

Chapter 9: K-means Clustering

Ex 2: Clustering Consulting Project - Hack_data - Solutions

A large technology firm needs your help, they've been hacked! Luckily their forensic engineers have grabbed valuable data about the hacks, including information like session time,locations, wpm typing speed, etc. The forensic engineer relates to you what she has been able to figure out so far, she has been able to grab meta data of each session that the hackers used to connect to their servers. These are the features of the data:

- 'Session Connection Time': How long the session lasted in minutes
- 'Bytes Transferred': Number of MB transferred during session
- 'Kali_Trace_Used': Indicates if the hacker was using Kali Linux
- 'Servers_Corrupted': Number of server corrupted during the attack
- 'Pages_Corrupted': Number of pages illegally accessed
- 'Location': Location attack came from (Probably useless because the hackers used VPNs)
- 'WPM_Typing_Speed': Their estimated typing speed based on session logs.

The technology firm has 3 potential hackers that perpetrated the attack. Their certain of the first two hackers but they aren't very sure if the third hacker was involved or not. They have requested your help! Can you help figure out whether or not the third suspect had anything to do with the attacks, or was it just two hackers? It's probably not possible to know for sure, but maybe what you've just learned about Clustering can help!

One last key fact, the forensic engineer knows that the hackers trade off attacks. Meaning they should each have roughly the same amount of attacks. For example if there were 100 total attacks, then in a 2 hacker situation each should have about 50 hacks, in a three hacker situation each would have about 33 hacks. The engineer believes this is the key element to solving this, but doesn't know how to distinguish this unlabeled data into groups of hackers.

```
In [4]: dataset.head()
Out[4]: Row(Session Connection Time=8.0, Bytes Transferred=391.09, Kali Trace Used=1, S
        ervers Corrupted=2.96, Pages Corrupted=7.0, Location='Slovenia', WPM Typing Spe
        ed=72.37)
In [5]:
        dataset.describe().show()
        +-----+-----
              --+----+
        |summary|Session Connection Time| Bytes Transferred| Kali Trace Used|Servers
                 Pages_Corrupted | Location | WPM_Typing_Speed |
        Corrupted
        -----+
                                 334
        | count|
                                                  334
                                                                  334
        334
                        334
                                   334
                                                   334
           mean|
                    30.008982035928145 | 607.2452694610777 | 0.5119760479041916 | 5.258502
        994011977 | 10.838323353293413 |
                                       null | 57.342395209580864 |
        stddev| 14.088200614636158|286.33593163576757|0.5006065264451406| 2.30190
                                      null | 13.41106336843464|
        693339697 | 3.06352633036022
                                                 10.0
                                                                    0|
            min|
                                 1.0
                        6.0 Afghanistan
                                                   40.0
        1.0
                                               1330.5
            max
                                60.0
                                                                    1
                        15.0
                               Zimbabwe
        10.0
                                                    75.0
                     -----+
        dataset.columns
In [6]:
Out[6]: ['Session Connection Time',
         'Bytes Transferred',
         'Kali Trace_Used',
         'Servers Corrupted',
         'Pages Corrupted',
         'Location',
         'WPM Typing Speed']
        from pyspark.ml.linalg import Vectors
In [7]:
        from pyspark.ml.feature import VectorAssembler
In [8]: feat cols = ['Session Connection Time',
                    'Bytes Transferred',
                    'Kali Trace Used',
                    'Servers Corrupted',
                    'Pages_Corrupted','WPM_Typing_Speed']
In [9]: vec assembler = VectorAssembler(inputCols = feat cols,
                                    outputCol='features')
In [10]: | final data = vec assembler.transform(dataset)
In [11]: from pyspark.ml.feature import StandardScaler
```

```
In [12]: | scaler = StandardScaler(inputCol="features",
                                  outputCol="scaledFeatures",
                                  withStd=True,
                                  withMean=False)
In [13]: # Compute summary statistics by fitting the StandardScaler
          scalerModel = scaler.fit(final data)
In [14]: # Normalize each feature to have unit standard deviation.
          cluster final data = scalerModel.transform(final data)
         ** Time to find out whether its 2 or 3! **
         kmeans3 = KMeans(featuresCol='scaledFeatures', k=3)
In [15]:
         kmeans2 = KMeans(featuresCol='scaledFeatures',k=2)
         model_k3 = kmeans3.fit(cluster_final_data)
In [16]:
         model_k2 = kmeans2.fit(cluster_final_data)
In [17]: | wssse_k3 = model_k3.computeCost(cluster_final_data)
         wssse k2 = model k2.computeCost(cluster final data)
         print("With K=3")
In [18]:
          print("Within Set Sum of Squared Errors = " + str(wssse_k3))
          print('--'*30)
         print("With K=2")
          print("Within Set Sum of Squared Errors = " + str(wssse_k2))
         With K=3
         Within Set Sum of Squared Errors = 434.1492898715845
         With K=2
         Within Set Sum of Squared Errors = 601.7707512676716
```

Not much to be gained from the WSSSE, after all, we would expect that as K increases, the WSSSE decreases. We could however continue the analysis by seeing the drop from K=3 to K=4 to check if the clustering favors even or odd numbers. This won't be substantial, but its worth a look:

Within Set Sum of Squared Errors = 247.80143915458297

Within Set Sum of Squared Errors = 232.65169349742308

Within Set Sum of Squared Errors = 219.57683951525962

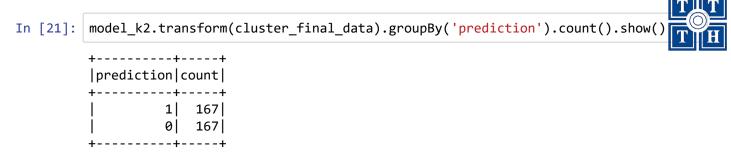
connection, it was quite tricky given what we've covered!**

```
** Nothing definitive can be said with the above, but wait! The last key fact that the engineer mentioned was that the attacks should be evenly numbered between the hackers! Let's check with the transform and prediction columns that result form this! Congratulations if you made this
```

prediction count				
 	1 2 0	167 83 84		
+	+-	+		

With K=6

With K=8



It was 2 hackers, in fact, our clustering algorithm created two equally sized clusters with K=2, no way that is a coincidence!

In []:		
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