Lab exploration: Network Profile Summary
Components of Learning in MA 4404

Network Profile Summary
- Each student picks a network to understand and explore
- As I teach concepts, each student tests the concepts on the chosen network (Gephi, Python, R)
- Deliverables:
  - Weekly one-slide presentation throughout the quarter
  - Final comprehensive PPT

Interactive lectures:
- New concepts introduction
- Conversation driven
- Guest lecturers provide different perspectives and application (ie. OR)

Exploratory group projects
- Open research topic that is currently relevant
- Provide research project experience and thesis in a group format (learn with mutual support)
- Focus on exploration not finding a “correct” answer

“Great course! I enjoyed exploring the course concepts by implementing them on my network profile. Great way to learn!” MA4404 student
Why?

• Best way to learn is to experiment rather than to observe.
• Transition from knowledge exposure to practice (without mimicking the instructor).
• You can experiment on your network:
  • exploring the topics as we present them, and
  • as your intellectual curiosity inspires you.

“This class is structured in the way I thought graduate school classes should be structured. Open research questions were effective in inspiring more advanced learning. An excellent class.”

MA4404 student
• Choose a network that interests you.
• You will be analyzing this network and present results about it.
• You are welcome to download a data set from http://faculty.nps.edu/rgera/MA4404/NetworkProfileSummaryResources.html or other data of interest.

“This was an engaging and interactive course. It covered an incredibly interesting topic and the instructor did a great job bridging the ‘math’ with the real world applications. I enjoyed working in the group for projects and believe that this is by and far the best way to learn. The lectures were interesting, improved my understanding of the material, and contributed directly to the quality of the projects. The instructor is passionate about the topics and passed that enthusiasm to the class. I wouldn’t change anything”

MA404 student
What?

• At the end of each week, create one (or two slides if absolutely needed) with your analysis of the topics presented that week, applied to your network: convincing, coherent, and cohesive.

• Students will present their findings, followed by a group discussion of all the networks’ analysis (similarities and dissimilarities).

• The cumulative PPT slides to be turned in the day of classes.

Let’s see some examples!

“Best. Teacher. Ever. Loved the course, and if you had a mic Raluca, this is the part where you would drop it and walk away.”

MA4404 student
Creative, Relevant Learning

**Healthcare, Logistics**
- Public Health,
- Travel

**Wargaming**
- Terrorist Networks

**Social Influence**
- Political Influence,
- HDD Mapping,
- LinkedIn

**Personal Interest**
- Star Wars
The Brain Network

- 297 Nodes - Neuron
- 2345 Edges - Synapse
- 15.79 Ave Degree
- 3.992 Ave Path
- 14 Diameter
- .482 Modularity
- 1 Connected Component
United States Airports and Flights

Nodes: 549 US Airports
Edges: 5450 directed edges

Public Health Application: Understanding the spread and determining measures for preventing the spread of infectious disease, from an airport/airline/travel perspective.

Logistics and Business Decision-Making: Where will they put new airports, and which airports will the new airport be connected to first? Future Capacity of Airports Considerations
Multiplex Terrorist Networks

- Boko Haram, Nigeria
- Noordin Top, Indonesia
- FARC, Columbia
Small, Dark, Real, Multiplex Network of the five Terrorist Organizations in Indonesia rendered as a Monoplex Network by Gephi.

- \( V = 133 \)
- \( E = 2451 \)
- Layers = 14
- AVG Path Length: 2.13
- Clustering Coeff: 0.71
- AVG Degree: 23
- AVG Weighted Degree: 37
Multiplex Terrorist Networks

- Trust
- Lines of Comms.
- Knowledge

The monoplex
Targeting a community in Terrorist networks

The same ten individuals appear in the same community in the communication layer.

They represent over 60% of a community in the full network (using only 20% of the ground truth).

This community represents a group that carried out an attack in Bali in 2005.

- Salik Firdaus, Misno, Aip Hidayat
- 3 suicide bombers from the Bali attack
- Not part of the Community in the Communication layer
No other American President has taken office with a giant network of businesses, investments and corporate connections.

How are people and organizations connected in this social network?

Who or what organizations have the most influence?

Data Statistics:
- Nodes: People and Organizations
- #Nodes: 145
- Edges: connection type (directed)
- #Edges: 281
- Strongly connected: 128
Automate extraction and construction of the social network of the user(s) of computers: HDD are scanned with forensic bulk extractor for email addresses.

Component 4:
  - Pearson Similarity: .837
  - avg degree: 7.678
  - avg path: 10.889

Possibly the address book?
Email mapping

- Email traffic from August ‘15 – Jan ‘16, (received and sent emails).
- Node: user accounts
- Edge: header field users (To, From, CC, BCC)
  - Colors based on degree
  - Miguel: Light green one
  - No weights on edges

Email content mapping

- Node: key words
- Edges: key words in the same email
Email content mapping

- Nodes: 499 and Edges: 13,078
- Avg. Clus. Coeff: 0.829
- Avg. Path Length: 2.369
- Net Diam.: 5
- Avg. Deg.: 52.417
- Avg. W. Deg.: 66.725
- Density: 0.053
- Modularity: 0.467

Centralities

- Eigenvector: (↓)
  - 1. ‘Miguel’: 1
  - 2. ‘Office’: 0.9985
  - 3. ‘Eric’: 0.9156
  - 4. ‘September’: 0.8637
  - 5. ‘Student’: 0.8377

- Closeness: (↑)
  - 1. ‘Office’: 1.5383
  - 2. ‘Miguel’: 1.5887
  - 3. ‘Student’: 1.6210
  - 4. ‘Eric’: 1.6633
  - 5. ‘September’: 1.7359

- Betweenness: (↓)
  - 1. ‘Office’: 42,900
  - 2. ‘Miguel’: 34,736
  - 3. ‘Student’: 31487
  - 4. ‘Eric’: 19,456
  - 5. ‘September’: 14,557
LinkedIn: Community Detection
STAR WARS IV, V, AND VI

Edges based on “interaction” in the movie
- Talked to
- Fought against/with
- Related to
- Worked for

It is not a 100% representation
- Couldn’t find some of
  the minor characters
  listed in credits
NPS Network Science Certificate cohorts

- Network as of 30JAN18
- Gephi algorithm repeatedly detected the same communities
- Detected communities generally corresponded to Network Science cohorts
- 13 of 54 students responded
- Sorted using Fruchterman Reingold algorithm
Network Profile Summary is:
- deck of slides on the personal network.

Network Profile Summary allows students to:
- find the why behind the what they observed,
- be motivated,
- be independent learner,
- continually apply newly learned concepts to their selected networks → realize the utility and place of these concepts,
- see coursework, concepts, and feedback as productive and globally meaningful rather than corrective and locally meaningful,
- engage with topics that mean something to them,
- while students are exposed to required material.
Thank you!

- Resources for data: https://faculty.nps.edu/rgera/MA4404/NetworkProfileSummaryResources.html
- Ralucca’s email: rgera@nps.edu
- Course info: http://faculty.nps.edu/rgera/MA4404.html