Geodatabase – An Introduction

Ralph Denkenberger – esri
Session Path

- **The Geodatabase**
  - What is it?
  - Why use it?
  - What types are there?

- Inside the Geodatabase
- Advanced Behavior
- Additional Geodatabase Datasets
What is the Geodatabase?

- **Core ArcGIS data model for the ArcGIS platform**
  - A comprehensive model for representing and managing GIS data

- **A physical container for storing geographic data**
  - Scalable storage model supported on different platforms

- **Fundamental elements of the geodatabase include feature classes, raster datasets and tables**
Why use the Geodatabase?

1. One centralized location for all of your geographic data
2. Model real work advanced spatial relationships
3. Smarter datasets with intelligence
4. Scalable (size and number of users)
5. Better maps
Why use the Geodatabase?

- Simple!
- The model to best support the ArcGIS platform within an organization

http://resources.arcgis.com/en/communities/geodata/
## 3 Types of Geodatabases

<table>
<thead>
<tr>
<th></th>
<th>Personal GDB</th>
<th>File GDB</th>
<th>Multiuser gdb (3 Types)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage Format</strong></td>
<td>Microsoft Access</td>
<td>Folder of binary files</td>
<td>DBMS</td>
</tr>
<tr>
<td><strong>Storage capacity</strong></td>
<td>2 GB</td>
<td>1 TB per table*</td>
<td>Depends on edition</td>
</tr>
<tr>
<td><strong>Supported OS platform</strong></td>
<td>Windows</td>
<td>Any platform</td>
<td>Depends on edition</td>
</tr>
<tr>
<td><strong>Number of users</strong></td>
<td>Single editor Multiple readers</td>
<td>Single editor Multiple readers</td>
<td>Multiple editors &amp; readers</td>
</tr>
</tbody>
</table>

* By default; option to have 256 TB per table
Editing Geodatabases...

- **Personal Geodatabases**
  - Mainly single user editing on small datasets
  - Multiple readers
  - Editing locks at geodatabase level

- **File Geodatabase**
  - Mainly single user editing small to very large datasets
  - Multiple readers
  - Editing locks at the dataset level
Editing Geodatabases...

• Multiuser Geodatabases
  - Editing with Versions
  - Multiuser editing without locking
  - Unique isolated view of the geodatabase

• Benefits of versioned editing
  - Multiple editors, editing over long periods of time
  - Archiving
  - Replication
Geodatabase Data Management

• Schema is defined in ArcCatalog
  - Define feature classes, datasets, relationships, etc
  - Import and convert data from other formats
    - Shapefile
    - Coverage
    - CAD
    - Raster
• Copy/Paste, Drag/Drop between geodatabases
• ArcGIS.com
  - Download layer and map packages from galleries, groups…
Creating a Geodatabase

- Creating a Geodatabase
- Loading existing data (shapefile, coverage, geodatabase)
Session Path

- The Geodatabase
- Inside the Geodatabase
  - Tables, Feature Classes, Rasters
  - Feature Datasets
  - Validation Rules
  - Domains, Subtypes, Relationship Classes
  - Annotation, Dimensions
- Advanced Behavior
- Additional Geodatabase Datasets
Geodatabase Elements
• Collection of data records organized by columns and rows
• Each row represents a single record
• All records in a table have the same attribute fields and behavior
Feature Classes

- Collection of man made or natural features
- Each record in the table corresponds to a feature
- All features have the same geometry and attribute fields
- The Shape field stores the geometry

<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>Shape*</th>
<th>ADMIN_NAME</th>
<th>CNTRY_NAME</th>
<th>POP_ADMIN</th>
<th>SQKM</th>
<th>Shape_Length</th>
<th>Shape_Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Polygon</td>
<td>Kohikeyeh va buyer Ahmadi</td>
<td>Iran</td>
<td>534688</td>
<td>13456.26</td>
<td>5.714665</td>
<td>1.267486</td>
</tr>
<tr>
<td>2</td>
<td>Polygon</td>
<td>Bushet</td>
<td>Iran</td>
<td>794785</td>
<td>24970.41</td>
<td>9.722385</td>
<td>2.308167</td>
</tr>
<tr>
<td>3</td>
<td>Polygon</td>
<td>Estfahan</td>
<td>Iran</td>
<td>4277722</td>
<td>111115.33</td>
<td>18.542057</td>
<td>10.740206</td>
</tr>
<tr>
<td>4</td>
<td>Polygon</td>
<td>Fars</td>
<td>Iran</td>
<td>4146405</td>
<td>128279.14</td>
<td>16.669143</td>
<td>11.902208</td>
</tr>
<tr>
<td>5</td>
<td>Polygon</td>
<td>Mazandaran</td>
<td>Iran</td>
<td>44395267</td>
<td>80264.21</td>
<td>16.028797</td>
<td>8.13271</td>
</tr>
<tr>
<td>6</td>
<td>Polygon</td>
<td>Semnan</td>
<td>Iran</td>
<td>541428</td>
<td>88762.32</td>
<td>15.024519</td>
<td>8.840354</td>
</tr>
<tr>
<td>7</td>
<td>Polygon</td>
<td>Tehran</td>
<td>Iran</td>
<td>11310730</td>
<td>19465.29</td>
<td>8.962299</td>
<td>1.938287</td>
</tr>
<tr>
<td>8</td>
<td>Polygon</td>
<td>Yazd</td>
<td>Iran</td>
<td>745249</td>
<td>68450.3</td>
<td>12.34858</td>
<td>6.520496</td>
</tr>
</tbody>
</table>
Feature Datasets

- A container for feature classes other datasets
  - Same spatial reference

- Contain geometric networks, topologies, terrains, etc…
  - Optionally relationship classes
Domains

• Describe the legal values of a field type
  - Used to ensure attribute integrity

• Defined at the geodatabase level

• Types of domains:
  - Range
    - Valid values between a min / max range
    - A road can have between one and eight lanes
    - A highway can have speeds between 50 and 70 miles per hour
  - Coded Value
    - Valid values chosen from a set list
    - A road can be made of dirt, asphalt, or concrete
Subtypes

- Categorize records or features into groups
  - Share the same attributes
- Defined at the class level
- Select a field to base the subtype on
  - Short or long integer field
  - Can have different default values and domains for each field
  - Can define behavior rules between subtypes
Relationship Classes

- Association between objects in one class and another
  - A class may participate in multiple relationship classes

- Simple relationships

- Composite relationships
  - Related objects can message each other
  - Can trigger behavior (cascade delete, move to follow, custom, etc.)

- Associate rules with relationship classes
  - Each Parcel can have between 1 to 3 Buildings

![Diagram showing association between Parcel and Building classes](image-url)
Annotation

- **Annotation feature classes**
  - Placing text and graphics on the map
  - Feature linked or Non-feature linked

- **Composite relationship manages link**

- **Can store text as well as other graphics**
  - Lines, arrows, boxes, etc...
  - Visible scale range
Raster Data

• Support for many formats
  - Tiff, bmp, GRID, among others

• Attribute field in a table

• Raster dataset

• Mosaic dataset
  - Data model for managing raster collections
  - Stored as a catalog, viewed as a mosaic
  - Advanced querying and on the fly processing
Exploring a Geodatabase

- Feature Class
- Feature Dataset
- Domains
- Annotation
- Mosaic Dataset
Session Path

- The Geodatabase
- Inside the Geodatabase
- Advanced Behavior
  - Attachments
  - Geodatabase Topology
  - Geometric Networks
  - Network Datasets
- Additional Geodatabase Datasets
Attachments

- Associate any type of file with a feature
- Available on a Feature Identify, attribute table and as HTML pop-up windows
- In ArcMap if the file type is known by Windows it can be directly accessed.
Geodatabase Topology

- A topology manages a set of simple feature classes that share geometry

- Topology is used to:
  - Constrain how features share geometry
  - Define data integrity rules
  - Ensure the quality of your data

- Rules enforced to maintain topological integrity
  - 30+ topology rules in ArcGIS
Topological Integrity

- Create topologies in a feature dataset
  - Participating feature classes / subtypes
  - Cluster tolerance, ranks and rules

- Define rules when creating the Topology
  - Rules are evaluated during validation

- Violations are expressed as error features
  - Managed in the database as a part of the topology
  - Examine and Fix errors in ArcMap

Province boundaries overlap
Geometric Networks

- Used to model non-decision based networks such as water, gas, oil, electric and telephone services
- Built in a feature dataset
- Geometric networks are comprised of two types of features: edges and junctions

<table>
<thead>
<tr>
<th>Water mains (Lines)</th>
<th>Water services (Lines)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OID</td>
<td>Shape</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>OID</td>
<td>Shape</td>
</tr>
<tr>
<td>13</td>
<td>1001</td>
</tr>
<tr>
<td>14</td>
<td>1002</td>
</tr>
</tbody>
</table>

Downstream Trace

Find Path Trace
Network Datasets

• Network designed for the transportation industry
• Multimodal scenarios
• Edges & Junctions
• Attributes
  - Properties to control traversability
  - Travel time, restrictions, speeds
  - On-the-fly calculation of costs
Exploring a Geodatabase

- Attachments
- Topology
- Geometric Network
Session Path

• The Geodatabase
• Inside the Geodatabase
• Advanced Behavior
• Additional Geodatabase Datasets
  - Terrains
  - Cartographic representations
Terrains

- Massive point datasets, multi-resolution, on-the-fly TIN
  - Dataset for modeling 3D surfaces
  - Modeled within a feature dataset
  - User defined terrain (pyramid) levels

- Requires 3D Analyst
  - Extension to define & edit
  - No license needed to view
Cartographic Representations

- Property of a feature class
  - Stores feature symbology
- One feature class – multiple representations
- Representation Management Toolset
Exploring a Geodatabase

- Terrains
- Cartographic Representations
Notes from the Field

Publishing & Authoring
- Publishing Services
- Cartographic Design
- Map Authoring
- Mash-up Maps
- Managing Teams

Geodatabases
- Spatial Data Management
- Data Science
- Enrichment
- Analysis

Products
- Web Applications
- Briefing Book
- Story Maps
- Geoblogging
Questions?
Ralph Denkenberger | Instructor
Educational Services
rdenkenberger@esri.com
Don’t forget to complete a session evaluation form!
Networking Reception
Smithsonian National Museum of Natural History
Tuesday, 6:30 PM–9:30 PM
Bus Pickup located on L Street
Print your customized Certificate of Attendance!

Printing stations located in Hall B and the 140/150 Room Concourse.
GIS Solutions EXPO, Hall B

Monday, 12:30 PM–6:30 PM
Tuesday, 10:45 AM–4:00 PM

- Exhibitors
- Hands-On Learning Lab
- Technical & Extended Support
- Demo Theater
- Esri Showcase
Interested in diving deeper into Esri technology?

Add a day to your Fed GIS experience and register to attend the Esri DevSummit Washington DC. Stop by the registration counter to sign up.