Converting a spatial network to a graph in R

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Spatial networks have been an important subject of many studies in quantitative geography and sociology (Barthelemy, 2010). In practical applications, they are traditionally managed in a geospatial vector format, in which spatial entities are recorded as polylines that are spaghetti collections of 2D/3D geospatial coordinates (George & Shekhar, 2008). On the other hand, a network can be regarded as a set of nodes, occupying particular positions and joined in pairs by physical or ephemeral constructs (Gastner & Newman, 2006). In this sense, networks are visualized in a link-node mode, termed as graph data model. Due to its great advantages in simplifying the representation of a network and facilitating related computations powered by graph theory, this model has been widely used as one of the central tools in spatial analysis (Hostis, 2007). Based on the **R** platform, a considerable number of packages have emerged for processing both kinds of objects. On the R-spatial website (Bivand, 2007), numerous packages are available for processing spatial data, especially like **sp** and **maptools**. As for graph, there are two popular packages to create and manipulate undirected and directed graphs, i.e. **graph** and **igraph**. However, there is no such thing to convert a *spatial* object to a *graph-class* object. This work aims to fill this gap.

Overall, all the functions are encapsulated in an **R** package named **shp2graph**. Its main utility is to convert a *SpatialLines* or *SpatialLinesDataFrame* object to a *graphNEL*, *graphAM* or *igraph* object. The principle is to abstract geospatial details, select two endpoints of each *spatialline* as spatially enabled nodes and then link them with an edge. Furthermore, the following issues have been provided for this conversion:

- Attribute heritage. Properties are guaranteed to inherit properly.
- Structure optimization. As for the potential redundant info, like self-loops, multiple-edges and pseudo-nodes, three optimization functions have been designed to remove them.
- Topology. Identified from the converting principle, topology errors could cause serious connectivity problems, and correct topology is the key to a successful conversion. Consequently, a self-test function of topology has been included in this package.
- Integration of data points and network. When we are dealing with a set of data points together with a spatial network, they may not be closely related. In this case, how to integrate these points into the network is concerned according to different accuracy requirements.

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