Overview

This course focuses on covert and illegal dark networks, such as drug trafficking and terror networks. The course’s first objective is to identify and describe these networks. We use various software packages to aid our identification and description efforts. The second is to design intervention strategies to disrupt, destabilize, and possibly destroy dark networks once you have identified and described them. The focus is on the tactical and operational levels, although the implications for strategic and policy levels may also inform our discussions.

The course has four sections. The first introduces the assumptions, concepts, and terms of social network analysis (SNA). The second covers how to code and manipulate social network data: the basics of social network analysis, so to speak. The third focuses on five different SNA “families” of metrics and/or algorithms: (1) network topography, (2) cohesive subgroups, (3) centrality, power, and prestige, (4) brokers and bridges, and (5) longitudinal networks. We may also have time to explore two types of computational text mining: (a) semantic network analysis and (b) topic modeling. The fourth and final section explores various strategic approaches for disrupting dark networks and asks students to craft three intervention strategies to disrupt, destabilize, or destroy the dark network they are analyzing (or if they are analyzing a light network, three strategies for making it more resilient and/or efficient).

The course involves a mixture of lectures, discussions, and hands-on experience (i.e., labs). Lectures dominate classes early in the quarter, but these will give way to class discussions and labs. Some class time will be devoted to class discussions of the assigned readings, so everyone should come to class prepared. However, since social network analysis is as much a series of techniques and methods as a body of theory, a large portion of class time will be spent on in-class labs or the data you are analyzing for your final projects.

I plan to record all classes using Zoom.

Requirements

Class participation – 5%
In-class Labs – 20% (credit/no credit)
Dark network project – 35%
Quizzes – 15%
Final Lab (take-home) – 25%

Grading Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>95-100</td>
</tr>
<tr>
<td>A-</td>
<td>90-94</td>
</tr>
<tr>
<td>B+</td>
<td>87-89</td>
</tr>
<tr>
<td>B</td>
<td>84-86</td>
</tr>
<tr>
<td>B-</td>
<td>80-83</td>
</tr>
<tr>
<td>C+</td>
<td>77-79</td>
</tr>
<tr>
<td>C</td>
<td>74-76</td>
</tr>
<tr>
<td>C-</td>
<td>70-73</td>
</tr>
<tr>
<td>D+</td>
<td>67-69</td>
</tr>
<tr>
<td>D</td>
<td>64-66</td>
</tr>
<tr>
<td>D-</td>
<td>60-63</td>
</tr>
<tr>
<td>F</td>
<td>0-59</td>
</tr>
</tbody>
</table>

Important Dates (Tentative)

Week of October 8th (3rd week)
- Optional Class (Monday)
- Dark Network Project “Proposal” Due (Wednesday)

Week of October 22nd (5th week)
- Quiz #1 (Wednesday)

Week of October 29th (6th week)
- Dark Network Project I due (Friday)

Week of November 12th (8th week)
- Dark Network Project II due (Friday)

Week of November 19th (9th week)
- Final Lab Distributed (Monday)

Weeks of November 26th and December 3rd (10th and 11th weeks)
- Quiz (Monday, November 27th)
- Project Presentations & Tournament

Friday, December 15th, 5:00 pm
- Final Project and Final Lab Due
The Fine Print

Requirements

Students can work by themselves or form up to three-person teams. Each person or team will analyze a different network relationship and use the social network metrics introduced in class.

1. **Class Participation (5% of Final Grade):** The class’s success depends on each member, including the instructor, doing their part. Each student should treat other students and the instructor with respect. Each team will present its dark network projects (see below). This does not have to be a formal presentation. You can use PowerPoint (or Keynote or Google Slides), but you don’t have to.

2. **In-class Lab Assignments (20% of Final Grade):** There will be a series of in-class lab assignments completed and turned in by each student (not team). They will be due one week after handing them out in class and graded credit/no credit. Students are allowed (and encouraged) to work together, but everyone must turn in their own work.

3. **Analysis of a Dark Network (35% of Final Grade):** Each person or team will collect and record data on a dark or light network (this can be a network recorded for the Visual Analytics class and/or your thesis), which you will analyze and then develop three strategies for disrupting (for a dark network) or making it more resilient (for a light network).

   a. **Proposal (Informal):** By the third week of the course, write a brief (e.g., a couple of sentences, a paragraph) summary of the dark or light network you intend to analyze.

   b. **Part I: Collecting and Recording of Dark Network (10% of Final Grade):** Each person or team will collect and record either a one-mode or two-mode social network plus attribute data of their chosen network. The number of networks and attributes each team codes will depend on team size. The following criteria serve as rough guidelines:

   - Single individuals: two relations (either one-mode or two-mode) and one attribute
   - Two-person teams: three relations (either one-mode or two-mode) and one attribute
   - Three-person teams: four relations (either one-mode or two-mode) and one attribute

   Individuals and teams can also record data about the Noordin Top terrorist network using the 2006 article on Noordin (please see me before doing so). Each person or group should submit the following:

   - A description of the sources from where the data were coded, including a description of how you defined your network’s boundaries
   - Specific definitions of the relationship(s) and attribute(s) you coded (in other words, a miniature codebook)
   - A sociogram (network map) of each of the relationship(s) and attribute(s) you coded
   - Network matrices or edge lists (Excel, etc.) of the relationship(s) and attribute(s) you coded

   c. **Part II: Exploratory Analysis of Dark Network (10% of Final Grade):** Each person or team will aggregate and analyze two or more relations using the metrics (e.g., topography, identification of subnetworks, and brokerage) introduced in class. At a minimum, each person’s or team’s description should include the following:

   - A separate sociogram (network map) of each relationship
   - A general description (visual and metrics) of each network
   - A sociogram that aggregates these relations together
   - General description (visual and metrics) of the aggregated network
   - An explanation of what you think the analyses imply about the aggregated network and how it operates
d. **Part III: Strategic Analysis of Dark Network (15% of Final Grade):** Based on the examination of their network using Gephi, snExplorer, and R and drawing on the course readings, each person or team will develop and consider the viability of *three possible strategies/tactics* to disrupt and/or destabilize their dark network (or building up their light network). Each person or team will make a presentation in class and turn in a paper:

- Treat the final paper as a research paper. It should be approximately 20 pages long, *excluding* appendices and references, and describe your strategies/tactics for disrupting your dark network (or building up your light network). It should include the following:
  1. Abstract (or executive summary)
  2. Introduction
  3. Literature review (justifies the analysis you propose)
  4. Detailed description of the data (adapted from Part I – the sources of the data, the boundaries of your network)
  5. Presentation and discussion of your results (adapted from Part II)
  6. Strategies for Disruption (these need to flow *directly* from your analysis)
  7. Conclusion
  8. Appendix (e.g., codebook, additional tables and graphs, etc.)
  9. References should be *in alphabetical order* and a standard format (i.e., they should include enough information so anyone reading the paper can track them down).

- In your presentation, describe and defend your strategies. You may use PowerPoint, but you do not have to.

4. **Quizzes (15% of Final Grade):** There will be two short-answer quizzes to check your learning to date. I will distribute (probably virtually) the quizzes at the beginning of class, and you will have two hours to complete them. They will be open book, open note, open PowerPoint, and so on (but not open neighbor).

5. **Final Lab (25% of Final Grade):** A take-home final lab will be given at the end of the quarter that will cover lectures, labs, discussions, and assigned readings.

- Unlike the in-class labs, you will need to complete this lab independently. It will be made available in the 9th week.
- You can turn it in early for a “tentative” grade and then “redo” it if you wish to improve your grade for up to 2/3 of the points initially marked off.
- Please return the original lab submission along with your resubmission.

**Software**

We will primarily use one software package, **Gephi**, a free, open-source, Java-based software written for Mac, PC, and Linux: [https://gephi.org/](https://gephi.org/). Its interface is available in several languages, including English, Spanish, French, and Japanese. Much of its functionality relies on “plugins,” which are add-ons that allow researchers and programmers to develop additional tools and techniques. Gephi recognizes several network file formats and is excellent for visualizing large networks. Unfortunately, it does not include several metrics and algorithms available in other packages, so we will occasionally turn to others, such as **snExplorer** and **R**.

**snExplorer** is an online social network package currently being developed by the CORE Lab, using what is known as a “Shiny app,” which is a tool that allows us to harness the power and flexibility of **R** (see below) but still keep the user interface simple: [https://corelab.shinyapps.io/shiny-snexplorer/](https://corelab.shinyapps.io/shiny-snexplorer/).

We will sometimes use **R**. Not too often, but when Gephi can’t do what we want it to do. **R** is a software environment for statistical computing and graphics widely used among statisticians for developing statistical software and data analysis, including social network analysis. Two primary social network analysis software packages are available in **R**: **statnet** and **igraph**. When we use
The labs will include step-by-step commands to help keep things simple. When we don’t use it, I will still include step-by-step commands, but these will be entirely optional. Download and install the most recent version of R here: https://cran.r-project.org/

We will use a few R packages/libraries designed for social network analysis. The two most common will be:

- **igraph** ([https://igraph.org/](https://igraph.org/)) is a package that estimates primarily descriptive social network analysis statistics. You can calculate measures related to network topography, centrality, subgroups, brokers, and bridges, among others.
- **statnet** ([https://statnet.org/](https://statnet.org/)) is a suite or “wrapper” of several SNA packages that provides users with many of the same descriptive measures (e.g., centrality) as igraph as well as functions to perform advanced modeling (e.g., ERGMs and SAOMs). Each package (e.g., *sna*, network, ergm) provides users unique functionality and is available after statnet is installed.

**RStudio** is an integrated development environment for R. It includes a console and a syntax-highlighting editor that supports direct script execution, as well as tools for plotting, history, debugging, and workspace management. It is available in open-source and commercial editions. It runs on the desktop (Windows, Mac, and Linux) or in a browser connected to RStudio Server or RStudio Server Pro (Debian/Ubuntu, RedHat/CentOS, and SUSE Linux). It makes the life of R users far easier. Download the most recent (and free) desktop version here: [https://www.rstudio.com/products/rstudio/download/](https://www.rstudio.com/products/rstudio/download/)

### Readings

One of the two following texts is required (chapter proofs are uploaded to Sakai):


Other required readings (e.g., journal articles and book chapters) are available through NPS’s Sakai/Collaborative Learning Environment (CLE) website – [https://cle.nps.edu/xsl-portal](https://cle.nps.edu/xsl-portal).

### The Writing of Research Papers

**Academic Honesty:** The NPS Student Information Handbook and Academic Honor Code state that all students are expected to complete their work, understand and avoid plagiarism, and follow NPS’s academic integrity and honesty policy. Anyone found violating these standards will be punished. **The basic rule is to give others credit for their ideas and not misrepresent others’ work, words, or creations as your own.** If you have any questions, ask before you submit your papers. **Note:** Since NPS is a government organization, not just an academic institution, you risk your entire career, not just your course grade, if you willfully violate the Academic Honor Code.

**Graduate Writing Center:** Consultation could involve brainstorming, dissecting readings, outlining, organization, argumentation, grammar, punctuation, citing, or paraphrasing. See [https://my.nps.edu/web/gwc/meet-with-a-writing-coach](https://my.nps.edu/web/gwc/meet-with-a-writing-coach). The Graduate Writing Center (GWC), located on the first floor of the Dudley Knox Library and at [https://my.nps.edu/web/gwc](https://my.nps.edu/web/gwc), is a resource for all NPS students, regardless of their comfort or proficiency with academic writing. The center offers one-to-one coaching, hands-on workshops, and online and hard-copy reference materials to support students throughout their time at NPS.

**Reasonable Accommodations for Students with Disabilities:** Any student who feels they may need accommodation based on the negative impact of a disability on their work should contact their program officer and professor to discuss specific needs. Please see [https://my.nps.edu/web/gwc/special-needs-reasonable-accommodation](https://my.nps.edu/web/gwc/special-needs-reasonable-accommodation) for more information.
Boilerplate

1. **Class Preparation:** Preparation is essential. Please complete the assignments (readings and exercises) before the class begins so you will get the most out of your educational experience (*including reading the syllabus*).

2. **Required Readings:** You are not expected to do the worked examples in any of the readings (e.g., in my “green” book). Instead, focus on the content discussed (e.g., topography, centrality).

3. **Arrive on Time:** Please try to get to class on time. Dealing with quirky software is hard enough, but concentrating when people rush to their seats, bump into chairs, and trip over and disconnect network cables is difficult.

4. **Lectures:** Lectures, when given, will not necessarily cover the reading material in-depth, so if you have questions, raise them in class or email me before class begins. If no questions are raised, I will assume you have understood the reading material, and I can move on to other issues and topics.

5. **PowerPoint Slides:** I will post all PowerPoint slides I present to Sakai, usually after class.

6. **Sakai Drop Box:** The drop box feature on Sakai is set up for you to upload digital copies of your papers, labs, and network data. *Please upload them rather than email them to me* because they are generally quite large due to their graphics.

7. **Portable File:** I use the portable file in Root 204 to return labs, papers, and other assignments. *Do not place hard copies of your labs or papers in the portable file,* I might miss seeing them.

8. **Labs:** Labs are due before class begins one week after they are handed out unless you have been granted an extension due to unforeseen circumstances. *When complete, upload them to Sakai through its drop box feature.* Please don’t email me digital copies; they tend to be quite large and fill up my inbox.

9. **Network data:** Network data should *be zipped together and uploaded* to Sakai.

10. **Final Project:** The final project is a research paper and should be written as one. It should include an introduction, a literature review justifying the analysis you propose, a description of the data, your results, a discussion of those results, and a conclusion. List references in *alphabetical order* and a standard format (i.e., they should include enough information that anyone reading the paper (not just me) can track them down). Finally, tables *cannot be* screenshots of output from Gephi, snExplorer, or R; you need to create your own (and only include metrics you plan to discuss). See the examples in the readings.

11. **Sample Papers:** I have uploaded well-written papers from previous classes to a folder on Sakai. These are provided to give you a sense of the variety of ways that dark networks can be disrupted using social network analysis and illustrate what a good paper looks like.

12. **Optional Readings:** I have included a series of optional readings in the syllabus. They are for future use (perhaps for your theses) or for those with the time and interest to explore topics beyond the required materials. Most are uploaded to the Sakai website. Some (e.g., book chapters) are not because of copyright restrictions; however, students interested in reading them can either borrow the book from me or check it out of the library.

**Additional Resources**

Below are a series of books, journals, and websites that you may find helpful now or in the future. As with the optional readings, some of you may find some useful for your thesis.

**Texts**


**Journals**

• *Connections*. Journal of the International Network for Social Network Analysis (INSNA). Membership in INSNA includes a subscription to Connections. Web versions and many past issues are available at https://www.insna.org/connections

• *Journal of Social Structure* (2000-present). An electronic journal publishing work on social networks, some of which display options not available for print journals. Articles through 2017 are available for free at http://www.cmu.edu/joss/index.html; more recent issues can be found here: https://www.exeley.com/articles/1/42


**Websites**

• International Network for Social Network Analysis website: http://www.insna.org/

• Social Network: http://en.wikipedia.org/wiki/Social_network

• Social Network Analysis: http://en.wikipedia.org/wiki/Social_network_analysis
Part I: Introduction to Social Network Analysis

Week 1: Class Overview (Monday)

Video


Required Readings

- Syllabus.

Optional Readings

- None.

Week 1: Introduction to Social Network Analysis and Dark Networks (Wednesday)

Audio (Weak and Strong Ties)


Required Readings


Optional Readings

SNA Introductions

Dark Networks


Week 2: Exploring Gephi and R (Monday)

**Required Readings**

- Cunningham et al. 2016. “Collecting, Coding, and Manipulating Social Network Data.” Pp. 35-57 (Chapter 3) in *Understanding Dark Networks*.

**Optional Readings**


**Part II: Social Network Analysis: Basics**

Week 2: Collecting and Recording Social Network Data; One-Mode Social Network Data (Wednesday)

**Required Readings**

Optional Readings

- Cunningham et al. 2016. “Collecting, Coding, and Manipulating Social Network Data.” Pp. 35-57 (Chapter 3) in *Understanding Dark Networks*.

Social Network Analysis Lab

- Lab #1: One-Mode Social Network Data

Week 3: Two-Mode Social Network Data & Simplifying Social Networks

Required Readings


Optional Readings

- ________. “Attributes and Relations.” Pp. 36-70 (Chapter 2) in *Exploratory Social Network Analysis with Pajek*.

Social Network Analysis Labs

- Lab #2: Two-Mode Social Network Data
- Lab #3: Simplifying Social Networks

Week 4: Aggregating Social Networks (Monday)

Required


Optional Readings

- None.

Social Network Analysis Lab

- Lab #4: Aggregating Social Networks
Part III: Social Network Analysis: Metrics and Algorithms

Week 4: Network Topography (Wednesday)

Required Readings


Optional Readings


Social Network Analysis Lab

- Lab #5: Network Topography

Week 5: Introduction to Dark Networks Game and Review (Monday)

Required Readings


Optional Readings


Week 5: Quiz #1 (Wednesday)

Required Readings

- None.

Optional Readings

- None.

Week 6: Detecting Subgroups (Monday)

Required Readings

Optional Readings

- Robert Schroeder, Sean F. Everton, and Russell Shepherd. 2012. “Mining Twitter Data from the Arab Spring.” Countering Terrorism Exchange 2:56-64.

Social Network Analysis Lab

- Lab #6: Detecting Subgroups

Week 6: Centrality and Power (Wednesday)

Required Readings


Optional Readings


Social Network Analysis Lab

- Lab #7: Centrality and Power

Week 7: Centrality and Prestige (Monday)

Required Readings

Optional Readings


Social Network Analysis Lab

- Lab #8: Centrality and Prestige

Week 7: Bridges and Brokers (Wednesday)

Required Readings


Optional Readings


Social Network Analysis Lab

- Lab #9: Brokers and Bridges

Week 8: Longitudinal Networks (Monday)

Required Readings

Optional Readings


Social Network Analysis Lab

- Lab #10: Longitudinal Networks

Week 8: Text Mining (Wednesday)

Required Readings

- None.

Optional Readings

- None.

Social Network Analysis Lab

- Lab #11: Text Mining (optional)

Part IV: Strategies for Disrupting Dark Networks

Week 9: Probability and Strategies, Review (Monday)

Required Readings

- Sean F. Everton. 2012. “Strategic Options for Disrupting Dark Networks.” Pp. 32-46 (Chapter 2) in *Disrupting Dark Networks*. OR

Discussion Readings (Required)


Optional Readings

Disruption


Prediction


Week 10: Quiz (Monday)

Required Readings

• None.

Optional Readings

• None.

Weeks 10 & 11: Project Presentations, Dark Networks Tournament (Beginning Wednesday)

Required Readings

• None.

Optional Readings

• None.