Calculating Clustering Coefficient

> In graph theory, a clustering coefficient is a measure of the degree to which nodes in a graph tend to cluster together. Evidence suggests that in most real-world networks, and in particular social networks, nodes tend to create tightly knit groups characterized by a relatively high density of ties; this likelihood tends to be greater than the average probability of a tie randomly established between two nodes – Wikipedia

Clustering coefficient is a local measure. Therefore we calculate clustering coefficient of a node by using following formula:

$$C_i = \frac{2L_i}{k_i(k_i - 1)}$$

Here, $\boldsymbol{K_i}$ is the degree of node ***i*** and $\mathbf{L_i}$ is the number of edges between the $\boldsymbol{k_i}$ neighbors of node ***i.***

The clustering coefficient of entire graph is average clustering coefficient of entire graph and can be calculated as:

$$\langle C \rangle = \frac{1}{N}\sum_{i=1}^{N} C_i \, .$$

Example:

Consider graph shown in Figure 1. Now we calculate clustering coefficient for each node.

For Node 1: K_1= 2 , L_1 = 1, $C_1 = \frac{2(1)}{2(2-1)} => C_1 = \frac{2}{2} => C_1 = 1$

For Node 2: K_2= 2 , L_2 = 1, $C_2 = \frac{2(1)}{2(2-1)} => C_2 = \frac{2}{2} => C_2 = 1$

For Node 3: K_3= 3 , L_2 = 1, $C_3 = \frac{2(1)}{3(3-1)} => C_3 = \frac{2}{6} => C_3 = 0.33$

For Node 4: K_4= 1 , L_4 = 0, $C_4 = \frac{2(0)}{1(1-1)} => C_4 = \frac{0}{0} => C_4 = 0$

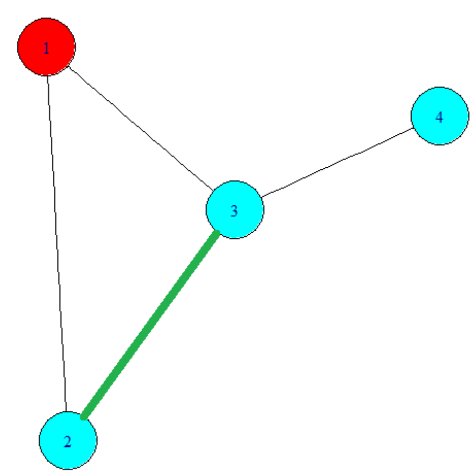

Figure 1: Green Line is the edge of neighbors for Node 1

For average clustering coefficient

$$\langle C \rangle = \frac{1}{N}\sum_{i=1}^{N} C_i => \frac{1}{4}\,(1 + 1 + 0.33 + 0) => 0.58$$

One can verify this by executing following lines in R:

```
g = graph(edges=c(1,2,1,3,2,3,3,4),directed=F)

transitivity(g, type="local", isolates = "zero")
```