**Task 1**

**A: Find sum of numbers in the list**

Define a variable sum initialized to 0. Iterate over the list using foreach and sum them

The scala code is as below:

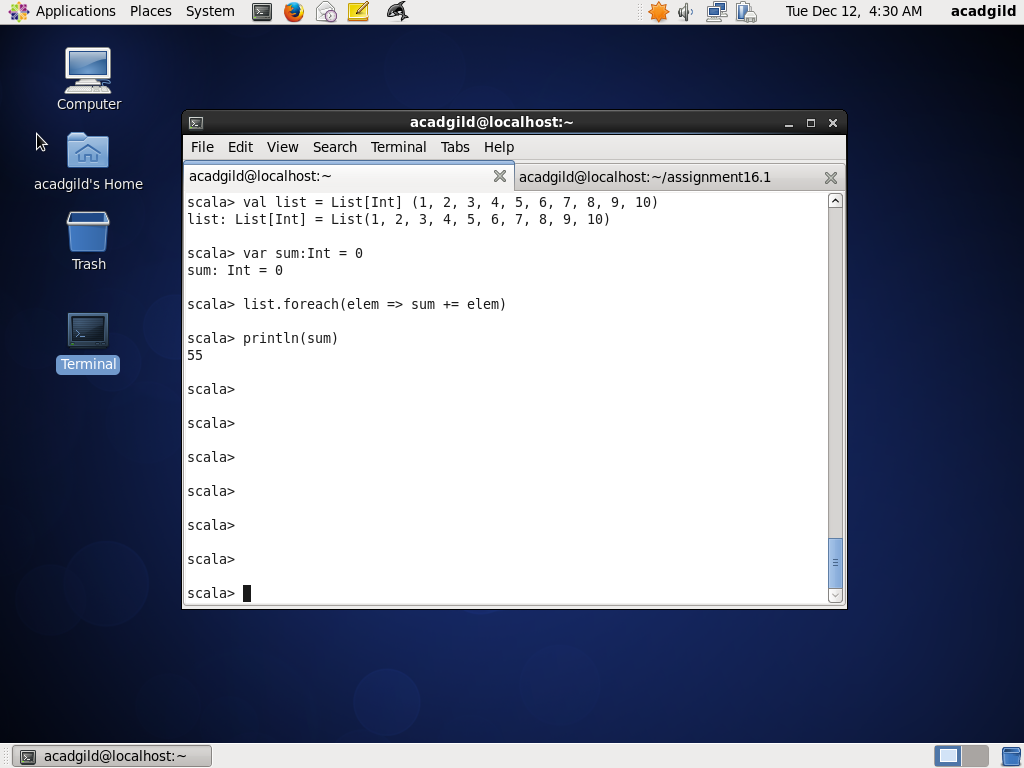
val list = List[Int] (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

var sum:Int = 0

list.foreach(elem => sum += elem)

println(sum)

Screenshot is:



**B: Find number of element in the list**

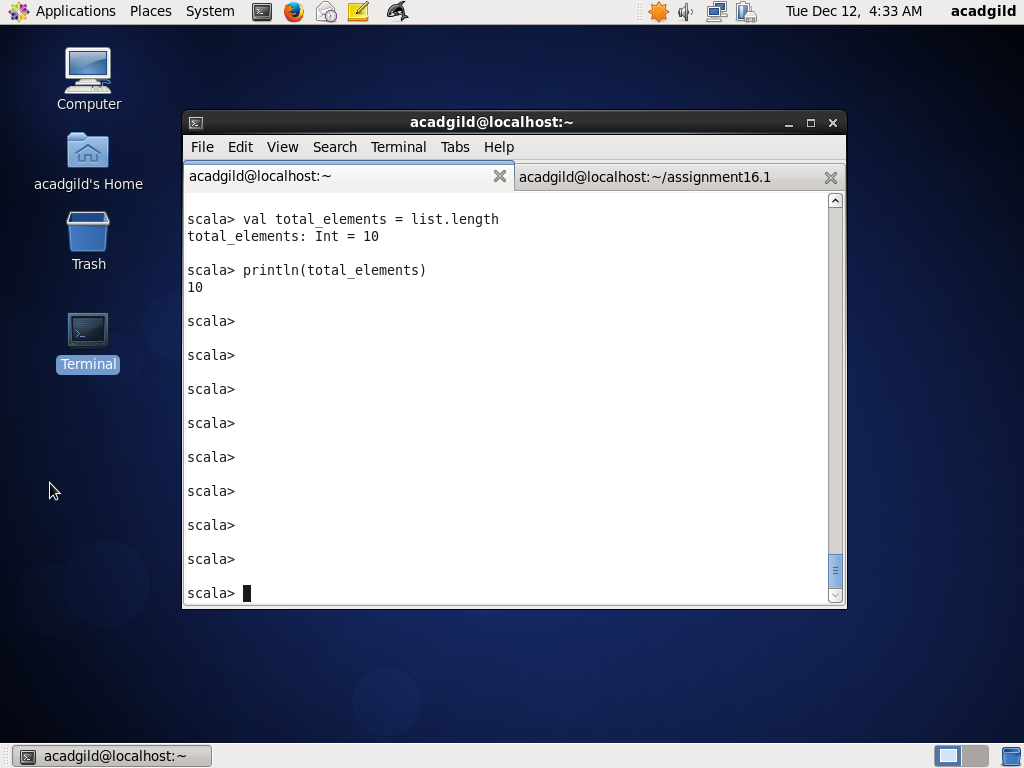
Define a variable total\_elements and initialize to list.length

The scala code is as below:

val total\_elements = list.length

println(total\_elements)

Screenshot is as below:



**C: Find average of all the numbers**

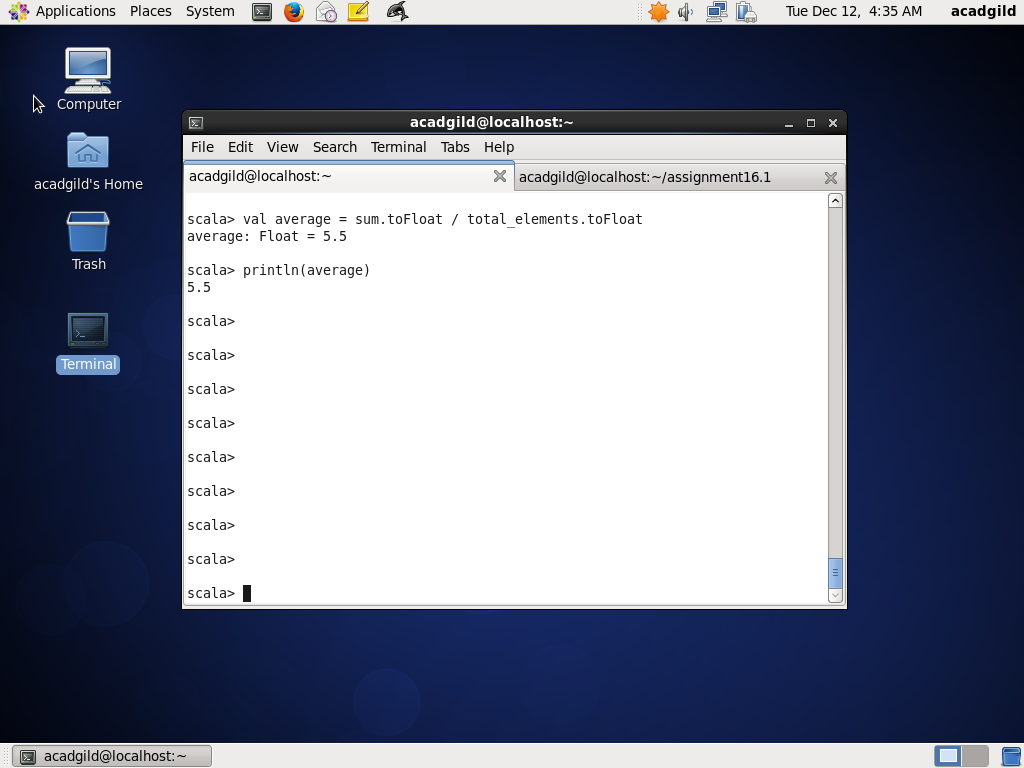
Use sum calculated from task1 and total\_elements from task2. Convert sum to Float and total\_elements to Float and divide and then initialize to average and print

Code is as below:

val average = sum.toFloat / total\_elements.toFloat

println(average)

Screenshot is as below:



**D: Find sum of event numbers in the list**

Intialize a variable sum\_even to 0. Then iterate over the list using foreach and element which is even (modulo 2 is 0) add to sum\_even. Print sum\_even

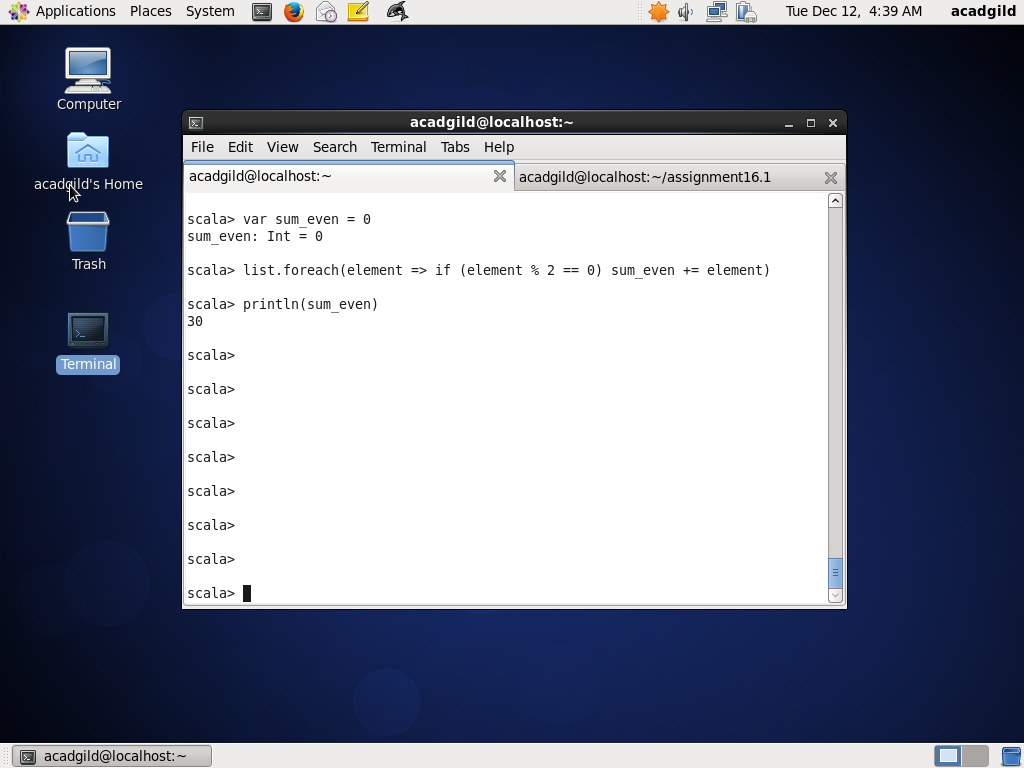
Scala code is as below:

var sum\_even = 0

list.foreach(element => if (element % 2 == 0) sum\_even += element)

println(sum\_even)

Screenshot is as below:



**E: Find count of numbers divisible by both 3 and 5**

Initialize a variable count\_elements\_divisible\_by\_3\_5 to 0. Then iterate over the list using foreach and if a element which is divisible by both 3 and 5 (modulo 3 is 0 and modulo 5 is ) , increment count\_elements\_divisible\_by\_3\_5 by 1

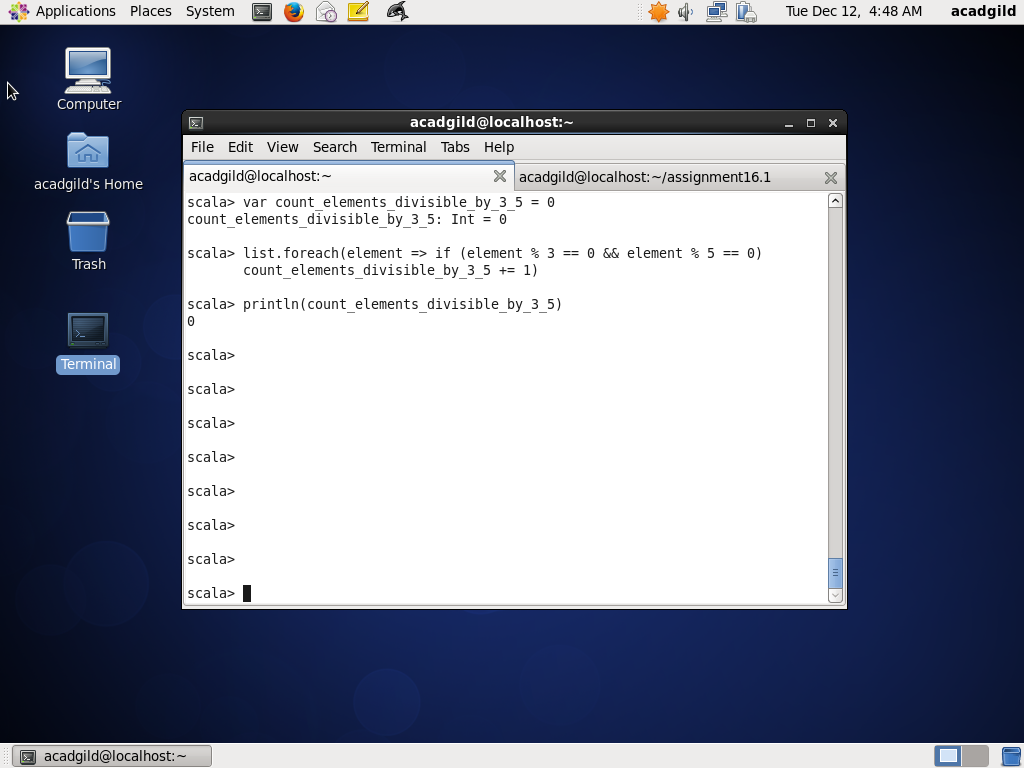
Scala code is as below:

var count\_elements\_divisible\_by\_3\_5 = 0

list.foreach(element => if (element % 3 == 0 && element % 5 == 0) count\_elements\_divisible\_by\_3\_5 += 1)

println(count\_elements\_divisible\_by\_3\_5)

Screenshot is as below:



**Task 2**

1. Pen down the limitations of MapReduce.

**Limitation of Map Reduce are:**

1. It is based on disk based computation which makes computation jobs slower
2. It is only meant for single pass computation, not iterative computations. It requires a sequence of Map Reduce jobs to run iterative task
3. Needs integration with several tools to solve big data usecases. Integration with Apache Storm is required for Stream data processing. Integration with Mahout required for Machine Learning
4. Problems that cannot be trivially partitionable or recombinable becomes a candid limitation of MapReduce problem solving. For instance, Travelling Salesman problem.
5. Due to the fixed cost incurred by each MapReduce job submitted, application that requires low latency time or random access to a large set of data is infeasible.
6. Tasks that has a dependency on each other cannot be parallelized, which is not possible through MapReduce.
7. What is RDD. Specify a few features of RDD

RDD is a logical reference of a dataset which is partitioned across many server machines in the cluster.It is the primary abstraction in Spark and is the core of Apache Spark. Immutable and partitioned collection of records, which can only be created by coarse grained operations such as map, filter, group-by, etc. Can only be created by reading data from a stable storage like HDFS or by transformations on existing RDD’s.

Features of RDD:

1. **Resilient**, i.e. fault-tolerant with the help of RDD lineage graph and so able to recompute missing or damaged partitions due to node failures
2. **Distributed** with data residing on multiple nodes in a cluster.
3. **Dataset** is a collection of partitioned data with primitive values or values of values, e.g. tuples or other objects
4. **In-Memory**, i.e. data inside RDD is stored in memory as much (size) and long (time) as possible.
5. **Immutable or Read-Only**, i.e. it does not change once created and can only be transformed using transformations to new RDDs.
6. **Lazy evaluated**, i.e. the data inside RDD is not available or transformed until an action is executed that triggers the execution.
7. **Cacheable**, i.e. we can hold all the data in a persistent "storage" like

memory (default and the most preferred) or disk (the least preferred due

to access speed).

1. **IParallel**, i.e. process data in parallel.
2. **Typed** — RDD records have types, e.g. Long in RDD[Long] or (Int, String) in RDD[(Int, String)].
3. **Partitioned** — records are partitioned (split into logical partitions) and distributed across nodes in a cluster.
4. **Location-Stickiness** — RDD can define placement preferences to

compute partitions (as close to the records as possible).

1. List a number of RDD operations and explain each of them
2. **map**: The map function iterates over every line in RDD and split into new RDD. Using **map()** transformation we take in any function, and that function is applied to every element of RDD.

Example:

tupleRDD has 4 fields ( name, subject, grade, marks). Using map operations two fields are taken (subject, marks)

val studentMarksSubjectRDD = tupleRDD.map(t=> (t.\_2, t.\_4)

1. **flatMap**: With the help of **flatMap()** function, to each input element, we have many elements in an output RDD. The most simple use of flatMap() is to split each input string into words. flatMap returns a collection of elements

Example:

Tis example takes a input file and split them into words

val rdd = sc.textFile("/home/acadgild/assignment\_17.1/wordcount\_input\_file")

val rdd\_words = rdd.flatMap(line=> line.split(" "))

1. **filter**: Spark RDD **filter()** function returns a new RDD, containing only the elements that meet a predicate. It is a narrow operation because it does not shuffle data from one partition to many partitions.

Example:

tupleRDD has 4 fields ( name, subject, grade, marks). Using filter operation only students who are in grade-2 taken

val grade2StudentRDD = tupleRDD.filter(t=> t.\_3 == "grade-2")

1. **mapPartition**: The**MapPartition** converts each partition of the source RDD into many elements of the result (possibly none). In mapPartition(), the map() function is applied on each partitions simultaneously. MapPartition is like a map, but the difference is it runs separately on each partition(block) of the RDD.
2. **Union**: With the **union()** function, we get the elements of both the RDD in new RDD. The key rule of this function is that the two RDDs should be of the same type.

**Example**:

In the example rdd1 has three dates, rdd2 has two dates and rdd3 has two dates, union operation is done on rdd1, rdd2, rdd3 to get new RDD rddUnion

val rdd1 = parallelize(Seq((1,"jan",2016),(3,"nov",2014),(16,"feb",2014)))

val rdd2 = spark.sparkContext.parallelize(Seq((5,"dec",2014),(17,"sep",2015)))

val rdd3 = spark.sparkContext.parallelize(Seq((6,"dec",2011),(16,"may",2015)))

val rddUnion = rdd1.union(rdd2).union(rdd3)

rddUnion.foreach(Println)

|  |  |
| --- | --- |
|  |  |

1. **Intersection:** With the **intersection()** function, we get only the common element of both the RDD in new RDD. The key rule of this function is that the two RDDs should be of the same type.

**Example:**

In the example rdd1 has three dates, rdd2 has two dates and rdd2 has two dates, intersection operation is done on rdd1, rdd2 to get new RDD rddCommon

val rdd1 = sc.parallelize(Seq((1,"jan",2016),(3,"nov",2014, (16,"feb",2014)))

val rdd2 = spark.sparkContext.parallelize(Seq((5,"dec",2014),(1,"jan",2016)))

val rddCommon = rdd1.intersection(rdd2)

rddCommon.foreach(Println)

1. **Distinct**: It returns a new dataset that contains the **distinct** elements of the source dataset. It is helpful to remove duplicate data.

**Example:**

In this example tuple RDD is created from a file which has student records. Distict is used to get distinct tuples

val baseRDD = sc.textFile("/home/acadgild/assignment\_17.2/17.2\_Dataset.txt")

val tupleRDD = baseRDD.map(x => (x.split(",")(0), x.split(",")(1), x.split(",")(2), x.split(",")(3).toInt))

val distinctTupleRDD = tupleRDD.distinct

1. **ReduceByKey**: When we use **reduceByKey** on a dataset (K, V), the pairs on the same machine with the same key are combined, before the data is shuffled.

Example:

In this example, distinctGradeStudentMapCountRDD has tuples with first elementa as key grade and second element as value marks. Using reduceByKey operations Marks for each grade are summed and put to gradeStudentCountRDD

val gradeStudentCountRDD = distinctGradeStudentMapCountRDD.reduceByKey((x, y) => x+y)

1. **SortByKe**y: When we apply the **sortByKey() function** on a dataset of (K, V) pairs, the data is sorted according to the key K in another RDD.

**Example:**

val data = spark.sparkContext.parallelize(Seq(("maths",52), ("english",75), ("science",82), ("computer",65), ("maths",85)))

val sorted = data.sortByKey()

sorted.foreach(println)

1. **Join:**

join() operation in Spark is defined on pair-wise RDD. Pair-wise RDDs are RDD in which each element is in the form of tuples. Where the first element is key and the second element is the value.

The advantage of using keyed data is that we can combine the data together. The join() operation combines two data sets on the basis of the key.

**Example**:

val data = spark.sparkContext.parallelize(Array(('A',1),('b',2),('c',3)))

val data2 =spark.sparkContext.parallelize(Array(('A',4),('A',6),('b',7),('c',3),('c',8)))

val result = data.join(data2)

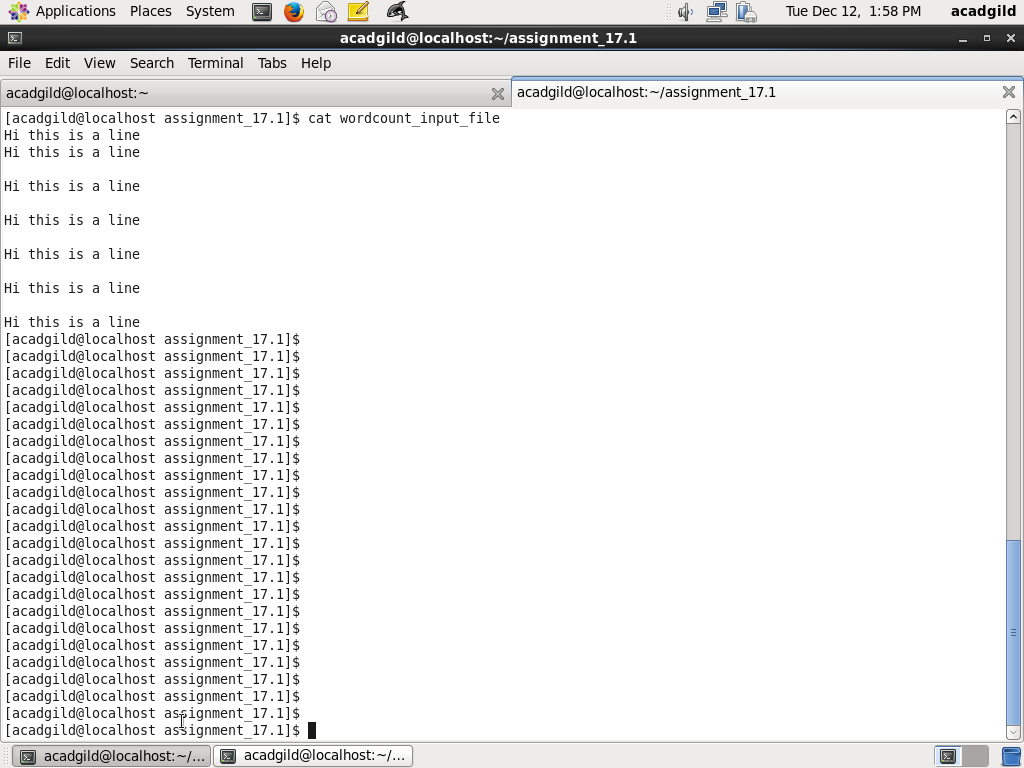
println(result.collect().mkString(","))

**Task 3**

1. Write a program to read a text file and print the number of rows of data in the document.

Step1:

First copy the wordcount\_input\_file. Contents of file is displayed below



Step2:

Create a RDD using the text file. Count number of lines in rdd and put to line\_count. Print line\_count.

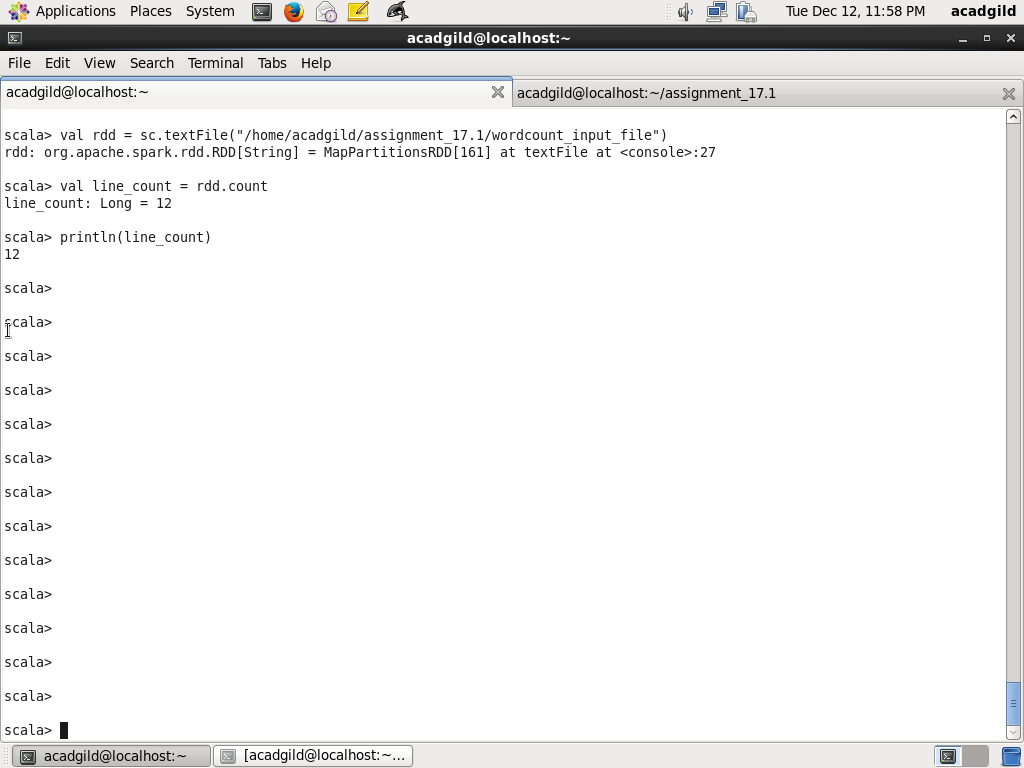
The code is as below:

val rdd = sc.textFile("/home/acadgild/assignment\_17.1/wordcount\_input\_file")

val line\_count = rdd.count

println(line\_count)

Screenshot is as below:



2. Write a program to read a text file and print the number of words in the document.

Create a rdd from the input file wordcount\_input\_file. Create a rdd\_words by splitting line based on blank space and using flatMap on rdd. Count the number of words using count method and assign to word\_count. Print word\_count

Code is as below:

val rdd = sc.textFile("/home/acadgild/assignment\_17.1/wordcount\_input\_file")

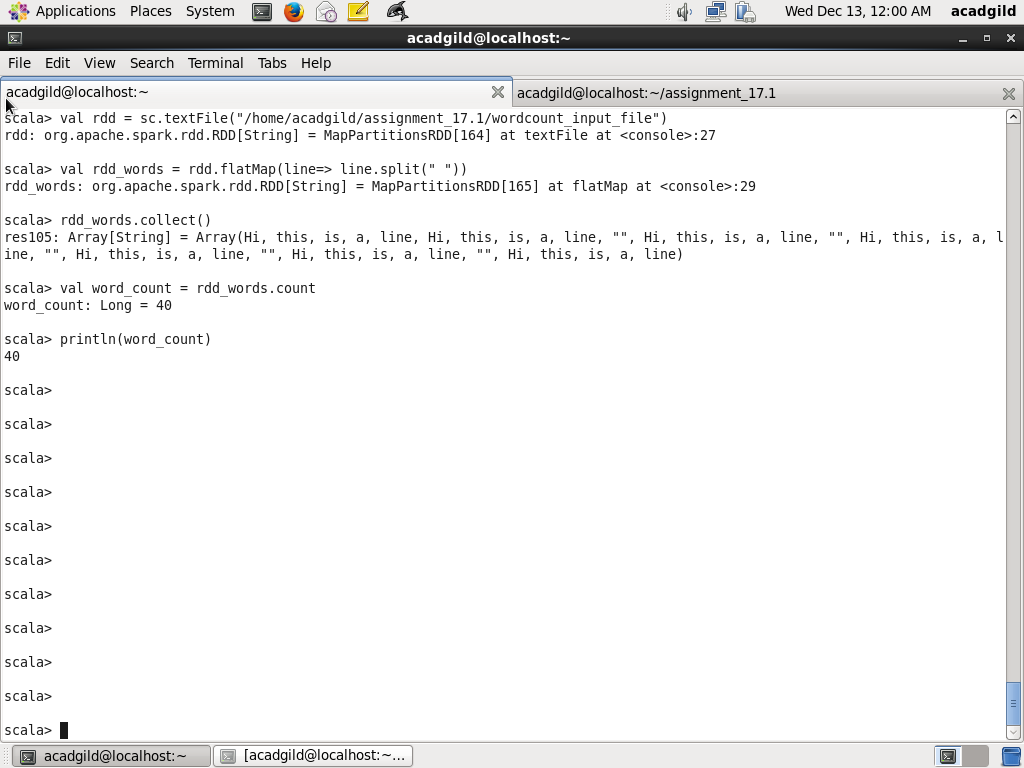
val rdd\_words = rdd.flatMap(line=> line.split(" "))

rdd\_words.collect()

val word\_count = rdd\_words.count

println(word\_count)

Screenshot is as below:



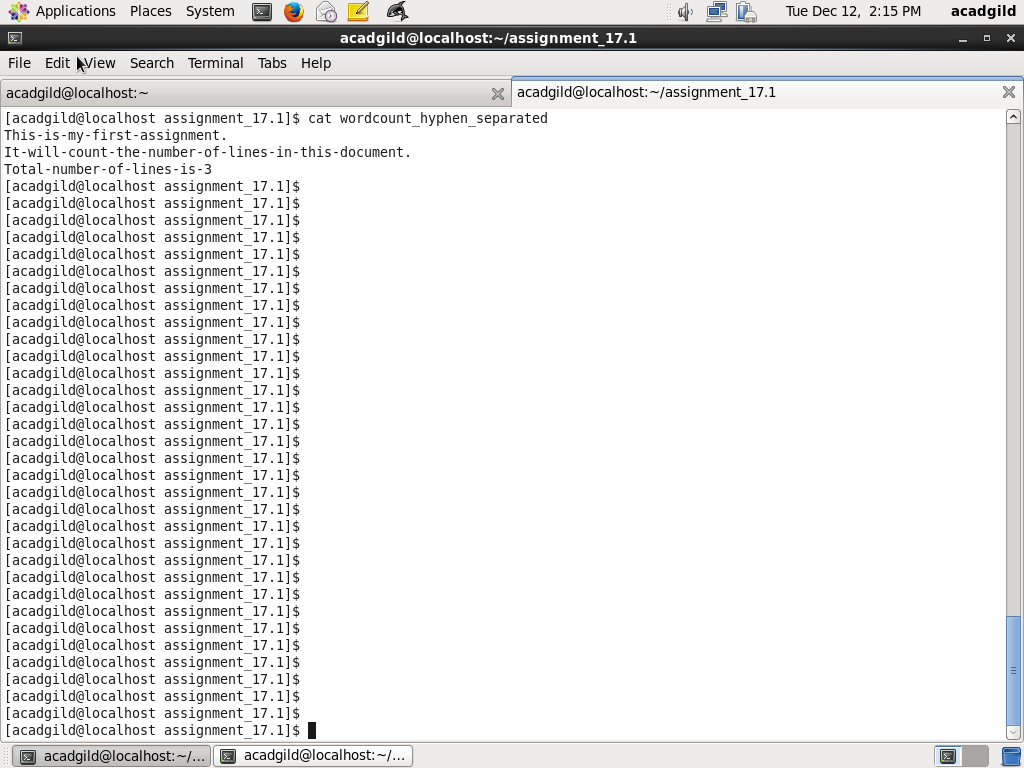
3. We have a document where the word separator is -, instead of space. Write a spark

code, to obtain the count of the total number of words present in the document.

Step1:

Copy the file wordcount\_hyphen\_separated to /home/acadgild/assignment\_17.1

Contents are as below:



Step2:

Create a RDD rdd\_hyphen from the wordcount\_hyphen\_separated file. Split each line based on separator hyphen (-) and use flatMap to combine the results. Use count method to get the count of works and assign to word\_hyphen\_separator\_count and print word\_hyphen\_separator\_count

Code is as below:

val rdd\_hyphen = sc.textFile("/home/acadgild/assignment\_17.1/wordcount\_hyphen\_separated")

val rdd\_hyphen\_words = rdd\_hyphen.flatMap(line=> line.split("-"))

rdd\_hyphen\_words.collect

val word\_hyphen\_separator\_count = rdd\_hyphen\_words.count

println(word\_hyphen\_separator\_count)

Screenshot is as below: