Information-theoretic Method (Infomap) for Community Detection

The detection of community structure in static and dynamic graphs (Fortunato, 2010) will be reviewed and applied to real data, such as social media and biological networks. The review will focus on the state-of-the-art Infomap method (Rosvall and Bergstrom, 2008; Rosvall et al., 2010; Bohlin et al., 2014), which requires a strong information-theoretic background that combines Huffman codes and Shannon’s source coding theorem (Cover and Thomas, 2012). The inventors of the Infomap method have shown that the problem of finding a community structure in networks is equivalent to solving a coding problem. Infomap method will be compared to the Louvain method (Blondel et al., 2008) and other traditional community detection methods (Girvan and Newman, 2002; Clauset et al., 2004), with respect to several evaluation measures. Since the Louvain method aims at maximizing the modularity and Infomap aims at minimizing the codelength description, it is necessary to compare existing community detection algorithms with respect to the same evaluation measures. Therefore, the candidate will investigate evaluation measures (beyond NMI, Rand, adjusted Rand, etc.) for a direct comparison between graph partitionings into communities and he/she is expected to implement them in R programming language, so as to provide a direct comparison between any two igraph “communities” objects (http://igraph.org/).

**References**

Blondel, V. D., Guillaume, J. L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *Journal of Statistical Mechanics: Theory and Experiment*, *2008*(10), P10008.

Bohlin, L., Edler, D., Lancichinetti, A., & Rosvall, M. (2014). Community detection and visualization of networks with the map equation framework. In *Measuring Scholarly Impact* (pp. 3-34). Springer International Publishing.

Clauset, A., Newman, M. E., & Moore, C. (2004). Finding community structure in very large networks. *Physical review E*, *70*(6), 066111.

Cover, T. M., & Thomas, J. A. (2012). *Elements of information theory*. John Wiley & Sons.

Fortunato, S. (2010). Community detection in graphs. *Physics Reports*, *486*(3), 75-174.

Girvan, M., & Newman, M. E. (2002). Community structure in social and biological networks. Proceedings of the national academy of sciences, 99(12), 7821-7826.

Rosvall, M., Axelsson, D., & Bergstrom, C. T. (2010). The map equation. *The European Physical Journal Special Topics*, *178*(1), 13-23.

Rosvall, M., & Bergstrom, C. T. (2008). Maps of random walks on complex networks reveal community structure. *Proceedings of the National Academy of Sciences*, *105*(4), 1118-1123.