

Spectral Graph Clustering

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Applications

- ▶ Social network analysis
- ▶ System recommendations in Marketing, Movies, etc.
- ▶ Documents classification.
- ▶ Political affinity.
- ▶ Image compression.

Algorithm

Given undirected graph $G(V, E)$, and its adjacency matrix A and D the diagonal matrix with degrees of the graph,

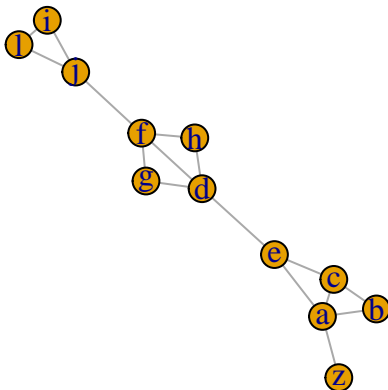
- ▶ Construct L normalized Laplacian matrix associated to A ($L = I - D^{-\frac{1}{2}}AD^{-\frac{1}{2}}$).
- ▶ Compute eigen descompotition of L .
- ▶ Set k number of clusters.
- ▶ Set U matrix of last k eigen vectors.
- ▶ Apply kmeans to U with k clusters.
- ▶ End.

Example in R

```
library(igraph)
```

```
g1 = graph_from_literal(a-b:c:e, b-c, d-g:e:f:h,  
                        f-h, e-c, f-g:j, j-i, i-l,  
                        l-j, a-z)
```

```
plot(g1)
```



Example in R

```
L = as.matrix(laplacian_matrix(g1,normalized = TRUE))  
spec = eigen(L,symmetric = T)  
U = spec$vectors[,10:12]  
km = kmeans(U,3)
```

Example in R

```
data.frame(nodes=V(g1)$name, cluster=km$cluster)
```

##	nodes	cluster
## 1	a	1
## 2	b	1
## 3	c	1
## 4	e	1
## 5	d	2
## 6	g	2
## 7	f	2
## 8	h	2
## 9	j	3
## 10	i	3
## 11	l	3
## 12	z	1