CSC 485B Assignment 1

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1 Question 1

1.1 1A

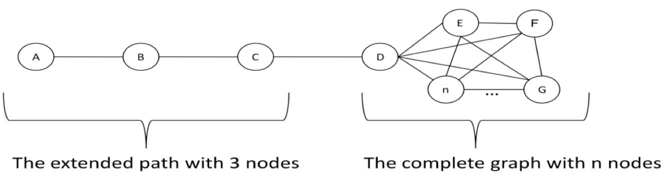

Figure 1: Graph for Question 1a.

The graph that consists of one complete graph K_n (of n vertices) and one arm, which is a maximal path of 3 nodes as show in the graph above.

The diameter of the graph is obviously 4, 3 for the length of the arm and 1 for the complete graph. The average distance between two nodes can be calculated:

$$Average = \frac{\frac{(n)(n+!)}{2} + 1 + 2 + 3 + 4(n-1) + 1 + 2 + 3(n-1) + 1 + 2(n-1)}{\frac{(n+3)(n+2)}{2}} = \frac{n^2 + 17n + 2}{n^2 + 5n + 6}$$

The diameter has to be at least three times as much as the average distance, so solving the following inequation for n,

$$\frac{n^2 + 17n + 2}{n^2 + 5n + 6} \leq 3$$

You get that $n \geq 31$. With a K_{31} graph and the extended arm of length 3, the diameter is still 4 and the average distance is $\frac{4}{\frac{1490}{1122}} \approx 3.012$

1.2 1B

The diameter of the graph is $c + 1$.

The average distance is:

$$Average = \frac{\frac{n(n-1)}{2} + \frac{c(c+3)}{2}(n-1) + \frac{(c+1)(c+2)}{6}}{\frac{(n+c)(n+c-1)}{2}}$$

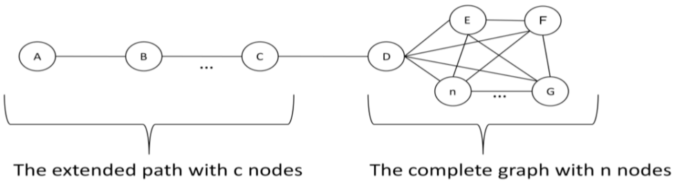

Figure 2: Graph for Question 1b.

The diameter is more than c times as large as the average distance, so we have

$$\frac{c+1}{Average} > 3$$

Solving for n, we get:

$$n < \frac{(c^3+c^2-2c+1) - \sqrt{(c^3+c^2 2c+1)^2 - 4 * \frac{(-c^4+3c^3+7c^2-3c)}{3}}}{2}$$

or

$$n < \frac{(c^3+c^2-2c+1) + \sqrt{(c^3+c^2 2c+1)^2 - 4 * \frac{(-c^4+3c^3+7c^2-3c)}{3}}}{2}$$

2 Question 2

2.1 2A

Please see the code attached to my dropbox on Connex. My student number is V00737042.

2.2 2B

If you consider an "isolated node" any node that has no outgoing edges, then there are 21 isolated nodes in this graph. There is a routine in the diameter java program that determines this. I have also confirmed by visual inspection of the raw data.

Since this is a directed graph,however, there is 11 nodes that are "isolated" (ie, they have no incoming or outgoing edges).

2.3 2C

My program gives the same result as Gephi when run on the same file. I assume Gephi

3 Question 3

Given time, through the principle of triadic closure, the edge AF will mostly likely form next, since both A and F share not one but two common friends in B and E. The edges AD and CF are likely to be formed since the vertices share common neighbours. (A and D share C as a common neighbour, C and F share D.)

In the same way, B and E share F and A as a common neighbour, and thus an edge will form between them as well.

4 Question 4

Number the K_{50} graph. Start with vertex 1. Since the graph is complete, there is an edge between 1 and every other vertex. Thus, there is an edge between the vertices numbered 1 and 20.The question defines 1 and 20 to be friends.

Now, vertex 20 is also connected to every other vertex in the graph. It is friends with the vertex numbered 21. The K_3 formed between the vertices 1, 20, and 21 is unbalanced since 1 is friends with 20, 20 is friends with 21, and 21 is not friends with 1.

Thus, the graph is unbalanced.