

Graph-Based Generation of Realistic City Networks

Objective: The goal of this internship is to propose a graph-based model for generating synthetic, yet realistic, cities (positions and populations) within a country/region, represented in the form of (weighted) graphs.

The resulting dataset will be used to benchmark various graph algorithms that rely on spatial and demographic data, such as transportation algorithms.

Project tasks: Different tasks can be considered according to the preferences of the student.

A literature review to identify existing methods and models for generating synthetic geospatial data. Focus on city networks and population distributions, from simplified ones to realistic ones.

An analysis of existing real-world networks, from different regions, to identify key features, being geographical oriented (distances between cities, coasts/mountains...) or graph oriented (degree distribution, connectivity, clustering, centrality...).

Propose one or more models, according to different key variables (coordinates, populations, city area) and constraints based on real-world data (population distribution, geographic constraints...).

Developing algorithms according to the model to generate datasets that mimic realistic data and compare them to assess realism.

Study the complexity of a Network Design problem (given a budget, select a subset of edges to minimize the sum of shortest paths between every pair of cities). Identify interesting parameters and study its parameterized complexity. It could be also interesting to generalize the problem to temporal graphs (a graph that change over time).

An interest in multidisciplinary projects is requested.

Practical information: The internship will be in LAMSADE, inside Paris Dauphine University. It will be supervised by Jérôme Lang and Florian Sikora, *firstname.lastname@dauphine.fr*. Informal requests are welcome.