parents: List(ShuffleMapStage 9)
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Submitting ShuffleMapStage 9 (MapPartitionsRDD[15] at map at <console>:30), wh
16/02/16 02:39:36 INFO storage.MemoryStore: Block broadcast_14 stored as values in memory (estimated size 4.1 KB, free 1011.4
16/02/16 02:39:36 INFO storage.MemoryStore: Block broadcast_14_piece0 stored as bytes in memory (estimated size 2.3 KB, free
16/02/16 02:39:36 INFO storage.BlockManagerInfo: Added broadcast_14_piece0 in memory on localhost:60615 (size: 2.3 KB, free:
16/02/16 02:39:36 INFO spark.SparkContext: Created broadcast 14 from broadcast at DAGScheduler.scala:1006
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Submitting 1 missing tasks from ShuffleMapStage 9 (MapPartitionsRDD[15] at map
16/02/16 02:39:36 INFO scheduler.TaskSchedulerImpl: Adding task set 9.0 with 1 tasks
16/02/16 02:39:36 INFO scheduler.TaskSetManager: Starting task 0.0 in stage 9.0 (TID 9, localhost, partition 0,PROCESS_LOCAL,
16/02/16 02:39:36 INFO executor.Executor: Running task 0.0 in stage 9.0 (TID 9)
16/02/16 02:39:36 INFO rdd.HadoopRDD: Input split: file:/home/hadoop/spark/README.md:0+3359
16/02/16 02:39:36 INFO executor.Executor: Finished task 0.0 in stage 9.0 (TID 9). 2253 bytes result sent to driver
16/02/16 02:39:36 INFO scheduler.TaskSetManager: Finished task 0.0 in stage 9.0 (TID 9) in 277 ms on localhost (1/1)
16/02/16 02:39:36 INFO scheduler.TaskSchedulerImpl: Removed TaskSet 9.0, whose tasks have all completed, from pool
16/02/16 02:39:36 INFO scheduler.DAGScheduler: ShuffleMapStage 9 (map at <console>:30) finished in 0.281 s
16/02/16 02:39:36 INFO scheduler.DAGScheduler: looking for newly runnable stages
16/02/16 02:39:36 INFO scheduler.DAGScheduler: running: Set()
16/02/16 02:39:36 INFO scheduler.DAGScheduler: waiting: Set(ResultStage 10)
16/02/16 02:39:36 INFO scheduler.DAGScheduler: failed: Set()
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Submitting ResultStage 10 (ShuffledRDD[16] at reduceByKey at <console>:30), wh
16/02/16 02:39:36 INFO storage.MemoryStore: Block broadcast_15 stored as values in memory (estimated size 2.6 KB, free 1016.3
16/02/16 02:39:36 INFO storage.MemoryStore: Block broadcast_15_piece0 stored as bytes in memory (estimated size 1589.0 B, fre
16/02/16 02:39:36 INFO storage.BlockManagerInfo: Added broadcast_15_piece0 in memory on localhost:60615 (size: 1589.0 B, free
16/02/16 02:39:36 INFO spark.SparkContext: Created broadcast 15 from broadcast at DAGScheduler.scala:1006
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Submitting 1 missing tasks from ResultStage 10 (ShuffledRDD[16] at reduceByKey
16/02/16 02:39:36 INFO scheduler.TaskSchedulerImpl: Adding task set 10.0 with 1 tasks
16/02/16 02:39:36 INFO scheduler.TaskSetManager: Starting task 0.0 in stage 10.0 (TID 10, localhost, partition 0,NODE_LOCAL,
16/02/16 02:39:36 INFO executor.Executor: Running task 0.0 in stage 10.0 (TID 10)
16/02/16 02:39:36 INFO storage.ShuffleBlockFetcherIterator: Getting 1 non-empty blocks out of 1 blocks
16/02/16 02:39:36 INFO storage.ShuffleBlockFetcherIterator: Started 0 remote fetches in 4 ms
16/02/16 02:39:36 INFO executor.Executor: Finished task 0.0 in stage 10.0 (TID 10). 7240 bytes result sent to driver
16/02/16 02:39:36 INFO scheduler.TaskSetManager: Finished task 0.0 in stage 10.0 (TID 10) in 195 ms on localhost (1/1)
16/02/16 02:39:36 INFO scheduler.TaskSchedulerImpl: Removed TaskSet 10.0, whose tasks have all completed, from pool
16/02/16 02:39:36 INFO scheduler.DAGScheduler: ResultStage 10 (collect at <console>:33) finished in 0.196 s
16/02/16 02:39:36 INFO scheduler.DAGScheduler: Job 9 finished: collect at <console>:33, took 0.517923 s
res13: Array[(String, Int)] = Array((package,1), (For,2), (Programs,1), (processing.,1), (Because,1), (The,1), (cluster.,1),
rough,1), (several,1), (This,2), (graph,1), (Hive,2), (storage,1), (["Specifying,1), (To,2), (page](http://spark.apache.org/d
, (engine,1), (version,1), (file,1), (documentation,,1), (processing,,1), (the,21), (are,1), (systems.,1), (params,1), (not,1
f,4), (build,3), (when,1), (be,2), (Tests,1), (Apache,1), (./bin/run-example,2), (programs,,1), (including,3), (Spark.,1), (p
>>,1), (programming,1), (...
```

I found I could list all of the output using `println(wordCountsResults.deep.mkString("\n"))`.



References

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