Session Path

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

- Inside the Geodatabase
- Advanced Behavior
- Geodatabase Potpourri
What is the Geodatabase?

• Core ArcGIS data model
  - A comprehensive model for representing and managing GIS data

• A physical store of geographic data
  - Scalable storage model supported on different platforms

• A transactional model for managing GIS workflows

• Set of COM components for accessing data
Geodatabase Data Management Approach

- The geodatabase is built on an extended relational database
  - Base relational model
  - Relational integrity
  - Base short transaction model
  - Supports continuous, large datasets
  - Reliability, Flexibility, Scalability

- Built on the simple feature model
  - Open access (OGC, C, COM, SQL)
Geodatabase Data Management Approach…

- Editing and data compilation
  - Rich set of editing tools
  - Maintain spatial and attribute integrity

- Versioning work flows
  - Undo and redo edits
  - Multiple users editing the same data
  - Archiving
  - Distributed data management

- Robust, customizable framework
  - Build and manage your own specific GIS solution
3 Types of Geodatabases

• Personal Geodatabase
  - Single user editing
  - Stored in MS Access
  - Size limit of 2 GB

• File Geodatabase
  - 1 TB per table
  - Cross platform

• Enterprise Geodatabase
  - Stored in an enterprise DBMS
  - Supports multiuser editing via versioning
  - Extremely large datasets
### 3 Types of Geodatabases...

<table>
<thead>
<tr>
<th></th>
<th>Personal GDB</th>
<th>File GDB</th>
<th>Enterprise gdb (3 Types)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cool Graphic</strong></td>
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<td><img src="link" alt="Folder of binary files" /></td>
<td><img src="link" alt="DBMS" /></td>
</tr>
<tr>
<td><strong>Storage Format</strong></td>
<td>Microsoft Access</td>
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<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</td>
<td>Single editor</td>
<td>Multiple editors &amp; readers</td>
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<tr>
<td></td>
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* By default; option to have 256 TB per table
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Multiple readers | Single editor
Multiple readers | Multiple editors & readers |

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Geodatabase Data Management

• Schema is defined in ArcCatalog
  - Define feature classes, datasets, relationships, etc
  - Catalog window in ArcMap @ 10

• Import and convert data from other formats
  - Shapefile
  - Coverage
  - CAD
  - Raster

• Copy and Paste

• ArcGIS.com
  - Import basemaps and layers from galleries, groups…

• Use an esri Data Model or Downloadable Template
  - Industry specific data models available
  - Download a geodatabase template from the resource centers
Editing Geodatabases

- ArcGIS datasets in the geodatabase are editable
  - Modify building footprints in parcel management
  - Add water mains to a water network
  - Update land owners information stored in a table
  - Etc…

- Transaction model for editing in ArcGIS
  - Edits are performed in an edit session
    - Open session – edit – save edits / don’t save edits
  - A series of edit operations constitutes a transaction
    - The transaction is either committed or rolled back
Editing Geodatabases…

• Personal Geodatabases
  • Mainly single user editing on small datasets
  • Multiple readers
  • Editing locks at geodatabase level
    • Two editors cannot edit within the same geodatabase at same time

• File Geodatabase
  • Mainly single user editing small to very large datasets
  • Multiple readers
  • Editing locks at the dataset level
    • Multiple editors cannot edit the same table or stand-alone feature class at the same time
    • Multiple editors cannot edit feature classes in the same feature dataset at the same time
Editing Geodatabases...

- Enterprise Geodatabases
  - Extend the transaction model with Versions
  - Multiuser editing without locking
  - Unique isolated view of the geodatabase

- Benefits of versioned editing
  - Multiple editors, editing over long periods of time
  - Undo / Redo
  - Archiving
  - Replication
Creating a Geodatabase

- Using ArcCatalog
- Creating a Geodatabase
- Loading existing data (shapefile)
Session Path

• The Geodatabase

• Inside the Geodatabase
  - Tables, Feature classes, Raster dataset
  - Feature datasets
  - Validation rules
  - Domains, Subtypes, Relationship classes
  - Annotation, Dimensions
  - Exploring a Geodatabase DEMO

• Advanced Behavior

• Geodatabase Potpourri
Inside the Geodatabase

• A geodatabase contains datasets

• Datasets represent collections of information with a real-world interpretation

• Types of geographic datasets:
  - Tables, feature classes, raster
  - Feature datasets
  - Networks, Topologies, Terrains

• Datasets have associated information
  - Manage integrity, behavior, and interpretation
  - Domains, Relational integrity, Topology, Metadata
Geodatabase Elements

**Geodatabase**

- Feature dataset
  - Spatial reference
  - Polygon
  - Line
  - Point
  - Annotation

- Feature classes
  - Route
  - Dimension

- Relationship classes

- Geometric networks

- Topology

- Network datasets

**Tables**

- Feature Classes

- Raster Datasets

  - Additional geodatabase elements
    - Parcel fabrics
    - Terrain datasets
    - Representations
    - Locators

**Toolboxes**

- Tool
- Model
- Script

**Behavior**

- Attribute defaults
- Attribute domains
- Split/merge policy
- Connectivity rules
- Relationship rules
- Topology rules
Objects and Object Classes - Tables

- Objects are entities with properties and behavior
- An object is an instance of an object class
- All objects in an object class have the same properties and behavior
- An object can be related to other objects via relationships

*A row stores an Object*
*A table stores an Object Class*
Features and Feature Classes

- Builds on the Relational Model
- A feature is a spatial object
- A feature is an instance of a feature class
- Extended the relational model
  - Geometry attribute types

A feature class is a table of rows, where each row has a geographic column

<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>SHAPE</th>
<th>PARCEL_ID</th>
<th>ZONE_CODE</th>
<th>SHAPE_Length</th>
<th>SHAPE_Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>4513</td>
<td>Polygon</td>
<td>67970</td>
<td>W</td>
<td>544.053559</td>
<td>3259.209335</td>
</tr>
<tr>
<td>4514</td>
<td>Polygon</td>
<td>67971</td>
<td>W</td>
<td>158.545394</td>
<td>774.602847</td>
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<tr>
<td>4515</td>
<td>Polygon</td>
<td>67973</td>
<td>10601</td>
<td>400.003000</td>
<td>7499.965473</td>
</tr>
<tr>
<td>4516</td>
<td>Polygon</td>
<td>67974</td>
<td>B1</td>
<td>236.126101</td>
<td>2905.890606</td>
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<tr>
<td>4517</td>
<td>Polygon</td>
<td>67982</td>
<td>B1</td>
<td>550.458538</td>
<td>17499.011493</td>
</tr>
</tbody>
</table>
Geodatabase Supports Advanced Geometry

- Points, lines, polygons
  - Single and multipart features

- Text and surfaces
- Flexible coordinates
  - XY, Z, M

Feature with many parts

One record in feature class table
Raster and Imagery

- Support for many formats
  - tiff, bmp, GRID, among others

- Raster dataset
  - Separate rasters
  - Mosaicking

- Attribute field in a table

- Raster catalog
  - A collection of raster datasets

- Mosaic dataset **(New at ArcGIS 10)**
  - Data model for managing raster collections
  - Stored as a catalog, viewed as a mosaick
  - Advanced querying and processing
Feature Datasets

- A container object for other datasets
  - **Same spatial reference**
- Analogous to a coverage
  - Less restrictive
- Contain geometric networks, topologies, terrains, etc…
  - Optionally relationship classes
Validation Rules

- Attribute, connectivity, and relationship rules
  - Stored on objects as part of the geodatabase

- Predefined, parameter driven
  - Attribute range rule
  - Attribute set rule
  - Connectivity rule

- Perform custom validation by writing code
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 tree can have a height between 0 and 300 feet
  - A road can have between one and eight lanes
- Coded Value
  - Valid values chosen from a set list
  - A tree can be of type oak, redwood, or palm
  - A road can be made of dirt, asphalt, or concrete
Subtypes

- Categorize objects 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

Descriptions

Codes
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

<table>
<thead>
<tr>
<th>Parcel</th>
<th>Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>OID</td>
<td>Parcel_ID</td>
</tr>
<tr>
<td>28</td>
<td>794</td>
</tr>
<tr>
<td>794</td>
<td>794</td>
</tr>
<tr>
<td>858</td>
<td>858</td>
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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
**Dimension Features**

- **Type of annotation that displays specific distances on a map**

- **Graphic features stored in a dimension feature class**
  - Can be created automatically from features
  - Set of editing tools
  - Define a style, description of symbology

1 3/8"
Object Behavior

• You can:
  - Control the default value and acceptable values for any attribute. *(Domains)*
  - Partition the objects into like groups. *(Subtypes)*
  - Instantiate classes with predefined behavior. *(Dimensions and Annotation)*
  - Control the general and network relationships in which an object can participate. *(Relationship Classes)*

• Out of the Box in ArcGIS!
  - Configurable, no programming required
Exploring a Geodatabase

- Tables / Feature Classes
- Subtypes
- Domains
- Relationship Classes
Session Path

- The Geodatabase
- Inside the Geodatabase
- Advanced Behavior
  - Geometric Networks
  - Network Datasets
  - Geodatabase Topology
  - Advanced behavior DEMO
- Geodatabase Potpourri
Geometric Networks

- Uses edges and junctions to model network systems

- Built in a feature dataset
  - Each feature class has a role in the network

- Connectivity relationships between feature classes
  - Based on geometric coincidence
  - Can associate connectivity rules with the network
  - Connectivity is maintained **on the fly**
Geometric Networks

• A geometric network is associated with a logical network
  - Each network feature is associated with one or more elements in the logical network

• Trace solvers on the logical network provide
  - Connectivity tracing, cycle detection, flow directions
  - Upstream/downstream tracing, Isolation tracing
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
  - Improves analysis
Network Dataset Functionality

- **Multimodal**
  - Points span multiple connectivity groups
  - Used to create connectivity between lines in different groups

- **Turns**
  - Turns do not alter connectivity, but traversability (e.g. U-Turn restriction)
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
  - Control editing tools
  - Validate features
  - Ensure the quality of your data
Topological Integrity

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

- 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
  - Error and Exceptions
  - Examine and Fix errors in ArcMap
Topology Error Examples

- Rules enforced to maintain topological integrity
  - 25+ topology rules in ArcGIS
  - 6 new rules at ArcGIS 10
Editing with a Topology

- Editing creates a **dirty area**
  - Area has been edited and may contain errors
  - Can be symbolized

- Errors are found during **validation**
  - Errors have properties
    - What rule was violated
    - Which feature(s) created the error

- Your options:
  - Ignore the error
  - Mark as exception
  - Fix the error

![Parcels overlap](image)
Exploring a Geodatabase

- Topology
- Geometric Network
Session Path

• The Geodatabase
• Inside the Geodatabase
• Advanced Behavior
• Geodatabase Potpourri
  • Terrains
  • Cartographic representations
  • Parcel fabrics
  • Geocoding
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
    - Different resolutions & vertical tolerances

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

- Property of a feature class
  - Stores info about feature symbology

- One feature class - multiple representations

- Rules and overrides

- Representation Management Toolset
Parcel Fabrics

• Solution for parcel data management
  - Survey Analyst extension

• Storage, maintenance and editing of parcels

• Create in a feature dataset

• Parcel editor toolbar
  - Streamline workflows
  - Increase spatial accuracy
Summary

- **The Geodatabase**
  - Data model, Storage, Transaction model, COM components

- **Inside the Geodatabase**
  - Datasets, Validation rules, data behavior and integrity

- **Advanced Behavior**
  - Geometric Networks, Network Datasets, and Topology

- **Geodatabase Potpourri**
  - Terrains, Representations, Parcel fabrics, Geocoding
Other Geodatabase Resources

- Geodatabase Island in the Showcase Area
  Meet the specialists!

- Geodatabase Resource Center
  http://resources.arcgis.com/content/geodatabases/10.0/about

- Inside the Geodatabase Blog

- ArcGIS.com
  http://www.arcgis.com/home/

- Modeling our world – Book available in the store here!
Thanks for listening!

- Fill out your surveys
- Ask questions?
Technical Workshops

• Editing Strategies for Enterprise Geodatabases
  - Thursday 10:15am Room 5A/B

• Understanding Geometric Networks
  - Tuesday 8:30am Room 14A
  - Wednesday 1:30pm Room 3

• Understanding Topology in the Geodatabase
  - Tuesday 1:30pm Room 6C
  - Thursday 8:30am Room 4

• Managing Distributed Data with Geodatabase Replication
  - Tuesday 3:15pm Room 6D
  - Thursday 10:15am Room 4

• Automating Geodatabase Creation Using Model Builder
  - Tuesday 1:30pm Room 6D
  - Thursday 8:30am Room 6D
Other Sessions

Demo Theatre Presentations

• Working with SQL Server Express Geodatabases
  - Tuesday 10:00am Geodatabase Management Demo Theatre

• Leveraging Relationship Classes in the Geodatabase
  - Tuesday 3:00pm Geodatabase Management Demo Theatre
  - Wednesday 5:30pm Geodatabase Management Demo Theatre

• File Geodatabase Overview
  - Wednesday 10:00am Geodatabase Management Demo Theatre
  - Thursday 10:00am Geodatabase Management Demo Theatre
Other Sessions

**Technical Workshop 20 Minute**

- **What is a Geodatabase?**
  - Tuesday 1:55pm Room 6B

- **Migrating Data to the Geodatabase**
  - Wednesday 3:40pm Room 6B

- **Enterprise Geodatabase Administration – Tips and Tricks**
  - Thursday 3:40pm Room 3

- **Road Ahead – GDB Admin**
  - Thursday 3:40 Room 27B

- **Road Ahead – Geodatabase**
  - Thursday 9:20am Room 6B