

# [[CENTRALITY MEASURES]]

[DISCUSSION] Why might we want to know what the most important nodes in a network are?

- Busiest stations for public transit
- Nodes that keep the network from breaking up (there could be physical communication towers, or friendships, or organizations).
- Influential nodes for marketing purposes
- Who to tell about vaccine interventions
- Who not to tell secrets to.

Degree centrality:  $C_{deg}(v) = \frac{d_v}{n-1}$   
Important nodes are those connected to lots of other nodes"

Closeness centrality: "Important nodes are those which are close to lots of other nodes"

For nodes  $u_1, u_2, \dots, u_n$ ,

$$C_{close}(v) = \begin{cases} (n-1) / (\text{dist}(v, u_1) + \text{dist}(v, u_2) + \dots + \text{dist}(v, u_n)) & \text{if the graph is connected} \\ \frac{(|R_v|-1)}{(n-1)} \cdot \frac{(|R_v|-1)}{\text{dist}(v, u_1^*) + \text{dist}(v, u_2^*) + \dots + \text{dist}(v, u_{|R_v|-1}^*)} & \text{if graph is disconnected} \end{cases}$$

Where  $u_1^*, u_2^*, \dots, u_{|R_v|}^*$  are the nodes in the same connected component as  $v$  and  $|R_v|$  is the number of nodes in  $v$ 's connected component.

Eigenvector Centrality: Stay tuned for our discussion on PageRank in Week 4.  
"important nodes are connected to other important nodes"

Betweenness Centrality:  $C_{bet}(v)$  = number of shortest paths between all pairs of nodes in the graph that pass through  $v$ .  
"important nodes connect other nodes"