Spatial Networks
Learning Objectives

• After this segment, students will be able to
  • Describe societal importance of spatial networks
  • Limitations of spatial querying for spatial networks
Navigation Systems

- **Historical**
  - Navigation is a core human activity for ages!
  - Trade-routes, Routes for Armed-Forces

- **Recent Consumer Platforms**
  - Devices: Phone Apps, In-vehicle, “GPS”, …
  - WWW: Google Maps, MapQuest, …

- **Services**
  - Display map around current location
  - Compute the shortest route to a destination
  - Help drivers follow selected route
Location Based Services

- **Location**: Where am I?
  - Geo-code: Place Name (or Street Address) \(\rightarrow\) <latitude, longitude>
  - Reverse Geo-code: <latitude, longitude> \(\rightarrow\) Place Name

- **Directory**: What is around me?
  - Where is the nearest Clinic? Restaurant? Taxi?
  - List all Banks within 1 mile.

- **Routes**: How do I get there?
  - What is the shortest path to get there?
  - ...
Spatial Networks & Modern Society

- Transportation, Energy, Water, Communications, ...
Limitations of Spatial Querying

- **OGIS Simple Feature Types**
  - Supports Geometry (e.g., Points, LineStrings, Polygons, ...)
  - However, lack `Graphs` data type, `shortest_path` operator

- **Traditional SQL**
  - Supports select, project, join, statistics
  - Lacked transitive closure, e.g., `network analysis` (next slide)
  - SQL3 added recursion & transitive closure
Spatial Network Analysis

• **Route** (A start-point, Destination(s))
  - What is the shortest path to get there?
  - What is the shortest path to cover a set of destinations?

• **Allocation** (A set of service centers, A set of customers)
  - Assign customers to nearest service centers
  - Map service area for each service center

• **Site Selection** (A set of customers, Number of new service centers)
  - What are best locations for new service centers?