Week 10

Network data

Elements of Data Visualization

Mar 23, 2026

Reminder: Revised class format (post spring break)

Monday/Tuesday: Hands-on work with remaining data formats (network, geospatial, etc.). Participation will be based on in-class notebooks. Hints on how to prepare for current week's Quiz.

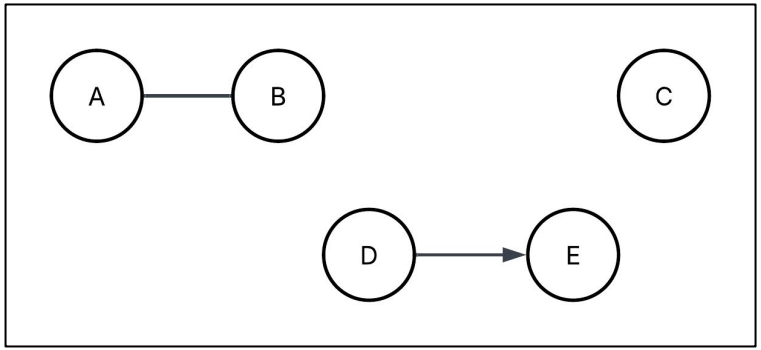
Wednesday/Thursday: Short lecture on Project 2 milestone. Group work time. Take Quiz.

What is a network?

Definition

A **network** is a set of things that are linked to each other. Networks are used in any domain where it is important to identify and gain insights into these connections.

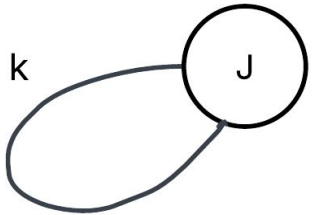
Two things make networks extremely useful: **visualization** and **graph theory**. There are well-defined Python libraries that we can use with both. Introducing you to these concepts, getting you up to speed, and building a network data intuition is the primary goal of this lecture.

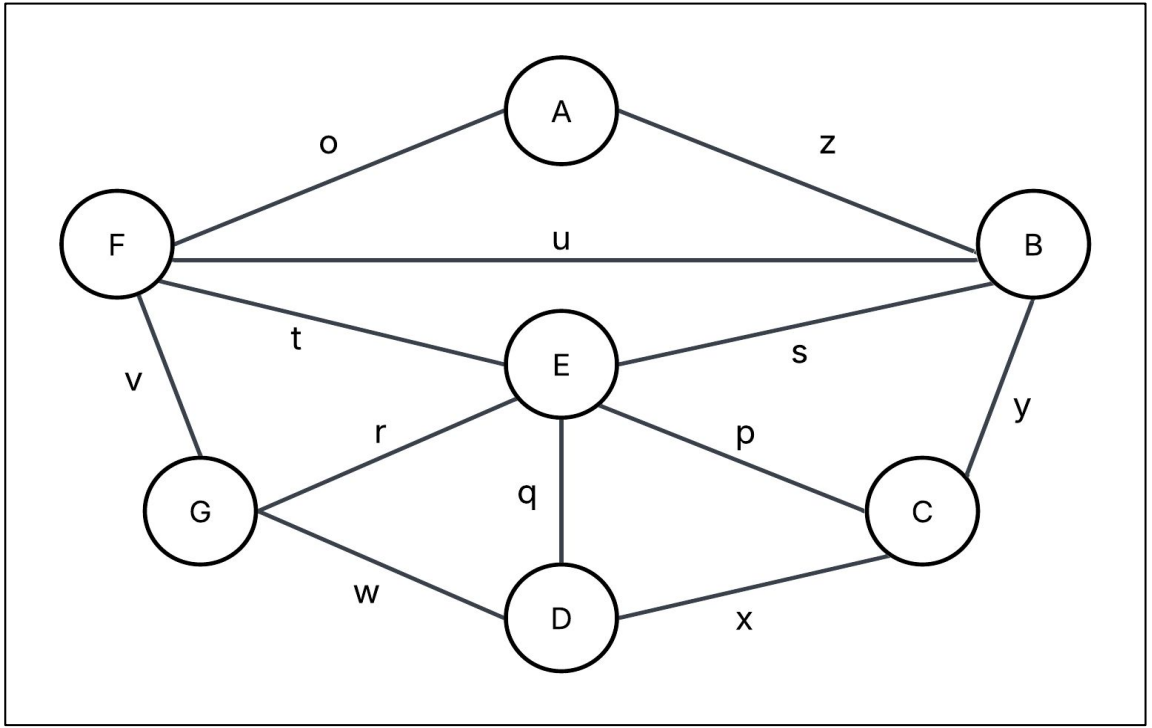


Network example 1

Key concepts

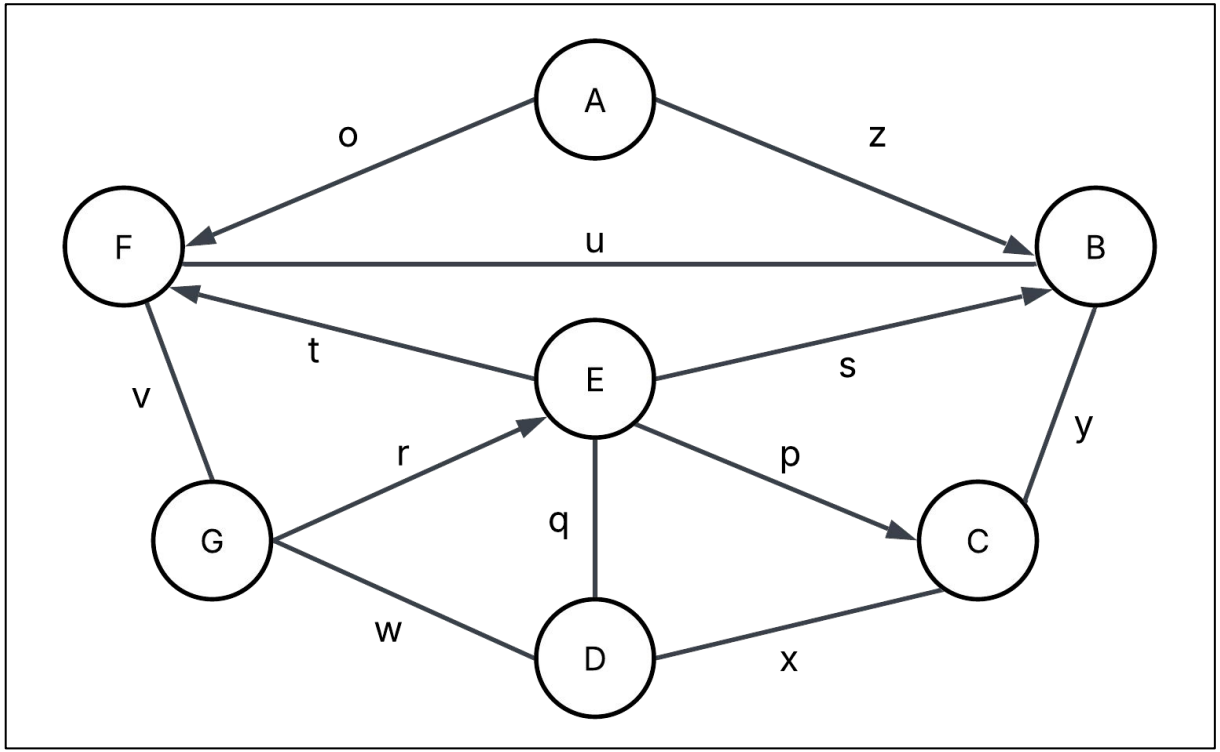
- Directed vs. undirected
- Weighted vs. unweighted
- Attributes
- Degree
- Centrality
- Shortest Path





Network example 2

How shortest path changes under a directed graph



Network example 3

Engineering team example

Individual	Role
A	Engineer
B	Program Manager
C	Project Tech Lead
D	Engineering Manager
E	Program Manager
F	Engineer
G	Engineer
H	Project Tech Lead

Engineering team roles

	A	B	C	D	E	F	G	H
A	0	1	1	0	0	0	0	0
B	1	0	1	0	0	0	0	0
C	1	1	0	1	0	0	0	0
D	0	0	1	0	1	0	1	1
E	0	0	0	1	0	1	0	1
F	0	0	0	0	1	0	0	1
G	0	0	0	1	0	0	0	1
H	0	0	0	1	1	1	1	0

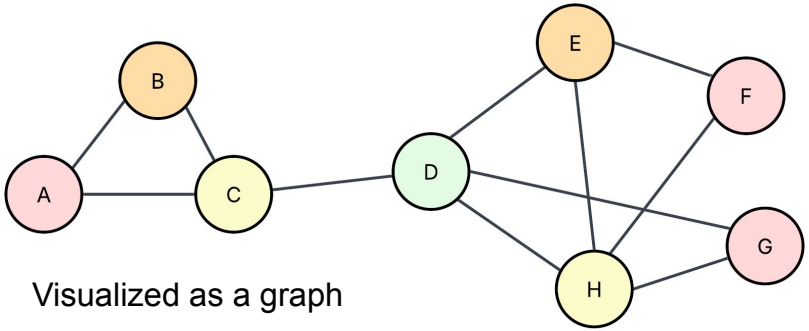
Which team members are in contact

Individual	Role
A	Engineer
B	Program Manager
C	Project Tech Lead
D	Engineering Manager
E	Program Manager
F	Engineer
G	Engineer
H	Project Tech Lead

Engineering roles

	A	B	C	D	E	F	G	H
A	0	1	1	0	0	0	0	0
B	1	0	1	0	0	0	0	0
C	1	1	0	1	0	0	0	0
D	0	0	1	0	1	0	1	1
E	0	0	0	1	0	1	0	1
F	0	0	0	0	1	0	0	1
G	0	0	0	1	0	0	0	1
H	0	0	0	1	1	1	1	0

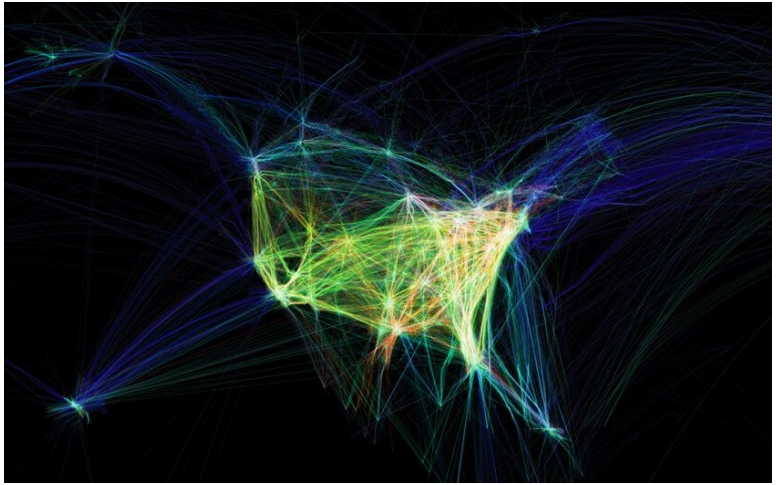
Which team members are in contact



Visualized as a graph

Classes of network problems

Problem type	Air travel example
Relationships	What does each airline network look like?
Flow	Do airports tend to have equal flow both in and out of them?
Hierarchies	Can we try to guess each airline's hubs from their airport network?
Communities	Which airports are most tightly clustered for each airline?
Spatial Networks	What is the cheapest, shortest flight path that I can take to get from point A to point B?



Aaron Koblin’s Flight Patterns

Let’s dive in:

Network coding lab

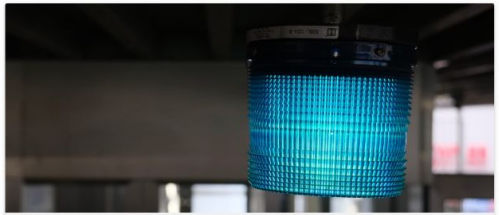
Project 2 kick-off

transitchicago.com/innovation-studio/

NEW! Winter 2025 problem statements

Crisis Intervention Safe Ride Specialist

How can the CTA compassionately engage and connect riders experiencing mental health crises, substance use challenges, and/or other vulnerabilities to supportive services and promote safe and welcoming spaces for all riders and employees?



Violence Interrupter Safe Ride Specialist

How can CTA effectively engage with groups of youth and young adults (typically ages 10-29) to promote a safer, more welcoming transit environment and discourage violent and disruptive incidents that occur on the system typically during the late afternoons and overnight hours as young community members gather on CTA vehicles and at facilities?

Fall & Summer 2025 problem statements *Applications closed*

Translation in rail stations

How can the CTA provide rail station attendants with tools to welcome and assist riders with limited English proficiency?

Rail simulator

How can CTA provide simulated training opportunities for rail operators to gain additional hands-on experience?

Mitigating the impact of smoking

How can CTA mitigate the impact to customers of smoking on trains and buses?

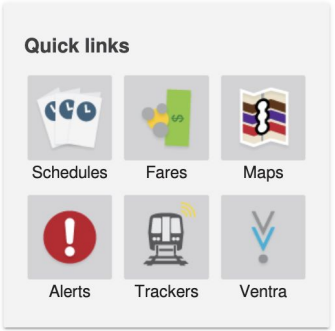
Bus stop asset monitoring

How can CTA automatically monitor the condition of physical assets at bus stops or their use over time?

Our riders engage with myriad public transit physical assets throughout the Chicagoland area. The monitoring of these bus-related assets presents a hefty operational burden on the CTA and its staff. To reduce this burden, we are seeking innovative solutions to monitor transit related physical infrastructure and its use. Proposed solutions should target at least one of the following:

- Cataloguing asset condition (e.g., bus stop signage, bus stop furniture, sidewalks);
- Occurrence of passengers not being able to board due to crowding;
- Customer alighting frequency and locale;
- Notifications of asset condition changes.

Solutions should work in a variety of weather and visibility conditions and, if scaled up, should allow for large scale monitoring of infrastructure and assets with minimal operational overhead. Ideal solutions would provide near real-time access to information about asset use or condition or, at the very least, do not require manual upload/processing.



RFP repo 1 repo 2

Internal Process Improvements

How can CTA automatically monitor the condition of physical assets at bus stops or their use over time?

Current state: CTA monitors assets at over 10,000 bus stops system wide

Problem: Creates heavy operational burden as manual checks of bus stop conditions conducted annually and in-person verification required when issues reported

Internal Process Improvements

How can CTA automatically monitor the condition of physical assets at bus stops or their use over time?

Proposed solutions should target at least one of the following:

- Cataloguing asset condition (e.g., bus stop signage, bus stop furniture, sidewalks);
- Occurrence of passengers not being able to board due to crowding;
- Notifications of asset condition changes.

Other RFP examples: OpenAI, ARIA, SVC Clean Energy

Key aspects

- Requirements are intentionally vague
- Timeline is short
- Data visualizations and live demos are very important

Getting started

- Review your RFP assignment
- Designate a primary GCP project for your group
- Grant elevated permissions to group members
- Download dataset(s) for your company:
  - Bucket: data-vis-open-access-p2
  - Each company has their own folder inside the bucket:
    - spotify
    - netflix
    - target
    - walmart
    - airbnb
    - bloomington
  - Example: https://storage.googleapis.com/data-vis-open-access-p2/spotify/fan_insights_2026.csv

Additional resources

- Marketline for company profiles and research reports
- UT Library's company research hub
- Consult with UT's Business Librarian, Loretta Wallace