Generalization for Multi-scale Mapping

Edie Punt
Jamie Conley
Why Generalize?

- Data is collected and maintained in high detail
- When drawn at a smaller scale:
  - it can be too detailed
  - symbols can conflict
- Consider:
  - visual acuity
  - output capabilities
Generalization is Subjective

Traditionally, generalization was performed manually at the discretion of the cartographer.

Easy for humans, hard for machines.

...generalization is difficult to automate.

"What is qualitatively the same on the ground is also represented in the same way everywhere on the map."

Swiss Society of Cartography, 1972
Automated Generalization in ArcGIS
Automated Generalization in ArcGIS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 and 8</td>
<td>command line feature-based generalization</td>
</tr>
<tr>
<td>9</td>
<td>feature-based generalization in geoprocessing</td>
</tr>
<tr>
<td>10.0</td>
<td>contextual generalization (roads and buildings)</td>
</tr>
<tr>
<td>10.1</td>
<td>support for large datasets</td>
</tr>
<tr>
<td>10.2</td>
<td>quality improvements</td>
</tr>
</tbody>
</table>

Feature-based Generalization

Early automated generalization tools considered the geometry of each feature sequentially without regard to symbology or other feature relationships.
Contextual Generalization

Contextual generalization tools assess multiple features from multiple layers simultaneously
- Maintain representative pattern, density, and character
- Resolve conflicts between symbolized features at scale
Automated Generalization with Geoprocessing

The Cartography toolbox contains tools for generalization and conflict detection
What’s the Difference?

**Generalization** clarifies the display of feature geometry at smaller scales

**Conflict Resolution** manages the extent and placement of symbolized features on maps

*Use both to retain characteristic form and pattern*
Contextual Generalization: Optimization

**Constraint:** ideal restriction on one or more features

buildings must be at least 15m apart

**Action:** modify the data to better meet constraints

move the building away

**Reflex:** constraint that must be met

a building cannot be moved onto a road
Generalizing Roads
Thin Road Network tool

- Removes less significant roads from display
- Retains representative pattern and connectivity
- Visibility controlled by attribute, easy to modify
Resolve Road Conflicts tool

• Adjust roads to show visual separation
  - highways, boulevards, dead-ends, roundabouts

• Less significant roads move to accommodate more significant roads
Merge Divided Roads tool

- Create a single road feature from ‘parallel’ pairs
- Merge only equal-class roads together
Collapse Road Detail tool

- Remove details or open interruptions at intersections
Generalizing Roads

1:50,000 and 1:100,000 scale
Generalizing Buildings
Propagate Displacement tool

- Adjust adjacent features to reestablish relationships after conflict resolution
- Use displacement output from other tools
  - *Merge Divided Roads tool*
  - *Resolve Road Conflicts tool*
Resolve Building Conflicts tool

- Separate buildings from each other and from barriers
  - Retain relative density and pattern
  - Adjust visibility, size, and spacing, orientation
Delineate Built-up Areas tool

- Use dense groups of buildings to define built-up area polygons using edge features
Generalizing Buildings

1:50,000 and 1:100,000 scale
Generalization Workflows
Partitioning Large Datasets

- Establish partitions for data
  - Feature layers, map sheet boundaries, or
  - use Create Cartographic Partitions tool
Partitioning Large Datasets

• Set the Cartographic Partitions geoprocessing environment variable to the partitions layer
  - Each partition processed independently
  - Edge matching handled
Geoprocessing Workflows

- Transform data in scale-specific steps
  - Chain steps in scripts or models
  - Automate entire workflow, or subdivide with manual editing and verification steps in between
- Some tools modify inputs; new data not created
  - Use representations to store changes as overrides
  - Original geometry is left intact for visual comparison or even reversion
Cartographic Production Workflow

Master Database

Scale-specific Data

Data Generalization

Symbolization

Cartographic Generalization

Annotation

Manual Editing

Map Layout

Output

Print

Export

Share
Multi-scale Mapping Workflow

Data Generalization
(Generalization toolset)

- Reduce feature count
- Aggregate Polygons
- Thin Road Network
- Merge Divided Roads
- Delineate Built-Up Areas
- Simplify Line
- Smooth Line
- Simplify Polygons
- Smooth Polygons
- Simplify Buildings
- Collapse Road Detail
- Simplify

Conflict Resolution
(Graphic Conflicts toolset)

- Symbolize data for output scale
- Resolve Road Conflicts
- Propagate Displacement
- Resolve Building Conflicts
- Detect Graphic Conflicts
- Manual editing
Large Dataset Workflow
Multiple scales
Thank you...

Please fill out the session evaluation

**Wednesday Offering ID:** 1341  
**Thursday Offering ID:** 1428

**Online** – www.esri.com/ucsessionsurveys  
**Paper** – pick up and put in drop box