# CS224W Analysis of Networks

## **Mining and Learning with Graphs**

**Project Ideas**

**Temporal Walk Based Centrality Metric for Graph Streams**

In dynamic networks, characterizing the temporal centrality of a node is a challenging task. In this work we develop an online updateable temporal network centrality measure. The metric is based on the concept of time-respecting walks containing a sequence of adjacent edges with timestamps ordered in time. We compare our algorithm against static centrality metrics like PageRank on data sets containing a stream of edges.

**Prerequisites:** Python   
**Contact:** [Robert Palovics](mailto:palovics@stanford.edu)

**Empirical Comparison of Euclidean and Hyperbolic Network Embeddings**

The project aims to conduct a large empirical evaluation of Euclidean and hyperbolic network embeddings. Euclidean embeddings, such as Node2vec, DeepWalk, and various GCN methods, have become a popular approach for learning with graphs and have proven successful in numerous important applications. When graphs have some latent hierarchical structure they might be more accurately embedded not in Euclidean but in hyperbolic space. Students will use networks from SNAP and BioSNAP, compute Euclidean and hyperbolic embeddings, and compare both types of embeddings for several prediction tasks, including node classification, link prediction, and community detection.

**Prerequisites:** Python; SNAP.py; PyTorch, TensorFlow or other deep learning framework   
**Contact:** [Marinka Zitnik](mailto:marinka@cs.stanford.edu)

**Network science of human tissues**

All cells in the human body have basically the same DNA and the same set of genes, however, cells organize themselves in tissues, such as lung and brain, which are very different from each other, even to the naked eye. How can we explain these differences? The project will use tissue-specific gene interaction networks from BioSNAP and perform a network science study comparing and analyzing gene interaction networks from many different human tissues.

**Prerequisites:** Python, SNAP or SNAP.py, PyTorch or TensorFlow, any introductory bioinformatics course   
**Contact:** [Marinka Zitnik](mailto:marinka@cs.stanford.edu)

**BioSNAP: Stanford Biomedical Network Dataset Collection**

We are building BioSNAP, Stanford Biomedical Network Dataset Collection (http://snap.stanford.edu/biodata). The goal of this project is to improve BioSNAP in several different directions. We would like to construct additional networks, analyze them, and incorporate them into BioSNAP. We would also like to improve the utility of BioSNAP by including mappings, which would allow us to easily construct large heterogeneous graphs.

**Prerequisites:** SNAP or SNAP.py, any introductory bioinformatics course   
**Contact:** [Marinka Zitnik](mailto:marinka@cs.stanford.edu)

**Weighted signed network embeddings for link prediction**

Signed social networks represent positive and negative relationships (e.g., trust/distrust and like/dislike) between nodes. These relations can be weighted to represent the strength of the sentiment. In this project, you will develop embedding based techniques to predict links and link weights in signed social networks. We will use it on bitcoin trust networks and in-person deception networks.

**Contact:** [Srijan Kumar](mailto:srijan@cs.stanford.edu)

**Weighted signed network embedding for fraud detection**

Signed social networks represent positive and negative relationships (e.g., trust/distrust and like/dislike) between nodes. These relations can be weighted to represent the strength of the sentiment. In this project, you will develop embedding based techniques to identify fraudulent users in weighted signed networks, with applications to identify scammers in bitcoin networks and e-commerce websites.

**Contact:** [Srijan Kumar](mailto:srijan@cs.stanford.edu)

**Signed temporal network embedding**

Signed social networks represent positive and negative relationships (e.g., trust/distrust and like/dislike) between nodes. These relations can be weighted to represent the strength of the sentiment. These networks can evolve over time. In this project, you will develop graph embedding based algorithms to predict future relations.

**Contact:** [Srijan Kumar](mailto:srijan@cs.stanford.edu)

## **Projects 2018**

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| [Uncovering Political Promotion in China: A Network Analysis of Patronage Relationship in Autocracy](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-1.pdf) |
| [Efficient Simulation of IBD Spectra in Inbred Populations using Network Convolution](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-2.pdf) |
| [A Network Approach to Detect Heavily Affected Cities and Regions using Facebook Movement Data](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-3.pdf) |
| [Link Prediction in Foursquare Social Network](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-4.pdf) |
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| [Bundle Generation and Group Recommendation applied to the Steam Video Game Platform](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-10.pdf) |
| [Stanford Memes Group: Network Construction, Community Detection, and Link Prediction](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-11.pdf) |
| [Improving Recall and Precision in Graph Convolutional Networks for Node Classification using Node2Vec Embeddings](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-12.pdf) |
| [Leveraging Network Structures to Reveal Obfuscated and Hidden Attributes in Google+ Networks](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-13.pdf) |
| [vec2rec: Network Embedding for Item-to-Item Recommendation](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-14.pdf) |
| [Exploring the Impact of Black-Box Adversarial Behavior in Graph-based Recommenders](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-15.pdf) |
| [Embeddings for Signed Weighted and Temporal Networks](http://snap.stanford.edu/class/cs224w-2018/reports/CS224W-2018-16.pdf) |
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