Aims

This exercise aims to get you to practice:

- Executing Spark step on AWS EMR
- Using Spark cluster on AWS EMR

Package the WordCount Jar File

1. Create a folder wcspark in your home folder:

```
$ mkdir -p wcspark/src/main/scala/comp9313/lab10
```

2. Download the WordCount.scala file in the created folder at:

https://webcms3.cse.unsw.edu.au/COMP9313/18s1/resources/16603

3. Change directory to ~/wcspark, create a file wc.sbt, and add the following contents:

```
name := "Word Count"
version := "1.0"
scalaVersion := "2.11.8"
libraryDependencies += "org.apache.spark" %% "spark-core" % "2.3.0"
```

4. Use sbt to package your project

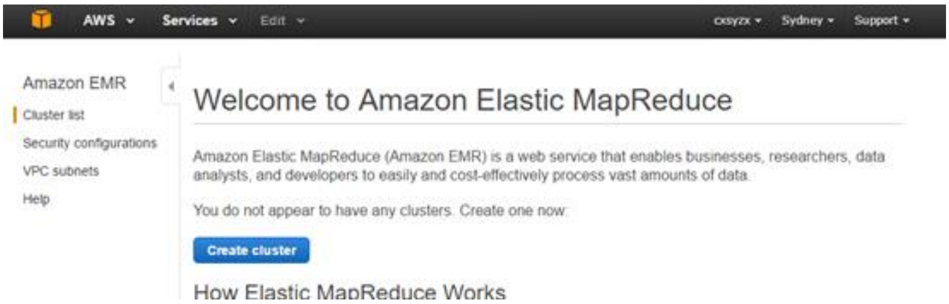
```
$ sbt package
```

The generated jar file is located at: ~/wcspark/target/scala-2.11/word-count_2.11-1.0.jar

5. Upload this jar file to your S3 bucket: S3://comp9313.<YOUR_StudentID>/

Run Spark Tasks on AWS EMR (Part 1)

1. Go to the AWS Management console and open the EMR console.



Welcome to Amazon Elastic MapReduce

Amazon Elastic MapReduce (Amazon EMR) is a web service that enables businesses, researchers, data analysts, and developers to easily and cost-effectively process vast amounts of data.

You do not appear to have any clusters. Create one now:

How Elastic MapReduce Works

2. At the top right corner, select the region as “Sydney”

3. Click Create cluster. On the Create Cluster page, you need to do the following:

In General Configuration section:

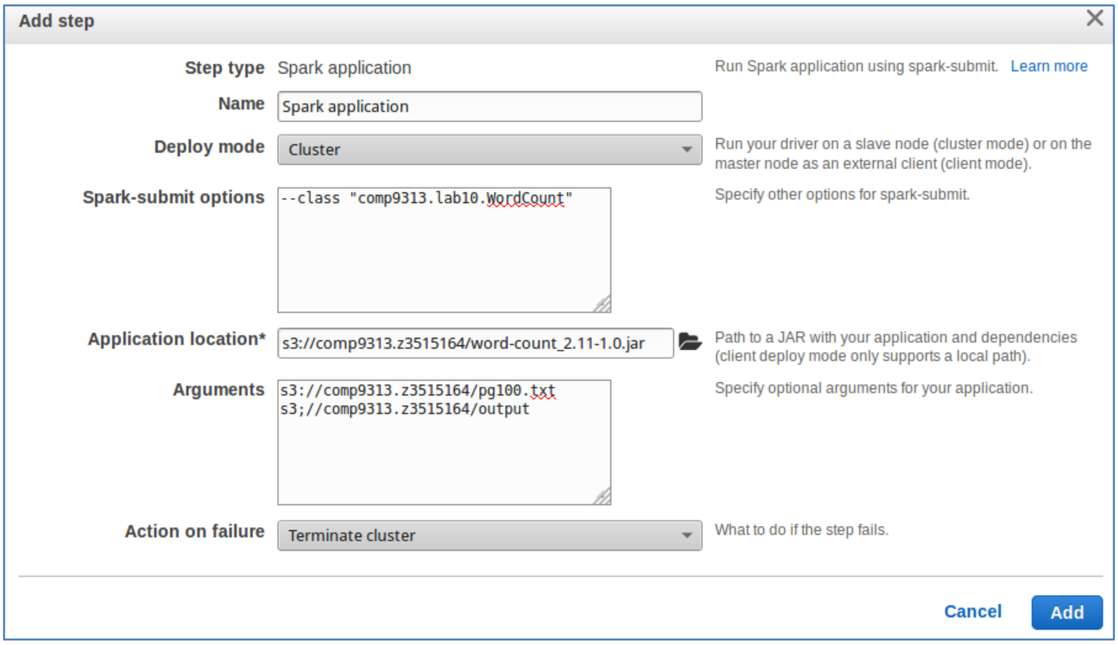
a) Cluster name: comp9313.lab10

b) Logging: Select

c) S3 folder: use default. The folder is used to store the logs.

d) Launch mode: select “Step execution. “

In Add steps section:



Add step

Step type: Spark application — Run Spark application using spark-submit. Learn more

Name: Spark application

Deploy mode: Cluster — Run your driver on a slave node (cluster mode) or on the master node as an external client (client mode).

Spark-submit options: Specify other options for spark-submit.

```
--class "comp9313.lab10.WordCount"
```

Application location*: s3://comp9313.z3515164/word-count_2.11-1.0.jar — Path to a JAR with your application and dependencies (client deploy mode only supports a local path).

Arguments: Specify optional arguments for your application.

```
s3://comp9313.z3515164/pg100.txt
s3;//comp9313.z3515164/output
```

Action on failure: Terminate cluster — What to do if the step fails.

Set the step type as Spark application, and then click “Configure”

a) Set Name as “WordCount”

b) Set Deploy mode as Cluster

c) Spark-submit options: --class “comp9313.lab10.WordCount” --master yarn

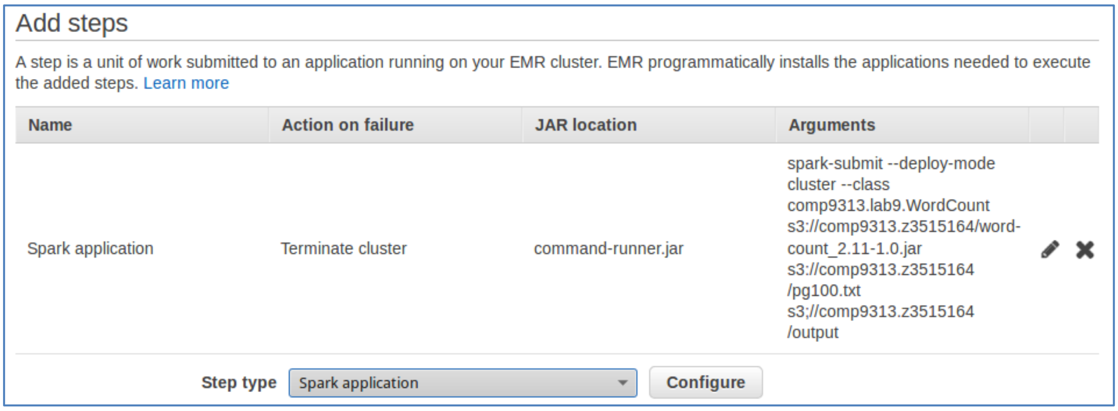
d) Application location: click the folder icon, select the jar file you uploaded to your s3 folder, “s3://comp9313.<YOUR_StudentID>/ word-count_2.11-1.0.jar”

e) Set Arguments as “s3://comp9313.<YOUR_StudentID>/pg100.txt s3://comp9313.<YOUR_StudentID>/output”

Remember that the output folder cannot be an existing folder in your S3.

f) Select “Terminate cluster” for Action on Failure, and finally click Add.

Then, in the Add steps section, you can see:



Add steps

A step is a unit of work submitted to an application running on your EMR cluster. EMR programmatically installs the applications needed to execute the added steps. Learn more

Name	Action on failure	JAR location	Arguments
Spark application	Terminate cluster	command-runner.jar	spark-submit --deploy-mode cluster --class comp9313.lab9.WordCount s3://comp9313.z3515164/word-count_2.11-1.0.jar s3://comp9313.z3515164 /pg100.txt s3;//comp9313.z3515164 /output

Step type: Spark application

In Software configuration section:

a) Release: Select the most recent version, emr-5.13.0

b) Application: Select Spark 2.3.0 on Hadoop Yarn

In the Hardware Configuration section:

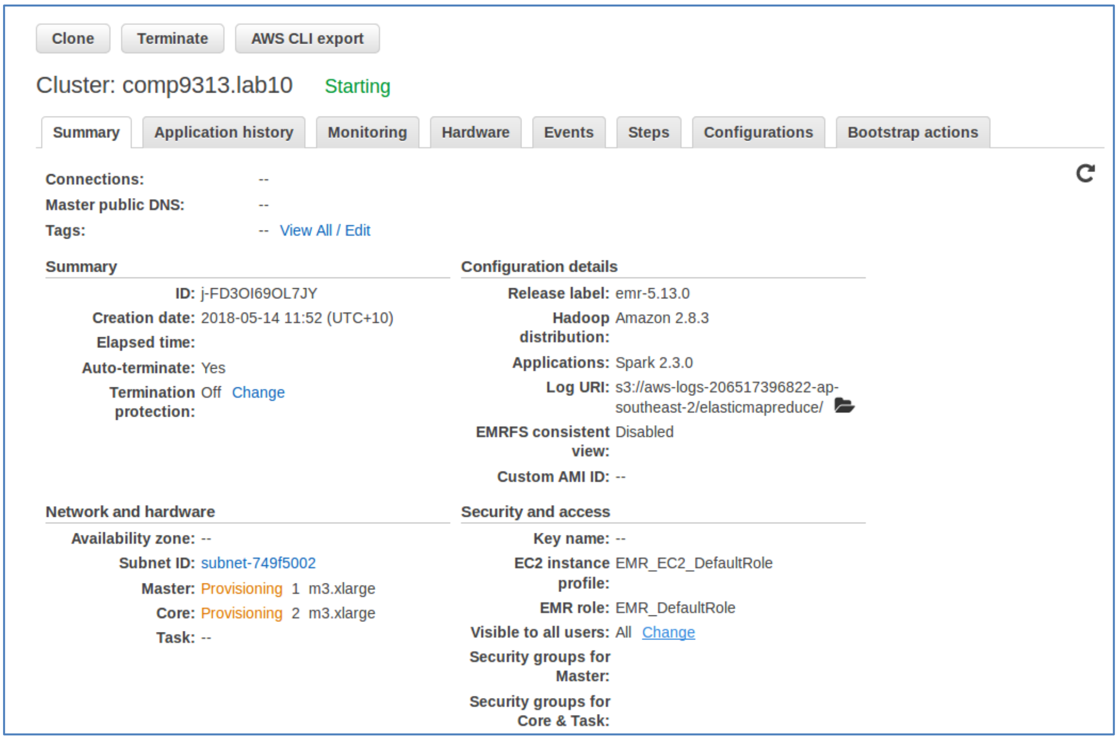
a) Instance type: use m3.xlarge

b) Number of instances: 3

In the Security and Access section:

Accept the remaining default options.

6. Choose Create cluster. You should see:



Cluster: comp9313.lab10 Starting

Connections: --
Master public DNS: --
Tags: -- View All / Edit

Summary

ID: j-FD3OI69OL7JY
Creation date: 2018-05-14 11:52 (UTC+10)
Elapsed time:
Auto-terminate: Yes
Termination protection: Off Change

Configuration details

Release label: emr-5.13.0
Hadoop distribution: Amazon 2.8.3
Applications: Spark 2.3.0
Log URI: s3://aws-logs-206517396822-ap-southeast-2/elasticmapreduce/
EMRFS consistent view: Disabled
Custom AMI ID: --

Network and hardware

Availability zone: --
Subnet ID: subnet-749f5002
Master: Provisioning 1 m3.xlarge
Core: Provisioning 2 m3.xlarge
Task: --

Security and access

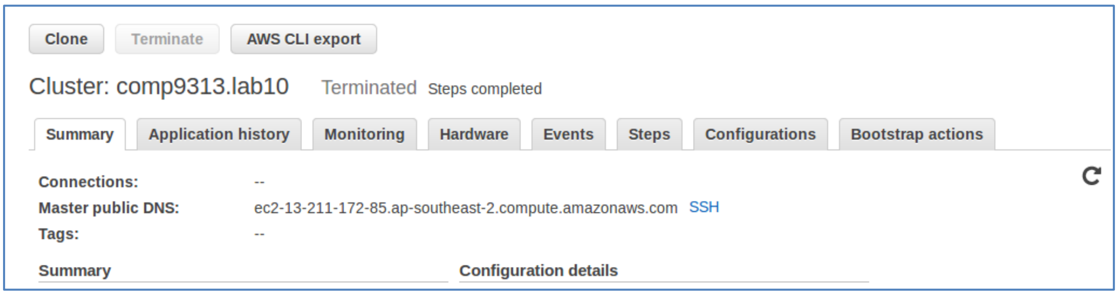
Key name: --
EC2 instance profile: EMR_EC2_DefaultRole
EMR role: EMR_DefaultRole
Visible to all users: All Change
Security groups for Master:
Security groups for Core & Task:

Later, you will see the information for Connections and Master public DNS is updated, since the cluster is already started.

7. Wait until the WordCount task is finished. Note that this may take several minutes.

In the meantime, you can begin working on the next section, and go back to check the results later.

8. If the task is completed, you should see:



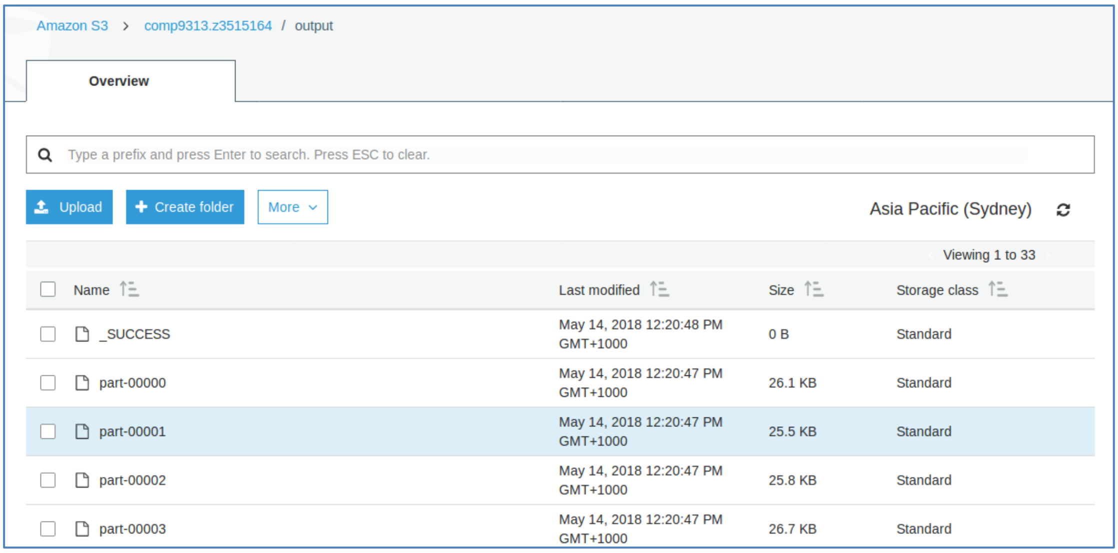
Cluster: comp9313.lab10 Terminated Steps completed

Connections: --
Master public DNS: ec2-13-211-172-85.ap-southeast-2.compute.amazonaws.com SSH
Tags: --

Summary

Configuration details

Go to your S3 bucket, the results should be stored there. You can see that several files are in the folder. Spark automatically computes the number of partitions for you already, and each partition corresponds to one result file. You can download these files to check the results.



Amazon S3 › comp9313.z3515164 / output
Overview
Type a prefix and press Enter to search. Press ESC to clear.
Upload
Create folder
More
Asia Pacific (Sydney)
Viewing 1 to 33

□	Name	Last modified	Size	Storage class
□	_SUCCESS	May 14, 2018 12:20:48 PM GMT+1000	0 B	Standard
□	part-00000	May 14, 2018 12:20:47 PM GMT+1000	26.1 KB	Standard
□	part-00001	May 14, 2018 12:20:47 PM GMT+1000	25.5 KB	Standard
□	part-00002	May 14, 2018 12:20:47 PM GMT+1000	25.8 KB	Standard
□	part-00003	May 14, 2018 12:20:47 PM GMT+1000	26.7 KB	Standard

Run Spark Tasks on AWS EMR (Part 2)

In this section, we will ssh to the cluster to do a Spark job.

1. Choose Create cluster. On the Create Cluster page, click “Go to advanced options”.

2. In Step 1, select emr-5.13.0 for Release, and select “Hadoop 2.8.3” and “Spark 2.3.0” in the cluster. Accept the other default configurations, and click “Next”.

3. In Step 2, select the default m3.xlarge as the instance type for both Master and Core. Accept all the other default configurations, and click “Next”

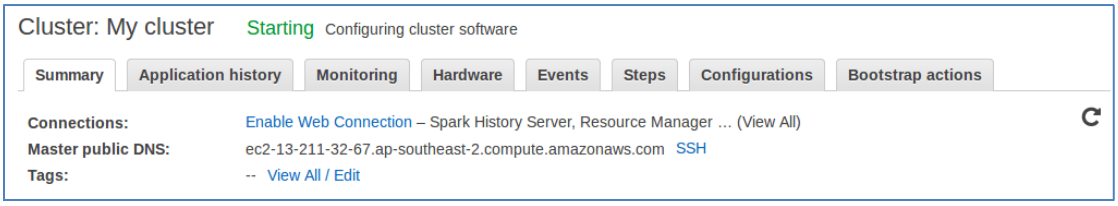
4. In Step 3, name your cluster and accept all default configurations and click “Next”.

5. In Step 4, use your key pair “comp9313” for the cluster. Click “EC2 Security Groups”, configure the security groups for both Master and Core as “launch-wizard-1”. Finally, click “Create Cluster”.

If you lost your key pair file “comp9313.pem”, please follow the lab9 instructions and create one key pair again. launch-wizard-1 is created in lab9 as well. If you cannot see it, please follow the EC2 instructions in lab9.

6. Waiting for the starting of the cluster. You can go back to check the results of your first cluster.

Once the information for “Connection” and “Master public DNS” is updated, your cluster is started, and you can ssh to the master node now.

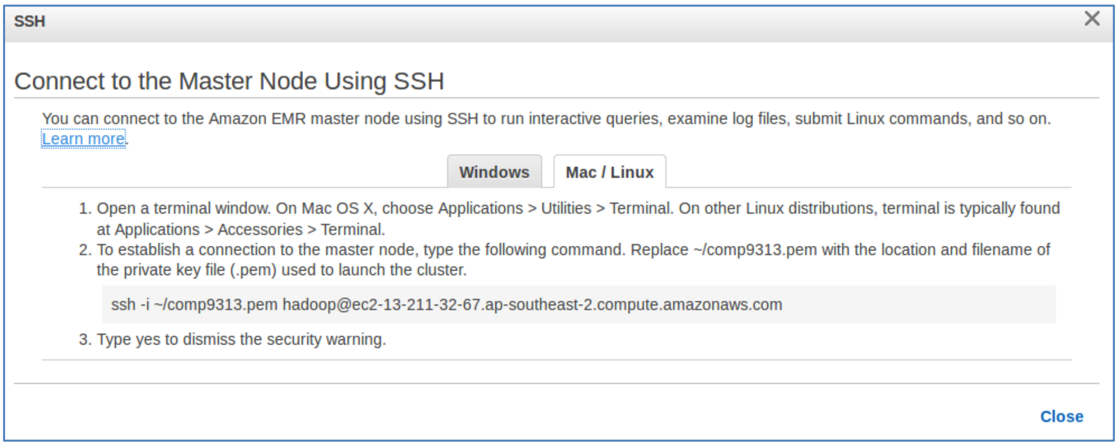


Connections: Enable Web Connection – Spark History Server, Resource Manager ... (View All)

Master public DNS: ec2-13-211-32-67.ap-southeast-2.compute.amazonaws.com SSH

Tags: -- View All / Edit

Click SSH in the line of "Master public DNS:", you will see:



Connect to the Master Node Using SSH

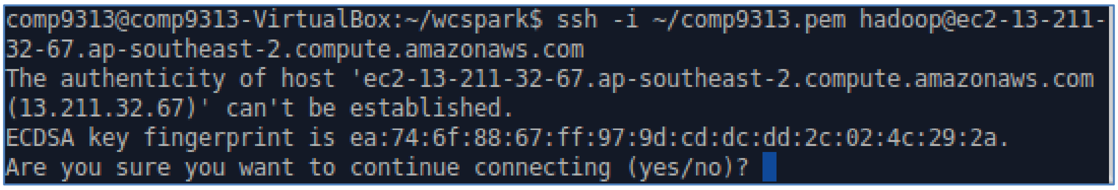
You can connect to the Amazon EMR master node using SSH to run interactive queries, examine log files, submit Linux commands, and so on. Learn more.

1. Open a terminal window. On Mac OS X, choose Applications > Utilities > Terminal. On other Linux distributions, terminal is typically found at Applications > Accessories > Terminal.
2. To establish a connection to the master node, type the following command. Replace ~/comp9313.pem with the location and filename of the private key file (.pem) used to launch the cluster.

   ```
   ssh -i ~/comp9313.pem hadoop@ec2-13-211-32-67.ap-southeast-2.compute.amazonaws.com
   ```
3. Type yes to dismiss the security warning.

SSH to the master node by copying the command as shown in the dialog:

```
$ ssh -i ~/comp9313.pem hadoop@YOUR_INSTANCE
```



```
comp9313@comp9313-VirtualBox:~/wcspark$ ssh -i ~/comp9313.pem hadoop@ec2-13-211-
32-67.ap-southeast-2.compute.amazonaws.com
The authenticity of host 'ec2-13-211-32-67.ap-southeast-2.compute.amazonaws.com
(13.211.32.67)' can't be established.
ECDSA key fingerprint is ea:74:6f:88:67:ff:97:9d:cd:dc:dd:2c:02:4c:29:2a.
Are you sure you want to continue connecting (yes/no)?
```

Enter "yes" to connect to the cluster

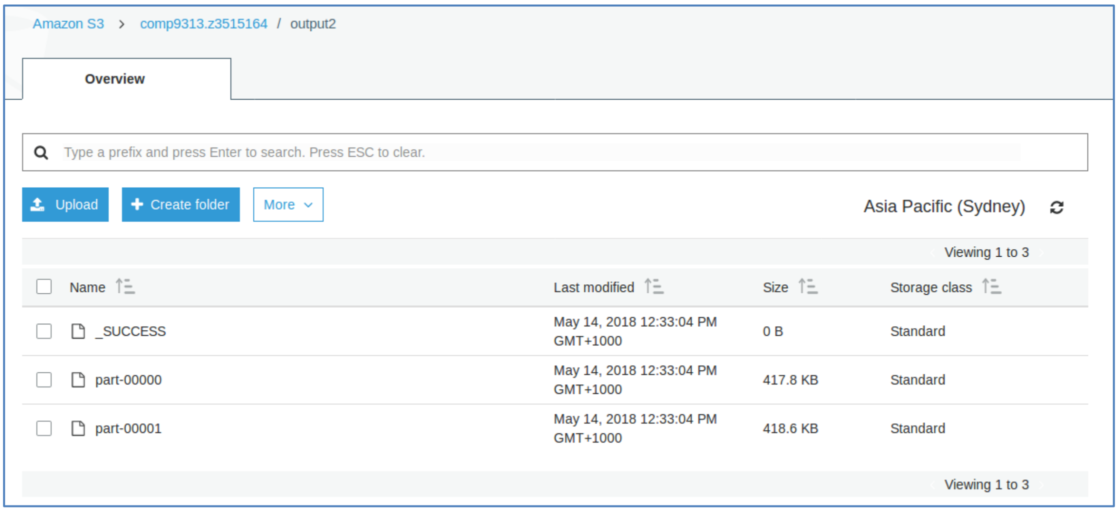
7. Download the jar file from S3 by the following command:

```
$ hadoop fs -get s3://comp9313.<YOUR_StudentID>/word-count_2.11-
1.0.jar
```

8. Run the Spark task. Generate the results in a different folder!

```
$ spark-submit --class "comp9313.lab10.WordCount" --master yarn word-
count_2.11-1.0.jar s3://comp9313.<YOUR_StudentID>/pg100.txt
s3://comp9313.<YOUR_StudentID>/output2
```

9. Wait for the completion of the task and check the results in your S3 bucket. You should see:


Amazon S3 › comp9313.z3515164 / output2
Overview
Type a prefix and press Enter to search. Press ESC to clear.
Upload
Create folder
More
Asia Pacific (Sydney)
Viewing 1 to 3

□	Name	Last modified	Size	Storage class
□	_SUCCESS	May 14, 2018 12:33:04 PM GMT+1000	0 B	Standard
□	part-00000	May 14, 2018 12:33:04 PM GMT+1000	417.8 KB	Standard
□	part-00001	May 14, 2018 12:33:04 PM GMT+1000	418.6 KB	Standard

10. You can also download “pg100.txt” from S3, and put the file to HDFS, and run the Spark task by reading/writing files from/to HDFS instead of S3.

```
$ hdfs dfs –mkdir input

$ hdfs dfs –put pg100.txt input

$ spark-submit --class “comp9313.lab10.WordCount” --master yarn word-count_2.11-1.0.jar input/pg100.txt output
```

Caution: The I/O between the cluster and S3 is also billed if your transfer exceeds the free tier limit!!!

11. You can also add a new step to this cluster to run a Spark task. Try it by yourself.

12. Caution: Do not forget to terminate the cluster after you finish all labs!!! (Click “Terminate” and turn termination protection off)