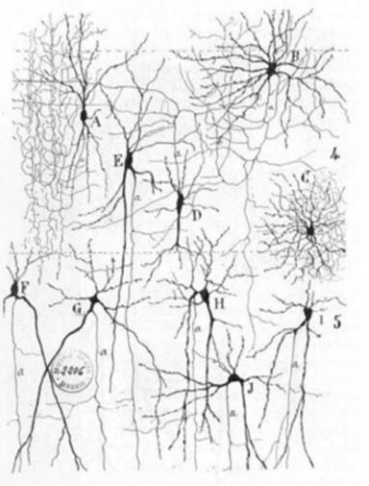
Network Analysis Tools

GIS III: GIS Analysis Toolset

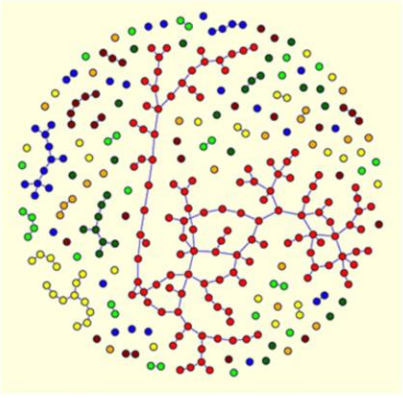
Learning Objectives

- Understand general network analysis concepts
- Introduce network analysis in ArcGIS
- Offer a few examples of current application



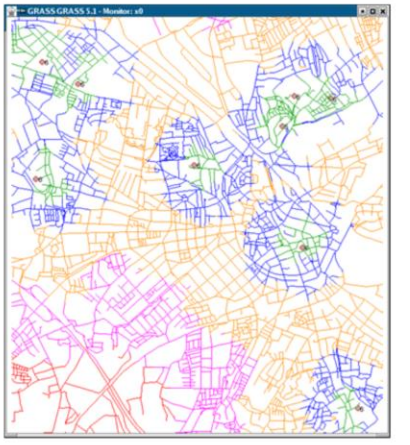
What is a Network?

- Interconnected set of points (nodes) and lines (edges)
- Examples
  - Information networks
  - Social networks
  - Stream networks
  - Transportation networks
- Connectivity allows for analysis/problem solving



Networks and GIS

- A set of interconnected line entities whose attributes share some common theme primarily related to flow- or movement
- Network lines define flow relationships between nodes
- Flow types:
  - Data
  - Objects
  - Materials



Set of nodes connected by lines

Represent some type of flow

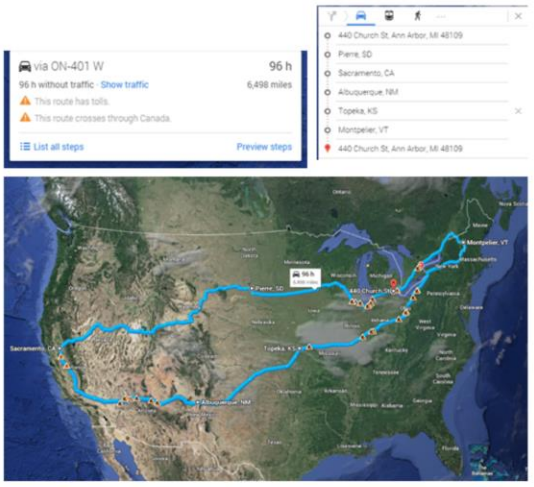
Incorporate flow rules

Rules determine cost

Road Networks and GIS

- **Cost:**
  What is the impact of an object flowing through the network?
- **Types**
  - **Time**
  - **Distance**

Based on connectivity, flow, and rules



Rules dictate how objects can move through the road network

Types

- Direction – one way streets
- Barriers
- Time of day
- Node restrictions
- Sequence – stop 1 then stop 2

Network Analyst

- Network analysis is a set of analysis techniques used with networks
- Network Analyst is the ESRI extension that performs network analysis in ArcMap
- Network Analyst uses network datasets
- Types of analysis:
  - Route
  - Service areas
  - Origin-destination cost matrix
  - Closest facility
  - Vehicle routing
  - Location allocation

Network Analyst

Route

- Can be simple – finding driving directions between two points
- More complex – best route between 10 different stops

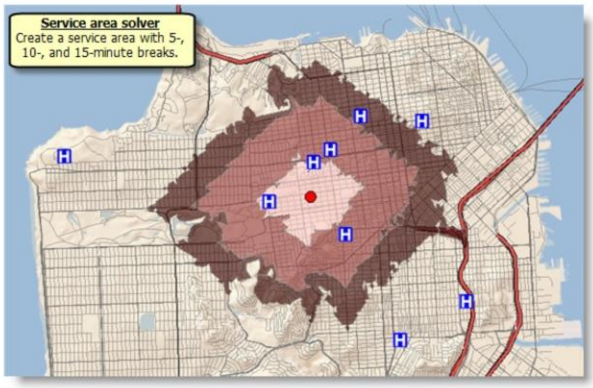
• "Best" can mean different things:

- Shortest distance
- Quickest
- Most scenic
- No highways

Network Analyst

Service areas:

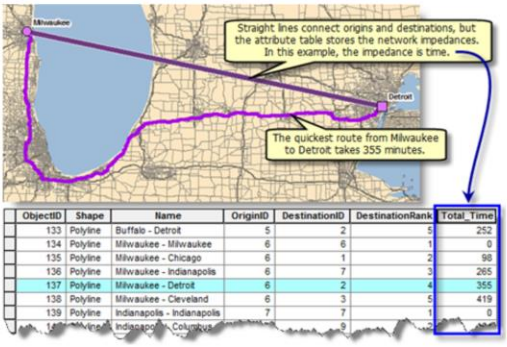
- Calculate an area based on time or distance from or to a point
- Good for estimating populations
- Different than a simple buffer



Network Analyst

Origin-destination cost matrix:

- Creates a cost matrix from multiple origins to multiple destinations
- Good for calculating distance or time between multiple start and end points



ObjectID	Shape	Name	OriginID	DestinationID	DestinationRank	Total_Time
133	Polyline	Buffalo - Detroit	5	2	5	252
134	Polyline	Milwaukee - Milwaukee	6	6	1	0
135	Polyline	Milwaukee - Chicago	6	1	2	98
136	Polyline	Milwaukee - Indianapolis	6	7	3	265
137	Polyline	Milwaukee - Detroit	6	2	4	355
138	Polyline	Milwaukee - Cleveland	6	3	5	419
139	Polyline	Indianapolis - Indianapolis	7	7	1	0

Getting Started with NA

1. Create network analysis layer
2. Add network locations
3. Set analysis properties
4. Perform analysis and display results

Applications to Access?

- Multiple dimensions*:
  1. availability
  2. Geographic accessibility
  3. accommodation
  4. affordability
  5. acceptability
- Geographic accessibility
  - *cost* for reaching resources, where cost is based on distance or travel time
  - Depends on the relative locations of population/individual and the resource(s) of interest

*Penchansky R, Thomas JW: The concept of access. Definition and relationship to consumer satisfaction. Medical Care. 1981, 19 (2): 127-140. 10.1097/00005650-198102000-00001.

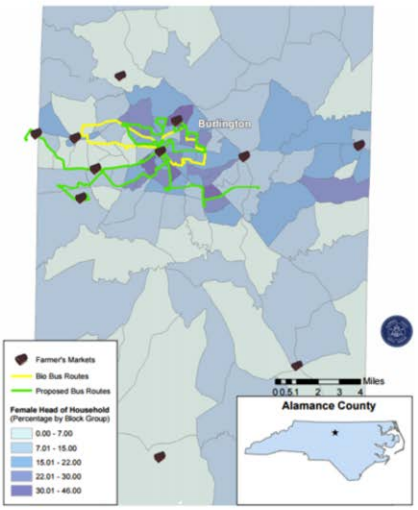
Evaluating accessibility of resources for individuals and or populations in multiple contexts…

Assumption; In other words: the individual/population is a potential user of the facility/service

Even with these assumptions identification of areas/populations/individuals with low to high geographic accessibility provides useful and practical information

Operationalizing Geographic Accessibility

- Define area of interest and appropriate scale
- Aggregate population
- Choose a measure of geographic accessibility



Bringing it All Together

Medication Therapy Management (MTM) Pharmacies within a 10 Minute Drive Time from High-Need Communities, Portsmouth Health District, 2016