topology

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Topics

- Explain topology and its related components
- Show how to build a topological relationship in ArcGIS
- Discuss the benefits and drawbacks of topological relationships
What is the Goal of Topology in Geographic Information Systems?

• Connectedness
  
  – Spatial Analysis

  &

  – Database Management
What is the Goal of Topology in MY Geographic Information System?

• Do I want to perform advanced analysis?

• Will I be editing or maintaining this data in any way?
Routing, Directions, and other Spatial Analysis

• By defining what features are connected, it becomes possible to ‘ask’:

  – What is the most direct path, following the connected features, between points A and B?

  – For instance, obtaining metro directions to the convention center
Database Structure and Function

• Connected features stay connected even while editing (moving nodes or edges)
• Reduce Number of Points Stored and Retrieved by SDE/Geodatabase
• Snap lower resolution or less critical features to coordinates of more precise data
Topics

• Explain topology and its related components

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Data

• What is the source format of the data?
• Are the projections/coordinate systems of the various data the same?
• Does the data already have a topological relationship that can be exploited?
Metadata

- For what purpose was the data created?
- What is the recommended scale of the data?
Topological Design

- What features will share geometry?
- Should edits to one feature modify others?
- How will data be organized?
- What topological rules will be followed?
- What is the desired accuracy of the data?
Implementation of Topology

- Build Test Database
- Copy Features to Feature Data Sets
- Implement design
- Validate topology
- Edit features
- Observe output
- Modify design
Choose the coordinate system that will be used for XY coordinates in this data.

Geographic coordinate systems use latitude and longitude coordinates on a spherical model of the earth's surface. Projected coordinate systems use a mathematical conversion to transform latitude and longitude coordinates to a two-dimensional linear system.

Name: WGS 1984

Contains coordinate systems:
- Geographic Coordinate Systems
- Projected Coordinate Systems
- WGS 1984
- <Unknown>
This wizard will help you build a new topology.

A topology allows you to model the integrated relationship of different data types.

Some examples include modeling adjacent land parcels or soil polygons, coastline and county boundaries, a road network, road and bus routes, and nested geography (census information).
Creating a new topology.

Enter a name for your topology: HSP_Metro_Topo.

Enter a cluster tolerance: 0.0000000000000000 degrees.

The cluster tolerance is a distance range in which all vertices and boundaries are considered identical, or coincident. Vertices and endpoints falling within the cluster tolerance are snapped together.

The default value is based on the XY tolerance of the feature dataset. You cannot set the cluster tolerance smaller than the XY tolerance.
A screenshot of a user interface with various options and settings. The interface includes a window titled "New Topology" with fields for entering the number of ranks and specifying the rank for a feature class.

The text within the "New Topology" window reads:

"Each feature class in a topology must have a rank assigned to it to control how much the features will move when the topology is validated. The higher the rank, the less the features will move. The highest rank is 1.

Enter the number of ranks (1-50):

Specify the rank for a feature class by clicking in the Rank column:

<table>
<thead>
<tr>
<th>Feature Class</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>TransitStation</td>
<td>2</td>
</tr>
<tr>
<td>TransitLine</td>
<td>1</td>
</tr>
</tbody>
</table>

The interface also shows a list of items in a directory, including files and directories related to geographic information systems (GIS) software.
Creates a new topology.
UNCLASSIFIED
Start Time: Tue Feb 19 22:00:20 2008
Found 111 point(s)
Executed (Near 3) successfully.
End Time: Tue Feb 19 22:00:21 2008
(Elapsed Time: 1.000 seconds)
Cluster Tolerance

Before Validate

Cluster Tolerance
Equal Ranks
Higher Ranks
Lower Ranks

After Validate

Equal Ranks
Unequal Ranks

From ESRI
## Determining Cluster Tolerance

If 100 feet ~equals 0.0003 decimal degrees and 100*12*25.4 mm equals 100 feet then 30480 mm equals 0.0003 decimal degrees and 1 mm equals 0.0000000098425 decimal degrees 3 mm equals 0.0000000295276 decimal degrees 10 mm equals 0.0000000984252 decimal degrees

Default cluster tolerance for WGS 84 0.0000000089832 decimal degrees
**Name:** HSIP_Metro_v2_Topology

**Cluster Tolerance:** 0.0000000984 degrees

**Status**

Validated - No Errors

All parts of the topology have been validated and there are no topology errors.
<table>
<thead>
<tr>
<th>Rule</th>
<th>Errors</th>
<th>Exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must Be Larger Than Cluster Tolerance</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Point Must Be Covered By Line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TransitStation, TransitLine</td>
<td>574</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>574</td>
<td>0</td>
</tr>
<tr>
<td>Rule</td>
<td>Errors</td>
<td>Exceptions</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td>Must Be Larger Than Cluster Tolerance</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Point Must Be Covered By Line</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TransitStation_v2, TransitLine_v2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
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Topology Validated

- Is the data better?
- Cluster tolerance and coordinate shifts
Topology isn’t

- A good way to “correct” data creation discrepancies

- Necessary for simple display/identification of data
Topology and shapefiles

• A final word of caution:
Understanding Topological “Errors”

• Errors are just violations of User Set Rules

• Setting Rules is arbitrary
Valid Reasons For Topological “Errors”

• Most important: Resolution of the data
• Definition of features and how they relate to each other
  – Not everyone looks at a river the same way.
Summary

• Talked about topology, cluster tolerances, and data source considerations
• Looked at an example of topology creation in ArcGIS
• Considered the ups and downs of topological relationships between datasets.
Thanks for sticking around!

• Questions

• Comments