Tutorial 1 - Network Properties / Centralities

Question 1

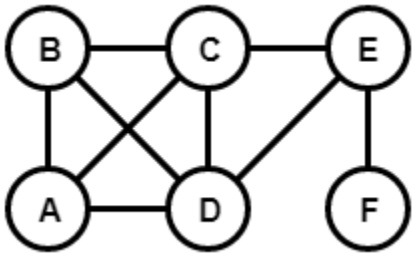
The snapshot of a particular social network is taken at two time instances, where some edges have been added to it over time (but the number of nodes remains the same). It is seen that the effective diameter has reduced over time.

Do you think the (i) diameter and (ii) clustering coefficient of the network, are likely to have changed (increased or decreased)? Give justifications for your answers.

Question 2

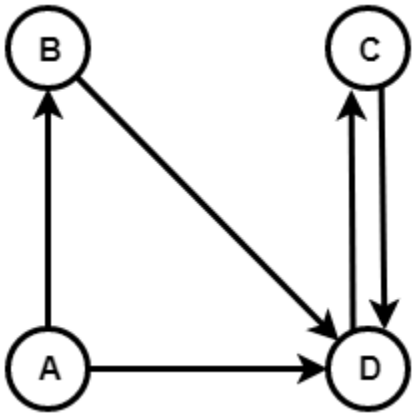
(i) Find out the local clustering coefficient of each node, and hence find the average local clustering coefficient of the network.

(ii) Compute the global clustering coefficient of the network in Figure 1.



Question 3

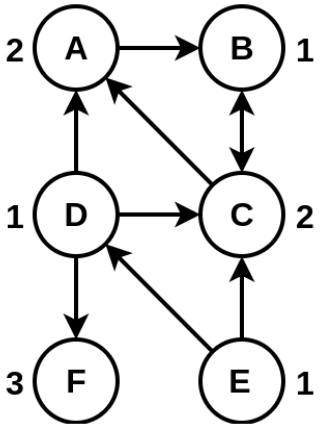
Calculate the closeness centrality of each node, considering edges as undirected.



Question 4

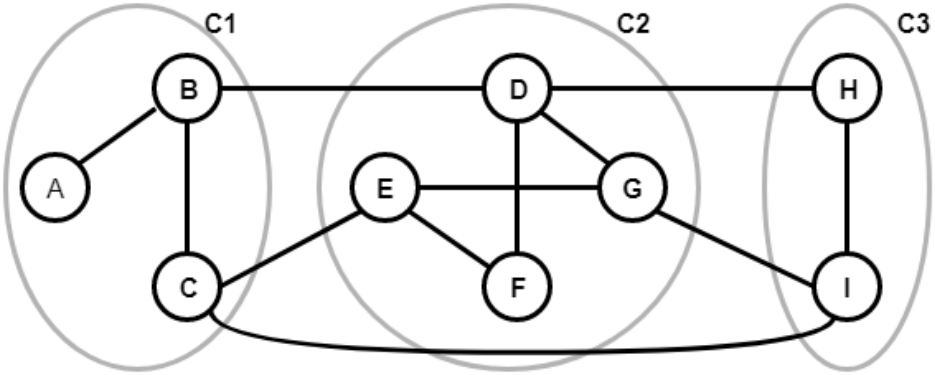
A new search engine Bingle ranks search results using a Biased PageRank method, by giving a different preference vector d(u) for pages u. For a particular query, d(u) is calculated by giving a score equal to the number of query terms matched to the page u (and then the scores are normalized by dividing each score by the sum of d(u) over all pages). The rest of the ranking algorithm is the same as standard PageRank.

Consider the graph shown in Figure 1, where each node represents a page. The number beside each node represents the number of query terms matched with the said page, for a particular query. Find the ranking along with the scores that the nodes in the network will be assigned by their search engine for the given query. Do the computations up to 2 iterations of PageRank, and assume the damping factor α to be 80%. Note that the scores are expected to be normalized so that they sum to 1.



Question 5

Consider the friendship network among 9 people given in Figure 4, having three communities of nodes: C1, C2 and C3. Calculate the assortativity coefficient of the network with respect to the three communities. [HINT: first create the matrix ‘e’ of mixing between the three communities, considering connections between pairs of nodes in each community]



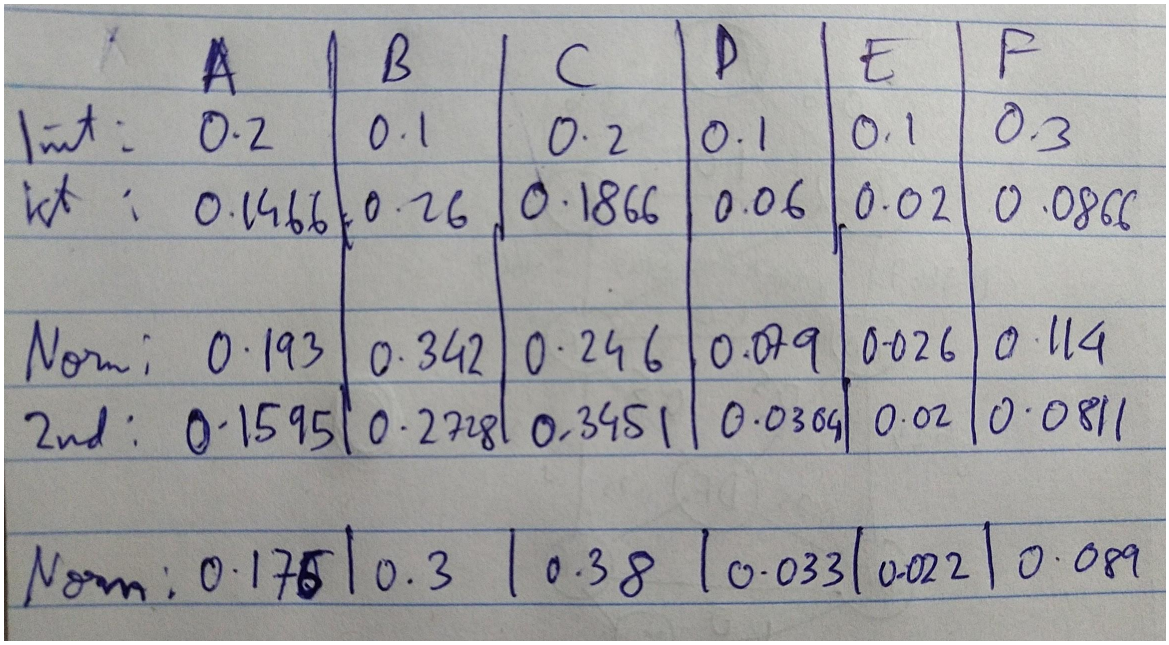
Answers

Question 1
(i) May decrease or remain the same. (ii) likely to increase

Question 2
Local nodes:- [1, 1, ⅔, ⅔, ⅓, 1]: Average: 7/9 = 0.778
Global: 5/7 = 0.714

Question 3
[¼, ¼, ⅕, ⅓]

Question 4



	A	B	C	D	E	F
Init:	0.2	0.1	0.2	0.1	0.1	0.3
1st:	0.1466	0.26	0.1866	0.06	0.02	0.0866
Norm:	0.193	0.342	0.246	0.079	0.026	0.114
2nd:	0.1595	0.2728	0.3451	0.0304	0.02	0.0811
Norm:	0.175	0.3	0.38	0.033	0.022	0.089

Question 5
Assortativity r = 0.3296