Spatial Data Science

Sankofa Curriculum - Summer 2025

Lesson 04:
Spatial Networks

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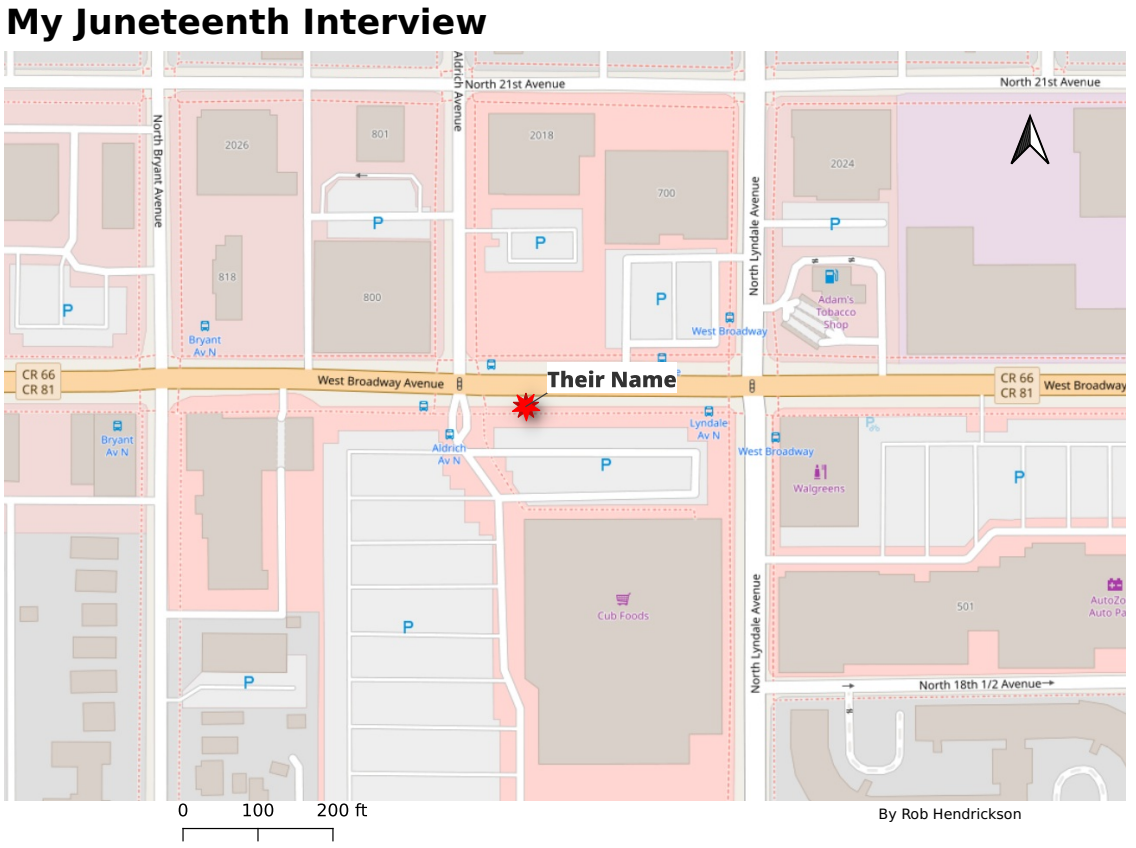
Activity – Share your Map!

- Share your map with a neighbor!



Agenda

I. **What is Geospatial Analysis?**

II. **Food Systems Revisited**

III. **Spatial Networks**

~~~ BREAK ~~~

IV. **Final Assignments & Lab**
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What is Geospatial Analysis?

Tobler’s First Law of Geography

“Everything is related to everything else, but near things are more related than distant things.”

- There is **spatial dependence** between all things
- **Distance is important** when considering spatial relationships

Definitions

Geography

A science that deals with **description**, **distribution**, and **interaction** of the diverse physical, biological, and cultural features of the **earth's surface**

(Merriam Webster Dictionary)

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Spatial Analysis

Spatial analysis is often called upon to **address scientific questions** relating to outcomes that are a consequence of **processes that by their nature are spatial**

(Fotheringham et al., 2008, p.13)

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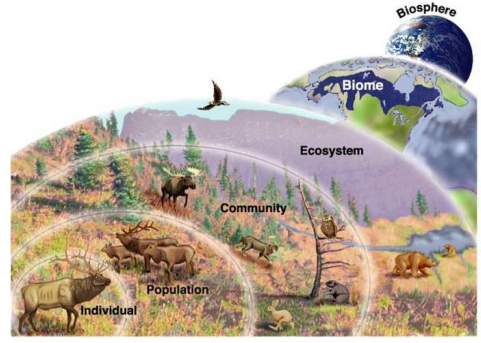
Geospatial Analysis

Spatial analysis techniques applied to phenomena at the "human scale" with results critically interrogated by knowledge from geography and various other disciplines.



https://maggiesscienceconnection.weebly.com/hierarchy-of-complexity.html

Beyond “GIS”

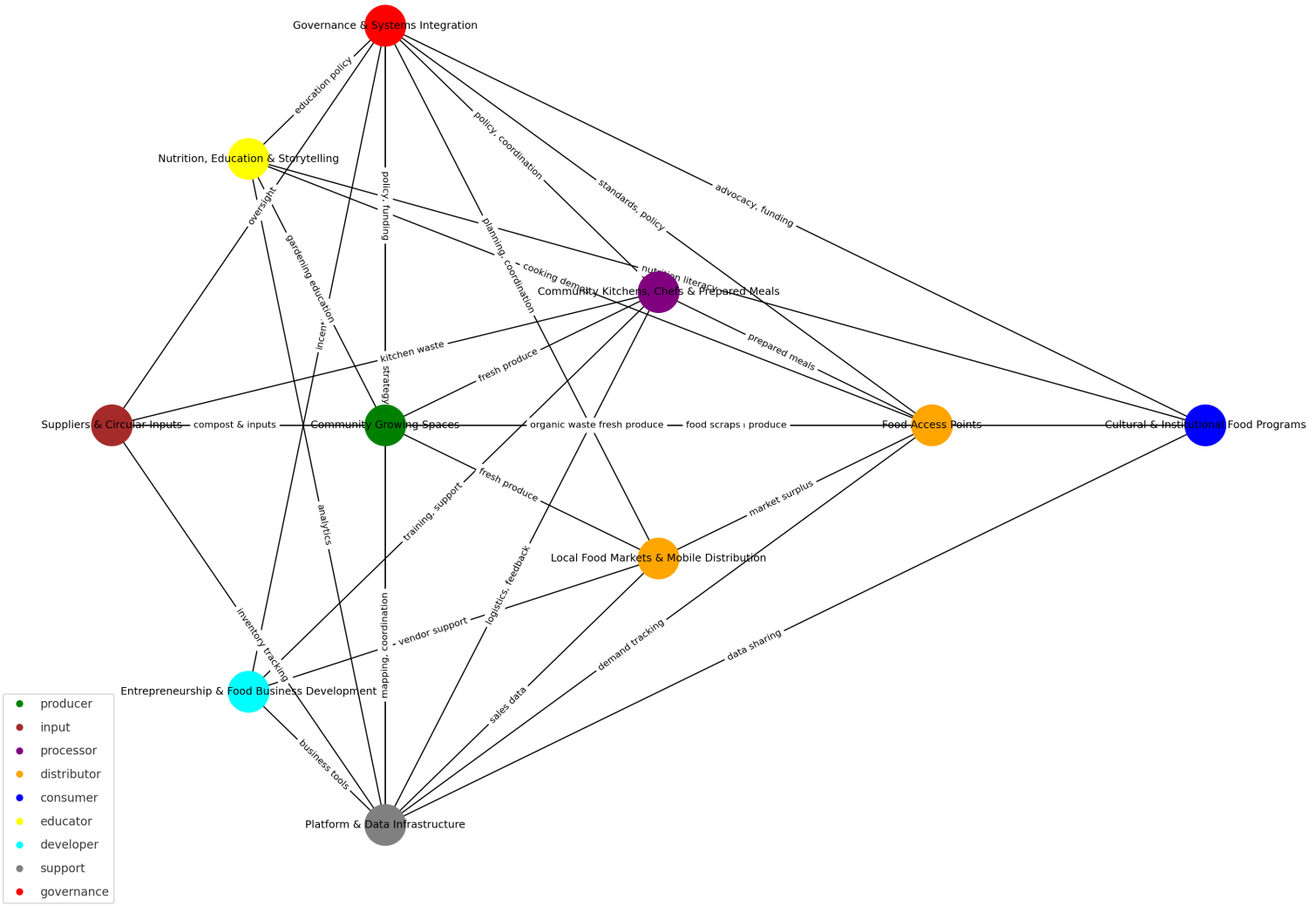
- Geographic Information System (GIS) products typically have a narrow definition of geospatial analysis. [1]
  - Spatial Data Visualization
  - Spatial Operations (overlays, buffering, map algebra, etc.)
  - Some geoprocessing & analysis tools
- These are important **pieces** of geospatial analysis!
- In Advanced Geopspatial Analysis, we will include:
  - **Statistical Techniques & Interpretation**, **Geoprocessing Workflows**, and **Spatial Thinking**

1. Goodchild et al, Geospatial Analysis - page 19

Questions in Spatial Analysis

- What?
  - **Descriptive** and **Exploratory** analysis of patterns, clusters, hotspots, disparities, ...
- Why?
  - **Explanatory** analysis searches for processes that create these patterns
- How?
  - **Predictions, Interpolation,** and **Models** quantify the most important interactions and use them to estimate unsampled areas and/or the future!
- Where?
  - **Applications** of Spatial Analysis can help with locational decisions, optimization

Food Systems Revisited


Community Food System Map (Centralized, With System Function Labels)
Governance & Systems Integration
Nutrition, Education & Storytelling
Community Kitchens, Chefs & Prepared Meals
Suppliers & Circular Inputs
Community Growing Spaces
Food Access Points
Cultural & Institutional Food Programs
Local Food Markets & Mobile Distribution
Entrepreneurship & Food Business Development
Platform & Data Infrastructure
education policy
policy, coordination
standards, policy
advocacy, funding
oversight
policy, funding
planning, coordination
cooking demos
nutrition literacy
gardening education
incentives
strategy
kitchen waste
fresh produce
prepared meals
compost & inputs
organic waste
fresh produce
food scraps
produce
training, support
fresh produce
market surplus
analytics
inventory tracking
vendor support
logistics, feedback
mapping, coordination
sales data
demand tracking
data sharing
business tools
producer
input
processor
distributor
consumer
educator
developer
support
governance

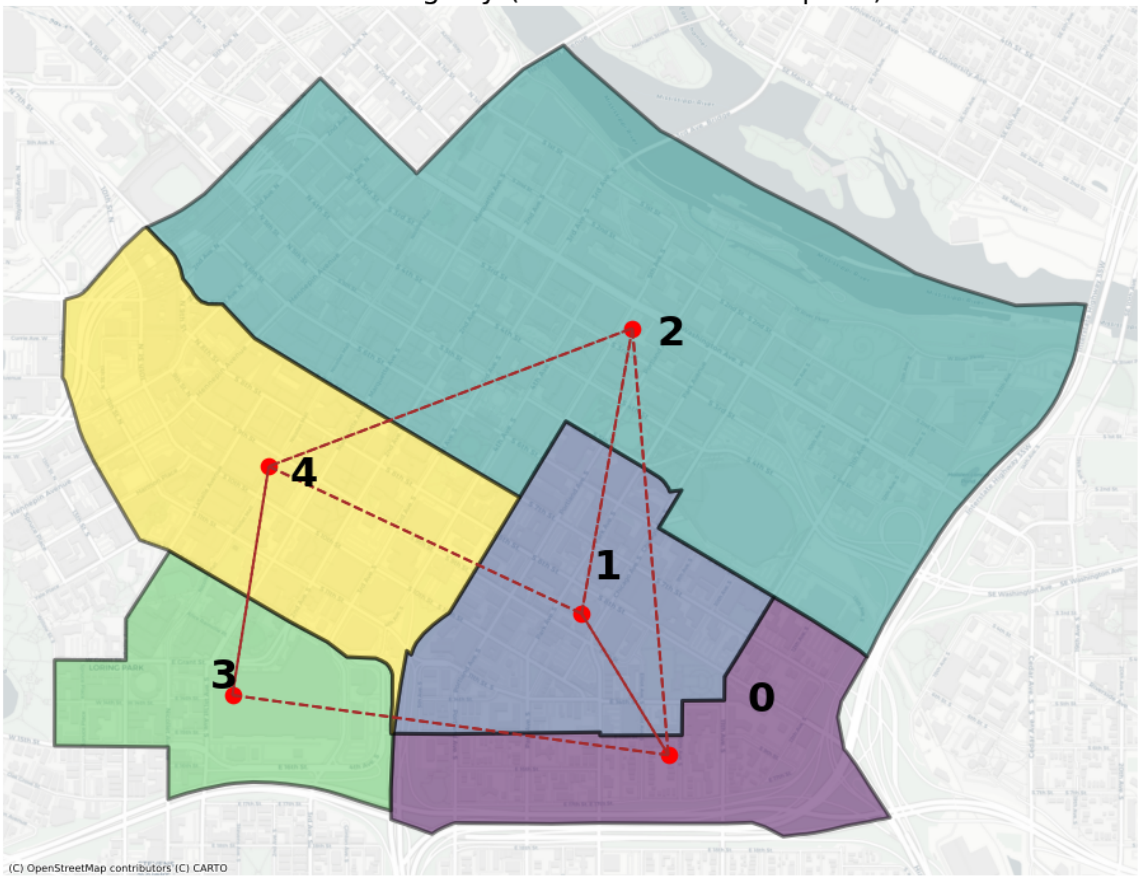
Spatial Networks

*Show video of Kepler Visualization

(Geo)Graph Theory

- **Graph Theory:** The study of mathematical structures (graphs) that model pairwise relations between objects
- **Nodes:** ~~Vertices~~/Points
- **Links:** ~~Edges~~/Lines
- Gives ideas of centrality & **connectedness**

Rook Contiguity (Downtown Minneapolis)

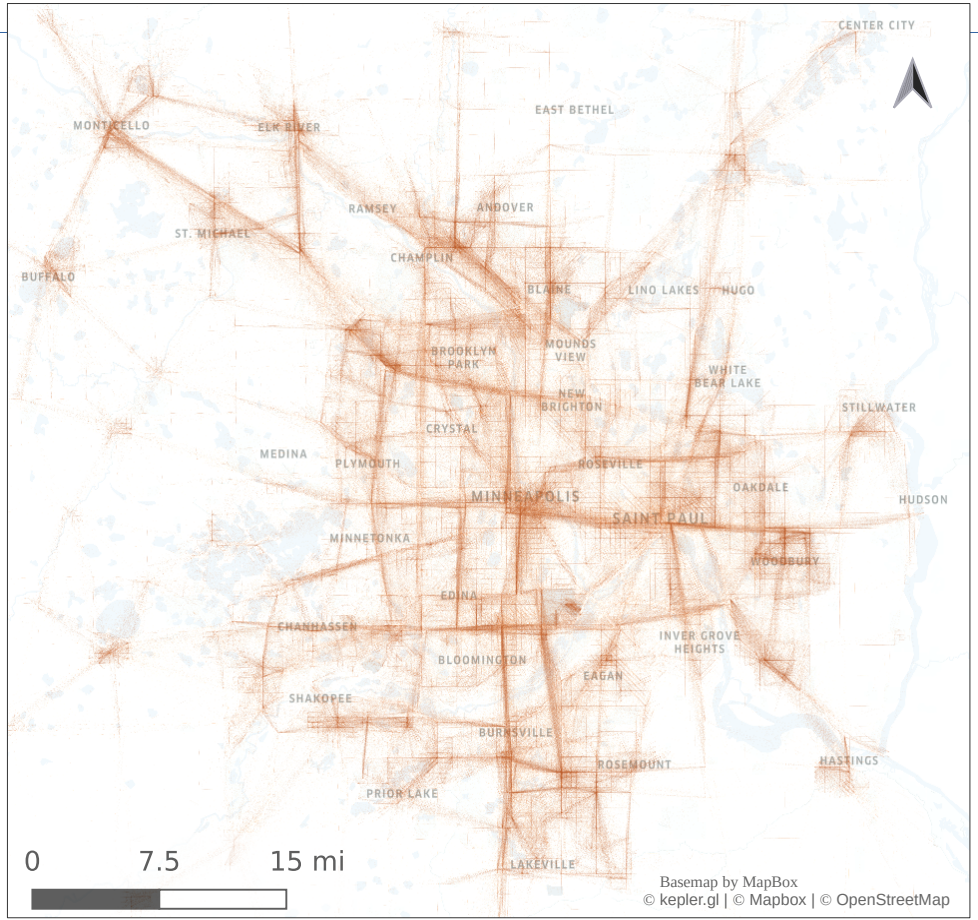


Read more here: https://en.wikipedia.org/wiki/Graph_theory | https://geographicdata.science/book/notebooks/04_spatial_weights.html

Networks

- **Network Theory:** The study of graphs where the links possess attributes
  - Can be thought of as paths along which something flows
- **Spatial Networks** relate the nodes and links of a graph to locations
  - This gives more powerful interpretation & weighting

Aggregated Trajectories
(July 2020 → Dec 2021)

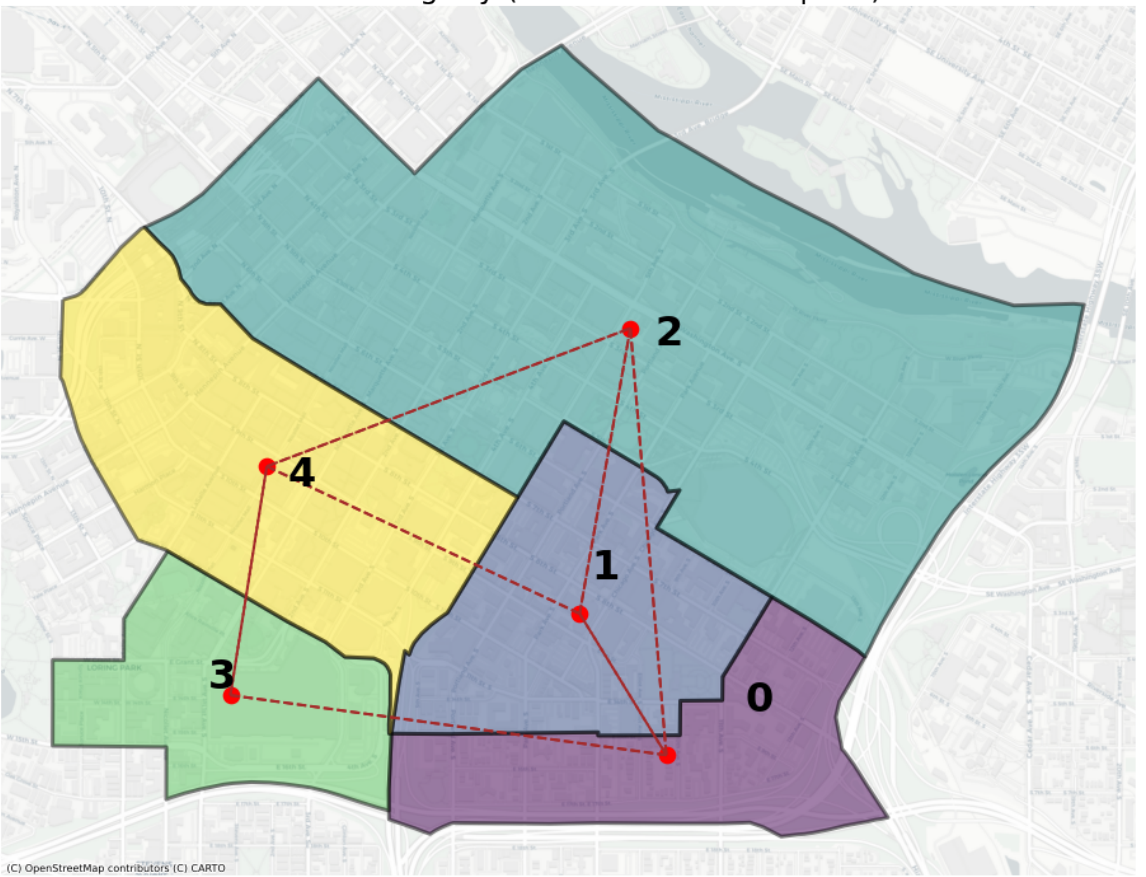


Read more here: https://en.wikipedia.org/wiki/Network_theory | https://en.wikipedia.org/wiki/Spatial_network

Important Terms

- **Degree:** Number of links (in/out/total) connected to a node
- **Directed** edges (arrows) make a graph much more complex/computationally intensive
  - as opposed to undirected graphs
- **Centrality** ranks nodes corresponding to their network position
  - Degree, eigenvector, betweenness

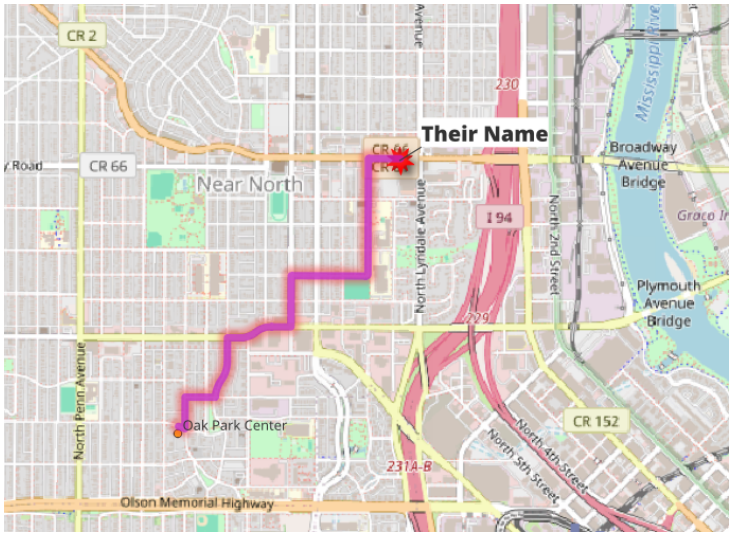
Rook Contiguity (Downtown Minneapolis)



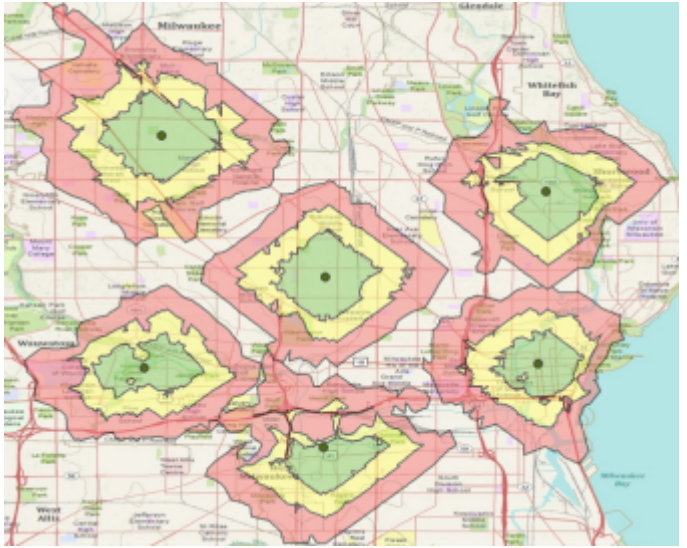
Read more here: https://en.wikipedia.org/wiki/Network_theory | https://en.wikipedia.org/wiki/Spatial_network

Some Applications

Routing



Service Area



From https://pro.arcgis.com/en/pro-app/latest/help/analysis/networks/service-area-analysis-layer.htm

Read more here: https://en.wikipedia.org/wiki/Network_theory | https://en.wikipedia.org/wiki/Spatial_network

BREAK!

(Please be back in 10 minutes)

Final GIS Assignments

I. **My Juneteenth Interview**

(PDF of QGIS Layout)

II. **Route to Oak Park** OR **Food System Service Area**

(Screenshot of QGIS Map View) – *Instructions Coming*

III. **GeoJSON of Food System Actor**

(Email GeoJSON to Rob)

IV. **Demographic Choropleth**

(PDF of QGIS Layout) – *Instructions Coming*

Lab Time!

Please go to

https://github.com/RwHendrickson/SankofaClass/blob/main/Session04/LabInstructions.pdf

Github.com/RwHendrickson/SankofaClass

Thank you!