



EH2745 Computer Application in Power System

Assignment 2

Explanation for labelling

Group 16

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After we perform the K-means method for clustering, the samples are divided into 4 clusters, in order to determine which label belongs to which cluster, we need to do some analytical work.

Define that:

- Cluster 1 --- High load rate during peak hours
- Cluster 2 --- Shut down of generator for maintenance
- Cluster 3 --- Disconnection of a line for maintenance
- Cluster 4 --- Low load rate during night

Cluster 1: High load rate during peak hours

In this 9-bus power system, we know that if the load rate increases, the voltage magnitude of each bus will decrease. After clustering, we get 4 clusters with 4 centroids, each centroid has 18 attributes (9 voltage magnitudes and 9 voltage angles). Then we calculate the average voltage magnitudes of the 4 final centroids. The one with the lowest average voltage magnitude corresponds to Cluster 1.

Cluster 2: Shut down of generator for maintenance

According to the topology of this 9-bus power system, we can find that generation bus 1 is connected to bus 4, generation bus 2 is connected to bus 8, generation bus 3 is connected to bus 6. If one generator is shut down, there will be no power flow between the two buses, and the voltage drop will be nearly 0. Thus, we calculate the voltage drop between bus 1 and bus 4, bus 2 and bus 8, bus 3 and bus 6. If one or more voltage drop is less than a threshold (we set it to be $1e-3$ in our codes), then this cluster belongs to cluster 2.

Cluster 3: Disconnection of a line for maintenance

There are 9 lines in this 9-bus power system, if one line is disconnected, then the voltage drop will be very large between the two corresponding buses. Thus, we calculate 9 voltage drops, if the one or more voltage drops is larger than a threshold (we set it to be 0.4 in our codes), then this cluster belongs to cluster 3.

Cluster 4: Low load rate during night

Similar to determine Cluster 1, if the load rate decreases, the voltage magnitude will increase, and the average value will usually exceeds 1 pu. After clustering, we get 4 clusters with 4 centroids, each centroid has 18 attributes (9 voltage magnitudes and 9 voltage angles). Then we calculate the average voltage magnitudes of the 4 final centroids. The one with the highest average voltage magnitude corresponds to Cluster 4.

How we do this in our codes:

After clustering, we get 4 clusters with 4 centroids.

Firstly, calculate average voltage magnitude of each centroid, and sort the clusters in ascending order according to their centroid's average voltage magnitude. In this way, we can find Cluster 1 (Low load rate during night) and Cluster 4 (High load rate during peak hours).

Then we need to determine the two remaining clusters (cluster A and cluster B), calculate the voltage drops in the two clusters.

If one or more voltage drops are higher than 0.4 in cluster A and one or more voltage drops are less than 10^{-3} between bus 1,4 bus 3,6 bus 2,8 in cluster B, then we assign cluster A to Cluster 3 (Disconnection of a line for maintenance), and assign cluster B to Cluster 2 (Shut down of generator for maintenance).

If one or more voltage drops are higher than 0.4 in cluster B and one or more voltage drops are less than 10^{-3} between bus 1,4 bus 3,6 bus 2,8 in cluster A, then we assign cluster B to Cluster 3 (Disconnection of a line for maintenance), and assign cluster A to Cluster 2 (Shut down of generator for maintenance).