

ProximityG: A Python package for proximity graphs in the plane

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Tags

Python; proximity graphs; biological graphs;

Summary

Let V be a (finite or discrete) point set in $\mathbb{R}^d$, with $d \geq 2$. For each pair of different points $\{p, q\} \in V \times V$ is associated a region or neighborhood $N(p, q) \subset \mathbb{R}^d$ and let $\mathcal{P}$ be a geometrical property defined in the set $\mathcal{N} = \{N(p, q) : \{p, q\} \in V \times V\}$. A proximity graph, also called a neighborhood graph [10], with regions in $\mathcal{N}$ and the property $\mathcal{P}$, is a graph $G_{\mathcal{N}, \mathcal{P}}(V, E)$ with the node set V and the set of edges E is such that

$$\{p, q\} \in E \Leftrightarrow N(p, q) \text{ holds } \mathcal{P} \quad (1)$$

In general, the property $\mathcal{P}$ is defined trying to represent some notion of closeness between a pair of points. If the property $\mathcal{P}$ is

$$N(p, q) \cap V \setminus \{p, q\} = \emptyset \quad (2)$$

it is called a empty neighborhood graph [5].

Two widely known proximity graphs defined to $d = 2$ are the Gabriel graph (GG) and the relative neighborhood graph (RNG). In the first, the region is defined as the (open) circle whose boundary trough p and q . In RNG, the neighborhood is the intersection of two (open) circles, with centers p and q , respectively, and radius the (euclidean) distance between p and q .

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Statement of need

Applications: clustering and manifold learning [18]

Machine learning [17]

Asymptotic analysis of proximity graphs [8, 6]

Probabilistic properties of the k -nearest-neighbors graph [9]

recomender systems [12]

Street network characterization [16, 13, 11]

See references about applications of the SIG (computer vision, cluster analysis, pattern recognition, SIG, modeling visual illusions, streaming process in music perception) in [15]

See references about applications of RNG, GG and β -skeletons (Morphology and computer vision, geographic analysis, pattern classification) [10]

See references about applications of the RNG (vision, cluster analysis, shape boundary detection, visualization and computer graphics, archaeology, natural computing, cosmology, urban planning, machine learning, percolation theory, wireless ad-hoc networks, graph theory) [14]

graph theory about proximity graphs [7, 4]

transport and fungi networks [2]

computational experiment about Asymptotic properties of β -skeletons [1, 3]

Statement of need

Package overview

Usage example

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