CIS 4930 Introduction to Hadoop and Big Data

Implement an Iterative Algorithm with Spark

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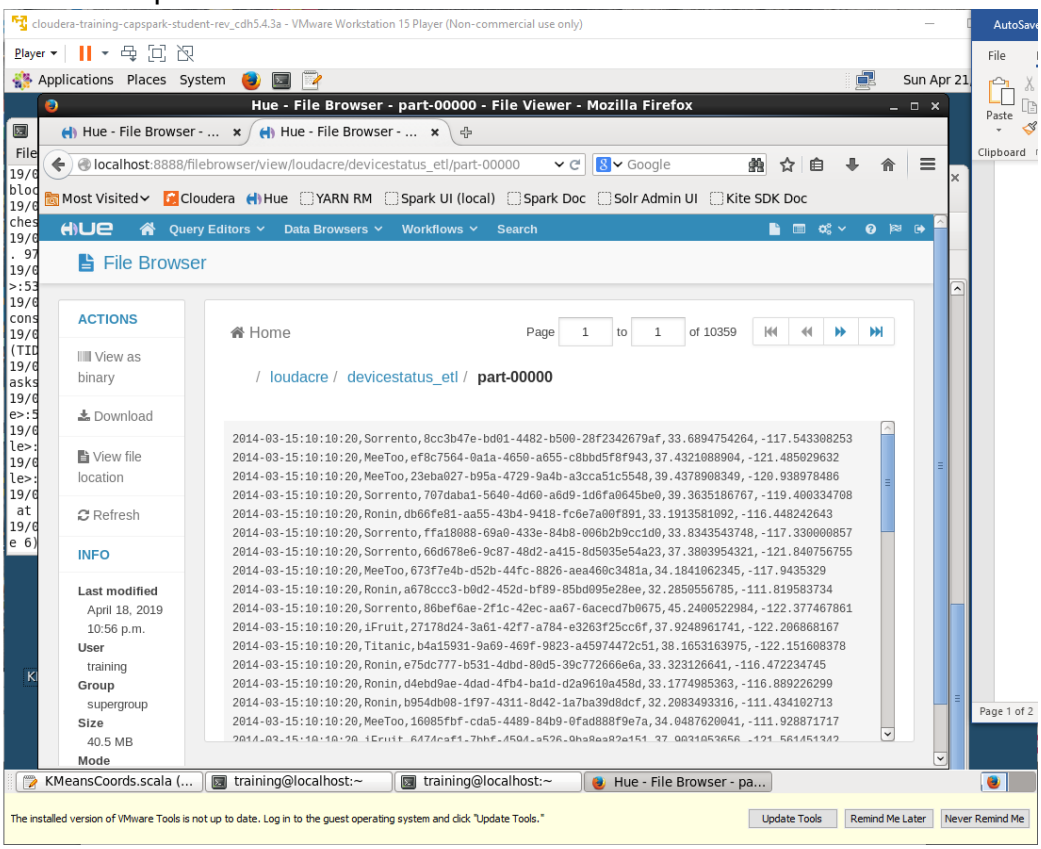
Introduction:

For this project, an iterative spark algorithm was developed using the scala language. The data that was transformed was located at /loudacre/devicestatus_etl/* on the HDFS. This data was transformed and uploaded to the HDFS in the lab “Use RDDs to Explore and Transform a Dataset”.

This is an example of the file used for this lab on the hue file browser:



Methodology:

Initially three helper functions were defined, which included *closestPoint, addPoints,* and *distanceSquared.* Next, the variables defined in the lab were defined in the scala file. This included K = 5, which is the number of means to calculate for this lab. Also, *convergeDist* = 0.1, which used to decide when the k-means calculation has been completed. This is in effect when the amount the

locations of the means changes between iterations is less than *convergeDist*. Since a perfect solution would have been 0, the approach in this lab was heuristic.

Next, the file in the directory /loudacre/devicestatus_etl/* was parsed. This file was split by its delimiting the character ‘,’ , into latitude and longitude pairs, which correspond to 4th and 5th fields in each line, at index 3 and 4. While parsing, only known locations were include as latitude and longitude pairs of 0,0 were filtered out. Lastly, the resulting RDD was persisted as it was being accessed in an iterative fashion.

File being parsed with the constraints mentioned above:

val data = fileRdd.map(line => line.split(',')).map(pair => (pair(3).toDouble, pair(4).toDouble)).filter(point => !((point._1 == 0) && (point._2 == 0))).persist()

Then we started with k randomly selected points from the dataset as center points and printed out their values with the following command:

```
var kPoints = pair.takeSample(false, K, 42)
        println("Final K center points: " )
        kPoints.foreach(println)
```

To find the distance between one iteration’s points and the next is less than the convergence distance of 0.5, a while loop was used. Next, an RDD of the closest point with was made using the helper function closestPoint. Then the RDD was reduced by key and saved as a new RDD. Then new points RDD was calculating by the average of the closest point. Then the distance between the current points and new points was calculated. Then the new points were saved to the kPoints array. The following displays the commands used:

```
var tempDist = Double.PositiveInfinity
while (tempDist > convergeDist) {
    val c = pair.map(point => (closestPoint(point, kPoints), (point, 1)))
    //closestToKpointRdd.foreach(println)
    val pointStats = c.reduceByKey{case ((point1,n1),(point2,n2)) => (addPoints(point1,point2),n1+n2) }

        // For each key (k-point index), find a new point by calculating the average of each closest point
        val newPoints = pointStats.map{case (i,(point,n)) => (i,(point._1/n,point._2/n))}.collectAsMap()

     // calculate the total of the distance between the current points and
```

```
new points
        tempDist = 0.0
        for (i <- 0 until K) {
          tempDist += distanceSquared(kPoints(i),newPoints(i))
        }
    println("Distance between iterations: "+tempDist)

        // Copy the new points to the kPoints array for the next iteration
        for (i <- 0 until K) {
            kPoints(i) = newPoints(i)
        }
}
```

The final output of running the spark application is the following:

Final center points:
(35.08592000544959,-112.57643826547951)
(36.025400882817564,-119.86128360401455)
(44.16453784336209,-121.68421197097716)
(34.177661753708364,-117.61626933369156)
(38.49271102063178,-121.28934110975781)

To submit the job to the cluster the following command was used:
scala> :load /home/training/Desktop/KMeansCoord.scala

The following image depicts the job being tracked on the Hadoop cluster: