Social Network Analysis

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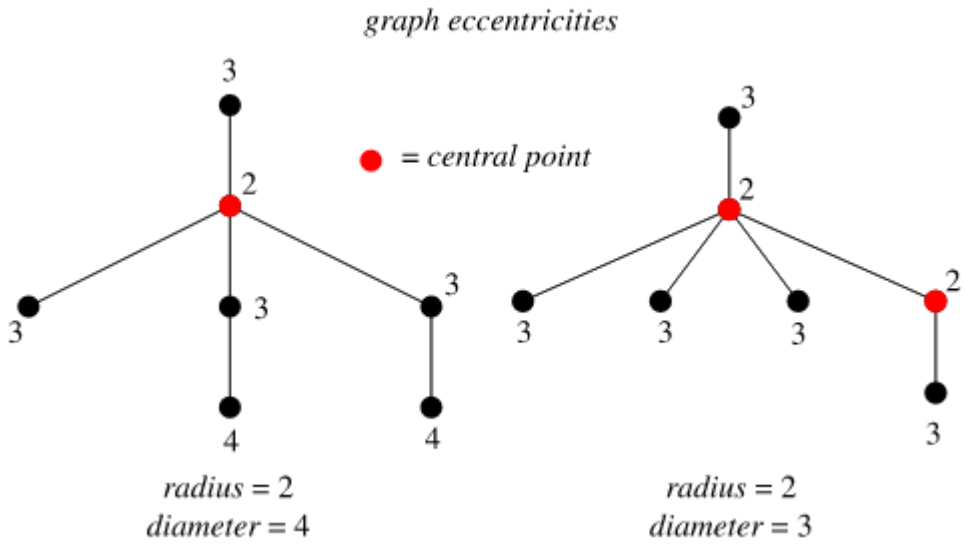
Graph- Measures

Eccentricity:

The eccentricity $\varepsilon(v)$ *of a graph vertex v* in a connected graph G is the ***maximum graph distance between v and any other vertex u of G***. For a disconnected graph, all vertices are defined to have infinite eccentricity (West 2000, p. 71).

- $\epsilon(v) = \max_{u \in V} d(u, v)$

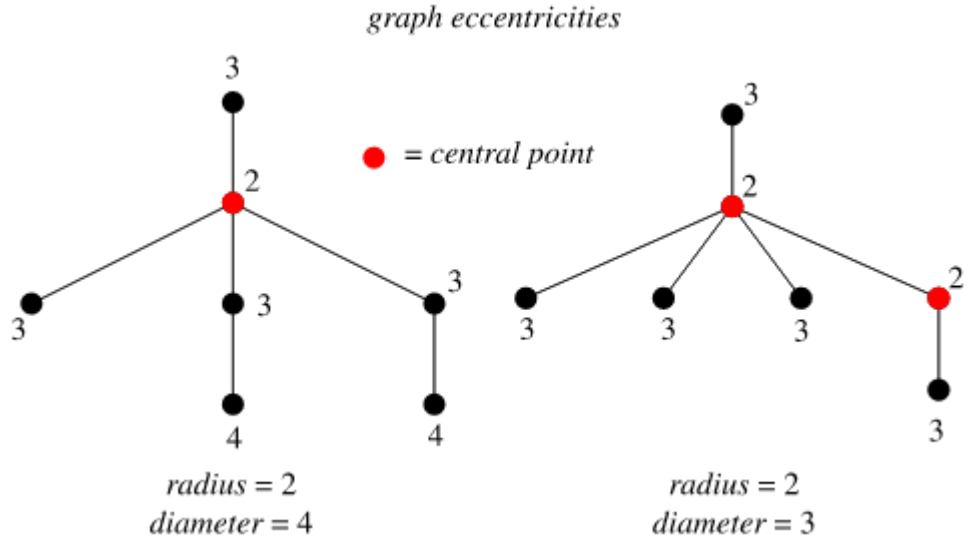


Graph- Measures

Diameter:

The maximum eccentricity

$$\mathrm{d} = \max_{v \in V} \epsilon(v)$$



Radius:

The minimum eccentricity

$$\mathrm{r} = \min_{v \in V} \epsilon(v)$$

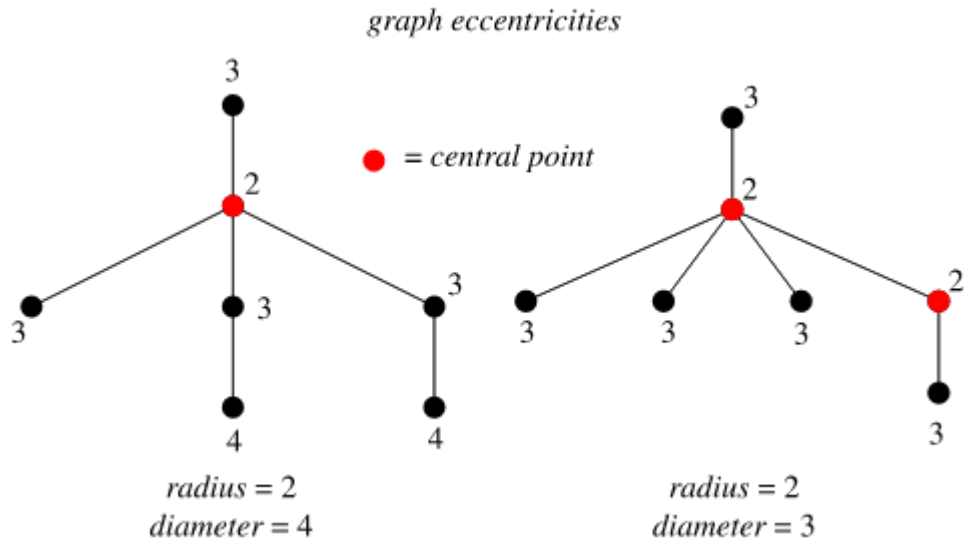
Central Point:

A point v is a central point of a graph, if the eccentricity of the point is equal to the graph radius “r”.

Graph- Measures

Graph Center:

is a set of vertices with graph eccentricity equals to the graph radius “r” .



Graph Periphery:

is a set of vertices with graph eccentricity equals to the graph diameter “d” .

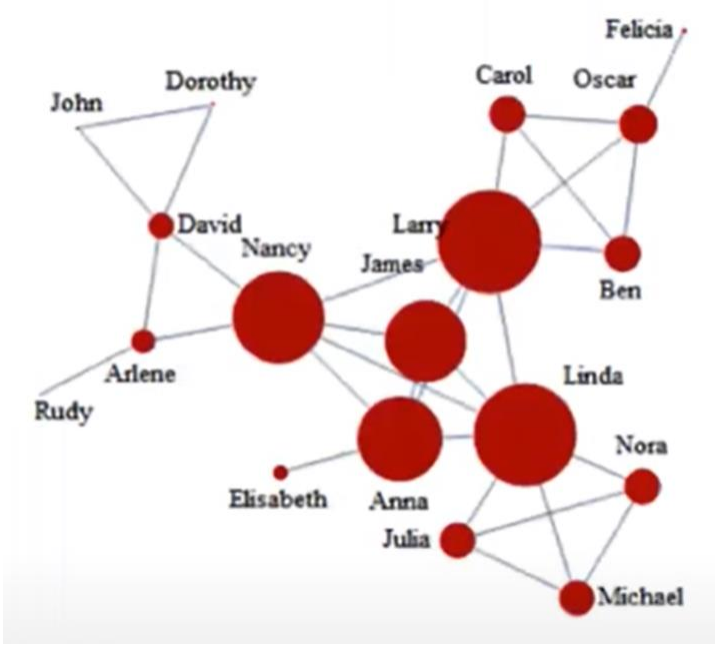
Eigenvector Centrality

Influence of a node in a network

Importance of a node depends on the importance of its neighbours in recursive manner.

$$A\,v = \lambda\,v$$

Select an eigen vector associated with the largest eigen value.



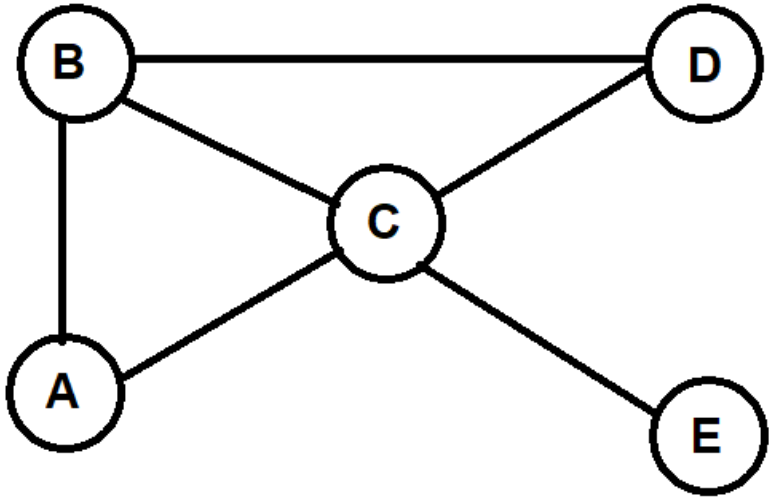
Relationship with Page rank??

https://en.wikipedia.org/wiki/PageRank

https://youtu.be/AjacGClQ56o

Eigenvector Centrality

Compute Eigen Value and corresponding vectors for given graph



	A	B	C	D	E
	-	-	-	-	-
A	0	1	1	0	0
B	1	0	1	1	0
C	1	1	0	1	1
D	0	1	1	0	0
E	0	0	1	0	0

https://www.emathhelp.net/en/calculators/linear-algebra/

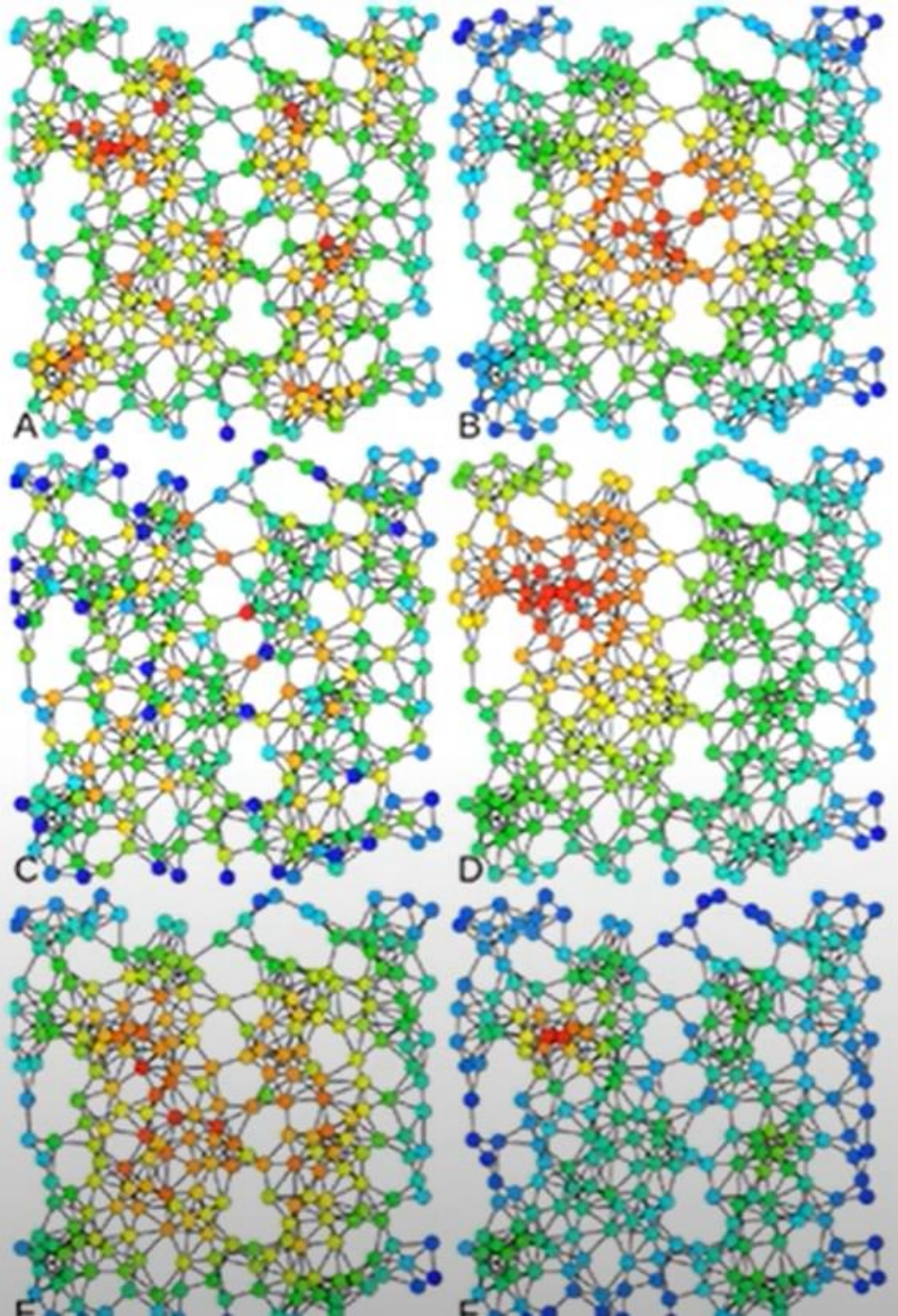
Katz Centrality

- introduced by Leo Katz in 1953 and is used to measure the relative degree of influence of an actor (or node) within a social network.
- Weighted count of all paths coming to the node
- the weight of the path of length n is counted with attenuation factor
- Connection from far nodes are penalized by an attenuation factor
- Unlike typical centrality measures which consider only the shortest path (the geodesic) between a pair of actors, Katz centrality measures influence by taking into account the total number of walks between a pair of actors.
- It is similar to Google's PageRank and to the eigenvector centrality
- https://en.wikipedia.org/wiki/Katz_centrality#:~:text=In%20graph%20theory%2C%20the%20Katz,of%20centrality%20in%20a%20network.&text=Unlike%20typical%20centrality%20measures%20which,between%20a%20pair%20of%20actors.

Bonacich Centrality

- Two parametric centrality measure $c(\alpha, \beta)$

- α is a normalisation factor
- β can be + ve or –ve; +ve if connected to powerful else –ve if connected to powerless



- A) Degree centrality
- B) Closeness centrality
- C) Betweenness centrality
- D) Eigenvector centrality
- E) Katz centrality
- F) Alpha centrality

Thank You!