# CS4973

## network analysis

# Raj Venkat

Assistant Teaching Professor

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Research Areas

- AI for Data Privacy
  (esp. genomic data)

- Graph Theory & Complex Networks

- Natural Language Processing

- CS Education

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Research Areas

Focus of this class:

- AI for Data Privacy
  (esp. genomic data)

- Graph Theory & Complex Networks

- Natural Language Processing
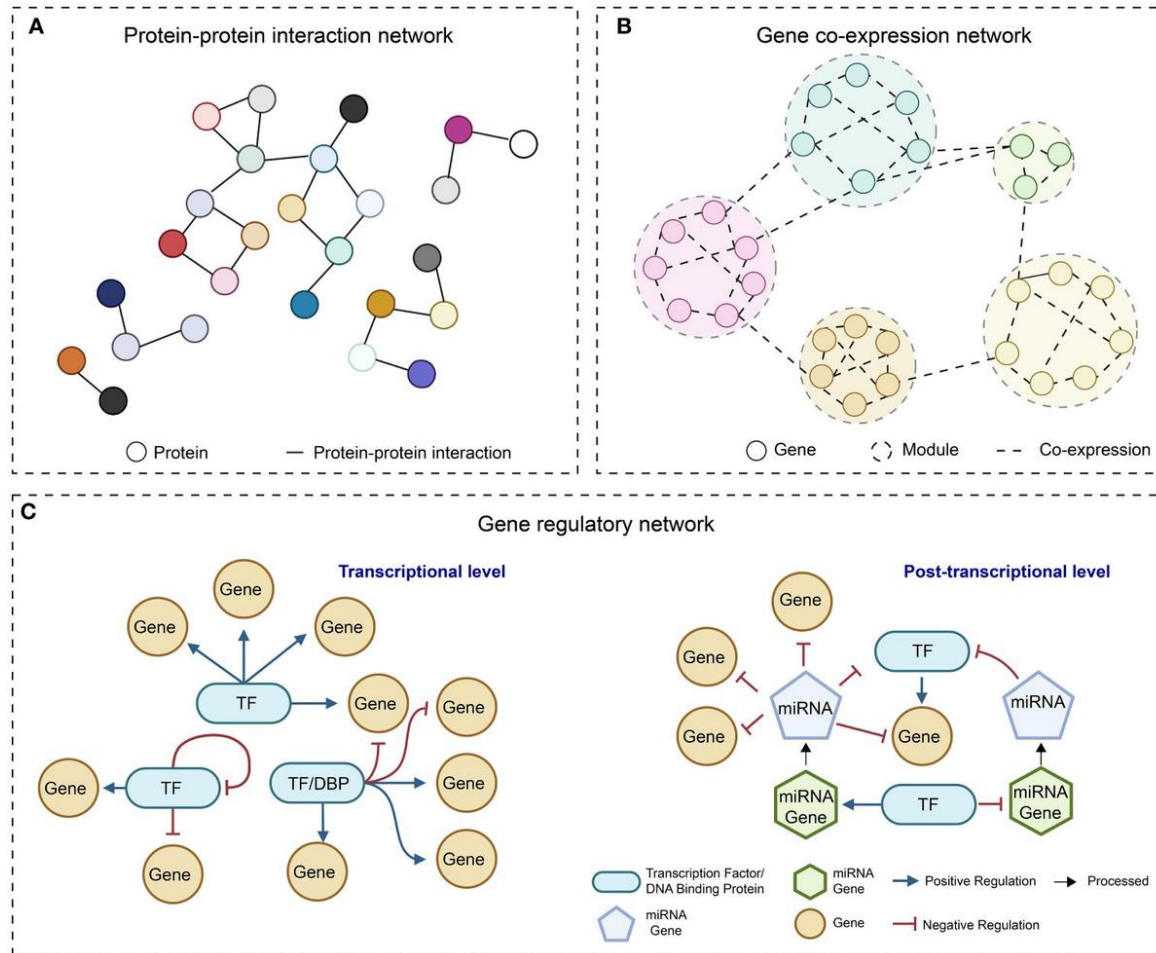
- CS Education

# What are Networks?

- A collection of entities and the relationships between them.

- In other words, a set of connected things.

- Networks are everywhere!
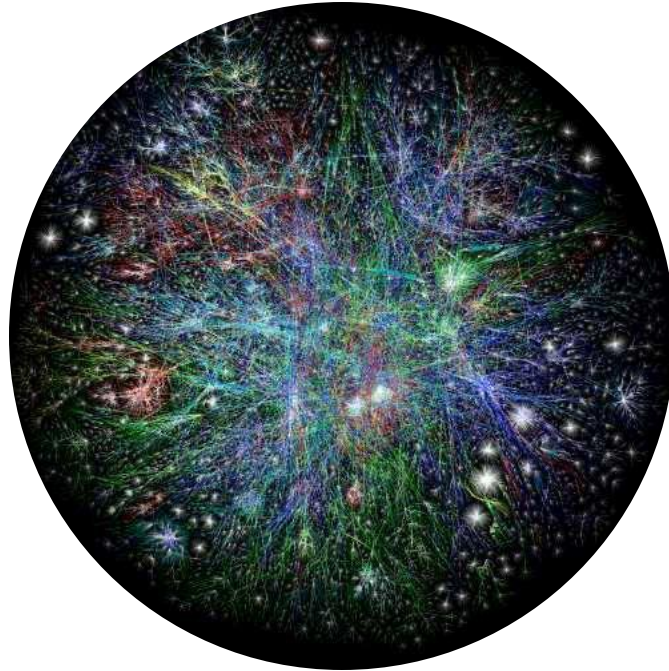
# Social Networks



- What are the entities and relationships in these networks?

- Are there more than 1 kind?

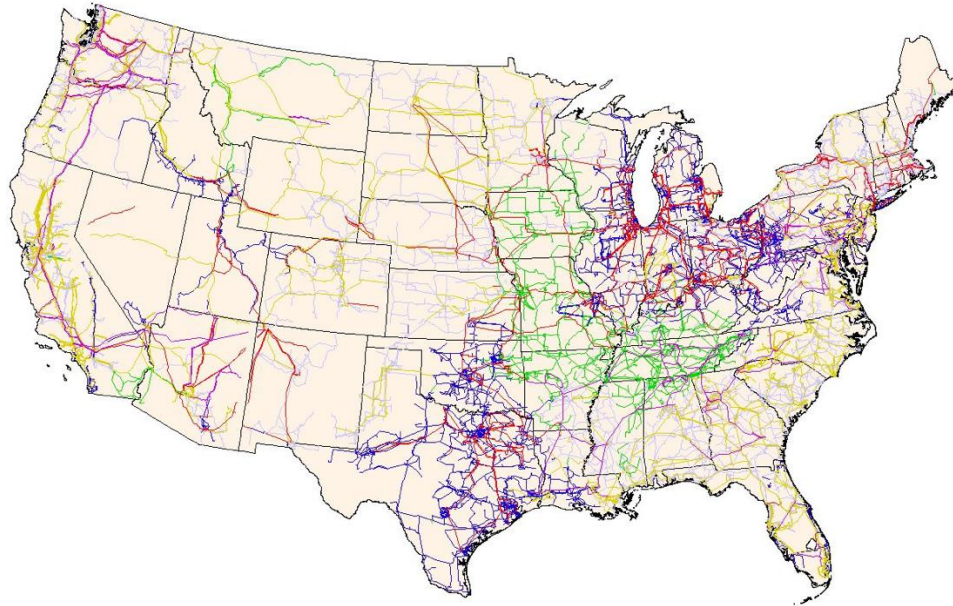- Can you think of more complex examples?

# Biological Networks
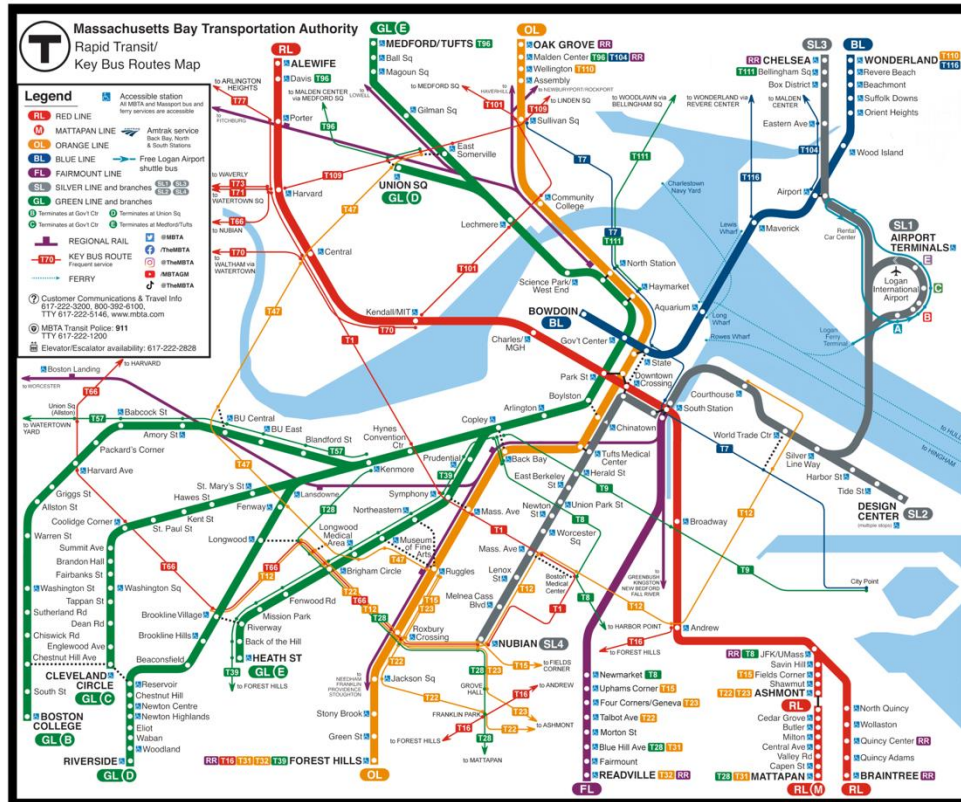
# Technological Networks



Any guesses as to what this is?
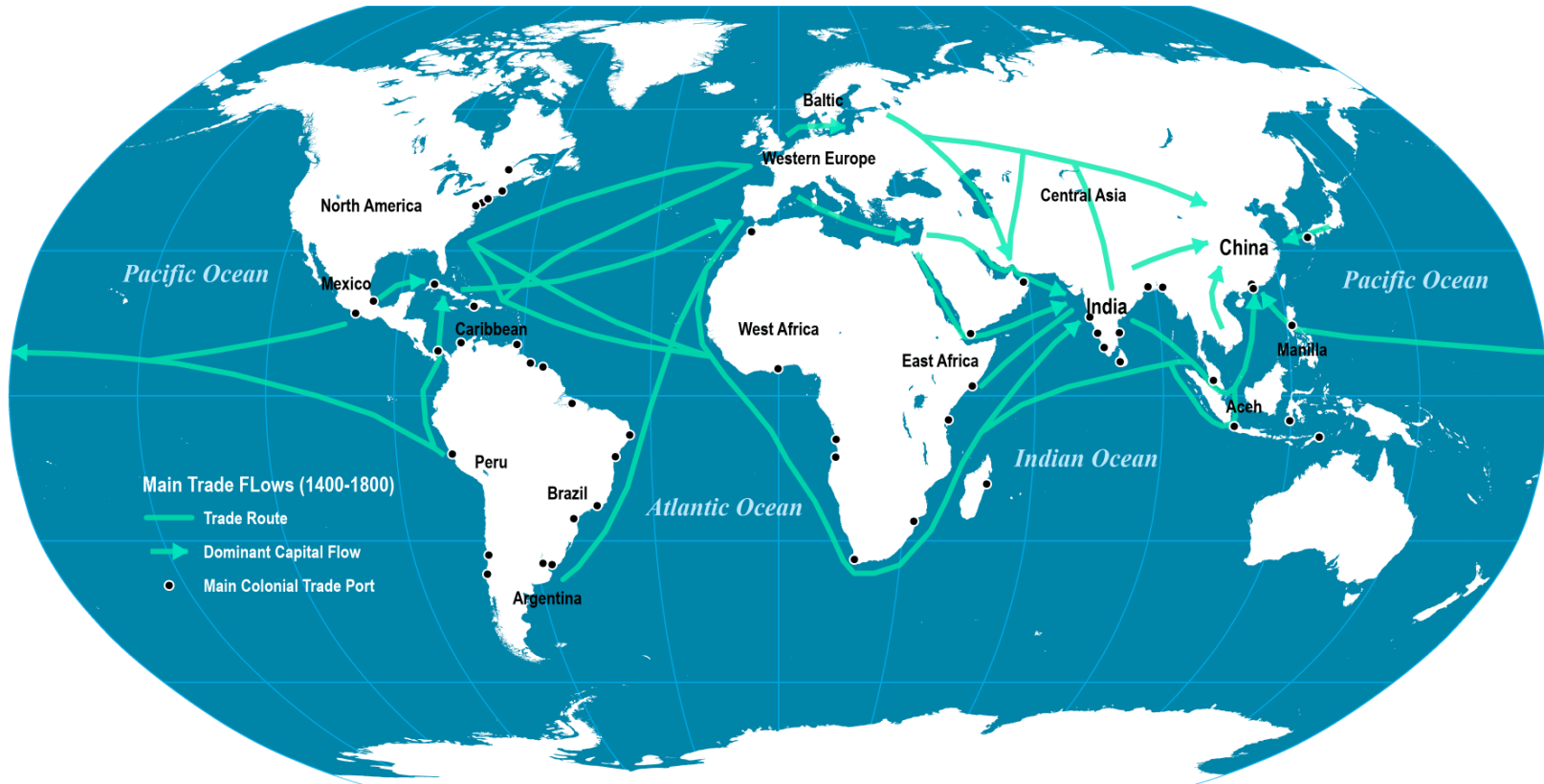
# Technological Networks



What about this one?

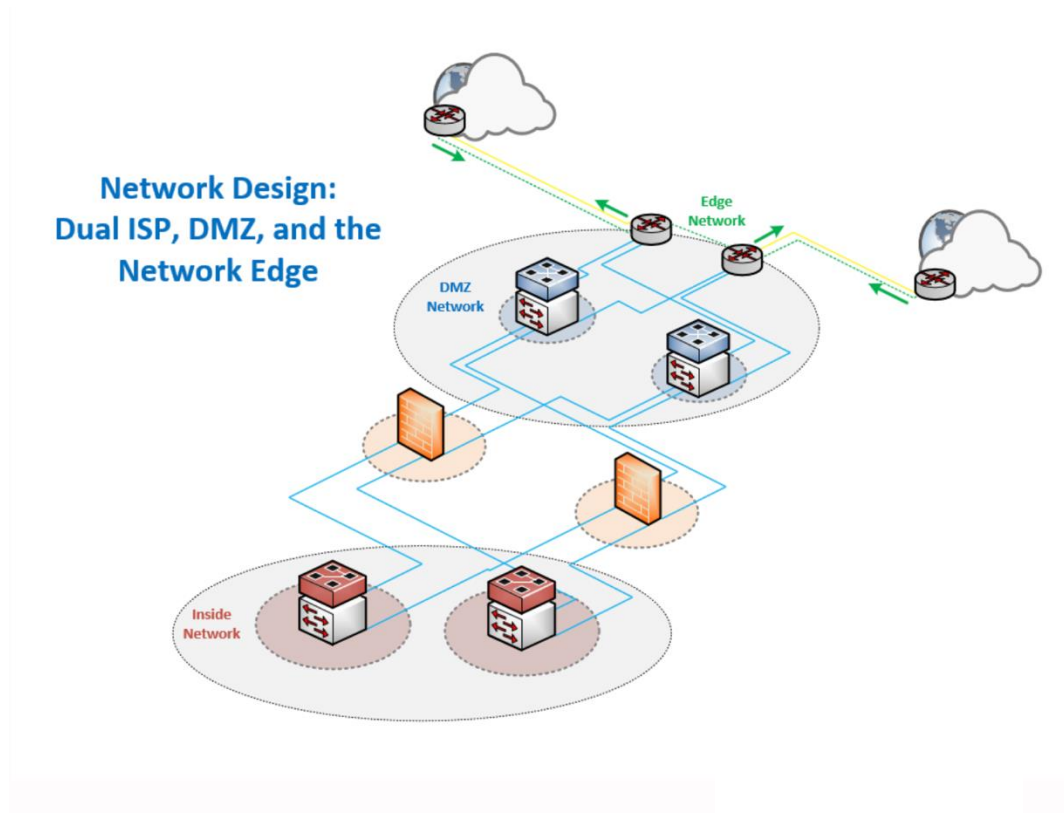# Transportation Networks



What's different about this MBTA map?

# Economic Networks



Trade routes from 1400-1800

# Cybersecurity



Data Network Topologies

# Why study networks?

- Most real-world systems are interdependent.

- Reveal underlying structures, improve decision-making.

- Impact across domains, from health to engineering.

# Some Applications

- **Social Sciences**: Community detection, influence analysis.

- **Biology**: Identifying critical genes, studying disease spread.

- **Computer Science**: Internet routing, recommendation systems.

- **Economics**: Analyzing market stability, fraud detection.

# This course covers:

- Graph theory & mathematical modeling

- Measures of network structure & influence

- Graph algorithms

- Information propagation
    - Ranking algorithms
    - Epidemic models
    - Viral marketing

- Community detection and clustering

- Practical considerations – working with large graphs

# Logistics

**Course Website:** venkat.prof/CS4973

**Online discussions, Q/A:** Campuswire (join code 6182)

**Office Hours:** After class, Mondays

**Assignments:** released on Canvas, submitted through Gradescope

**Deadines:** Fridays at 6 pm Eastern

Automatic extension until Sunday at 6 for assignments, but not for project-related stuff

# Textbooks

Primary texts (free, online):

- [Network Science by Albert-László Barabási](#)

- [Social Media Mining by Reza Zafarani, Mohammad Ali Abbasi and Huan Liu](#)

# Lectures (...not really)

This is a special topics course $\Longrightarrow$ tons of flexibility

Great opportunity to push yourselves, and work closely with me!

Here's my proposed plan:

- I lecture for ~3 weeks to cover basic theory
- Starting Feb, flipped classroom
- Some in-class coding, part of homework assignments
- Towards end of semester, student-led research paper discussions
- Final project presentations

# Submissions & Grading

- Grading will be based on the following split over deliverables:

  - **3 Assignments, worth 30%**

  - **Final Project, worth 50%**
    (proposal, progress report, final report and presentation)

  - **In-class activities, worth 20%**
    (missing a total of 2-3 lectures is fine, prolonged absence will affect this grade)

- For in-class activities, weekly grade of 'satisfactory' or 'unsatisfactory' for 15 weeks. 3 lowest dropped, rest normalized to 10%.

- Remaining 10% from research paper discussions.

# Homework Policies

- Type your solutions, no handwritten scans. LaTeX highly encouraged.

- Collaboration is encouraged on homeworks, but please write your answers on your own, and disclose your collaborators. No direct copying!

- GenAI tools not permitted for homework assignments.
  Useful to understand research papers – encouraged.

- **Regrade requests:** submit on Gradescope within a week of receiving your score.

# Academic Integrity

- I have very lenient policies.

- Any identified violations will result in academic penalties,
  up to and including an F in the course.

- Violations will also be reported to OSCCR.

- I'm always here to help you, please don't hesitate to reach out.

# Before Wednesday...

- Visit the course website, and familiarize yourself with my policies.

- Log on to Campuswire and send me a DM. Could be anything – your interests, your hobbies, or any questions you may have for me.

- Go through the assigned reading (Chapter 1, Network Science), linked on the course website next to the topic for 8-Jan.