

Research Projects:

During this course you will learn to work with many different types of networks. In order to better benefit from the content, you will follow a small research project, where you will advance focussing in one network. This way, you will be more familiar with it, and you will better understand what you can do with it. These are the ones available, all of them are loaded into a data-frame of interactions format.

Social & Quantitative humanities:

- 1- Games of thrones social network (weighted, temporal)
- 2- Star wars social network (weighted, temporal)
- 3- Lord of the rings network (weighted, temporal, node attributes)

Infrastructure & flows:

- 4- Import/Export trade network (bipartite, weighted, temporal)
- 5- Airport network (weighted, temporal, node properties, link properties)

Ecological & Biological:

- 6- Foodwebs (weighted, directed, multiple networks)
- 7- Multilayer intertidal network (link properties, node properties).
- 8- Mutualistic networks (bipartite, multiple networks, multiple types)
- 9- Metacommunities (weighted, multiple networks in various sites):

Your own proposal

e.g. Citation/Coauthorship network, a problem you want to solve,

Games of thrones social network

Character Interaction Networks for George R. R. Martin's "A Song of Ice and Fire" saga.

The dataset is publicly available for each of the 5 books at

<https://github.com/mathbeveridge/asoiaf>

These networks were created by connecting two characters whenever their names (or nicknames) appeared within 15 words of one another in one of the books in "A Song of Ice and Fire." The resulting DataFrame books has 5 columns: Source, Target, Type, weight, and book. Source and target are the two nodes that are linked by an edge. As we know a network can have directed or undirected edges and in this network all the edges are undirected. The weight attribute of every edge tells us the number of interactions that the characters have had over the book, and the book column tells us the book number.

You can use this data to explore the dynamics of the Seven Kingdoms using network science techniques. For example, community detection finds coherent plotlines. Centrality measures uncover the multiple ways in which characters play important roles in the saga. You can start to investigate this data by using the pandas DataFrame. As you can see this data easily translates to a network problem. You can create a multigraph, or a list of graphs, with the temporal snapshots.

Resources:

<https://ericmjl.github.io/Network-Analysis-Made-Simple/05-casestudies/01-gameofthrones/>

Star wars social network

Character Interaction Networks for the first 7 Star Wars movies. The dataset is publicly available at <https://github.com/evelinag/StarWars-social-network/tree/master/networks>

In this case there are two types of interactions: mentions (a link is established between two characters if they appear in the same scene), and interactions (a link is established between two characters if they speak in a scene). Interactions-allCharacters contains the interaction network between humanoid characters with the interactions of Chewbacca and R2D2.

Similarly as before, you can use this data to explore the dynamics of the Star Wars universe using network science techniques. For example, community detection finds coherent plotlines. Centrality measures uncover the multiple ways in which characters play important roles in the saga. You can start to investigate this data by using the pandas DataFrame. As you can see this data easily translates to a network problem. You can create a multigraph, or a list of graphs, with the temporal snapshots.

Resources:

<https://evelinag.com/blog/2015/12-15-star-wars-social-network/>

Lord of the rings social network

Character Interaction Networks for the three books. In this project the nodes represent entities (characters, places or groups) and two of them are connected by an edge if in any paragraph of the books there are references to these two entities. There are also two files that contains two tables with basic information about the entities, so in this case, the nodes have attributes (if it is a charcter or a place, if it is human or other race, etc.).

Similarly as before, you can use this data to explore the dynamics of the Lord of the Rings story using network science techniques. For example, community detection finds coherent plotlines. Centrality measures uncover the multiple ways in which characters play important roles in the saga. You can start to investigate this data by using the pandas DataFrame. As you can see this data easily translates to a network problem. You can create a multigraph, or a list of graphs, with the temporal snapshots.

Resources:

<https://towardsdatascience.com/lord-of-the-rings-analysis-8a246643bf45/>

<https://github.com/Nab-88/social-graphs-and-interactions/tree/master>

Import/Export World Trade Network

Bipartite Import/Export network of world trade. BACI provides data on bilateral trade flows for 200 countries at the product level (~1300 products). Downloaded from

https://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37

Since the networks are too heavy, you can download them locally from here

https://mega.nz/file/0NZQQD5S#xmEQZy6hI6BoQqKt_WVa9rVGS2R5M1sfSaBaCdhOVQA

You can use this data to build and explore the dynamics of the world commerce. Part of this project is build the network using the database provided ()

Community detection, Ranking of countries, and continuity of the roles in the network of commerce. Centrality measures uncover different ways in which countries play a role in commerce.

You can start to investigate this data by using the pandas DataFrame. As you can see this data easily translates to a network problem. You can create a multigraph, or a list of graphs, with the temporal snapshots.

Resources: <https://www.nature.com/articles/srep00723>

USA Air Traffic Network

US Airport Network between 1990 and 2015. This dataset contains data for 25 years[1995-2015] of flights between various US airports and metadata about these routes. Taken from Bureau of Transportation Statistics, United States Department of Transportation. In the

pass_air_data dataframe we have the information of number of people that fly every year on a particular route, and the list of airlines that fly that route. The coordinates of the airports are also available.

As you can see this data easily translates to a network problem. You can create a multigraph, or a list of graphs, with the temporal snapshots.

Resources: <https://ericmjl.github.io/Network-Analysis-Made-Simple/05-casestudies/02-airport/>

Web of life Foodwebs

A collection the 17 available weighted foodwebs downloaded from the web of life database. The information of each network location and study is in the data frame "references_df", while the different foodwebs can be loaded independently. In the original adjacency matrices the rows represent the preys and the columns the predators. When the matrices are read, a dataframe containing the information of each link is created, similarly as in all the other projects.

Resources:

<https://www.web-of-life.es/map.php>

Multilayer Intertidal Network

The dataset includes all the species that were found to co-occur during community structure surveys carried out at several rocky intertidal sites with similar wave exposure spread along 700 km of the central Chilean coast. An interaction was included in the network if one species plausibly had a direct measurable effect on the growth, survival, or feeding rates of another species over an ecologically relevant time period. The network was split into three separate matrices for trophic, positive non-trophic, and negative non-trophic interactions (in each matrix, interactions are coded as 0 or 1). Apart from the interactions there is also information on the species (nodes) such as the species name, phylum, trophic level, sessile or mobile character, and body mass.

Resources:

<https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1002527>

<https://esajournals.onlinelibrary.wiley.com/doi/10.1890/13-1424.1>

Web of life Mutualistic networks

A collection of 14 Seed dispersal and 11 plant pollinator networks from the web of life database. The information of each network location and study is in the data frame "references_df", while the different mutualistic networks can be loaded independently. In

both cases (pollination and seed dispersal) the plants are the rows and the columns are the animals (either seed dispersers or pollinators) of the original adjacency matrices. The matrices are read and the interactions stored in a dataframe of interactions, similarly as in the rest of projects.

Full database can be accessed in: <https://www.web-of-life.es/map.php>

Spatial pollination networks

This datasets contains 9 plant-pollinator networks located at different places. You can try to disentangle them from the associated research paper. This data allows to study networks that change in space and time.

Resource:

https://digital.csic.es/bitstream/10261/338981/1/Spatio_temporal_variation_Hervias_Parejo.pdf

https://figshare.com/articles/dataset/Spatio-temporal_variation_in_plant-pollinator_interactions/21213587?file=37620695