Assortativity: the preference of a network's nodes to attach to others that have similar degree

It's an important property for a network to be more or less assortative

How do we compute it?

We choose a degree (ex: degree 1, we must do it for every degree, ex: 1,2,3,4,..)

We must define the $k_{nn,i}$

degree — nearest neighbours — of the i-th node

It's the average degree of the nearest neighbors of node i

$$\underbrace{\langle k_{nn} \rangle} = \frac{1}{\underbrace{N_k}} \sum_{i}^{N} k_{nn,i} \, \underbrace{\delta_{k_i k}}$$

the assortativity is defined for every degree, so we must compute it for k=1, k=2 ecc

number of nodes with degree k

delta kronecker, it means we compute k_{nn} only for nodes with chosen degree k

If our network has (for example) no node with degree 130, we don't compute assortativity for k = 130

We can also compute:

$$\text{Assortativity (for degree } k) = \frac{1}{\underbrace{N_k}_{\text{number of nodes with degree } k}} \sum_{i}^{N_k} \underbrace{k_{nn_i}}$$

$$k_{nn_i} = \underbrace{\frac{1}{N_v}\left(k_1 + k_2 + \dots\right)}_{\text{average of the degree of the nearest neighbour of the node } i}$$

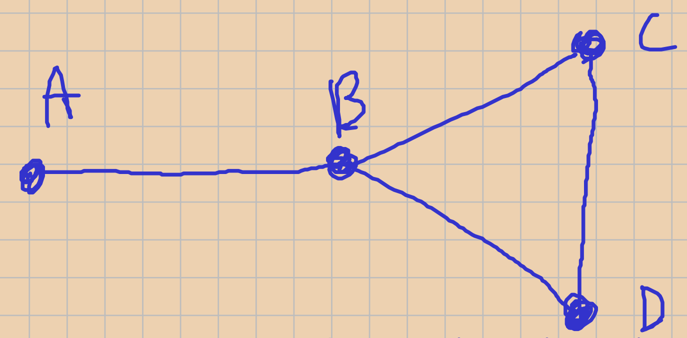
We plot assortativity(y) and all degree(with at least one node present, in x)

We won't make a fit on assortativity, but we make general comments on it's shape

The betweenness is computed for each node

The betweenness of a node z is the number of times the node MUST be traversed (choosing only the shortest path possible) if we want to get from node x to node y for every x and y in the graph.

ex:



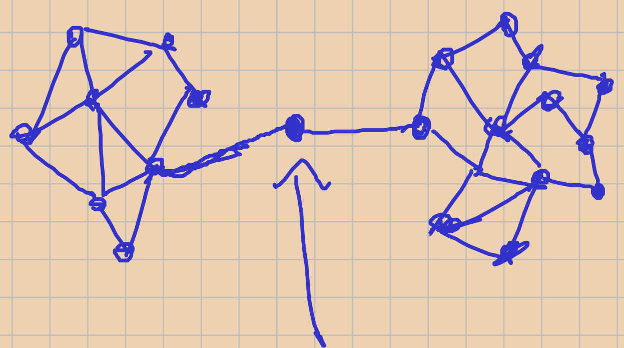
Every node has betweenness 0, except for B that has betweenness 2, because it must be traversed if we want to go (in the shortest path possible) from A to C and from A to D

From C to D the shortest path is just (C,D), (C,B,D) is possible but it's longer, so it's not considered

Note: in a graph with N nodes, we can have N(N-1) links at best, if every node is connected to each other.

In most cases a node with high degree tends to have high betweenness, but they're not strictly correlated, we can have a node with degree = 2 and betweeneess 1000, but also a node with high degree and relatively low betweeneess

If we plot the correlation between degree and betweenness, it's higher for nodes with high degree.
It's easy to make examples of nodes with low degree and very high betweenness, but it's much harder to make an example of nodes with high degree and low betweenness



This node has degree =2 , but very high betweenness

Betweenness is very hard to compute