igraph – a package for network analysis

Gábor Csárdi

Department of Medical Genetics, University of Lausanne, Switzerland.

The igraph R package is an interface to the C library with the same name, developed for implementing graph algorithms. As many graph algorithms are already included in igraph, it is also a handy tool for (exploratory) network analysis.

Main igraph features:

- igraph uses a simple, flat data structure for graph representation, this allows handling graphs with millions of edges and/or vertices.
- It is possible to assign attributes to the vertices or edges of the graph, or to the graph itself, the attributes can be arbitrary R objects.
- Graph visualization, both interactive and non-interactive, using 1) traditional R graphics, 2) Tcl/Tk or 3) OpenGL via rgl.
- A variety of classic and recent graph algorithms are implemented in igraph: ◦ Shortest paths and shortest path based measures, e.g. diameter. ◦ Weakly and strongly connected components, biconnected components and articulation points. ◦ Maximum flows and minimum cuts, edge and vertex connectivity. ◦ Various centrality measures: degree, closeness, betweenness, Burt's constraints, Page Rank, eigenvector centrality, Kleinberg's hub and authority scores. ◦ Fast graph and subgraph isomorphism algorithms. ◦ Cliques and independent vertex sets. ◦ Graph motifs. ◦ Community structure detection based on many recently published heuristics. ◦ K-cores, transitivity, minimum spanning trees, toplogical sorting, etc.
- Graphs can be created in various ways: ◦ From data frames, edge lists, adjacency matrices, from a simple R formula notation. ◦ From a list of famous graphs, predefined structures like rings, stars, trees, etc. or from the Graph Atlas. ◦ Using random graph models, like preferential attachment, or the small-world model.
- igraph supports many commonly used file formats for storing graphs, like GraphML, GML or the format used by Pajek.

In this lecture I will show several practical examples on how to turn data into igraph graphs, how to calculate various graph properties: vertex centrality and community structure, and graph visualization.