Contemporary Computer Science - Network Analysis

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1 Group Graphs

Once the group graph has been implemented as per the specification, we then move on to examining the effect of changing the parameters. All experiments for this are conducted on a graph with 400 vertices. While examining the effect of changing p and q, we set $m = 20$ and $k = 20$ to create 20 groups of 20 vertices. We vary p between 0.25 and 0.50, and vary q between 0.25 and 0.00 to satisfy the constraint $p + q = 0.5$. As Figure 1 below shows, this variation causes a reduction in the degree as p increases. This variation also reduces the spread of the distribution, and therefore an increase in the height of the peaks.

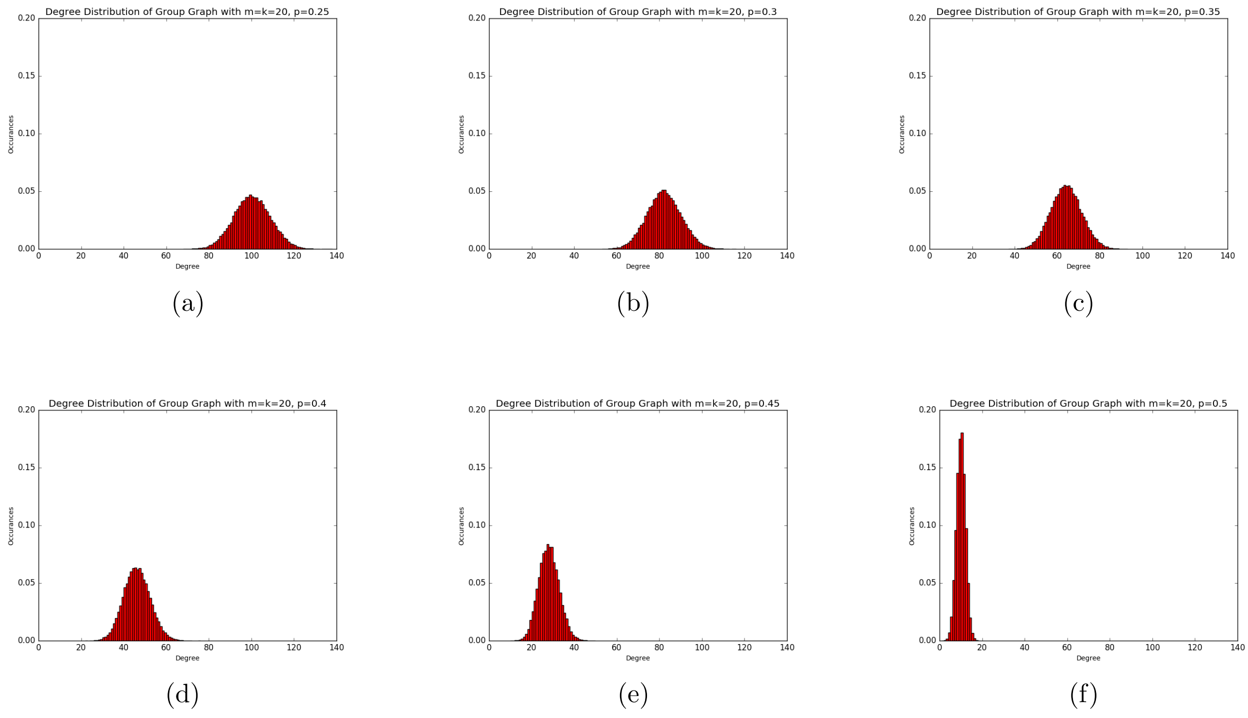
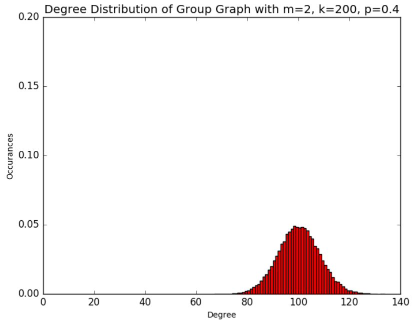
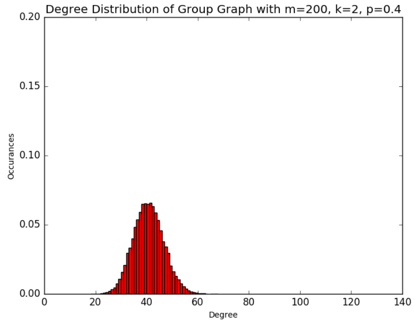


Figure 1: Effect of changing p and q

Having experimented with p and q, we now fix $p = 0.4$ and $q = 0.1$ and vary m and k. To get an idea of the effect of this variation, we have run experiments with 2 groups of 200 nodes, and 200 groups of 2 nodes. As Figure 2 below shows, the degree distribution is larger for larger groups, as for these values of p and q, making the groups larger will lead to far greater connectivity of the vertices.



(a) 2 groups of 200 nodes



(b) 200 groups of 2 nodes

Figure 2: Effect of changing m and k

From here, we then experiment with the diameter, varying p. However, as Figure 3 below shows, this variation in p has very little effect on the diameter of the group graph when averaged over 100 graphs.

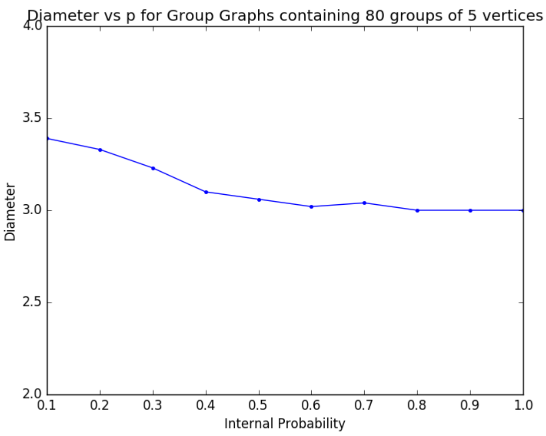
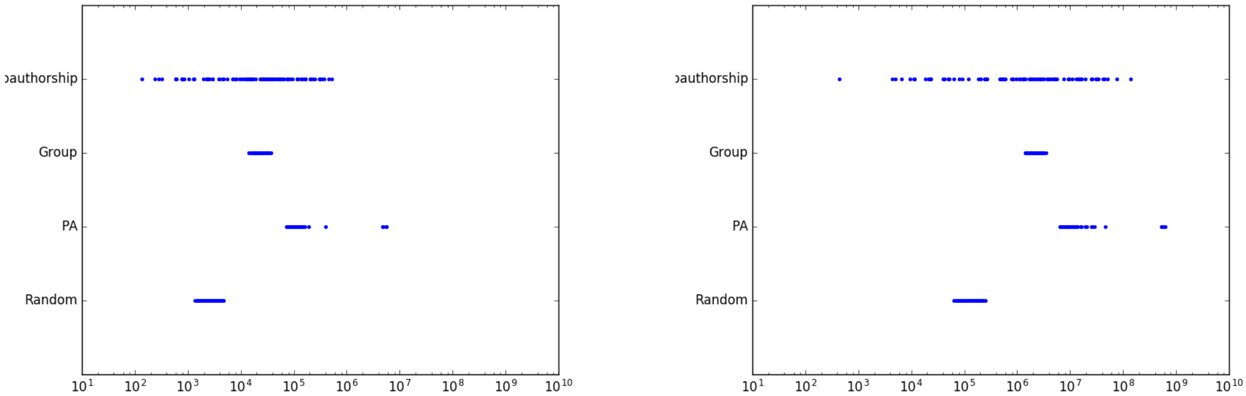


Figure 3: Diameter

2 k-cycles

For experimenting with cycles, appropriate parameters were chosen for the random, PA and group graphs so that they had similar number of vertices and edges as the coauthorship graph. Each of these experiments were run on a random sample of 100 vertices from all of the graphs, and the results are given in the figure below.



(a) Four Cycles

(b) Five Cycles

Figure 4: Number of four and five cycles per graph

As we can see, both four and five cycles have a similar distribution, but there are more five cycles across all of the graphs. The split in the distribution of the PA graph is due to the fully connected region, as there are notably more cycles present in this region. The distribution of random and group graphs are quite narrow.

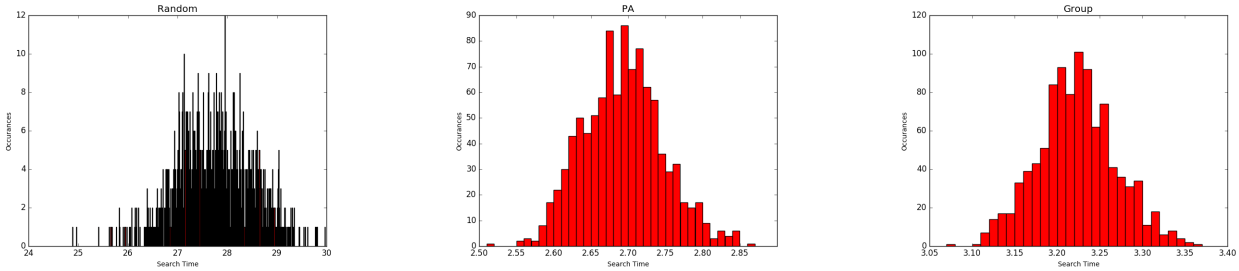
3 Searching

For random graphs, given the limited information that we have, our search strategy is fairly simple. We first check if the destination is a neighbour of the current vertex. If it is, we move to this and end the search, if not, we move to one of the neighbours of the current node, first checking if there are any that we haven't visited, and going to one of these if there are, else going to a random neighbour that has already been visited to backtrack.

For searching the PA graph, this approach must be ammended to accommodate the fully connected section. We follow the same procedure as the random graph, but prioritise nodes that are in the complete graph, and move to these whenever possible, as these nodes are more likely to be connected to the goal, leading to much shorter search times than the random graph.

For searching the group graph, we have to expand this approach again. As we know what group the target node is in, we can use this to inform our search strategy. If we are already in the correct group, then we must try to stay in this group. Otherwise, we endeavour to move to this group if possible. If our current vertex is not in the correct group and does not have a neighbour in the correct group, then we follow the same strategy as the random searching to select a new node.

The figure below shows the results of these search strategies, run on 1000 of each type of graph, using the same parameters as were used in part 2. The random graph is by far the slowest to search, while the PA graph and group graph are much faster , with PA being the fastest on this set of parameters due to the adjustment of the search strategy, which gives all of the graphs similar numbers of vertices and edges.



(a) Random (b) PA (c) Group

Figure 5: Results of Searching