CCS - Network Analysis Assignment

Fatema Alkhanaizi

November 3, 2018

Clearly document what you have done. For each question you should report on what you did and include, as needed, illustrative plots.

Question 1

Ring Group Graph Degree Distribution when $p + q = 0.5$, $p > q$

- Investigate the degree distribution of Ring Group Graphs for p + q = 0.5, p ¿ q.
- Decide which values of m, k, p and q to investigate.
- You should report on how the structure changes as p and q vary and whether the same effects are found for different values of m and k.
- Use plots to illustrate your observations.

Diameter of Ring Group Graph and p (for a fixed q, $p > q$)

- Investigate the relationship between the diameter of Ring Group Graphs and p (for fixed q, p ¿ q).

Question 2

Distribution of Vertex Brilliance

- Construct the undirected graph defined in coauthorship.txt. Ignore edge weights.
- For the graph from coauthorship.txt, investigate the distribution of vertex brilliance.
- For each of the following types of graph
  - PA Graphs
  - Ring Group Graphs

  create examples with approximately the same number of vertices and edges as the graph from coauthorship.txt and investigate the distribution of vertex brilliance. Comment on what you find.

Question 3

The search time for a given start and target is the total number of queries made in reaching the target from the start (the number of intermediate vertices is not counted). The search time for a graph is the average search time over all pairs of start and target vertices. Clearly these times depend on the algorithm used for deciding when to query, when to move to a new vertex and how to decide which vertex to move to. The aim is that the search time is as small as possible.

Note that the array of neighbours of a vertex should not be considered ordered. If you create graphs in such a way that the neighbours are ordered, then either randomize the ordering or, when querying the array of neighbours, choose a random member of the array (from amongst those not already queried).

- describe an algorithm for searching in the graphs. (I expect that you will have different algorithms for the different types of graphs.)
- You should explain why you believe your strategy might be effective and implement and test it on many instances. You can choose the parameters yourself as long as you are not perverse for example, the groups in the Ring Group Graph should not be of size 1 or n and it is acceptable that all your testing for a particular type of graph is on instances generated with the same parameters.
- As searching on graphs that are not connected can be impossible, you should choose parameters so that the graphs are very likely to be connected.
- Plot search time against the number of instances that achieve that time. Comment on your plots. It is acceptable to estimate search time by looking at only a sample set of pairs of vertices.
- Credit will be given for the effectiveness of the algorithm you design, and also, independently, for your explanation of the rationale behind the design.

Search Random Graph

for Random Graphs, each vertex is labelled with a unique integer between 1 and n.

Search Ring Group Graph

for Ring Group Graphs, each vertex is assigned a unique integer and the label of its group (see Question 1)