Spark Administration

We can set up and launch a standalone cluster or set up on a single machine for the personal development or testing purpose. In this lab, we will be providing steps to configure spark on single node.

Apache Spark Installation

Make sure you have compatible java installed on your machine. You can verify it by typing command:

```
java -version
```

Apache spark setup has been downloaded on the following path and added to $PATH variable:

```
/headless/Downloads/spark-2.4.7-bin-hadoop2.7/
```

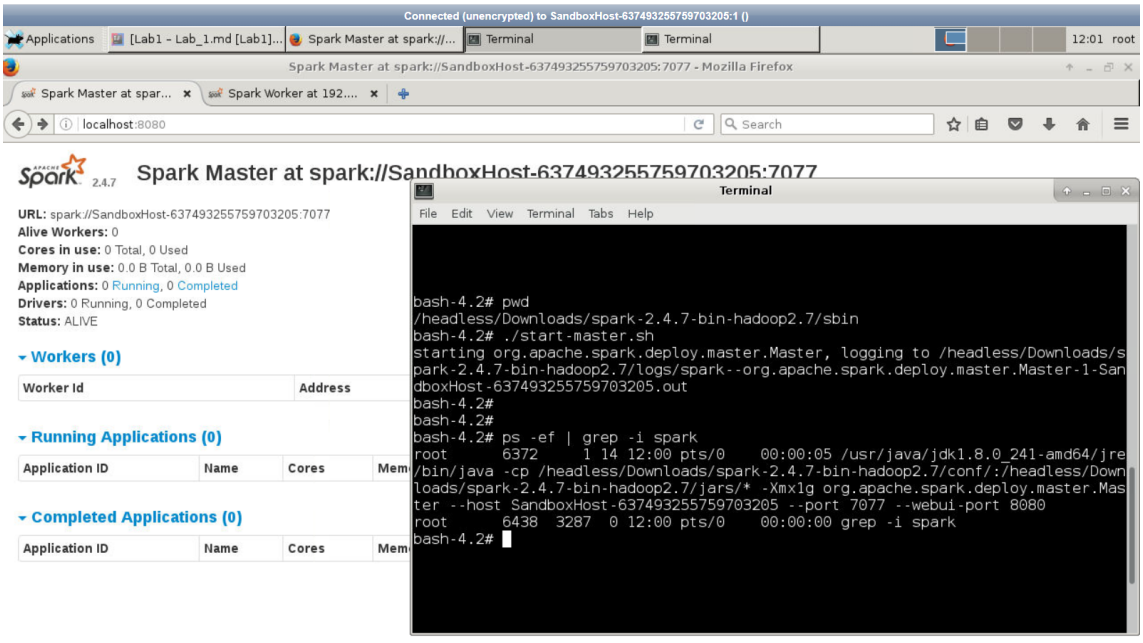
Start Master

```
cd /headless/Downloads/spark-2.4.7-bin-hadoop2.7/

./sbin/start-master.sh
```

Inspect the response:

```
starting org.apache.spark.deploy.master.Master, logging to /headless/Downloads/spark-2.4.7-bin-hadoop2.7/logs/spark--org.apache.spark.deploy.master.Master-1-SandboxHost-637493255759703205.out
```



Logs Path

Now inspect the `.out` file

```
cd /headless/Downloads/spark-2.4.7-bin-hadoop2.7/logs/

ls -ltr

cat filename
```

```
bash-4.2# pwd
/headless/Downloads/spark-2.4.7-bin-hadoop2.7/logs
bash-4.2#
bash-4.2#
bash-4.2# ls -ltr
total 20
-rw-r--r-- 1 root root 10454 Feb 19 13:00 spark--org.apache.spark.deploy.worker.Worker-1-SandboxHost-637493255759703205.out
-rw-r--r-- 1 root root  5053 Feb 19 13:00 spark--org.apache.spark.deploy.master.Master-1-SandboxHost-637493255759703205.out
bash-4.2#
```

```
bash-4.2# cat spark--org.apache.spark.deploy.master.Master-1-SandboxHost-637493255759703205.out
Spark Command: /usr/java/jdk1.8.0_241-amd64/jre/bin/java -cp /headless/Downloads/spark-2.4.7-bin-hadoop2.7/conf/:/headless/Dow
nloads/spark-2.4.7-bin-hadoop2.7/jars/* -Xmx1g org.apache.spark.deploy.master.Master --host SandboxHost-637493255759703205 --p
ort 7077 --webui-port 8080
========================================
Using Spark's default log4j profile: org/apache/spark/log4j-defaults.properties
21/02/19 12:00:08 INFO Master: Started daemon with process name: 6372@SandboxHost-637493255759703205
21/02/19 12:00:08 INFO SignalUtils: Registered signal handler for TERM
21/02/19 12:00:08 INFO SignalUtils: Registered signal handler for HUP
21/02/19 12:00:08 INFO SignalUtils: Registered signal handler for INT
21/02/19 12:00:08 WARN Utils: Your hostname, SandboxHost-637493255759703205 resolves to a loopback address: 127.0.0.1; using 1
92.168.0.209 instead (on interface eth0)
21/02/19 12:00:08 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
21/02/19 12:00:09 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes
where applicable
21/02/19 12:00:09 INFO SecurityManager: Changing view acls to: root
21/02/19 12:00:09 INFO SecurityManager: Changing modify acls to: root
21/02/19 12:00:09 INFO SecurityManager: Changing view acls groups to:
21/02/19 12:00:09 INFO SecurityManager: Changing modify acls groups to:
21/02/19 12:00:09 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users  with view permissio
ns: Set(root); groups with view permissions: Set(); users  with modify permissions: Set(root); groups with modify permissions:
 Set()
21/02/19 12:00:09 INFO Utils: Successfully started service 'sparkMaster' on port 7077.
21/02/19 12:00:09 INFO Master: Starting Spark master at spark://SandboxHost-637493255759703205:7077
21/02/19 12:00:09 INFO Master: Running Spark version 2.4.7
21/02/19 12:00:10 INFO Utils: Successfully started service 'MasterUI' on port 8080.
21/02/19 12:00:10 INFO MasterWebUI: Bound MasterWebUI to 0.0.0.0, and started at http://192.168.0.209:8080
21/02/19 12:00:10 INFO Master: I have been elected leader! New state: ALIVE
21/02/19 12:02:51 INFO Master: Registering worker 192.168.0.209:33781 with 3 cores, 6.9 GB RAM
21/02/19 12:06:03 INFO Master: Registering app Spark shell
21/02/19 12:06:03 INFO Master: Registered app Spark shell with ID app-20210219120603-0000
21/02/19 12:06:03 INFO Master: Launching executor app-20210219120603-0000/0 on worker worker-20210219120249-192.168.0.209-3378
1
21/02/19 12:06:44 INFO Master: Received unregister request from application app-20210219120603-0000
21/02/19 12:06:44 INFO Master: Removing app app-20210219120603-0000
21/02/19 12:06:44 INFO Master: 127.0.0.1:58338 got disassociated, removing it.
21/02/19 12:06:44 INFO Master: 192.168.0.209:41351 got disassociated, removing it.
```

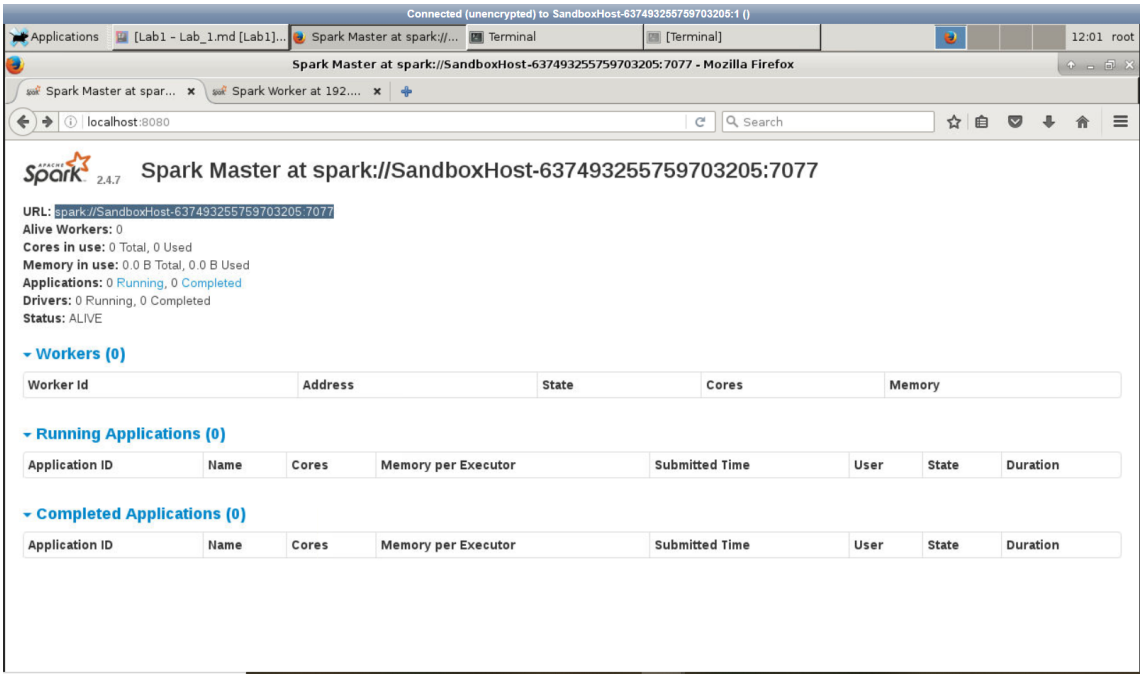
Once started, the master will print out a spark://HOST:PORT URL for itself, which you can use to connect workers to it, or pass as the “master” argument to SparkContext. You can also find this URL on the master’s web UI, which is http://localhost:8080 by default.

Similarly, you can start one or more workers and connect them to the master via:

Start Worker

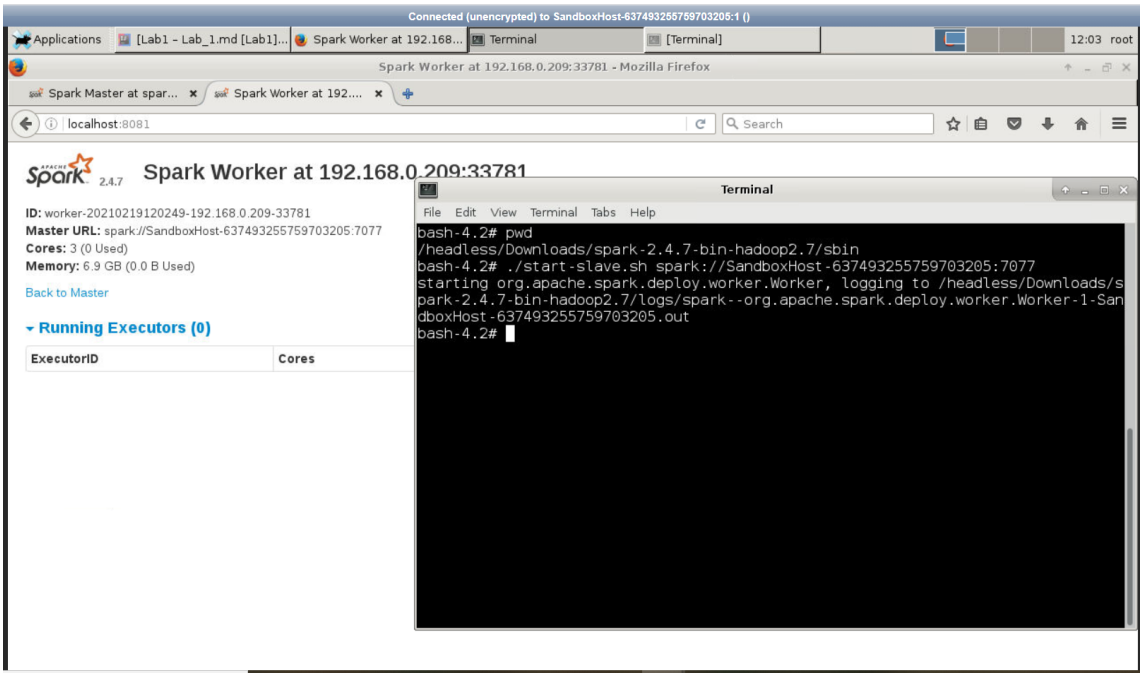
Start Worker and register the worker with master

Open `http://localhost:8080/` in browser and copy the master url

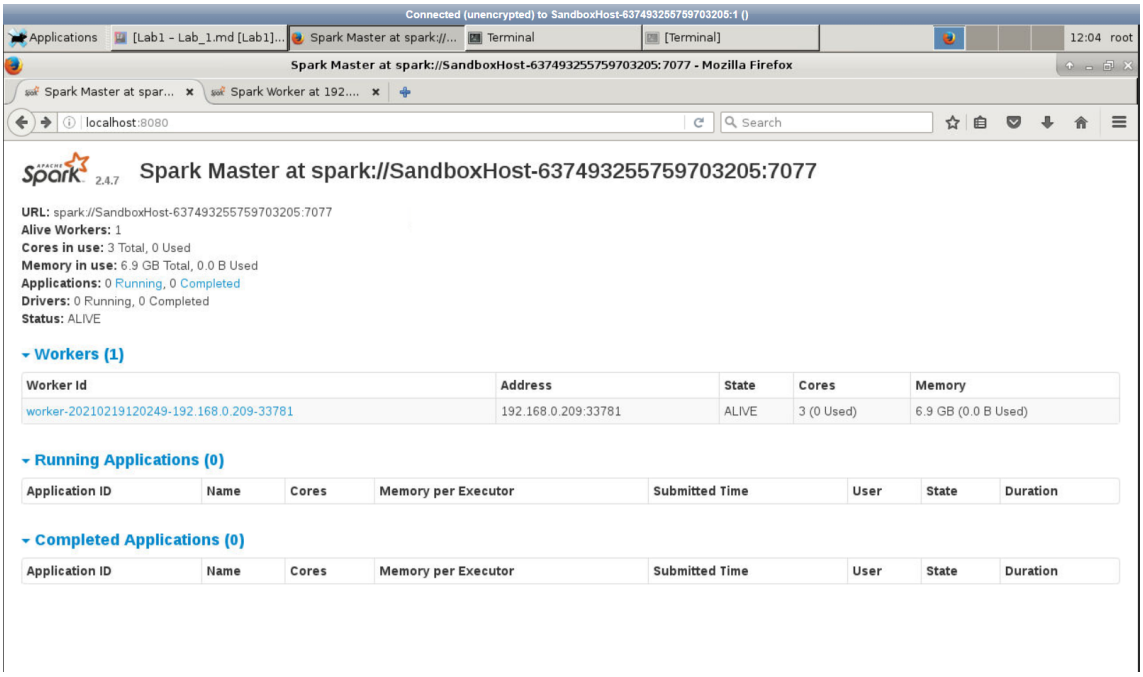


now start the worker and register it with master using following command

```
./sbin/start-slave.sh spark://hostname:7077
```



Worker webUI: `http://localhost:8081`



Once you have started a worker, look at the master's web UI (http://localhost:8080 by default). You should see the new node listed there, along with its number of CPUs and memory (minus one gigabyte left for the OS).

Finally, the following configuration options can be passed to the master and worker:

Argument	Meaning
`-h HOST`, `--host HOST`	Hostname to listen on
`-i HOST`, `--ip HOST`	Hostname to listen on (deprecated, use -h or --host)
`-p PORT`, `--port PORT`	Port for service to listen on (default: 7077 for master, random for worker)
`--webui-port PORT`	Port for web UI (default: 8080 for master, 8081 for worker)
`-c CORES`, `--cores CORES`	Total CPU cores to allow Spark applications to use on the machine (default: all available); only on worker
`-m MEM`, `--memory MEM`	Total amount of memory to allow Spark applications to use on the machine, in a format like 1000M or 2G (default: your machine's total RAM minus 1 GiB); only on worker
`-d DIR`, `--work-dir DIR`	Directory to use for scratch space and job output logs (default: SPARK_HOME/work); only on worker
`--properties-file FILE`	Path to a custom Spark properties file to load (default: conf/spark-defaults.conf)

Logs Path

```
cd /headless/Downloads/spark-2.4.7-bin-hadoop2.7/logs/

ls -ltr

cat filename
```

Now inspect the `.out` file, you will see the log like this:

```
2019-09-12 13:41:07 INFO Worker:2612 - Started daemon with process name:
144697@hostname 2019-09-12 13:41:07 INFO SignalUtils:54 - Registered signal handler
for TERM 2019-09-12 13:41:07 INFO SignalUtils:54 - Registered signal handler for HUP
2019-09-12 13:41:07 INFO SignalUtils:54 - Registered signal handler for INT 2019-09-12
13:41:08 WARN NativeCodeLoader:62 - Unable to load native-hadoop library for your
platform... using builtin-java classes where applicable 2019-09-12 13:41:08 INFO
SecurityManager:54 - Changing view acls to: user 2019-09-12 13:41:08 INFO
SecurityManager:54 - Changing modify acls to: user 2019-09-12 13:41:08 INFO
SecurityManager:54 - Changing view acls groups to: 2019-09-12 13:41:08 INFO
SecurityManager:54 - Changing modify acls groups to: 2019-09-12 13:41:08 INFO
SecurityManager:54 - SecurityManager: authentication disabled; ui acls disabled; users
with view permissions: Set(user); groups with view permissions: Set(); users with
modify permissions: Set(user); groups with modify permissions: Set() 2019-09-12
13:41:08 INFO Utils:54 - Successfully started service 'sparkWorker' on port 35633.
2019-09-12 13:41:08 INFO Worker:54 - Starting Spark worker 100.2.101.101:35633 with 32
cores, 124.6 GB RAM 2019-09-12 13:41:08 INFO Worker:54 - Running Spark version 2.3.4
2019-09-12 13:41:08 INFO Worker:54 - Spark home: /headless/Downloads/spark-2.4.7-bin-
hadoop2.7 2019-09-12 13:41:08 INFO log:192 - Logging initialized @1510ms 2019-09-12
13:41:08 INFO Server:351 - jetty-9.3.z-SNAPSHOT, build timestamp: unknown, git hash:
unknown 2019-09-12 13:41:08 INFO Server:419 - Started @1576ms 2019-09-12 13:41:08 INFO
AbstractConnector:278 - Started ServerConnector@3f9e3902{HTTP/1.1,[http/1.1]}
{0.0.0.0:8081} 2019-09-12 13:41:08 INFO Utils:54 - Successfully started service
'WorkerUI' on port 8081. 2019-09-12 13:41:08 INFO ContextHandler:781 - Started
o.s.j.s.ServletContextHandler@1dc21140{/logPage,null,AVAILABLE,@Spark} 2019-09-12
13:41:08 INFO ContextHandler:781 - Started
o.s.j.s.ServletContextHandler@5896ed4f{/logPage/json,null,AVAILABLE,@Spark} 2019-09-12
13:41:08 INFO ContextHandler:781 - Started
o.s.j.s.ServletContextHandler@1d9a25f0{/,null,AVAILABLE,@Spark} 2019-09-12 13:41:08
INFO ContextHandler:781 - Started
o.s.j.s.ServletContextHandler@1ad57f24{/json,null,AVAILABLE,@Spark} 2019-09-12
13:41:08 INFO ContextHandler:781 - Started
o.s.j.s.ServletContextHandler@754605a4{/static,null,AVAILABLE,@Spark} 2019-09-12
13:41:08 INFO ContextHandler:781 - Started
o.s.j.s.ServletContextHandler@c5e9251{/log,null,AVAILABLE,@Spark} 2019-09-12 13:41:08
INFO WorkerWebUI:54 - Bound WorkerWebUI to 0.0.0.0, and started
athttp://hostname.com:8081 2019-09-12 13:41:08 INFO Worker:54 - Connecting to master
hostname.com:7077... 2019-09-12 13:41:08 INFO ContextHandler:781 - Started
o.s.j.s.ServletContextHandler@4ac9255f{/metrics/json,null,AVAILABLE,@Spark} 2019-09-12
13:41:08 INFO TransportClientFactory:267 - Successfully created connection to
hostname.com/199.6.212.152:7077 after 40 ms (0 ms spent in bootstraps) 2019-09-12
13:41:09 INFO Worker:54 - Successfully registered with master
spark://hostname.com:7077
```

Note that above scripts must be executed on the machine you want to run the Spark master on, not your local machine.

You can optionally configure the cluster further by setting environment variables in conf/spark-env.sh. Create this file by starting with the conf/spark-env.sh.template, and copy it to on your worker machine for the settings to take effect. The following settings are available:

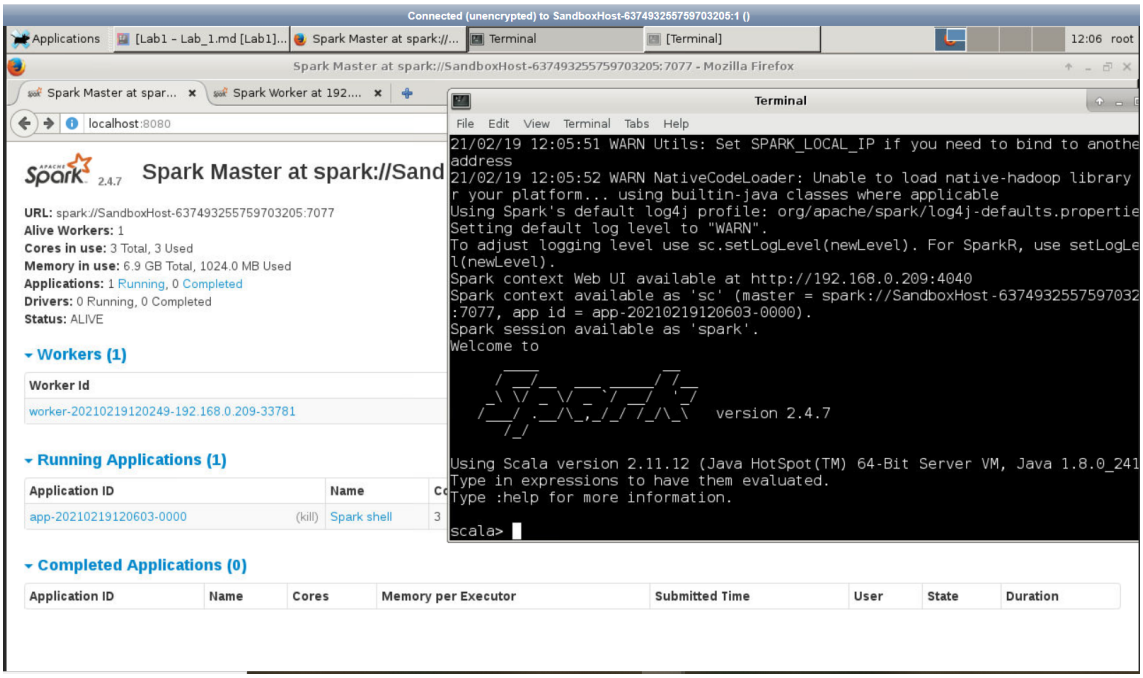
Environment Variable	Meaning
`SPARK_MASTER_HOST`	Bind the master to a specific hostname or IP address, for example a public one.
`SPARK_MASTER_PORT`	Start the master on a different port (default: 7077).
`SPARK_MASTER_WEBUI_PORT`	Port for the master web UI (default: 8080).
`SPARK_MASTER_OPTS`	Configuration properties that apply only to the master in the form "-Dx=y" (default: none). See below for a list of possible options.
`SPARK_LOCAL_DIRS`	Directory to use for "scratch" space in Spark, including map output files and RDDs that get stored on disk. This should be on a fast, local disk in your system. It can also be a comma-separated list of multiple directories on different disks.
`SPARK_WORKER_CORES`	Total number of cores to allow Spark applications to use on the machine (default: all available cores).
`SPARK_WORKER_MEMORY`	Total amount of memory to allow Spark applications to use on the machine, e.g. `1000m`, `2g` (default: total memory minus 1 GiB); note that each application's *individual* memory is configured using its `spark.executor.memory` property.
`SPARK_WORKER_PORT`	Start the Spark worker on a specific port (default: random).
`SPARK_WORKER_WEBUI_PORT`	Port for the worker web UI (default: 8081).
`SPARK_WORKER_DIR`	Directory to run applications in, which will include both logs and scratch space (default: SPARK_HOME/work).
`SPARK_WORKER_OPTS`	Configuration properties that apply only to the worker in the form "-Dx=y" (default: none). See below for a list of possible options.
`SPARK_DAEMON_MEMORY`	Memory to allocate to the Spark master and worker daemons themselves (default: 1g).
`SPARK_DAEMON_JAVA_OPTS`	JVM options for the Spark master and worker daemons themselves in the form "-Dx=y" (default: none).
`SPARK_DAEMON_CLASSPATH`	Classpath for the Spark master and worker daemons themselves (default: none).
`SPARK_PUBLIC_DNS`	The public DNS name of the Spark master and workers (default: none).

Spark Shell

Your cluster on single node is ready now, you can test it using running command **spark-shell**

```
[user@hostname ~]$ spark-shell --master spark://hostname:7077
```

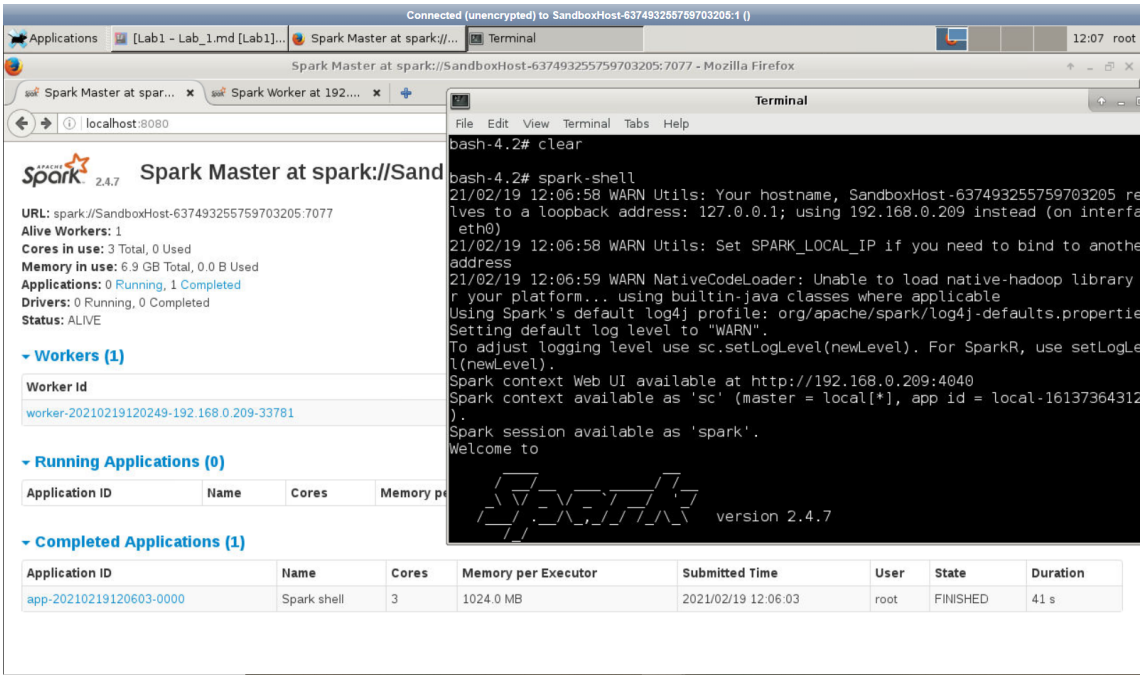
Reload the master webui. You will get one running application:



You can exit the spark shell using typing `:q` then enter

Task

1) Run spark-shell command after removing `--master` parameter from the spark-shell command and verify that it does not appear in master or worker UI. Because we did not specify master url while running spark-shell command.



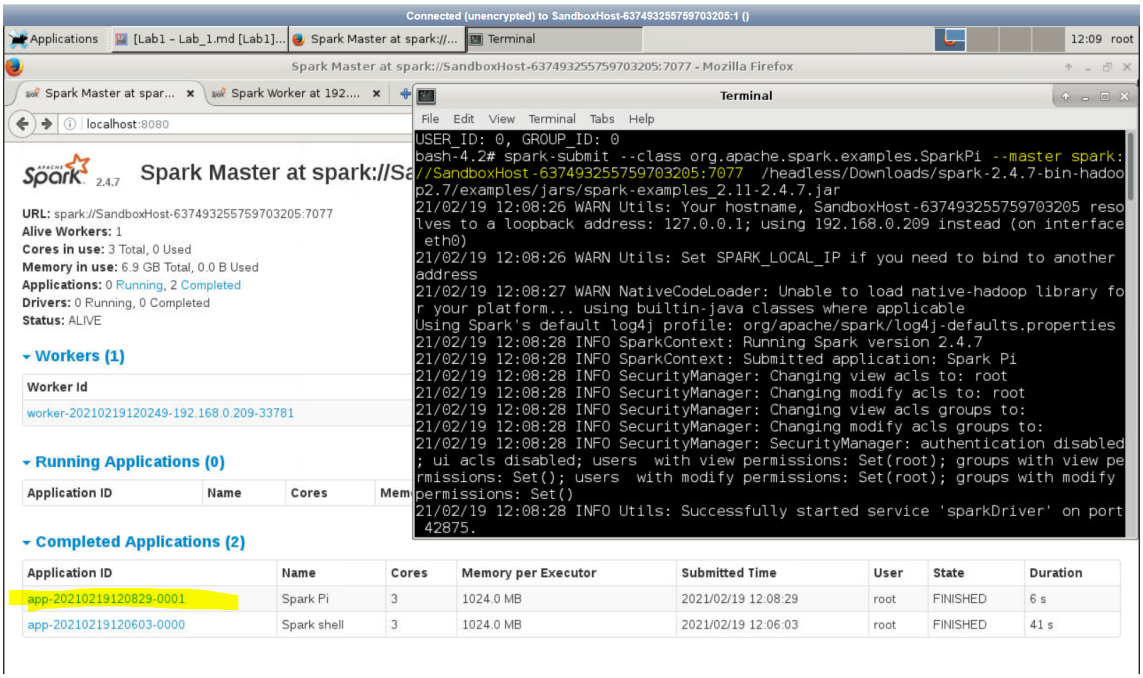
Spark Submit

Now submit example application using spark-submit. Replace `spark://hostname:7077` with hostname of master node first.

```
spark-submit --class org.apache.spark.examples.SparkPi --master spark://hostname:7077
/headless/Downloads/spark-2.4.7-bin-hadoop2.7/examples/jars/spark-examples_2.11-
2.4.7.jar
```

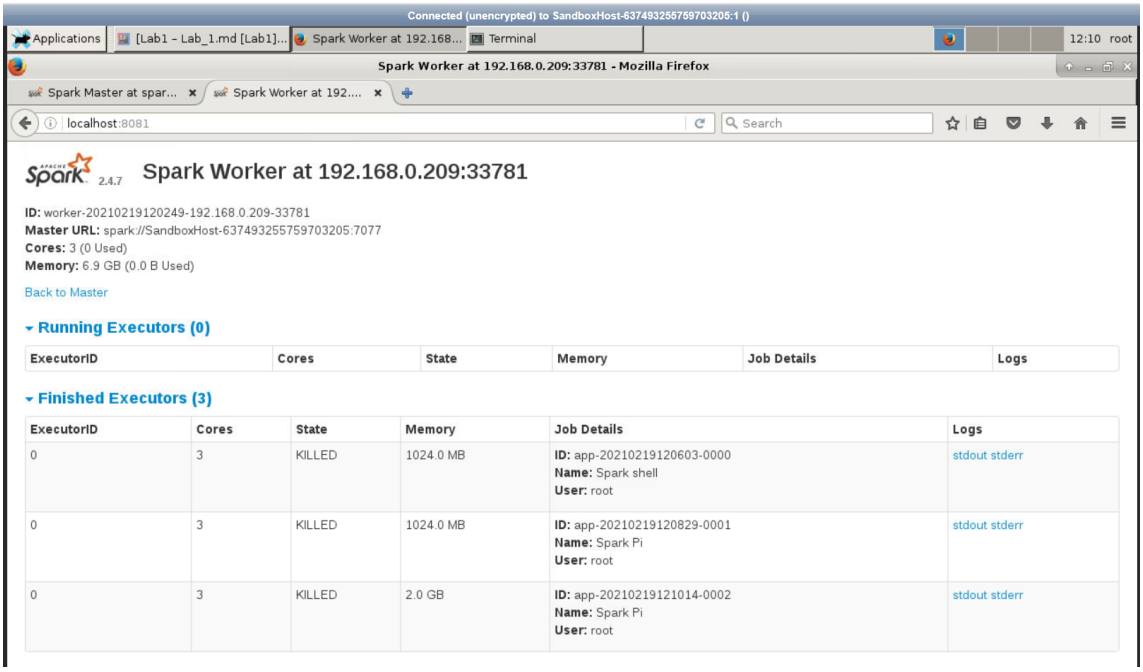
If this example execute successfully, your spark installation is fine. You can see the results in console log

```
2019-09-12 13:53:27 INFO DAGScheduler:54 - Job 0 finished: reduce at SparkPi.scala:38,
took 0.615754 sPi is roughly 3.1416557082785412 2019-09-12 13:53:27 INFO
AbstractConnector:318 - Stopped Spark@6914bc2c{HTTP/1.1,[http/1.1]}{0.0.0.0:4040}
```



Task

1) Run above spark-submit command but assign '2g' memory. You will get output after running spark-submit command as shown in the screenshot below:



Hint: `spark-submit --help`. Solution is available in `solution.txt` file.

2) Run spark-submit command after removing `--master` parameter from the spark-submit command and verify that it does not appear in master or worker UI after refreshing the browser window.