Submitting Spark Applications

Starting an interactive session:

1. Start an interactive session asking three nodes, using the ***start_interactive*** script . This script requests by default one node from the y15 reservation **for an hour**:
   a. Modify ***./start_interactive.sh.*** script with your reservation number and walltime.

```
#qsub -IVl select=3:ncpus=36,walltime=01:00:00,place=scatter:excl -A y15
-q <reservation number> -j oe
```

   This will give you an interactive session into a node (e.g. node **r1i3n0**) and you will see something like this:

```
[USERNAME@r1i3n0~]$./start_interactive.sh
qsub: waiting for job 399686.indy2-login0 to start
qsub: job 399686.indy2-login0 ready
[USERNAME@r1i3n0~]$
```

Starting a Spark cluster :

2. Start the spark cluster using the ***start_spark*** script. It will configure a spark cluster, with the master running in a node, and three workers (with 72 cores per worker) running in each reserved node. Remember to use **source** for exporting the environment variables into your PATH.

```
[USERNAME@r1i3n0~]$ source./start_spark.sh
3 node(s) assigned
Autoloading gcc/6.2.0
starting org.apache.spark.deploy.master.Master, logging to
/lustre/home/y15/rosaf3/spark-2.4.0-bin-hadoop2.7/logs/spark-
rosaf3-org.apache.spark.deploy.master.Master-1-r1i3n0.out
r1i3n0: starting org.apache.spark.deploy.worker.Worker, logging to
/lustre/home/y15/rosaf3/spark-2.4.0-bin-hadoop2.7/logs/spark-
rosaf3-org.apache.spark.deploy.worker.Worker-1-r1i3n0.out
r1i3n14: starting org.apache.spark.deploy.worker.Worker, logging
to /lustre/home/y15/rosaf3/spark-2.4.0-bin-hadoop2.7/logs/spark-
rosaf3-org.apache.spark.deploy.worker.Worker-1-r1i3n14.out
r1i3n13: starting org.apache.spark.deploy.worker.Worker, logging
to /lustre/home/y15/rosaf3/spark-2.4.0-bin-hadoop2.7/logs/spark-
rosaf3-org.apache.spark.deploy.worker.Worker-1-r1i3n13.out
starting org.apache.spark.deploy.history.HistoryServer, logging to
/lustre/home/y15/rosaf3/spark-2.4.0-bin-hadoop2.7/logs/spark-
rosaf3-org.apache.spark.deploy.history.HistoryServer-1-r1i3n0.out
```

Submitting a Spark Application to the Spark Cluster – using cluster mode:

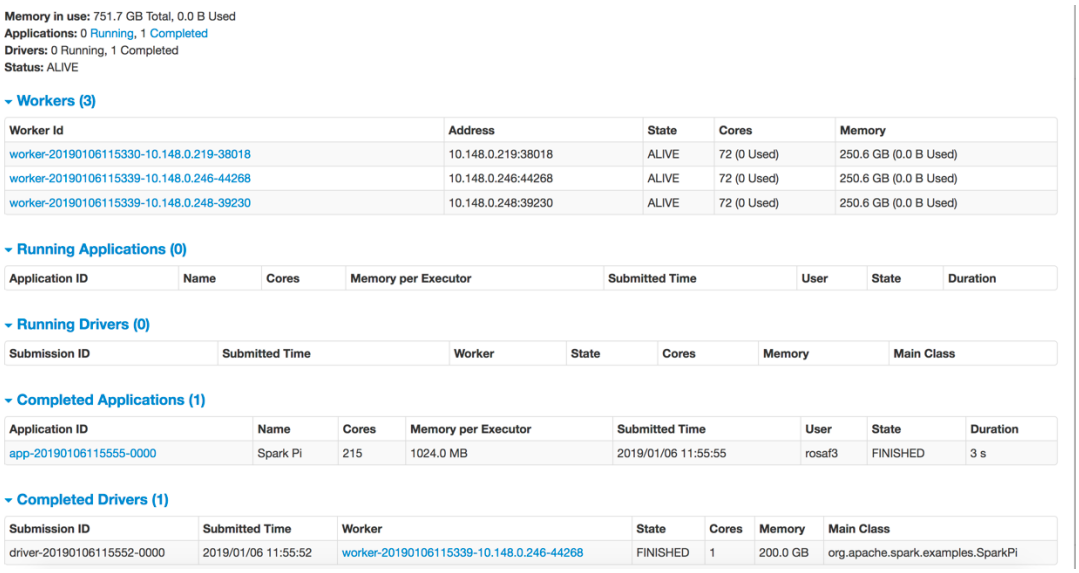
3. Submit the ***SparkPi*** application (which is an example that comes with spark) to your Spark Cluster that you have started by using ***spark_submit_SparkPi*** script.

   Note: You will have to modify this script to replace the master node (`--master spark://MASTER NODE:7077`), with the node where you master is running.

4. Check the result inside the $HOME/spark-2.4.0-bin-hadoop2.7/work/ directory. The result will be a driver directory corresponding with this application:
   a. more $HOME/spark-2.4.0-bin-hadoop2.7/work/driver-20190106121316-0001/stdout | grep Pi → Pi is roughly 3.1403511403511404

5. To monitor the spark applications in your spark cluster, just launch another terminal session and run something like this:

   a. `ssh USER@login.cirrus.ac.uk -L8080:MASTER NODE:8080`
   b. `Web browser → localhost:8080`



Memory in use: 751.7 GB Total, 0.0 B Used
Applications: 0 Running, 1 Completed
Drivers: 0 Running, 1 Completed
Status: ALIVE

Workers (3)

Worker Id	Address	State	Cores	Memory
worker-20190106115330-10.148.0.219-38018	10.148.0.219:38018	ALIVE	72 (0 Used)	250.6 GB (0.0 B Used)
worker-20190106115339-10.148.0.246-44268	10.148.0.246:44268	ALIVE	72 (0 Used)	250.6 GB (0.0 B Used)
worker-20190106115339-10.148.0.248-39230	10.148.0.248:39230	ALIVE	72 (0 Used)	250.6 GB (0.0 B Used)

Running Applications (0)

Application ID	Name	Cores	Memory per Executor	Submitted Time	User	State	Duration

Running Drivers (0)

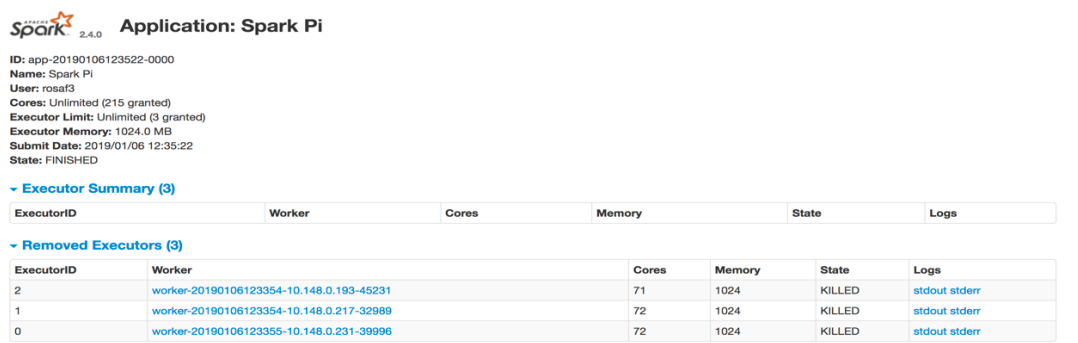
Submission ID	Submitted Time	Worker	State	Cores	Memory	Main Class

Completed Applications (1)

Application ID	Name	Cores	Memory per Executor	Submitted Time	User	State	Duration
app-20190106115555-0000	Spark Pi	215	1024.0 MB	2019/01/06 11:55:55	rosaf3	FINISHED	3 s

Completed Drivers (1)

Submission ID	Submitted Time	Worker	State	Cores	Memory	Main Class
driver-20190106115552-0000	2019/01/06 11:55:52	worker-20190106115339-10.148.0.246-44268	FINISHED	1	200.0 GB	org.apache.spark.examples.SparkPi



Spark 2.4.0 **Application: Spark Pi**

ID: app-20190106123522-0000
Name: Spark Pi
User: rosaf3
Cores: Unlimited (215 granted)
Executor Limit: Unlimited (3 granted)
Executor Memory: 1024.0 MB
Submit Date: 2019/01/06 12:35:22
State: FINISHED

Executor Summary (3)

ExecutorID	Worker	Cores	Memory	State	Logs

Removed Executors (3)

ExecutorID	Worker	Cores	Memory	State	Logs
2	worker-20190106123354-10.148.0.193-45231	71	1024	KILLED	stdout stderr
1	worker-20190106123354-10.148.0.217-32989	72	1024	KILLED	stdout stderr
0	worker-20190106123355-10.148.0.231-39996	72	1024	KILLED	stdout stderr

Tuning Resource Allocations:

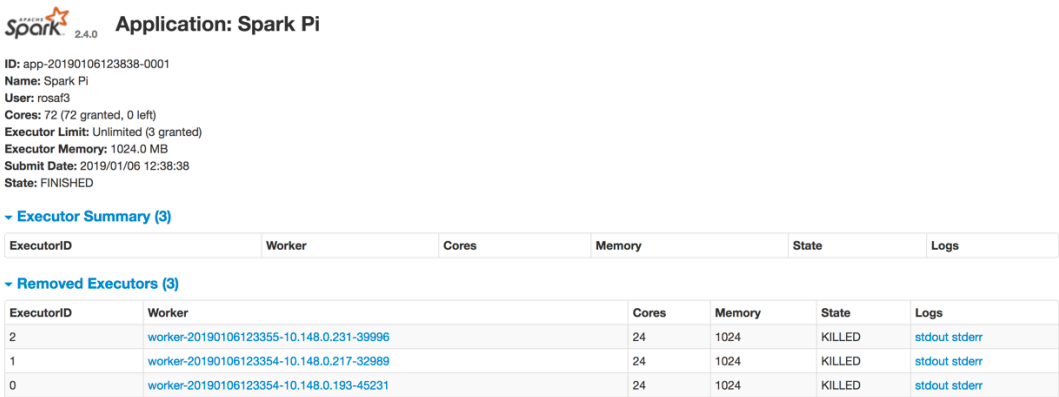
6. We can also modify the number of cores to use per worker/executor, by using the -–total-executor-cores in our spark-submission script.

   For example, if we decide to use 72 cores for running this spark application:

   >> spark-2.4.0-bin-hadoop2.7/bin/spark-submit --verbose --class org.apache.spark.examples.SparkPi --master spark://r1i2n5:7077 --deploy-mode cluster **--total-executor-cores 72** spark-2.4.0-bin-hadoop2.7/examples/jars/spark-examples_2.11-2.4.0.jar 10

   Note: You will have to modify this script to replace the master node (`––master spark://MASTER NODE:7077`), with the node where you master is running.

   We can see that the spark cluster will run the application using the 3 workers/executors, but using only 24 cores per worker/executor.



Spark 2.4.0 **Application: Spark Pi**

ID: app-20190106123838-0001
Name: Spark Pi
User: rosaf3
Cores: 72 (72 granted, 0 left)
Executor Limit: Unlimited (3 granted)
Executor Memory: 1024.0 MB
Submit Date: 2019/01/06 12:38:38
State: FINISHED

Executor Summary (3)

ExecutorID	Worker	Cores	Memory	State	Logs

Removed Executors (3)

ExecutorID	Worker	Cores	Memory	State	Logs
2	worker-20190106123355-10.148.0.231-39996	24	1024	KILLED	stdout stderr
1	worker-20190106123354-10.148.0.217-32989	24	1024	KILLED	stdout stderr
0	worker-20190106123354-10.148.0.193-45231	24	1024	KILLED	stdout stderr

Submitting a Spark Application to the Spark Cluster – using client mode:

7. We can also submit the wordcount.py application stored in *Spark_Applications* folder, using the **client deployment mode**.

   In cluster mode, the Spark driver runs inside an application master process which is managed by cluster-manager on the cluster, and the client can go away after initiating the application. **In client mode**, the driver runs in the client process, and the application master is only used for requesting resources from spark cluster.

   >> export PYSPARK_PYTHON=/lustre/sw/anaconda/anaconda3-5.1.0/bin/python3

   >> $SPARK_HOME/bin/spark-submit --verbose --master spark:// r1i2n5:7077 --deploy-mode client wordcount.py $HOME/spark-2.4.0-bin-hadoop2.7/README.md

   Note: You will have to modify this script to replace the master node (`––master spark://MASTER NODE:7077`), with the node where you master is running.

   You can replace *$HOME/spark-2.4.0-bin-hadoop2.7/README.md*, by other FILE that you will like to use as an input for counting the words in it.

Important: Currently, the **standalone mode** does not support **cluster mode** for **Python applications**