Spark 安裝介紹

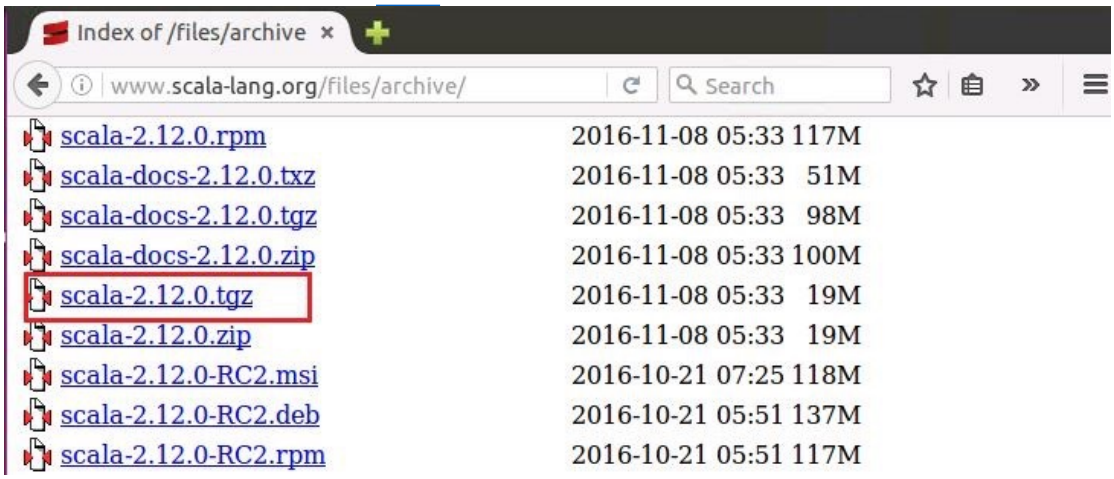
Spark Cluster Manager可以執行在下列模式：

1. 本機執行(Local Machine)：於本機執行，適合入門學習，測試用。
2. Spark Standalone cluster：由Spark提供的cluster管理模式，若沒有架設Hadoop Multi Node cluster，可以用本模式操作HDFS。
3. Hadoop YARN：於YARN上執行，由YARN進行多台機器的資源管理。
4. 雲端執行：針對更大型規模的計算工作，可以將Spark程式在雲端執行，如AWS的EC2平台。

本文將教導本機執行和Spark Standalone cluster和YARN的安裝和執行方式。

1. Scala安裝

- Spark可以用python、Java等多種語言執行，本文選擇scala為主
- 下載 Scala，可於網址看到不同版本的Scala



- 執行 wget http://www.scala-lang.org/files/archive/scala-2.12.0.tgz

- 解壓縮Scala，輸入 tar xvf scala-2.12.0.tgz

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ tar xvf scala-2.12.0.tgz
scala-2.12.0/
scala-2.12.0/man/
scala-2.12.0/man/man1/
scala-2.12.0/man/man1/scala.1
scala-2.12.0/man/man1/scalap.1
scala-2.12.0/man/man1/fsc.1
scala-2.12.0/man/man1/scaladoc.1
scala-2.12.0/man/man1/scalac.1
scala-2.12.0/bin/
scala-2.12.0/bin/scalac
```

- 搬移至/usr/local下，輸入 sudo mv scala-2.12.0 /usr/local/scala

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ sudo mv scala-2.12.0 /usr/local/scala
[sudo] password for hduser:
hduser@hadoopmaster:~$
```

- 編輯~/.bashrc，輸入 sudo gedit ~/.bashrc

```
Export SCALA_HOME=/usr/local/scala
Export PATH=$PATH:$SCALA_HOME/bin
```

```
hduser@hadoopmaster:~$ sudo gedit ~/.bashrc
Open ▾   *.bashrc ~/   Save
export YARN_HOME=$HADOOP_HOME
export HADOOP_COMMON_LIB_NATIVE_DIR=$HADOOP_HOME/lib/native
export HADOOP_OPTS="-Djava.library.path=$HADOOP_HOME/lib"
export JAVA_LIBRARY_PATH=$HADOOP_HOME/lib/native:$JAVA_LIBRARY_PATH
#Hadoop Variables
#SCALA Variables
export SCALA_HOME=/usr/local/scala
export PATH=$PATH:$SCALA_HOME/bin
#SCALA Variables
```

- 讓~/.bashrc生效，輸入source ~/.bashrc

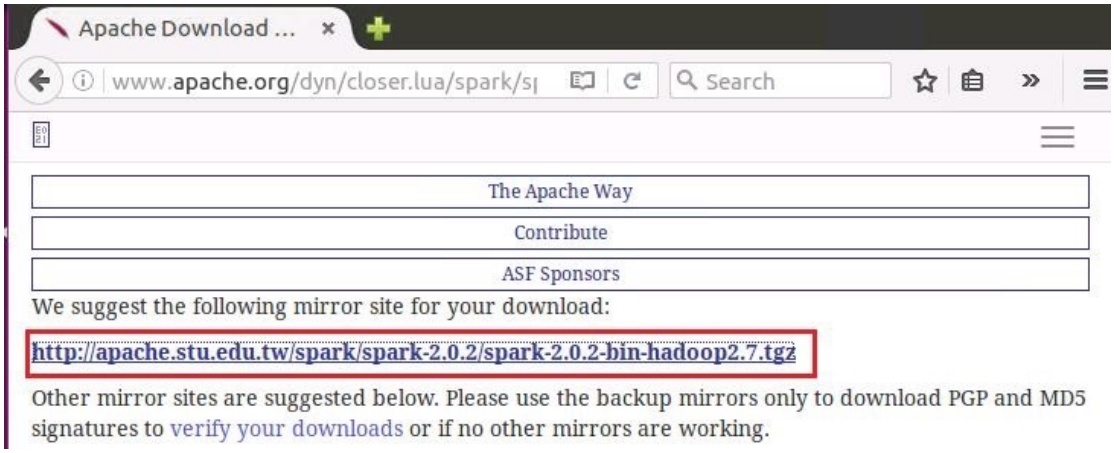
```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ source ~/.bashrc
hduser@hadoopmaster:~$ ~
```

- 到此即可執行Scala，輸入 scala，測試輸入程式執行

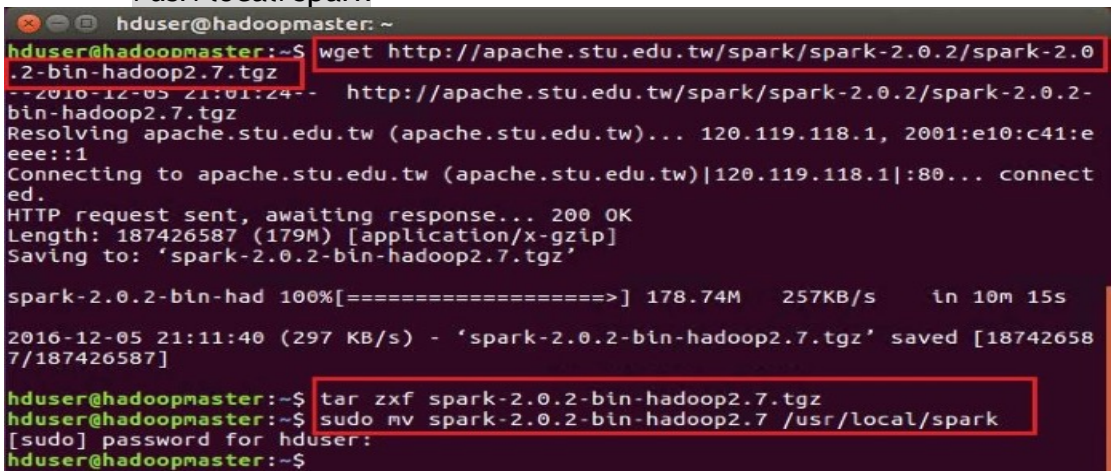
```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ scala
Welcome to Scala 2.12.0 (OpenJDK 64-Bit Server VM, Java 1.8.0_111).
Type in expressions for evaluation. Or try :help.

scala> 1+1
res0: Int = 2

scala> :q
hduser@hadoopmaster:~$
```

2. 安裝Spark

- 到Spark網址下載Spark，注意需配合Hadoop版本來選擇Spark版本



- 下載Spark，輸入 wget http://apache.stu.edu.tw/spark/spark-2.0.2/spark-2.0.2-bin-hadoop2.7.tgz
- 解壓縮，輸入 tar zxf spark-2.0.2-bin-hadoop2.7.tgz
- 搬移至/usr/local/spark下，輸入 sudo mv spark-2.0.2-bin-hadoop2.7 /usr/local/spark



- 編輯~/.bashrc，輸入 sudo gedit ~/.bashrc

```
Export SPARK_HOME=/usr/local/spark
Export PATH=$PATH:$SPARK_HOME/bin
```

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ sudo gedit ~/.bashrc
```

```
Open ▾        *.bashrc        Save
#Hadoop Variables
#SCALA Variables
export SCALA_HOME=/usr/local/scala
export PATH=$PATH:$SCALA_HOME/bin
#SCALA Variables
#SPARK Variables
export SPARK_HOME=/usr/local/spark
export PATH=$PATH:$SPARK_HOME/bin
#SPARK Variables
```

- 讓設定生效，輸入 source ~/.bashrc

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ source ~/.bashrc
hduser@hadoopmaster:~$
```

- 啟動spark-shell，輸入spark-shell

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ 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).
16/12/05 21:19:21 WARN NativeCodeLoader: Unable to load native-hadoop library fo
r your platform... using builtin-java classes where applicable
16/12/05 21:19:26 WARN SparkContext: Use an existing SparkContext, some configur
ation may not take effect.
Spark context Web UI available at http://192.168.59.137:4040
Spark context available as 'sc' (master = local[*], app id = local-1480943965187
).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.0.2
      /_/

Using Scala version 2.11.8 (OpenJDK 64-Bit Server VM, Java 1.8.0_111)
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```

- 設定spark-shell互動介面的顯示訊息，因為預設會顯示過多訊息，影響閱讀。
  i. cd /usr/local/spark/conf
  ii. cp log4j.properties.template log4j.properties
  iii. 編輯log4j.properties，輸入sudo gedit log4j.properties

```
hduser@hadoopmaster: /usr/local/spark/conf
hduser@hadoopmaster:~$ cd /usr/local/spark/conf
hduser@hadoopmaster:/usr/local/spark/conf$ cp log4j.properties.template log4j.pr
operties
hduser@hadoopmaster:/usr/local/spark/conf$ sudo gedit log4j.properties
Open ▾                *log4j.properties                Save
                      /usr/local/spark/conf
# limitations under the License.
#

# Set everything to be logged to the console
log4j.rootCategory=WARN, 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
```

- 再次進入spark-shell，輸入spark-shell，會發現少了一些訊息

```
hduser@hadoopmaster: /usr/local/spark/conf
hduser@hadoopmaster:/usr/local/spark/conf$ spark-shell
16/12/05 21:28:31 WARN NativeCodeLoader: Unable to load native-hadoop library fo
r your platform... using builtin-java classes where applicable
16/12/05 21:28:36 WARN SparkContext: Use an existing SparkContext, some configur
ation may not take effect.
Spark context Web UI available at http://192.168.59.137:4040
Spark context available as 'sc' (master = local[*], app id = local-1480944514757
).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.0.2
      /_/

Using Scala version 2.11.8 (OpenJDK 64-Bit Server VM, Java 1.8.0_111)
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```

3. 本機執行Spark

- 啟動虛擬機HadoopMaster、HadoopSlave1、HadoopSlave2
- 啟動Hadoop，於HadoopMaster輸入 start-all.sh

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ start-all.sh
This script is Deprecated. Instead use start-dfs.sh and start-yarn.sh
Starting namenodes on [hadoopmaster]
hadoopmaster: starting namenode, logging to /usr/local/hadoop/logs/hadoop-hduser
-namenode-hadoopmaster.out
hadoopslave1: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser
-datanode-hadoopslave1.out
hadoopslave2: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser
-datanode-hadoopslave2.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /usr/local/hadoop/logs/hadoop-hd
user-secondarynamenode-hadoopmaster.out
starting yarn daemons
starting resourcemanager, logging to /usr/local/hadoop/logs/yarn-hduser-resource
manager-hadoopmaster.out
hadoopslave1: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduse
r-nodemanager-hadoopslave1.out
hadoopslave2: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduse
r-nodemanager-hadoopslave2.out
hduser@hadoopmaster:~$
```

- 進入spark-shell，輸入spark-shell --master local[4]

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ spark-shell --master local[4]
16/12/09 19:44:30 WARN NativeCodeLoader: Unable to load native-hadoop library fo
r your platform... using builtin-java classes where applicable
16/12/09 19:44:36 WARN SparkContext: Use an existing SparkContext, some configur
ation may not take effect.
Spark context Web UI available at http://192.168.59.137:4040
Spark context available as 'sc' (master = local[4], app id = local-1481283874802
).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.0.2
      /_/

Using Scala version 2.11.8 (OpenJDK 64-Bit Server VM, Java 1.8.0_111)
Type in expressions to have them evaluated.
Type :help for more information.
```

- 測試讀取本機檔案，輸入
  i. val textFile=sc.textFile(“file:/usr/local/spark/README.md”)
  ii. textFile.count

```
scala> val textFile=sc.textFile("file:/usr/local/spark/README.md")
textFile: org.apache.spark.rdd.RDD[String] = file:/usr/local/spark/README.md Map
PartitionsRDD[1] at textFile at <console>:24

scala> textFile.count
res0: Long = 99
```

- 讀取HDFS的檔案(假設在HDFS上有一個/user/hduser/test/README.txt的檔案)
  iii. val textFile=sc.textFile(“hdfs://hadoopmaster:9000/user/hduser/test/README.txt”)
  iv. textFile.count

```
scala> val textFile = sc.textFile("hdfs://hadoopmaster:9000/user/hduser/test/REA
DME.txt")
textFile: org.apache.spark.rdd.RDD[String] = hdfs://hadoopmaster:9000/user/hduse
r/test/README.txt MapPartitionsRDD[5] at textFile at <console>:24

scala> textFile.count()
res2: Long = 31

scala>
```

4. 在Spark standalone cluster環境執行
   - 自樣本建立spark-env.sh檔案，輸入cp /usr/local/spark/conf/spark-env.sh.template /usr/local/spark/conf/spark-env.sh

```
hduser@hadoopmaster:~$ cp /usr/local/spark/conf/spark-env.sh.template  /usr/loca
l/spark/conf/spark-env.sh
```

   - 設定spark-env.sh，設定每個worker的資源分配，輸入sudo gedit /usr/local/spark/conf/spark-env.sh(注意：**每個worker的記憶體不得低於1G**，否則無法運行)

```
export SPARK_MASTER_IP=hadoopmaster
export SPARK_WORKER_CORE=1
export SPARK_WORKER_MEMORY=1g
export SPARK_WORKER_INSTANCES=2
```

```
Open ▾   *spark-env.sh  /usr/local/spark/conf   Save
# - SPARK_NICENESS       The scheduling priority for daemons. (Default: 0)
#export SPARK_MASTER_IP=hadoopmaster
export SPARK_MASTER_IP=hadoopmaster
export SPARK_WORKER_CORE=1
export SPARK_WORKER_MEMORY=1g
export SPARK_WORKER_INSTANCES=2
```

   - 將hadoopmaster的Spark程式複製到HadoopSlave1，輸入以下指令
     i. ssh hadoopslave1
     ii. sudo mkdir /usr/local/spark
     iii. sudo chown hduser:hduser /usr/local/spark
     iv. exit

```
hduser@hadoopmaster:~$ ssh hadoopslave1
Welcome to Ubuntu 16.04.1 LTS (GNU/Linux 4.4.0-31-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

196 packages can be updated.
4 updates are security updates.

*** System restart required ***
Last login: Thu Dec  8 20:24:01 2016 from 192.168.59.137
hduser@hadoopslave1:~$ sudo mkdir /usr/local/spark
[sudo] password for hduser:
hduser@hadoopslave1:~$ sudo chown hduser:hduser /usr/local/spark
hduser@hadoopslave1:~$ exit
logout
Connection to hadoopslave1 closed.
hduser@hadoopmaster:~$ sudo scp -r /usr/local/spark hduser@hadoopslave1:/usr/loc
al
The authenticity of host 'hadoopslave1 (192.168.59.134)' can't be established.
ECDSA key fingerprint is SHA256:l5HfVz2GKon2xpmavQSLRqfvPdxuogiqaF/Xjx5XV3E.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'hadoopslave1,192.168.59.134' (ECDSA) to the list of
known hosts.
hduser@hadoopslave1's password:
NOTICE                                        100%   24KB  24.2KB/s   00:00
hello.txt                                     100%   13     0.0KB/s   00:00
userlib-0.1.zip                               100%  668     0.7KB/s   00:00
```

- 仿上面步驟將Spark複製到HadoopSlave2
- 編輯slaves檔案，設定Spark Standalone cluster有那些伺服器，輸入 sudo gedit /usr/local/spark/conf/slaves

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ sudo gedit /usr/local/spark/conf/slaves
Open ▾   *slaves  /usr/local/spark/conf   Save
hadoopslave1
hadoopslave2
```

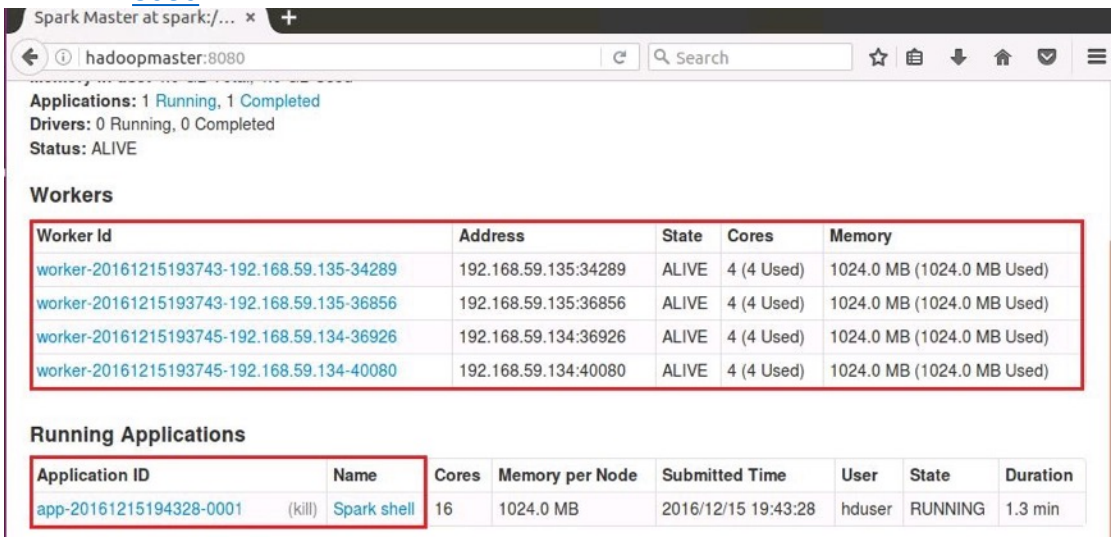
- 啟動Spark Standalone cluster，輸入/usr/local/spark/sbin/start-all.sh

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ /usr/local/spark/sbin/start-all.sh
starting org.apache.spark.deploy.master.Master, logging to /usr/local/spark/logs
/spark-hduser-org.apache.spark.deploy.master.Master-1-hadoopmaster.out
hadoopslave2: starting org.apache.spark.deploy.worker.Worker, logging to /usr/lo
cal/spark/logs/spark-hduser-org.apache.spark.deploy.worker.Worker-1-hadoopslave2
.out
hadoopslave1: starting org.apache.spark.deploy.worker.Worker, logging to /usr/lo
cal/spark/logs/spark-hduser-org.apache.spark.deploy.worker.Worker-1-hadoopslave1
.out
hadoopslave2: starting org.apache.spark.deploy.worker.Worker, logging to /usr/lo
cal/spark/logs/spark-hduser-org.apache.spark.deploy.worker.Worker-2-hadoopslave2
.out
hadoopslave1: starting org.apache.spark.deploy.worker.Worker, logging to /usr/lo
cal/spark/logs/spark-hduser-org.apache.spark.deploy.worker.Worker-2-hadoopslave1
.out
hduser@hadoopmaster:~$
```

- 可由上圖得知，共啟動了4個worker
- 執行Spark-shell，輸入spark-shell --master spark://hadoopmaster:7077

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ spark-shell --master spark://hadoopmaster:7077
16/12/09 20:13:14 WARN NativeCodeLoader: Unable to load native-hadoop library fo
r your platform... using builtin-java classes where applicable
16/12/09 20:13:16 WARN SparkConf:
SPARK_WORKER_INSTANCES was detected (set to '2').
This is deprecated in Spark 1.0+.

Please instead use:
 - ./spark-submit with --num-executors to specify the number of executors
 - Or set SPARK_EXECUTOR_INSTANCES
 - spark.executor.instances to configure the number of instances in the spark co
nfig.

16/12/09 20:13:34 WARN SparkContext: Use an existing SparkContext, some configur
ation may not take effect.
Spark context Web UI available at http://192.168.59.137:4040
Spark context available as 'sc' (master = spark://hadoopmaster:7077, app id = ap
p-20161209201330-0001).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.0.2
      /_/

Using Scala version 2.11.8 (OpenJDK 64-Bit Server VM, Java 1.8.0_111)
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```

- 查看Spark Standalone WebUI，於瀏覽器輸入 http://hadoopmaster:8080



- 讀取本地檔案
  v. val textFile=sc.textFile("file:/usr/local/spark/README.md")
  vi. textFile.count

```
scala> val textFile=sc.textFile("file:/usr/local/spark/README.md")
textFile: org.apache.spark.rdd.RDD[String] = file:/usr/local/spark/README.md MapPartitionsRDD
[1] at textFile at <console>:24

scala> textFile.count
res0: Long = 99
```

- 讀取HDFS的檔案(假設在HDFS上有一個/user/hduser/test/README.txt的檔案)

vii. val textFile=sc.textFile(“hdfs://hadoopmaster:9000/user/hduser/test/README.txt”)

viii. textFile.count

```
scala> val textFile=sc.textFile("hdfs://hadoopmaster:9000/user/hduser/test/README.txt")
textFile: org.apache.spark.rdd.RDD[String] = hdfs://hadoopmaster:9000/user/hduser/test/README
.txt MapPartitionsRDD[1] at textFile at <console>:24

scala> textFile.count
res0: Long = 31
```

- 停止Spark Standalone cluster，輸入 /usr/local/spark/sbin/stop-all.sh

```
hduser@hadoopmaster:~$ /usr/local/spark/sbin/stop-all.sh
hadoopslave1: stopping org.apache.spark.deploy.worker.Worker
hadoopslave2: stopping org.apache.spark.deploy.worker.Worker
hadoopslave1: stopping org.apache.spark.deploy.worker.Worker
hadoopslave2: stopping org.apache.spark.deploy.worker.Worker
stopping org.apache.spark.deploy.master.Master
```

5. 在Hadoop YARN執行spark

- 執行YARN需指定HADOOP_CONF_DIR參數，輸入sudo gedit ~/.bashrc，加入下列參數

```
export HADOOP_CONF_DIR=/usr/local/hadoop/etc/hadoop
```

```
hduser@hadoopmaster:~$ sudo gedit ~/.bashrc
Open  .bashrc ~/  Save
fi

#Hadoop Variables
export JAVA_HOME=/usr/lib/jvm/java-8-openjdk-amd64
export HADOOP_HOME=/usr/local/hadoop
export HADOOP_CONF_DIR=/usr/local/hadoop/etc/hadoop
export PATH=$PATH:$HADOOP_HOME/bin
export PATH=$PATH:$HADOOP_HOME/sbin
export HADOOP_MAPRED_HOME=$HADOOP_HOME
```

- 讓~/.bashrc生效，輸入source ~/.bashrc
- 在YARN上執行spark-shell，輸入/usr/local/spark/bin/spark-shell --master yarn --deploy-mode client

```
hduser@hadoopmaster: ~
hduser@hadoopmaster:~$ /usr/local/spark/bin/spark-shell --master yarn --deploy-m
ode client
```

```
Spark context Web UI available at http://192.168.59.137:4040
Spark context available as 'sc' (master = yarn, app id = application_14827350680
75_0002).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.0.2
      /_/

Using Scala version 2.11.8 (OpenJDK 64-Bit Server VM, Java 1.8.0_111)
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```

- 測試讀取本機資料，輸入

i. val textFile=sc.textFile("file:/usr/local/spark/README.md")

ii. textFile.count

```
scala> val textFile=sc.textFile("file:/usr/local/spark/README.md")
textFile: org.apache.spark.rdd.RDD[String] = file:/usr/local/spark/README.md Map
PartitionsRDD[1] at textFile at <console>:24

scala> textFile.count
res0: Long = 99
```

- 測試讀取HDFS資料，輸入

  iii. val textFile=sc.textFile("hdfs://hadoopmaster:9000/user/hduser/test/README.txt")

  iv. textFile.count

```
scala> val textFile=sc.textFile("hdfs://hadoopmaster:9000/user/hduser/test/READM
E.txt")
textFile: org.apache.spark.rdd.RDD[String] = hdfs://hadoopmaster:9000/user/hduse
r/test/README.txt MapPartitionsRDD[3] at textFile at <console>:24

scala> textFile.count
res1: Long = 31
```

- 到Hadoop Web介面查看