COMPARISON OF TWO CENTRALITY-BASED VERTEX REMOVAL METHODS FOR TWO CENTRALITY MEASURES AND TWO GRAPHS

Let f be a function that accepts a graph with n vertices as input and returns a vector of length n measuring the centralities of centralities of the vertices of the graph. Let k be a number of vertices to remove.

Method 1. Remove the k vertices of G with the k highest values in $f(G)$. If there are ties, choose randomly among the lowest-scoring vertices.

Method 2. Let v be the vertex with the highest value in $f(G)$; if there are ties choose one of the highest-scoring vertices at random. Remove v from G and apply the method to $G\backslash v$. Repeat the process until k vertices have been removed.

These methods were evaluated using two graphs: the karate social network graph (`https://networkrepository.com/soc-karate.php`) and a football network (`http://www-personal.umich.edu/~mejn/netdata/`), and using spread and eigenvector centrality measures. The karate graph has 34 vertices and 156 edges; 17 vertices were selected for removal. The football graph has 115 vertices and 613 edges; 57 vertices were selected for removal.

Method 1 results

Table 1 shows the largest eigenvalue of the remaining graph after the vertices selected by Method 1 have been removed. The final values for the two centrality measures for the karate graph are identical; however they did not remove exactly the same vertices. Specifically, there were two vertices removed for each measure that were not removed for the other.

Centrality measure	Karate	Football
Spread	2.48	9.06
Eigenvector	2.48	9.09

Table 1. Method 1 results

Method 2 results

Table 2 shows the largest eigenvalue of the remaining graph after the vertices selected by Method 2 have been removed. The final value for the karate graph is the minimum possible value for a graph with at least one edge.

Centrality measure	Karate	Football
Spread	1.00	4.14
Eigenvector	1.85	4.05

Table 2. Method 2 results

Figure 1 shows the largest eigenvalue of the remaining graph at each step of execution of Method 2 for the karate graph, using both centrality measures. The values do not differ until six vertices have been removed.

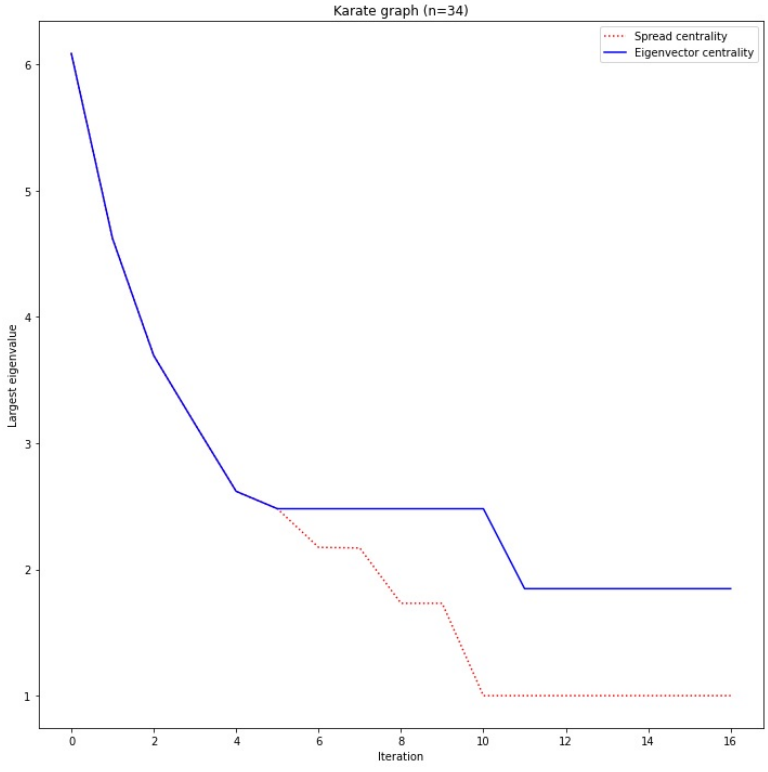

Figure 1. Method 2 step-by-step results for the karate graph

Figure 2 shows the largest eigenvalue of the remaining graph at each step of execution of Method 2 for the football graph, using both centrality measures. The value from using spread centrality is lower than the value from using eigenvector centrality in 13 of the 57 iterations.

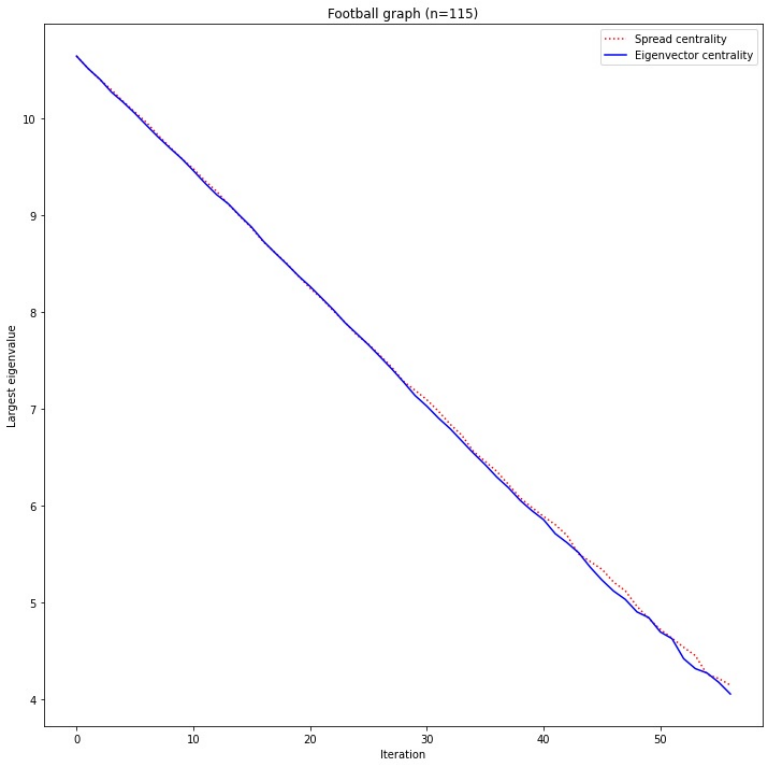

FIGURE 2. Method 2 step-by-step results for the football graph