Assignment BDA PartB

1.a.)

Diameter of a network is defined as the number of steps required for two distant nodes in the network to reach one another.

Diameter of a network can be measured by considering the network to be either

1.) Directed, or 2.) Undirected.

Let’s consider case to be Directed.

Following are the outward paths:

|  |
| --- |
| 1->4  1->5  1->7 |
| 4->8 |
| 0->4 |
| 2->5 |
| 0->2 |
| 7->8 |
| 3->7 |
| 3->8 |
| 3->9 |
| 6->8 |
| 0->8 |

While the diameter for the network for undirected graph is ‘4’.

Since, we are considering the network to be directed the diameter would be 2:

Paths that form diameter are:

1->4->8

1->7->8

0->2->5

1.b.) refer to 1b.csv

1.c.)

A network with numbers and lines

AI-generated content may be incorrect.

1.d.) Adjacency matrix of the network with aij=1 if there is an edge from node i -> node j

We have 10 nodes, labelled {0,1,2,3,4,5,6,7,8,9}

So, our adjacency matrix is a 10X10 matrix.

Pasting the snapshot of the 10X10 matrix:

A grid of numbers on a white background

AI-generated content may be incorrect.

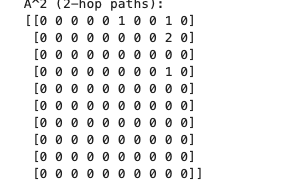
1.e.) As how an adjacency matrix represents direct connections i.e. paths with just 1 hop.

Similarly, A^2 implies Number of 2-hops from node I to node j and A^3 implies number of 3 hop paths between node I and node j.

For programmatic calculation of A^2 and A^3, refer to 1e.ipynb

A snapshot of A^2 and A^3 from the output is as follows:

A^2:



Examine the following paths:

0->2->5 (it takes two hops for 0 to reach 5)

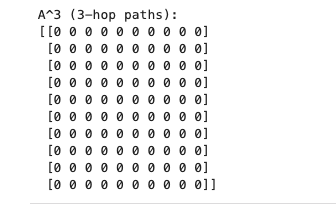
0->4->8 (although there is a direct connection from 0->8, there is also 2-hop path)

1->7->8

1->4->8

3->7->8

A^3:



Similarly, examine the 3-hop paths in the network:

There are none, because the diameter of the network is itself 2.

Which means the maximum steps for two distant nodes to reach each other is only 2 hops.

1.f.) When we consider a network to be undirected, the node I if connected node j is not just considered i->j, but it is considered i-j.

It means, the aij=1 and also aji=1. Unlike the case of them being in a directed graph,

Where aij=1 and aji=0.

In that case, following are the nodes that are connected to node 0 as root.

Level1:

0-2

0-4

0-8

Level 2:

0-2-5

0-4-1

0-8-7

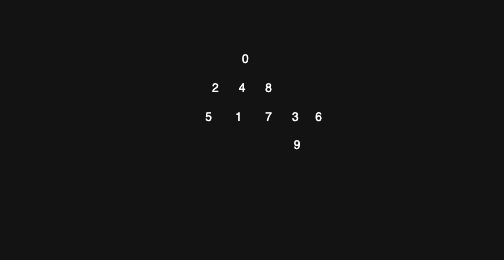
0-8-3

0-8-6

Level3:

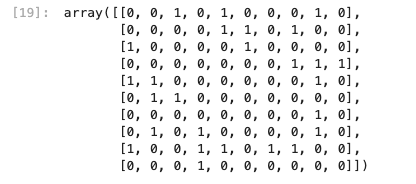
0-8-3-9

Hence, the BFS can look like:



1.g.) As I have explained above, aij=1 and aji=1 for an undirected graph:

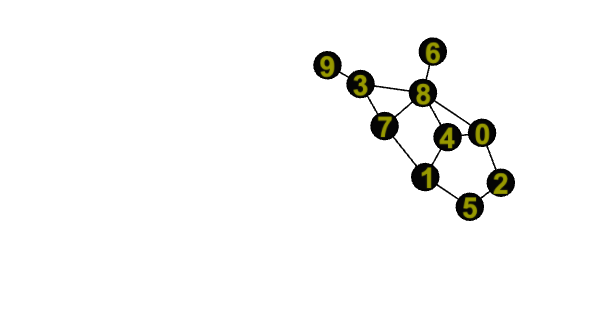
Here is a snapshot of adjacency matrix for an undirected network:



Answer 2:

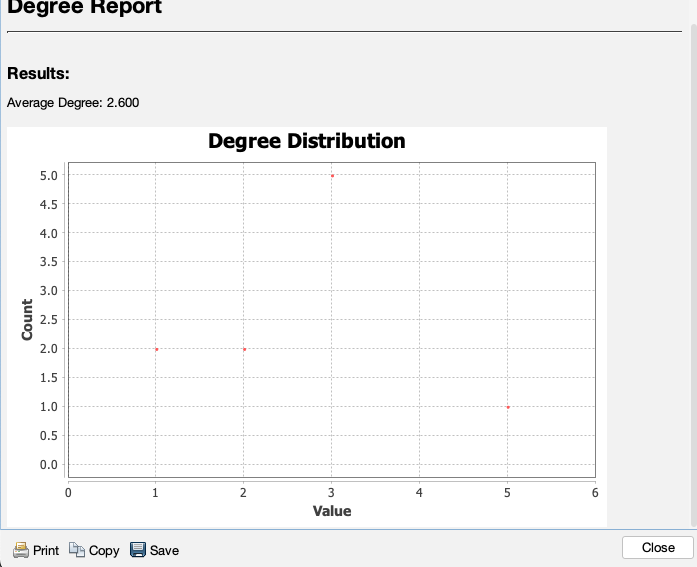
2.a) 2a.csv is the modified csv.

Here is the undirected network:

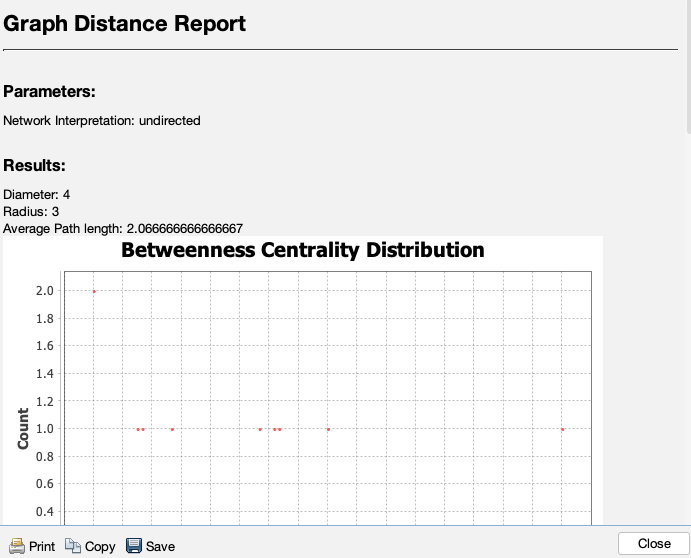


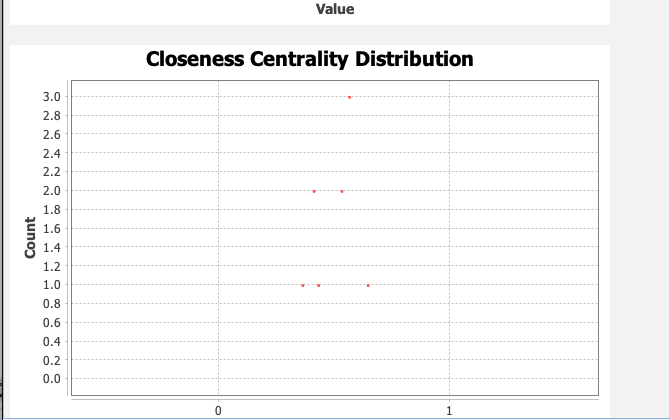
Here are the Average Degree, Network Diameter, Graph Density snapshots from gephi:

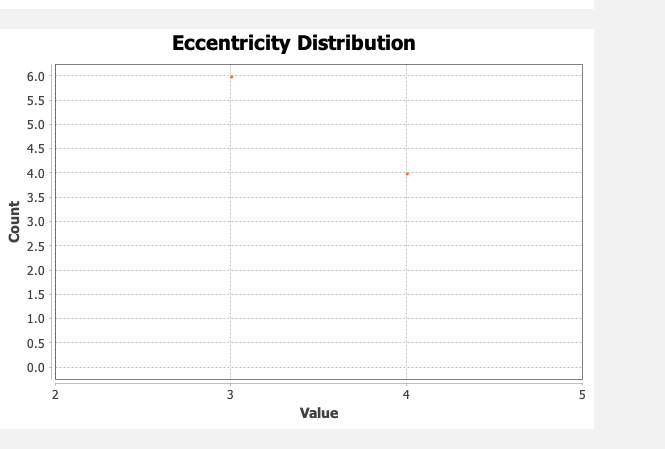
Average Degree:



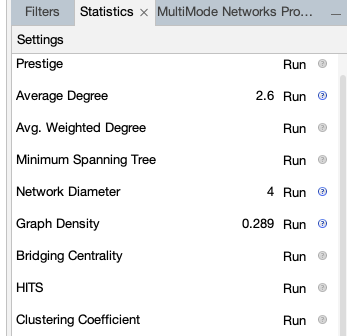
Network Diameter:







Graph Density:



Now, let’s derive them without using tool: