Bounding Eccentricities

Very Large Graphs

Abstract

This paper is a summary of our research and development of the Bounding Eccentricities algorithm introduced in the 2013 article Computing the Eccentricity Distribution of Large Graphs by Frank W. Takes and Walter A. Kosters. In this report we restate all of the methodologies from the original paper that were applied during the implementation of the Bounding Eccentricities algorithm, as well as any other external concepts originating from other research on the same topic. We also show the results of various experiments using the same performance measures as in the original paper for the sake of simplifying comparison. Additionally, we also show the relative improvement brought forth by of all of the main methodologies introduced in the paper over previous versions, namely selection strategies and graph prunning.

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Contents

1 Experiments

In this section we present some performance analysis of our implementation of this algorithm. To assess the performance of our implementation with respect to the results found in section 6 of the paper [1] we provide some of the same performance analysis. We have thus measured the number of execution of our shortest path search algorithm required to compute all of the eccentricities. In this section we shall first analyse the performance of the different selection strategies as well as the graph prunning strategy given in the paper. The number of iteration taken after the implementation of each method presented in the respect columns for the ca-CondMat, ca-HepPh and ca-HepTh is given in the following table:

Dataset	Random	Pruning	Interchanging bound	Degree centrality
ca-CondMat	9439	9268	3486	3271
ca-HepPh	8444	8211	1662	1589
ca-HepTh	6175	5886	1101	1053

The best performing variant was evaluated on 3 more datasets of higher sizes. The following table shows the results:

TODO

2 Conclusion

We have thus implemented the algorithm and have found very similar results for each of the graphs used in the paper. We also have seen the relative improvement of each optimization method proposed in the reasearch paper. However, there are still some improvements that can be performed. A possible route for improvement would be to find a better candidate selection method, however this would require more research to be performed. Another route for improvement that would require less effort would be to parallelise the shortest path computations to leverage as most as possible multiple core systems which are much more popular today than they were in 2013.

3 References

1. Takes, F.W.; Kosters, W.A. Computing the Eccentricity Distribution of Large Graphs. Algorithms 2013, 6, 100-118. https://doi.org/10.3390/a6010100
2. Frank W. Takes and Walter A. Kosters. 2011. Determining the diameter of small world networks. In Proceedings of the 20th ACM international conference on Information and knowledge management (CIKM '11). Association for Computing Machinery, New York, NY, USA, 1191–1196. DOI:https://doi.org/10.1145/2063576.2063748