

Designing Synthetic Networks

Team Research project for MA 4404

We live in a connected world, where networks dominate our economy, our environment and society, and most people are not aware of them. Understanding these networks can aid researchers in prevent devastating outcomes. While real networks are insightful, they are usually hard to obtain (especially samples of the same type of network), they have PII information and many times they are at the wrong scale.

Thus, network scientists desire methodologies to create synthetic networks that resemble the real networks to get insights from the real world networks. Additionally, synthetic networks proves the researchers modalities to change some parameters while keeping others constant to create different scale of given networks by preserving certain properties observed in the real networks. Generative models aim to explain how networks form and evolve specific structural features.

The goal of this project is to create networks that:

1. have varying parameters to get different scales
2. have similar properties to real ones
3. **optional** you could bring a focus on multilayer networks, in which you can capture the layer level topology (matching the properties of the real one when the synthetic network is at the same scale as the real network)

If you work with multilayered network, keep in mind that edges appear in different layers based on the type of relationship they capture. Additionally, if the nodes are identical in each layer, we call this network a multiplex, see Figure1. Unfortunately, there aren't nice tools to visualize multilayered networks. The choices are to use MuxViz which indeed visualizes them, but it is a lot of work to install and learn to use it. Second option, is to visualize each layer individually using Gephi, Python, R, or anything like it.

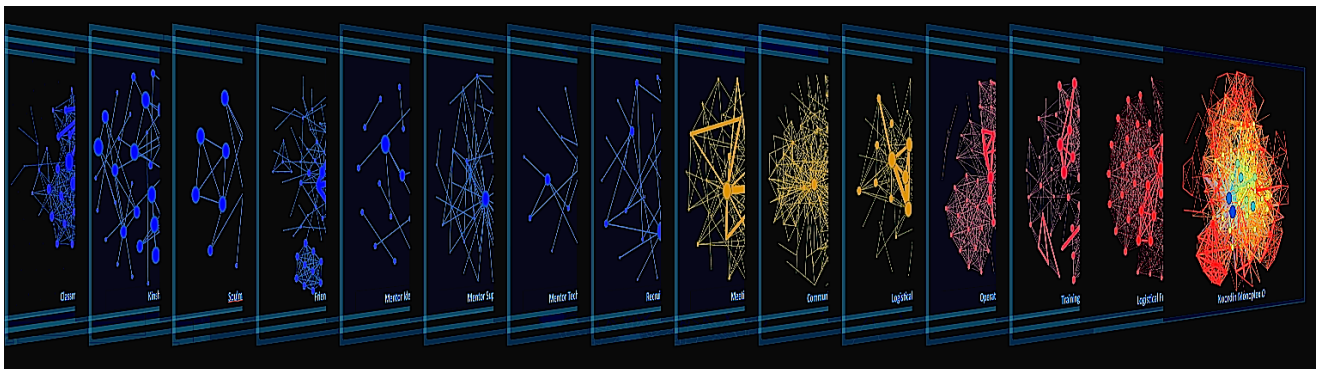


Figure 1: Examples of multiplex networks from MuxViz

An example of a reference paper can be found [here](#). For examples of multilayered synthetic network paper example see [this paper](#) or [this one](#). Complement this list by searching for more articles on synthetic multilayered network.