Geocoding
&
Dynamic Segmentation

Basic GIS Feature Types

• Point
  – Cities, control points (BM), weather stations
  – Location, distance (buffer), point pattern, interpolation

• Polygon
  – States, land-use (zoning), land-cover, eco-region
  – Location (area coverage), distance, shape metrics, overlay

• Line
  – Roads, streams, utility lines, path
  – Location (linear referencing), distance, shape metrics (e.g., sinuosity), connectivity
Linear Feature Analysis

- Linear referencing – location
  - Geocoding (e.g., address matching)
  - Dynamic segmentation
- Network connectivity - connectivity
  - Path analysis (e.g., shortest path)
  - Location allocation
  - Tracing (e.g., up stream area)

Geocoding & Dynamic Segmentation

- Dynamic segmentation
  - Sections and routes (for linear referencing)
  - Events
- Network
  - Line (coverage)
  - Edge + junctions (geodatabase)
Types of Geocoding

- Address matching
- Corner (intersection) matching
- ZIP code geocoding
- Reverse geocoding

Geocoding Applications

- Location-based services (GPS, e911)
- Geodemographic analysis
- Public health
- Crime analysis
Geocoding

- Input: street addresses in text format
- Reference database: street map (e.g., TIGER)
  - Street name, prefix/suffix, and type
  - Beginning and end address numbers (left, right)
  - ZIP code (left, right)
- Process: Geocoding engine (linear interpolation)
  - Side offset, end offset
- Output: address points in GIS format

![RLIS Streets](image-url)
Causes of Geocodeing Errors

- Misspelling of address
- Incorrect address number
- Incorrect street prefix/suffix
- Incorrect street type
- Abbreviations
- Matching scoring system

Dynamic Segmentation

- DS is the process of computing the location of events along a route.
- Routes ((multipart) polylines – M-Aware)
- Sections (polylines)
- Events
Routes in Coverage Data Model

<table>
<thead>
<tr>
<th>Section</th>
<th>Arc</th>
<th>F-Meas</th>
<th>T-Meas</th>
<th>F-Pos</th>
<th>T-Pos</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>0</td>
<td>40</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>40</td>
<td>170</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>170</td>
<td>210</td>
<td>0</td>
<td>80</td>
</tr>
</tbody>
</table>

Section 3 To measure = 170 + (length of arc 9) x 0.8, or 210

Routes in Geodatabase Data Model

<table>
<thead>
<tr>
<th>Point</th>
<th>X</th>
<th>Y</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X1</td>
<td>Y1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>X2</td>
<td>Y2</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>X3</td>
<td>Y3</td>
<td>170</td>
</tr>
<tr>
<td>4</td>
<td>X4</td>
<td>Y4</td>
<td>220</td>
</tr>
</tbody>
</table>
Creating Routes

• Create route geometric objects
  – Polylines or multipart polylines

• Linear Referencing Tools (ArcToolBox)
  – Create Routes: enable route measures on routes (i.e., create measured polylines)
  – Calibrate Routes: recalculate route measures using points.

• Types of routes
  – Simple
  – Combined
  – Split route
  – Looping route
  – Hierarchical route
Calibrate Routes

- Interpolation / extrapolation
- Spatial gaps

Example of Hierarchical Route

Local Roads: Hierarchy 3
Hierarchical Route
Secondary Roads: Hierarchy 2
Primary Roads: Hierarchy 1
Create Routes in ArcInfo

• Interactive
  – Arcedit: MAKEROUTE, REMEASURE
  – Network: PATH
• Bulk
  – Arc: ARCROUTE, MEASUREROUTE

Event Tables

• Types of events
  – Point events: mileposts, traffic accidents, dams
  – Linear events: speed limits, stream reaches

• Event tables creation and analysis (linear referencing tools in ArcToolBox)
  – Locate events along routes: create route event tables by intersection overlay
  – Overlay route events: union or intersect route event tables.
  – Transform route reference: transforms the measures of events from one route reference to another.
<table>
<thead>
<tr>
<th>usstations#</th>
<th>bus#</th>
<th>measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>899.930</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2359.145</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2476.239</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2849.655</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>3163.485</td>
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<tr>
<td>6</td>
<td>1</td>
<td>4173.557</td>
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<tr>
<td>7</td>
<td>1</td>
<td>5446.844</td>
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<tr>
<td>8</td>
<td>1</td>
<td>6451.580</td>
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<tr>
<td>9</td>
<td>1</td>
<td>9368.944</td>
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<td>1</td>
<td>10412.696</td>
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<tr>
<td>13</td>
<td>1</td>
<td>11728.987</td>
</tr>
</tbody>
</table>

Table 16.5 A point event table showing bus stops along the bus route

<table>
<thead>
<tr>
<th>inter-id</th>
<th>from</th>
<th>to</th>
<th>year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44700</td>
<td>90000</td>
<td>1995</td>
</tr>
<tr>
<td>1</td>
<td>123648</td>
<td>180000</td>
<td>1989</td>
</tr>
<tr>
<td>1</td>
<td>239375</td>
<td>270000</td>
<td>1992</td>
</tr>
<tr>
<td>2</td>
<td>74024</td>
<td>78000</td>
<td>1988</td>
</tr>
<tr>
<td>2</td>
<td>154873</td>
<td>180000</td>
<td>1993</td>
</tr>
<tr>
<td>2</td>
<td>356992</td>
<td>400000</td>
<td>1987</td>
</tr>
<tr>
<td>3</td>
<td>78065</td>
<td>90000</td>
<td>1988</td>
</tr>
<tr>
<td>4</td>
<td>40000</td>
<td>72033</td>
<td>1986</td>
</tr>
</tbody>
</table>

Table 16.7 A linear event table showing year of pavement resurfacing on the interstate highway route system
Dynamic Segmentation

• Make route event layer tool
• Overlay/dissolve event layers