CSI 445/660: Network Science – Part 0 (Course Overview)

Ref: Chapter 1 of [Easley & Kleinberg].

Examples of Networks

- Infrastructure Networks
  - Telephone networks
  - Computer networks
  - Transportation networks
- Information Networks (e.g. World Wide Web)
- Social contact networks
- Bibliographic networks
- Financial networks

Classical definition of a social network:

Network of interactions or relationships among people.

Discussion on Networks (continued)

- Current definition of a social network is broader; the new definition permits online interactions.
- Technological developments have made it possible to collect data and construct large networks.
- Analysis of networks helps in understanding their behavior.
- Manual analysis is impossible because
  - the networks are very large and
  - they evolve over time.

Network Science: Goals

Definition of Network Science (due to National Research Council):

> *Study of network representations of physical, biological and social phenomena leading to* **predictive** *models of these phenomena.*

Some goals:

- To be able to predict the behavior of a network based on its structure and other available information.
- To understand the phenomena that govern the evolution of a network over time.

Topics to be Covered

Note: Chapter numbers given below are with respect to the text by Easley & Kleinberg.

- Basics of Graph Theory (Chapters 1 and 2).
- Strong and weak ties (Chapters 2 and 3).
- Networks in their surrounding contexts (Chapter 4).
- Introduction to CINET.
- Positive/negative relationships and structural balance (Chapter 5).
- Centrality measures for networks.

Topics to be Covered (continued)

- Models for random graphs.
- Introduction to game theory and applications in modeling network traffic (Chapters 6 and 8).
- Structure of the web (Chapter 13).
- Link analysis and web search (Chapter 14).
- Power Laws for social networks (Chapter 18).
- Cascading behavior (Chapter 19).

Course Objectives

For all students:

- Develop familiarity with some types of analyses carried out on networks.
- Understand how structural features of a network influence its dynamic behavior.
- Develop the ability to apply these methods on networks that arise in your area of study.

For Computer Science students:

- Understand the formulation of and solution methods for some optimization problems arising in network analysis.
- Develop new algorithms for solving such problems.

Some Sources for Research Papers

General:

- List of references in the required and reference texts.
- A useful website: `http://www.network-science.org`

Journals:

- Network Science (published by Cambridge University Press).
- Journal of Complex Networks (published by Oxford University Press).
- IEEE Transactions on Computational Social Systems.
- Social Networks (published by Elsevier).
- Journal of Mathematical Sociology (published by Routledge).

Some Sources for Research Papers (continued)

Conferences:

- Proceedings of many data mining conferences (e.g. ACM SIGKDD, IEEE ICDM, SIAM Conference on Data Mining, PKDD) and workshops held as part of these conferences (e.g. SNA-KDD Workshop).
- Proceedings of many database conferences (e.g. ACM SIGMOD, VLDB).
- Proceedings of many AI and Machine Learning conferences (e.g. AAAI, IJCAI, ICML).
- Proceedings of IEEE International Conference on Social Computing (SocialCom).
- Proceedings of International Conference on Social Computing, Behavioral-Cultural Modeling and Prediction (SBP).