Integration of Generalization and Text Placement in ArcGIS

ICA MPMG Seminar, Sept. 2000

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Topics

- **GIS-based cartography with ArcGIS**
  
  *Multi-purpose, multi-scale mapping from master databases*  
  *ArcGIS - the new generation of ESRI GIS software*

- **Map generalization**
  
  *In Workstation ArcInfo, ArcToolbox, and ArcGIS*

- **Text placement**
  
  *Dynamic labeling, feature linked annotation, and Maplex*
GIS-based Cartography with ArcGIS
GIS-based cartography

Today’s cartographers compile databases and maps

Source information
- field survey
- existing map
- photogrammetry
- remote sensing
- GPS

Geo-processing, cartographic generalization and text placement

Geo-processing and database generalization

Master Database

Data Set

Display

Carto-DB

Maps
ArcGIS
single, scalable, unified GIS software

Clients
ArcView
ArcEditor
ArcInfo

ArcExplorer
Web Apps

Services
ArcSDE
ArcIMS

Data
CAD
Grid
Tin
Shapefile
Coverage
Image

RDBMS
(pGDB)

Internet

(pGDB)

(RDBMS)

(GeoDatabase)
ArcView 8.1

Desktop mapping GIS software,
a powerful tool for the management, display,
query, and analysis of spatial information

- **ArcMap**: the map-centric application for editing, displaying, querying
- **ArcCatalog**: the data-centric application that locates, browses, and manages spatial data
- **ArcToolbox**: environment for performing the hundreds of rich geoprocessing operations provided by ArcInfo
ArcEditor 8.1
Define and edit custom features and object classes

ArcMap  
ArcCatalog  
ArcToolbox

And:
• Coverage Editing
• Enterprise Geodatabase Editing
• Utility Network Solvers
• Dimensions
• Feature Linked Annotation
ArcInfo 8.1
the full-featured GIS with tools for automation, modification, management, analysis, and display of geographic information

ArcMap
ArcCatalog
ArcToolbox

And:
• Advanced Geoprocessing
• Advanced ArcToolbox
• Advanced Editing
• Workstation ArcInfo

And:
• Coverage Editing
• Enterprise Geodatabase Editing
• Utility Network Solvers
• Dimensions
• Feature Linked Annotation
Geodatabase concept

Feature datasets
- Spatial reference

Object classes subtypes

Feature classes subtypes

Relationship classes
- Geometric networks
- Planar topologies

Domains

Validation rules

Raster datasets
- Rasters

TIN datasets
- nodes
- edges
- faces

Locators
- Addresses
- x,y locations
- ZIP Codes
- Place names
- Route locations
Creating a geodatabase
Map Generalization

Support multiple-purpose, multiple-scale data transformation and map production
Recent releases in Workstation ArcInfo

- Focus on database generalization
- Support attribute transfer
- Facilitate post-processing and editing

BENDSIMPLIFY operator – ArcInfo 7.1.2
ORTHOGONAL operator – ArcInfo 7.2.1
BUILDINGSIMPLIFY command – Workstation ArcInfo 8.0.1
FINDCONFLICTS command – Workstation ArcInfo 8.0.1
CENTERLINE command – Workstation ArcInfo 8.0.1
AREAAGGREGATE command – Workstation ArcInfo 8.0.2

Enhancements to the GENERALIZE command
- a minor enhancement for Workstation ArcInfo 8.0.1;
- a major enhancement to be released in Workstation ArcInfo 8.1
GENERALIZE
(pointremove vs. bendsimplify)
BUILDINGSIMPLIFY
FINDCONFLICTS

- checking buffer
- conflicting areas (frequency = 2 or more)
- simplified building (input)
CENTERLINE
AREAAGGREGATE
(orthogonal)
AREAAGGREGATE
(non_orthogonal)
Gen-tools in ArcToolbox

- Conversion Tools
- Data Management Tools
- Generalization
- Composite Features
- Projections
- Tables
- Topology

- Tools
- Help

- Simplify Buildings
  - Input coverage: C:\bldg
  - Tolerance: 50
  - Minimum area: 1000
  - Selection file: (optional)
  - Output coverage: C:\bldgsim

- Find Building Conflicts
  - Input coverage: C:\bldgsim
  - Distance: 10
  - Output coverage: C:\bldgconf

- Create Centerlines
  - Input coverage: C:\casings
  - Maximum width: 80
  - Minimum width: 5
  - Output coverage: C:\centerlines
Example of Macro-procedures

- Polygon extend
- Clipping lines by buffers
- Grouping by buffering
- Meeting lines by GRID
Development of generalization tools for ArcGIS

More functions, flexibility, and productivity

Extending the following areas:

- **Geodatabase tools**
  - Derive target schema, feature classification and extraction;
  - Maintain feature links between source and target data

- **Geometry processing**
  - Add generalization operators

- **Editor tools**
  - Allow interactive generalization and queued edit

- **User interface**
  - Add a gen-toolbar, menus, forms, and controls
Database generalization

Define/create target feature classes (attribute fields and domains)

Define and link source feature categories to target features

Transforming source features to generalized features (in batch)

<table>
<thead>
<tr>
<th>Source feature</th>
<th>Output feature</th>
<th>Steps</th>
<th>Master database</th>
</tr>
</thead>
<tbody>
<tr>
<td>category 1</td>
<td>trans100k-fr001</td>
<td>simplification, elimination</td>
<td>master25k</td>
</tr>
<tr>
<td>category 2</td>
<td>trans100k-fr002</td>
<td>typification, simplification</td>
<td>source1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td></td>
<td>road25k</td>
</tr>
<tr>
<td>category 11</td>
<td>veg100k-fv011</td>
<td>aggregation, smoothing</td>
<td>vegpoly25k</td>
</tr>
</tbody>
</table>

Generalized database

(with 1-to-1 relation) (with n-to-1 relation)
Cartographic generalization

Set global parameters (scale, min-sizes, priorities, symbols)

Interactive processes (testing, measuring, analyzing, saving parameters)

Batch processes

Interactive processes (Queued editing, resolving conflicts, refinement)

Generalized cartographic database

Maps for internet
Linking source and target features

**Feature link specification**

**Derive source feature list**
- From current TOC
- From maps
- From .lyr files

**Default target dataset location**
- D:\genprojects\maps25k.mxd
- D:\genprojects\maps5k.lyr
- D:\genprojects\maps25k.mxd

**Source**
- bndnet25k: commercial bldg
- vegnet25k: post offices
- transnet25k: railroad
- popnet25k: residential house
- transnet25k: road class 1
- transnet25k: road class 2
- elevation25k: spot elevation

**Target**
- bndnet100k: f-code
- vegnet100k: f-code
- transnet100k: f-code
- popnet100k: f-code
- transnet100k: f-code
- reliefpt100k: f-code

**Generalization steps**
- Road5k feature class: road class 1
  - Job ID: 103 Simplification
  - Job ID: 104 Smoothing

**View steps**
- Clear all
- Reset
- View steps

**OK**
**Cancel**
Interactive tools

Select an operator: Power of averaging

Exponential averaging

Select features to connect:
- Road

Selected features to connect:
- None

Apply to linear features only.

Save parameters to file: vegsmoth.xml
Queued editing

Problem Description
Operator name: bendsimplify
Parameters: distance = 80; min. area = 200 map units
Description: a line segment was under-generalized due to conflicts
Text Placement

A major component of cartography
Dynamic labeling in ArcMap

- Places labels at "ideal" location on the fly
- For on-line display or as batch process for creating persistent annotation
- Can place multiple labels / feature
- Uses expression based on VB- or Java-script to derive text.
Handles overflow (unplaced) labels
Feature-linked annotation in ArcGIS

- A geodatabase feature class with custom behavior
- One or more annotations linked to a feature (point, line, polygon, ...)  
- Annotation text derived from feature attribute
- Position maintained in relation to feature
- Updating the feature automatically updates the linked annotation
Feature-linked annotation
Maplex

Currently a separate product
Will be integrated with ArcMap in future

**Cartographic Design**
- Many input and output formats
- Standard carto symbology built-in
- Custom symbology easily added
- Rule-based projects allow repeatable design styles

**Automated Text Placement**
- Unambiguously label all features
- Conflict Resolution Between Placements
- User-specified Rules
- Prioritization of features, labels
- Label Points, Lines, Area, Streets, Parcels

Will be integrated with ArcMap in future
The data manager

The data manager

Feature Class Codes and Label Field are specified here.

Projections, Units, Scale and Map Extents are also set at load time.
The rule-base parameters

Symbology *(style, color, size...*)

Labels *(font, color, size, box...*)

Placement *(the label in relation to its feature)*

Priorities *(features/labels importance ordering)*

Stacking *(breaking up multi word labels)*

Multi-labels *(> one label per feature)*

Deletion *(what to do if no label is placed)*

Export *(create layered export files)*

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The width of the label box when the longest line in the label has two characters: the box graphics are scaled horizontally to fit this width. You can specify this as a % of the nominal box width. (Applies for complex box shapes only.)
Placement styles and strategies

Point Features
- Centered
- Offset (freedom to move)
- Offset (with preferred zones such as east or north side)

Line Features
- Centered
- Horizontal
- Curved
- Straight
- Offset (left, right)
- Perpendicular (left, right)
Area features

- Center horizontal or Offset
- Center straight or offset
- Center curved or offset

Placement strategies

- US-Style Streets
- European-Style Streets
- Parcels
- Petroleum
- Atlases
- Standard point, line, polygon