

Calculating Average Path Length

Average path length is a concept in network topology that is defined as the average number of steps along the shortest paths for all possible pairs of network nodes. It is a measure of the efficiency of information or mass transport on a network. – Wikipedia

We can calculate average path length of a graph by using following formula:

$$l_G = \frac{1}{n \cdot (n - 1)} \cdot \sum_{i \neq j} d(v_i, v_j)$$

Here $d(v_i, v_j)$ represents the length of shortest path exists between two vertices. So, we take sum of all shortest paths between all vertices and divide number of all possible paths.

Example:

Consider graph shown in Figure 1. Now we calculate shortest path for each pair of vertices

$d(1,2) = 1$	$d(1,3) = 1$	$d(1,4) = 2$
$d(2,1) = 1$	$d(2,3) = 1$	$d(2,4) = 2$
$d(3,1) = 1$	$d(3,2) = 1$	$d(3,4) = 1$
$d(4,1) = 2$	$d(4,2) = 2$	$d(4,3) = 1$

By putting in formula, we get:

$$\begin{aligned} &= \frac{1}{4(4-1)} (1 + 1 + 2 + 1 + 1 + 2 + 1 + 1 + 1 + 2 + 2 + 1) \\ &= \frac{1}{12} (16) \\ &= \frac{4}{3} \\ &= 1.33 \end{aligned}$$

You can verify by executing following lines in R:

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g = graph(edges=c(1,2,1,3,2,3,3,4),directed=F)
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average.path.length(g)
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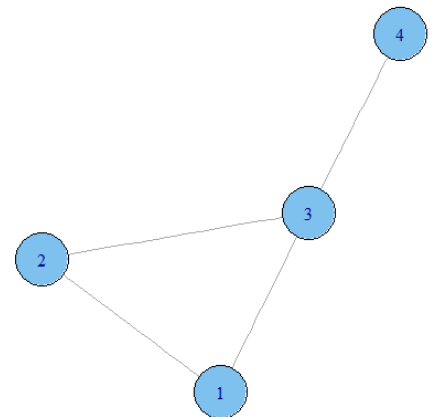


Figure 1