Step 1: Install Apache Spark

1. **Download Apache Spark**: Go to the Apache Spark website (https://spark.apache.org/downloads.html) and download the latest version of Apache Spark.
2. **Extract Spark**: After downloading, extract the contents of the downloaded file to a directory of your choice. (Create DSBDAL folder in home directory and extract the contents)
3. **Set up Environment Variables**: Add Spark's `bin` directory to your `PATH` environment variable. You can do this by modifying your shell profile file (e.g., `.bashrc`, `.bash_profile`, `.zshrc`, etc.) (Our is bash)
    a. **Open your Terminal**: Launch your terminal application. This process may differ slightly depending on your operating system (e.g., Terminal on macOS, Command Prompt or PowerShell on Windows, Terminal on Linux).
    b. **Determine your Shell**: Before proceeding, determine which shell you're using. Common shells include Bash, Zsh, and Fish. You can typically find out your current shell by running the following command:

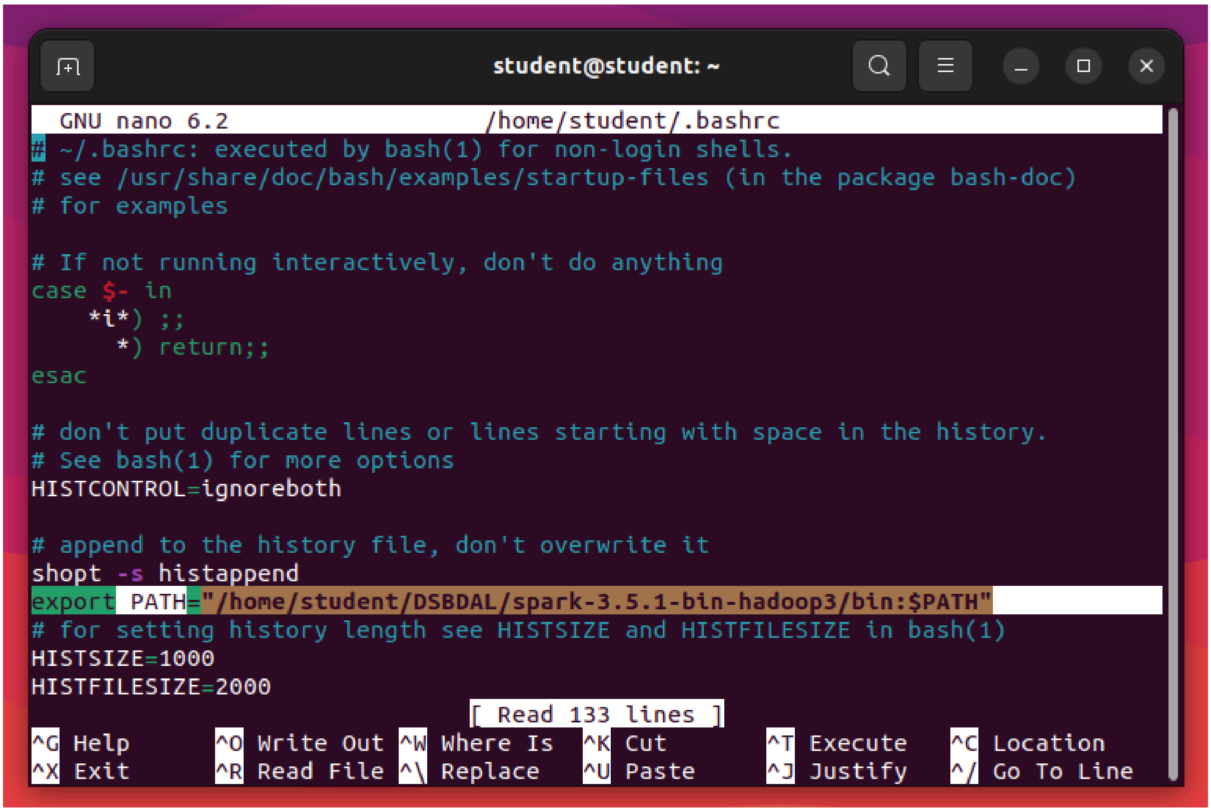
    ```
    echo $SHELL
    ```

    c. **Edit the Shell Profile File**: Based on your shell, you'll edit the corresponding profile file:
        i. For Bash (`~/.bashrc`):

        ```
        nano ~/.bashrc
        ```

    d. **Add Spark's bin Directory to PATH**: Inside the opened file, add the following line:

    ```
    export
    PATH="/home/student/DSBDAL/spark-3.5.1-bin-hadoop3/bin:$PATH"
    ```



```
  GNU nano 6.2                    /home/student/.bashrc
# ~/.bashrc: executed by bash(1) for non-login shells.
# see /usr/share/doc/bash/examples/startup-files (in the package bash-doc)
# for examples

# If not running interactively, don't do anything
case $- in
    *i*) ;;
      *) return;;
esac

# don't put duplicate lines or lines starting with space in the history.
# See bash(1) for more options
HISTCONTROL=ignoreboth

# append to the history file, don't overwrite it
shopt -s histappend
export PATH="/home/student/DSBDAL/spark-3.5.1-bin-hadoop3/bin:$PATH"
# for setting history length see HISTSIZE and HISTFILESIZE in bash(1)
HISTSIZE=1000
HISTFILESIZE=2000
                               [ Read 133 lines ]
^G Help        ^O Write Out ^W Where Is  ^K Cut         ^T Execute     ^C Location
^X Exit        ^R Read File ^\ Replace   ^U Paste       ^J Justify     ^/ Go To Line
```

e. **Save and Exit**: After adding the line, save the file and exit the editor. In Nano, you can do this by pressing `Ctrl + O` to write the file and `Ctrl + X` to exit.

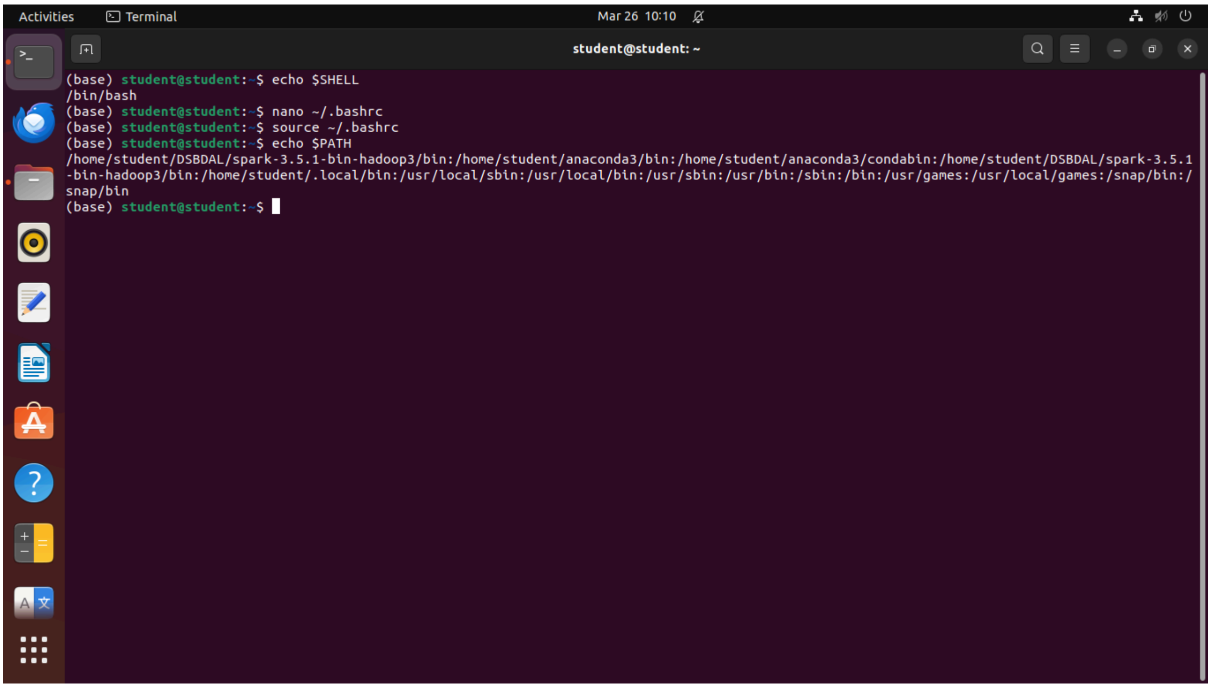
f. **Apply Changes**: To apply the changes to your current terminal session, either close and reopen the terminal or run:

```
source ~/.bashrc
```

g. **Verify**: You can verify that Spark's `bin` directory has been added to your `PATH` by running:

```
echo $PATH
```

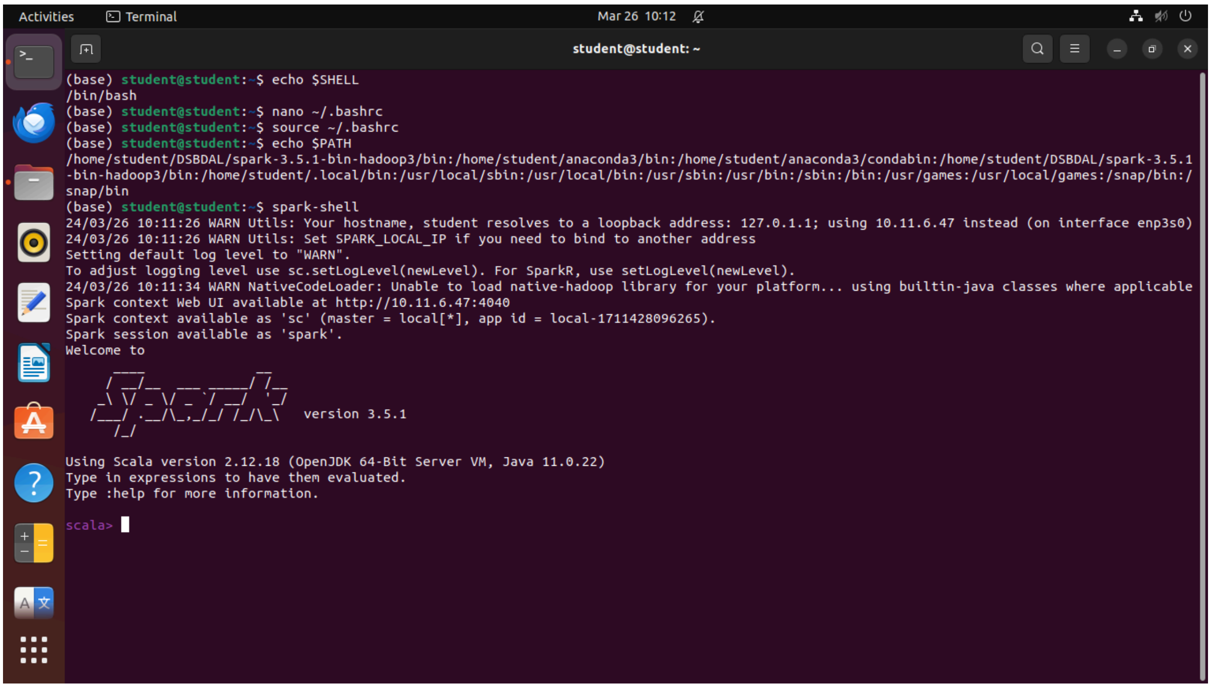
You should see the path to Spark's `bin` directory listed in the output.



```
(base) student@student:~$ echo $SHELL
/bin/bash
(base) student@student:~$ nano ~/.bashrc
(base) student@student:~$ source ~/.bashrc
(base) student@student:~$ echo $PATH
/home/student/DSBDAL/spark-3.5.1-bin-hadoop3/bin:/home/student/anaconda3/bin:/home/student/anaconda3/condabin:/home/student/DSBDAL/spark-3.5.1
-bin-hadoop3/bin:/home/student/.local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/
snap/bin
(base) student@student:~$ 
```

4. **Verify Installation**: Open a new terminal window and type `spark-shell`. If Spark has been installed correctly, you should see the Spark shell prompt.

```
spark-shell
```



```
(base) student@student:~$ echo $SHELL
/bin/bash
(base) student@student:~$ nano ~/.bashrc
(base) student@student:~$ source ~/.bashrc
(base) student@student:~$ echo $PATH
/home/student/DSBDAL/spark-3.5.1-bin-hadoop3/bin:/home/student/anaconda3/bin:/home/student/anaconda3/condabin:/home/student/DSBDAL/spark-3.5.1
-bin-hadoop3/bin:/home/student/.local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/
snap/bin
(base) student@student:~$ spark-shell
24/03/26 10:11:26 WARN Utils: Your hostname, student resolves to a loopback address: 127.0.1.1; using 10.11.6.47 instead (on interface enp3s0)
24/03/26 10:11:26 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
24/03/26 10:11:34 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Spark context Web UI available at http://10.11.6.47:4040
Spark context available as 'sc' (master = local[*], app id = local-1711428096265).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 3.5.1
      /_/

Using Scala version 2.12.18 (OpenJDK 64-Bit Server VM, Java 11.0.22)
Type in expressions to have them evaluated.
Type :help for more information.

scala> 
```

Step 2:

Use following link to execute word count scala program on apache spark

https://www.tutorialspoint.com/apache_spark/apache_spark_introduction.htm

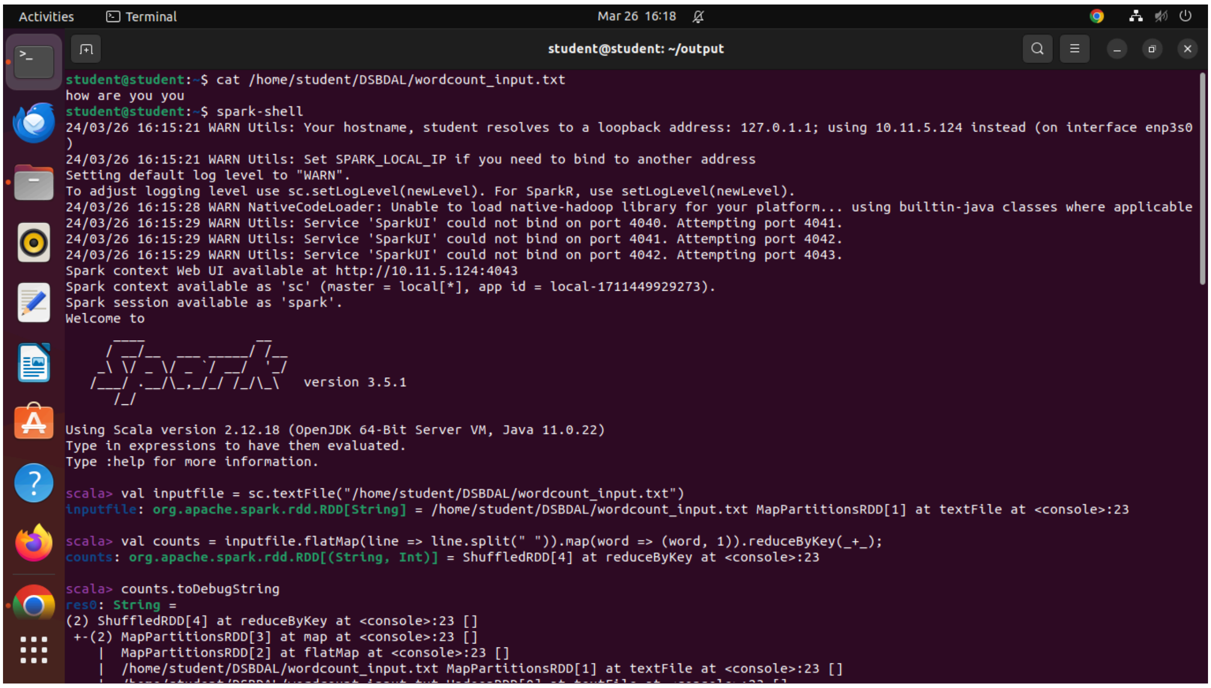
val inputfile = sc.textFile("/home/student/DSBDAL/wordcount_input.txt")

val counts = inputfile.flatMap(line => line.split(" ")).map(word => (word, 1)).reduceByKey(_+_);

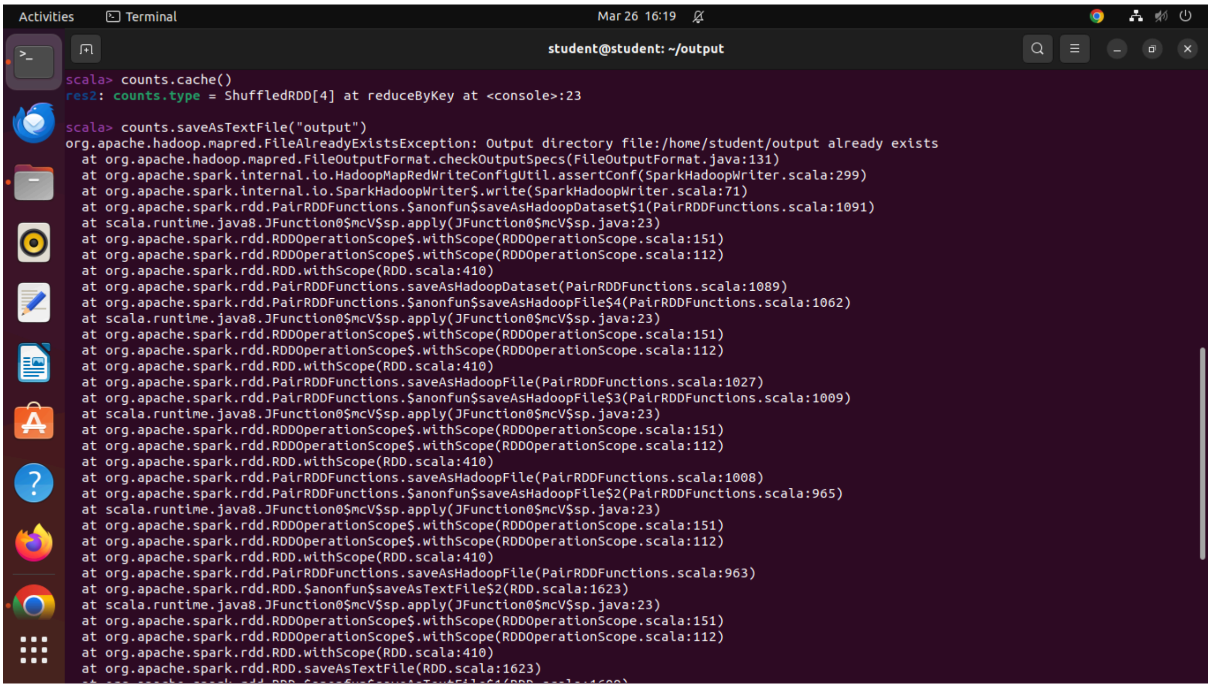
counts.toDebugString

counts.cache()

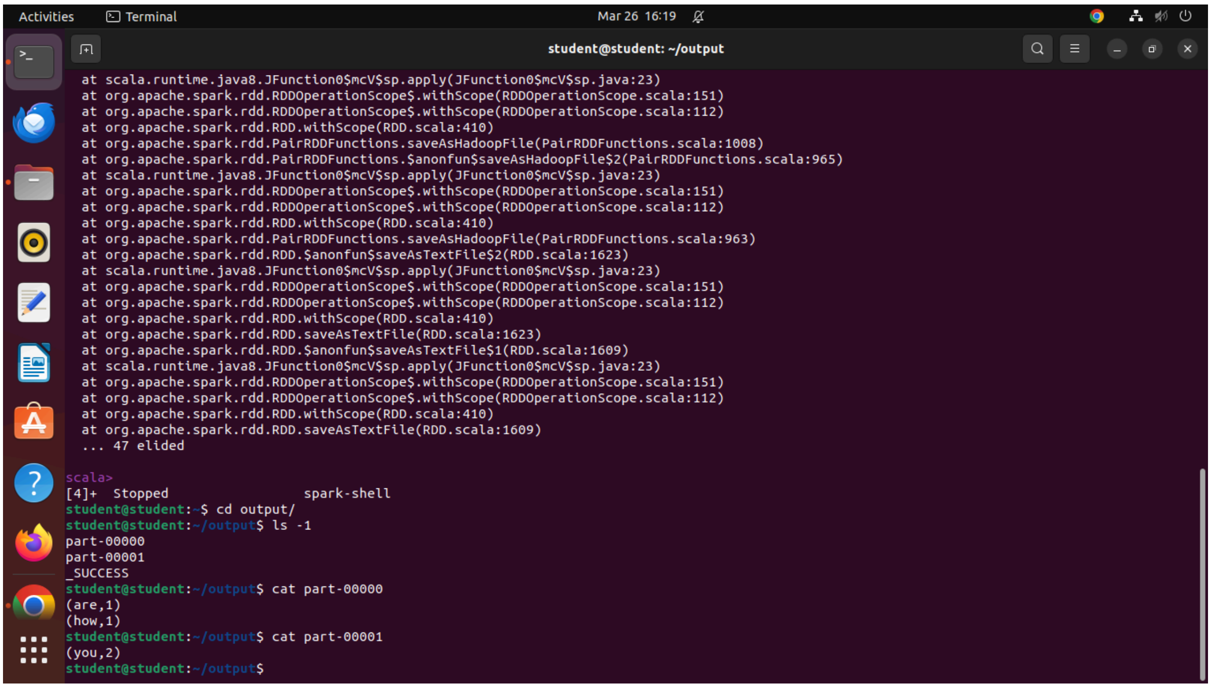
counts.saveAsTextFile("output")



```
student@student:~$ cat /home/student/DSBDAL/wordcount_input.txt
how are you you
student@student:~$ spark-shell
24/03/26 16:15:21 WARN Utils: Your hostname, student resolves to a loopback address: 127.0.1.1; using 10.11.5.124 instead (on interface enp3s0
)
24/03/26 16:15:21 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
24/03/26 16:15:28 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
24/03/26 16:15:29 WARN Utils: Service 'SparkUI' could not bind on port 4040. Attempting port 4041.
24/03/26 16:15:29 WARN Utils: Service 'SparkUI' could not bind on port 4041. Attempting port 4042.
24/03/26 16:15:29 WARN Utils: Service 'SparkUI' could not bind on port 4042. Attempting port 4043.
Spark context Web UI available at http://10.11.5.124:4043
Spark context available as 'sc' (master = local[*], app id = local-1711449929273).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 3.5.1
      /_/

Using Scala version 2.12.18 (OpenJDK 64-Bit Server VM, Java 11.0.22)
Type in expressions to have them evaluated.
Type :help for more information.

scala> val inputfile = sc.textFile("/home/student/DSBDAL/wordcount_input.txt")
inputfile: org.apache.spark.rdd.RDD[String] = /home/student/DSBDAL/wordcount_input.txt MapPartitionsRDD[1] at textFile at <console>:23

scala> val counts = inputfile.flatMap(line => line.split(" ")).map(word => (word, 1)).reduceByKey(_+_);
counts: org.apache.spark.rdd.RDD[(String, Int)] = ShuffledRDD[4] at reduceByKey at <console>:23

scala> counts.toDebugString
res0: String =
(2) ShuffledRDD[4] at reduceByKey at <console>:23 []
 +-(2) MapPartitionsRDD[3] at map at <console>:23 []
    |  MapPartitionsRDD[2] at flatMap at <console>:23 []
    |  /home/student/DSBDAL/wordcount_input.txt MapPartitionsRDD[1] at textFile at <console>:23 []
```



```
scala> counts.cache()
res2: counts.type = ShuffledRDD[4] at reduceByKey at <console>:23

scala> counts.saveAsTextFile("output")
org.apache.hadoop.mapred.FileAlreadyExistsException: Output directory file:/home/student/output already exists
  at org.apache.hadoop.mapred.FileOutputFormat.checkOutputSpecs(FileOutputFormat.java:131)
  at org.apache.spark.internal.io.HadoopMapRedWriteConfigUtil.assertConf(SparkHadoopWriter.scala:299)
  at org.apache.spark.internal.io.SparkHadoopWriter$.write(SparkHadoopWriter.scala:71)
  at org.apache.spark.rdd.PairRDDFunctions.$anonfun$saveAsHadoopDataset$1(PairRDDFunctions.scala:1091)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.PairRDDFunctions.saveAsHadoopDataset(PairRDDFunctions.scala:1089)
  at org.apache.spark.rdd.PairRDDFunctions.$anonfun$saveAsHadoopFile$4(PairRDDFunctions.scala:1062)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.PairRDDFunctions.saveAsHadoopFile(PairRDDFunctions.scala:1027)
  at org.apache.spark.rdd.PairRDDFunctions.$anonfun$saveAsHadoopFile$3(PairRDDFunctions.scala:1009)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.PairRDDFunctions.saveAsHadoopFile(PairRDDFunctions.scala:1008)
  at org.apache.spark.rdd.PairRDDFunctions.$anonfun$saveAsHadoopFile$2(PairRDDFunctions.scala:965)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.PairRDDFunctions.saveAsHadoopFile(PairRDDFunctions.scala:963)
  at org.apache.spark.rdd.RDD.$anonfun$saveAsTextFile$2(RDD.scala:1623)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.RDD.saveAsTextFile(RDD.scala:1623)
```



```
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.PairRDDFunctions.saveAsHadoopFile(PairRDDFunctions.scala:1008)
  at org.apache.spark.rdd.PairRDDFunctions.$anonfun$saveAsHadoopFile$2(PairRDDFunctions.scala:965)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.PairRDDFunctions.saveAsHadoopFile(PairRDDFunctions.scala:963)
  at org.apache.spark.rdd.RDD.$anonfun$saveAsTextFile$2(RDD.scala:1623)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.RDD.saveAsTextFile(RDD.scala:1623)
  at org.apache.spark.rdd.RDD.$anonfun$saveAsTextFile$1(RDD.scala:1609)
  at scala.runtime.java8.JFunction0$mcV$sp.apply(JFunction0$mcV$sp.java:23)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:151)
  at org.apache.spark.rdd.RDDOperationScope$.withScope(RDDOperationScope.scala:112)
  at org.apache.spark.rdd.RDD.withScope(RDD.scala:410)
  at org.apache.spark.rdd.RDD.saveAsTextFile(RDD.scala:1609)
  ... 47 elided

scala>
[4]+  Stopped                 spark-shell
student@student:~$ cd output/
student@student:~/output$ ls -1
part-00000
part-00001
_SUCCESS
student@student:~/output$ cat part-00000
(are,1)
(how,1)
student@student:~/output$ cat part-00001
(you,2)
student@student:~/output$
```