Assignment 3: Due Thursday 28th March at 5pm

Late assignments will not be accepted except by prior arrangement (for a good reason)

Please include your student number in your handed up work, as Canvas doesn't give this to me automatically.

1. Use your existing code to read in an undirected graph specified as an edge list in TGF (Trivial Graph Format). At

   `https://roughan.info/notes/Network_Modelling/10data.html`

   you will find a second data file `a1010101_graph_A3.tgf` (in the same format) for you to apply this to.

   (a) Write a function to calculate assortativity of the graph.

   [2 marks]

   (b) Write a function to calculate global clustering coefficient for the network.
   [Hint: You may want to consider how to use the adjacency matrix to calculate the number of triangles and triplets. Think about a triple or a triangle as a walk.]

   [2 marks]

   (c) Write a function to calculate PageRank centrality for each node (ith a damping factor of $d = 0.85$ (presuming links are directed in both directions). Write out the first values for the 1st six nodes.

   [3 marks]

2. The following game is a variant on Nim. There are two piles of counters. Players take turns removing counters from the piles. The winner is the person who takes the last counter(s).

   The critical difference from standard Nim is that a Player can take counters from one, or *both* piles at once. However, if they take counters from both, it must be the same number.

   The following is an example sequence of play.

player	pile 1	pile 2	
start	7	4	
Player A	6	4	Player A took 1 counter from pile 1
Player B	4	2	Player B took 2 counters from both piles
Player A	4	0	Player A took 2 counters from pile 2
Player B	0	0	Player B took all remaining counters and wins

   (a) Construct a finite subgraph of the graph that shows possible positions as nodes and legal moves as directed edges. Your subgraph will be a portion of $\mathbb{Z}^2$ in the positive quadrant. You only need to consider the region created by starting the piles with no more than 6 stones.

   [Hint: you may not want to try to draw all edges – you might indicate a set of edges together.]

   (b) Derive, from this graph, a winning strategy assuming the piles start with less than 6 stones. Indicate your strategy with a new directed graph on the nodes. Which player can use this strategy?

   [Hint: look for "safe" positions, *i.e.,* positions you could leave the game in, such that the other player can't win.].

   (c) * Generalise your strategy to any starting number of stones.

[3 marks]