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Esri International User Conference | San Diego, CA
Technical Workshops | July 11 – 15, 2011

Introduction to the Geodatabase

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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

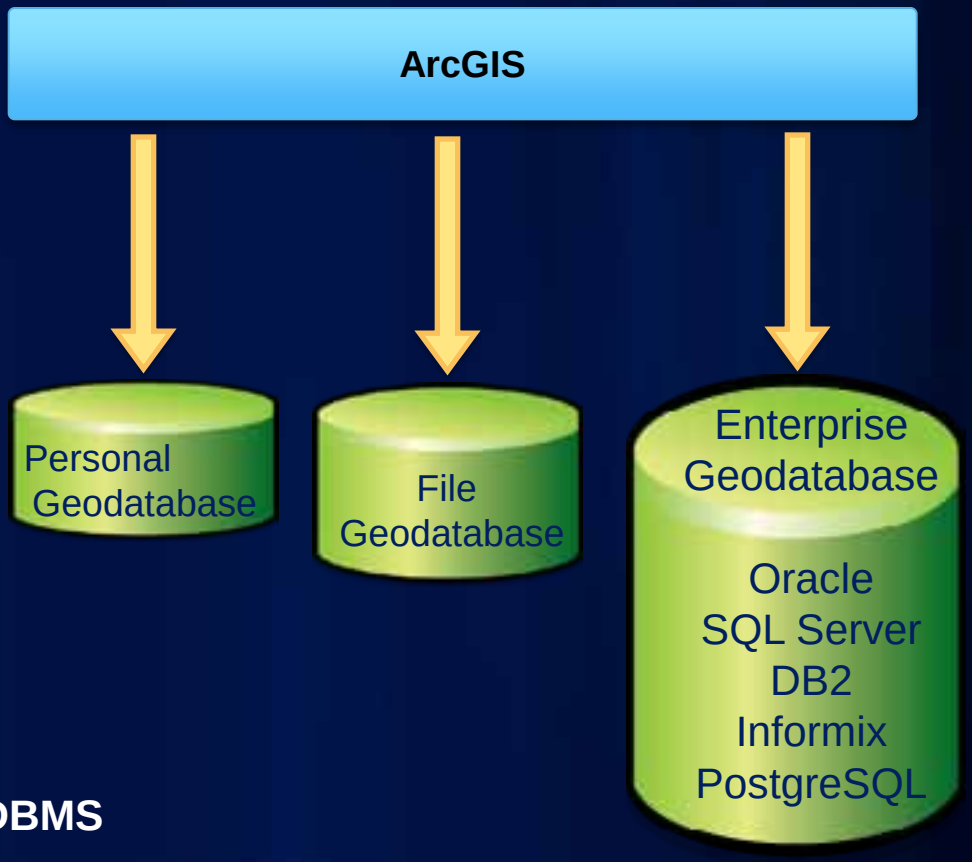
- Built on the simple feature model
  - Open access (OGC, C, COM, SQL)

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…

	Personal GDB	File GDB	Enterprise gdb (3 Types)
Cool Graphic			
Storage Format	Microsoft Access	Folder of binary files	DBMS
Storage capacity	2 GB	1 TB per table*	Depends on edition
Supported OS platform	Windows	Any platform	Depends on edition
Number of users	Single editor Multiple readers	Single editor Multiple readers	Multiple editors & readers

* By default; option to have 256 TB per table

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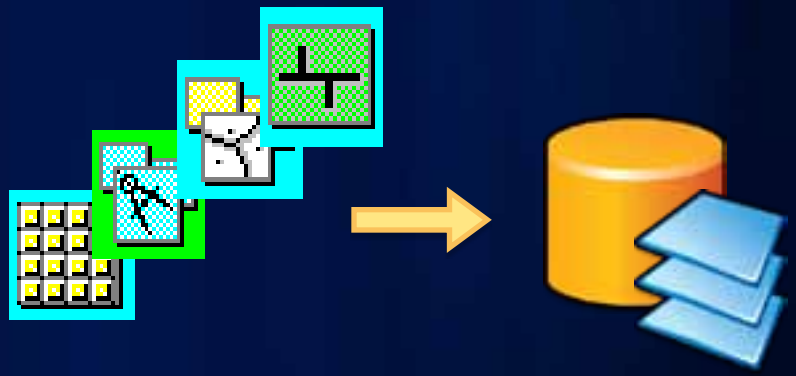
Geodatabase Data Management

- 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…

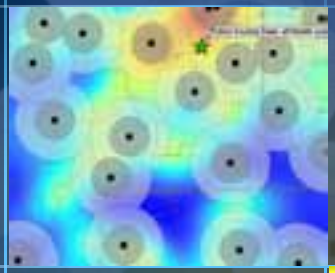
- Personal Geodatabases
  - Mainly single user editing on small datasets
  - Multiple readers
  - Editing locks at geodatabase level
    - Two editors cannot edit within the same geodatabase at same time

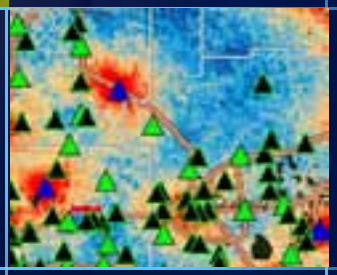
- File Geodatabase
  - Mainly single user editing small to very large datasets
  - Multiple readers
  - Editing locks at the dataset level
    - Multiple editors cannot edit the same table or stand-alone feature class at the same time
    - Multiple editors cannot edit feature classes in the same feature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

Relationship classes

Geometric networks

Topology

Network datasets

Tables

Feature Classes

Raster Datasets

Additional geodatabase elements

- Parcel fabrics
- Representations
- Terrain datasets
- 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

Attributes of Parcels

OBJECTID*	SHAPE*	PARCEL_ID*	ZONE_CODE*	SHAPE_Length	SHAPE_Area
4513	Polygon	67970	W	544.053559	9259.209935
4514	Polygon	67971	W	158.545394	774.602847
4515	Polygon	67973	RCOM	400.003000	7499.965473
4516	Polygon	67974	B1	236.126101	2905.890606
4517	Polygon	67982	B1	550.458538	17499.011493

Geodatabase Supports Advanced Geometry

- Points, lines, polygons
  - Single and multipart features

Feature with many parts

Attributes of States

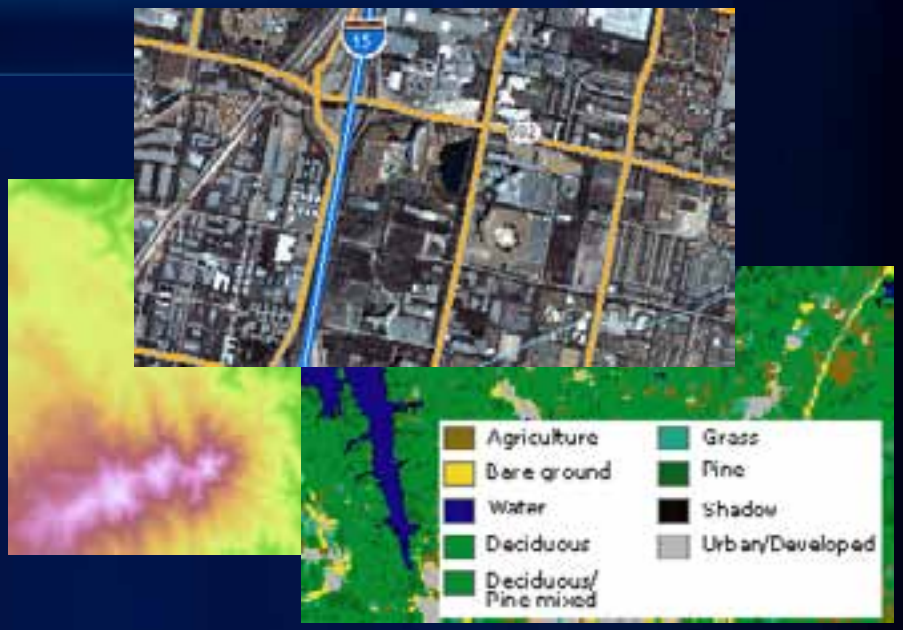
OBJECTID*	Shape*	STATE_NAME
48	Polygon	Florida
44	Polygon	Georgia
50	Polygon	Hawaii

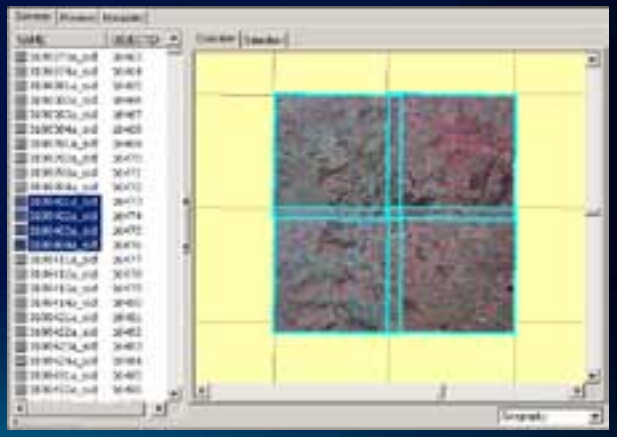
One record in feature class table

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

Raster and Imagery

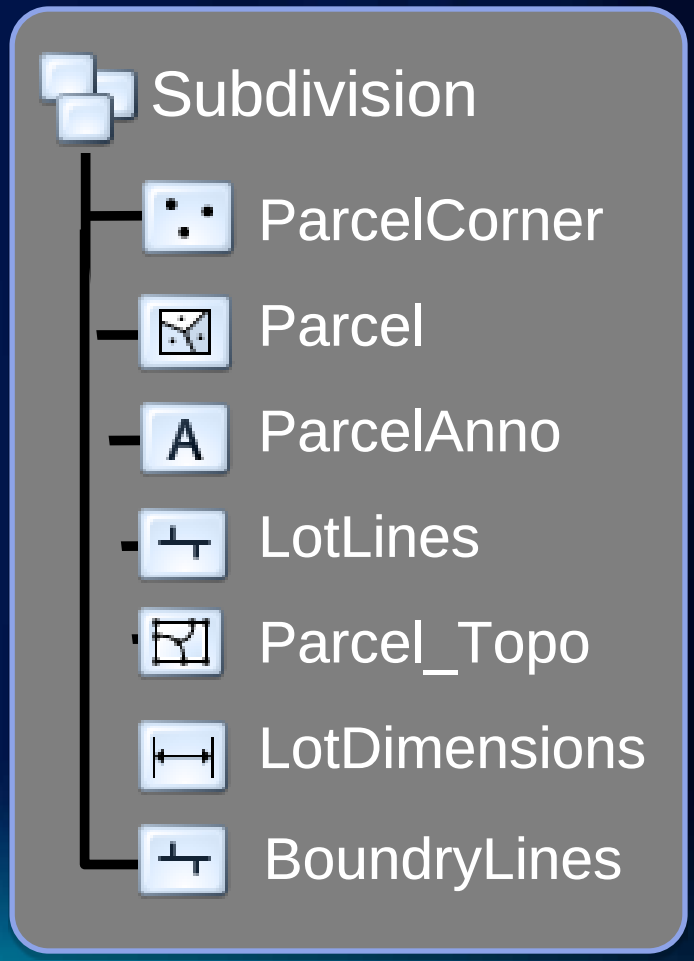
- Support for many formats
  - tiff, bmp, GRID, among others
- Raster dataset
  - Separate rasters
  - Mosaicking
- Attribute field in a table
- Raster catalog
  - A collection of raster datasets
- Mosaic dataset **(New at ArcGIS 10)**
  - Data model for managing raster collections
  - Stored as a catalog, 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

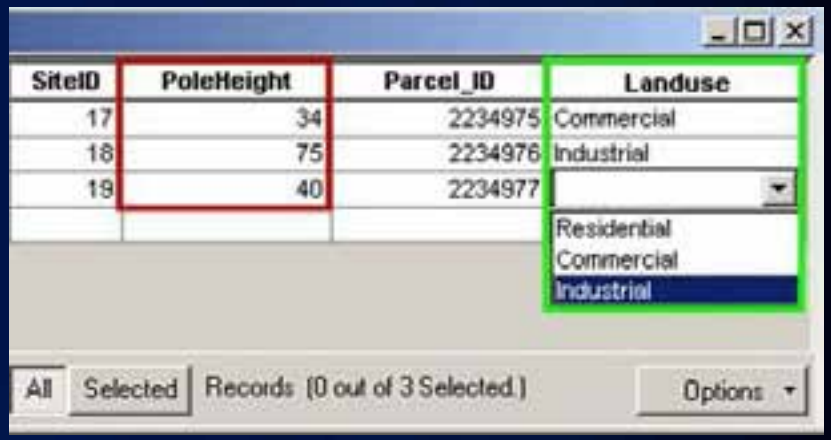


Validation Rules

- 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

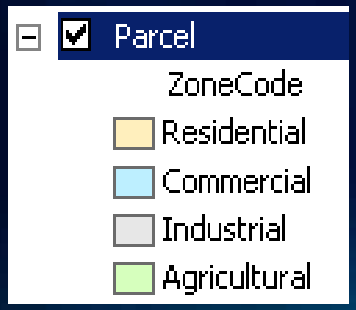
- Describe the legal values of a field type
  - Used to ensure attribute integrity
- Defined at the geodatabase level
- Types of domains:
  - Range
    - Valid values between a min / max range
    - A tree can have a height between 0 and 300 feet
    - A road can have between one and eight lanes
  - 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



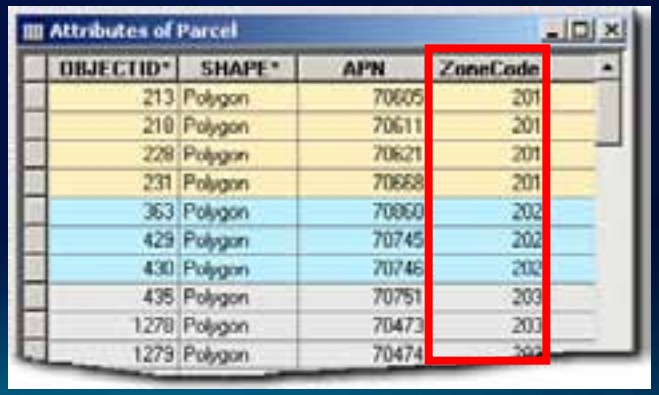
Subtypes

- 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

ParcelToBuilding

Parcel

OID	Zone	Area
28	Commercial	10000
794	Residential	5000
858	Residential	6050

Buildings

OID	Parcel_ID	Building Type
1	28	Office Building
2	794	Townhouse
3	794	Townhouse
4	858	Condo

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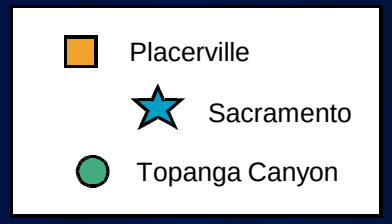
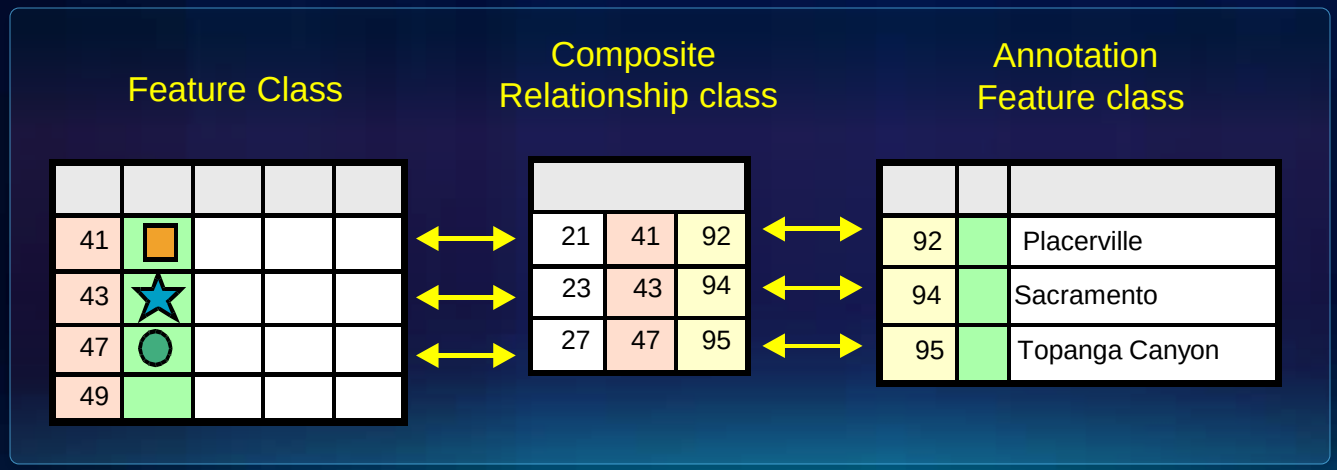
Annotation

- **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**

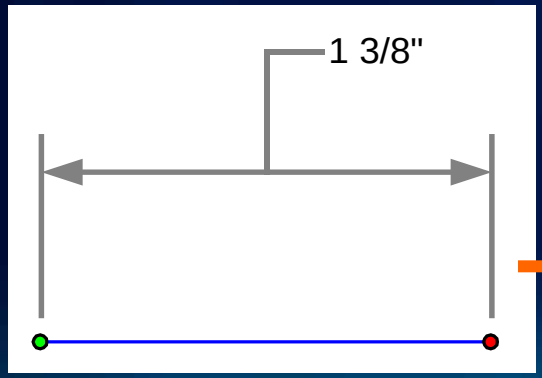


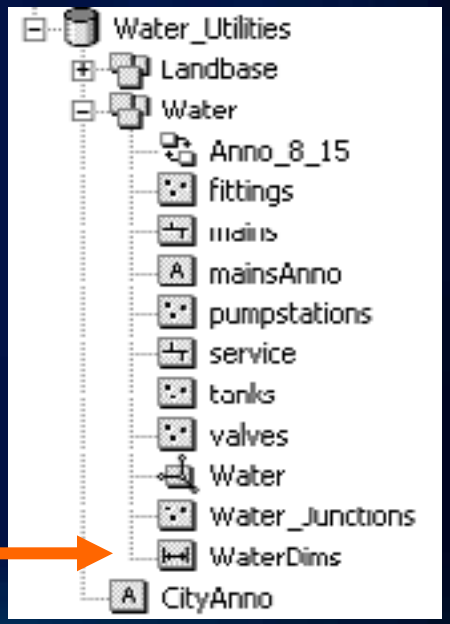


Dimension Features

- 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



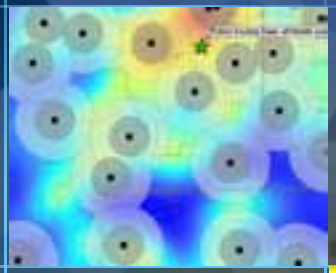


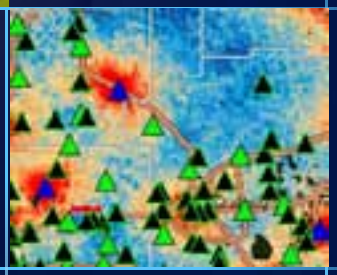
Object Behavior

- 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

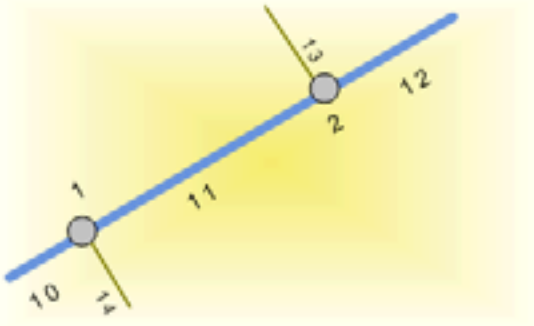
- Tables / Feature Classes
- Subtypes
- Domains
- Relationship Classes

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



Water junction fittings (Points)

OID	Shape	Equip ID	Valve Type
1		816-32	T203
2		816-45	Y53

Water mains (Lines)

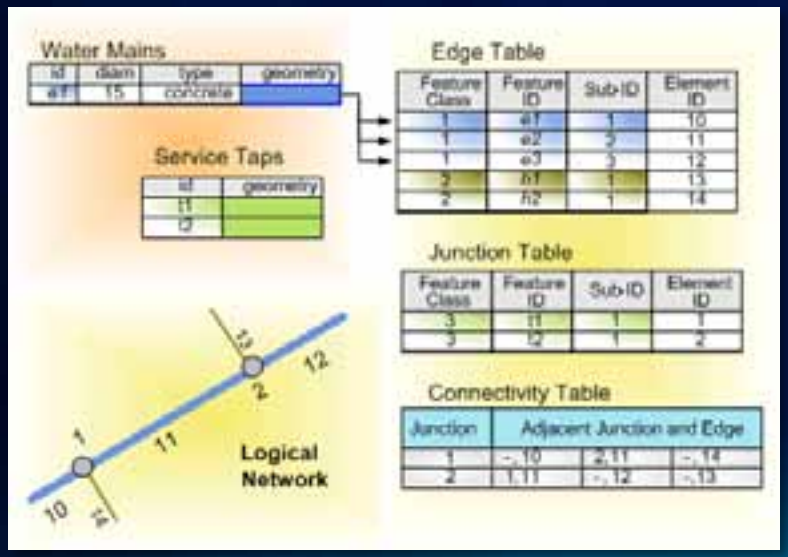
OID	Shape	Diameter	Material
10		8	Concrete
11		10	PVC
12		8	Concrete

Water services (Lines)

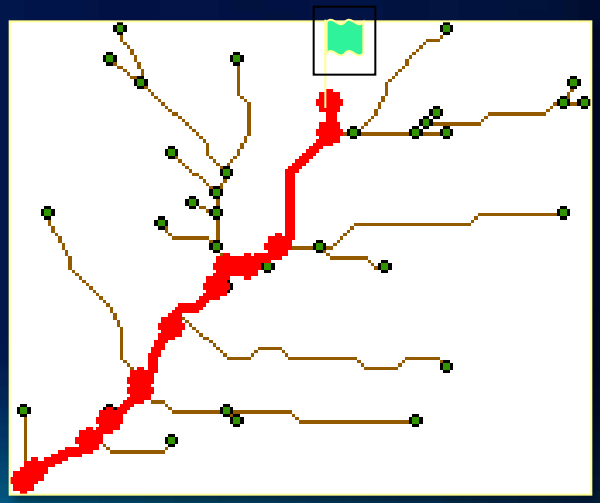
OID	Shape	Service ID	Material
13		1001	Cast iron
14		1002	Copper

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



Downstream Trace



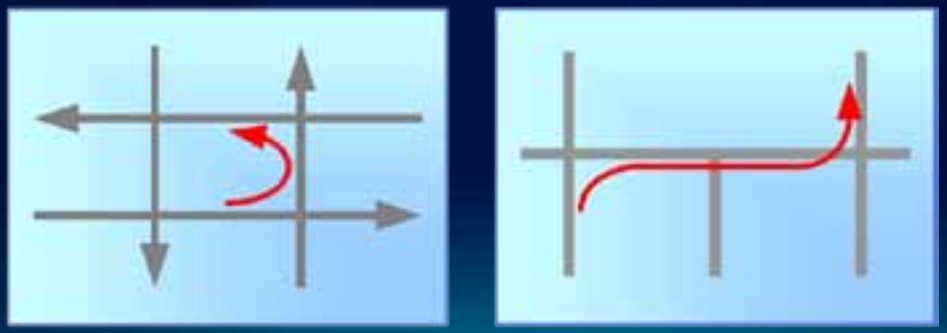
Network Datasets

- 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
  - Improves analysis

Network Dataset Functionality

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

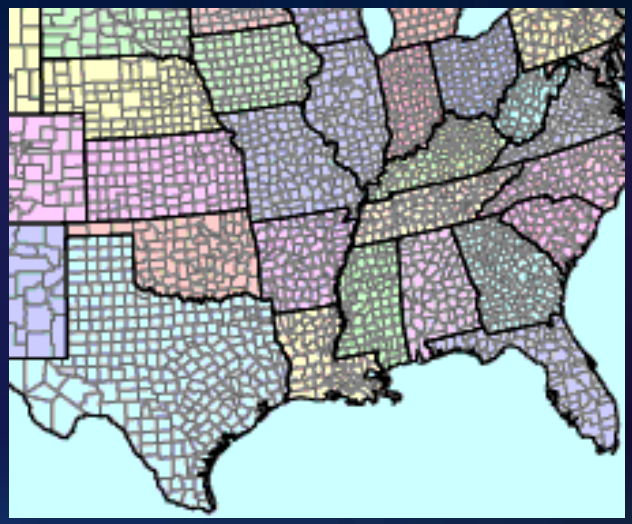
- **Turns**
  - **Turns do not alter connectivity, but traversability (e.g. U-Turn restriction)**



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

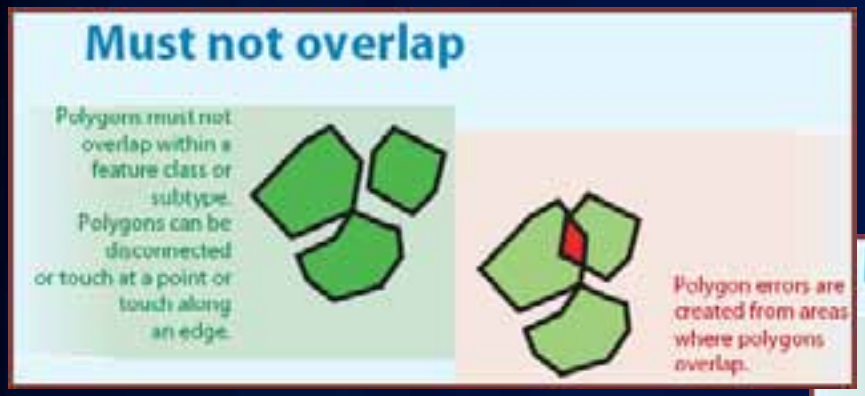


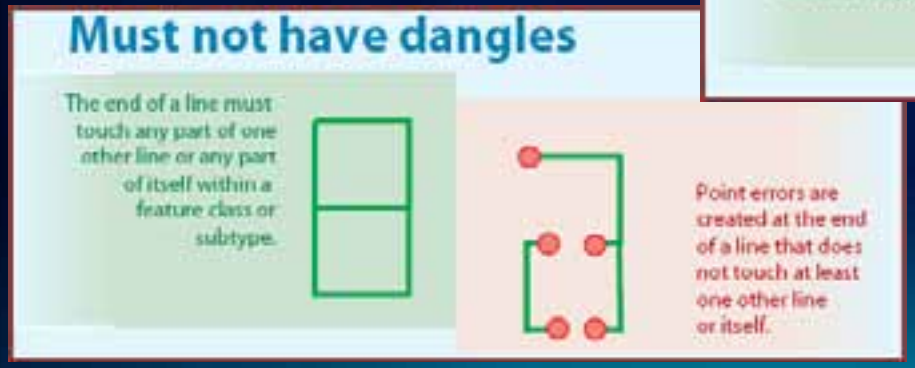
Topological Integrity

- 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**



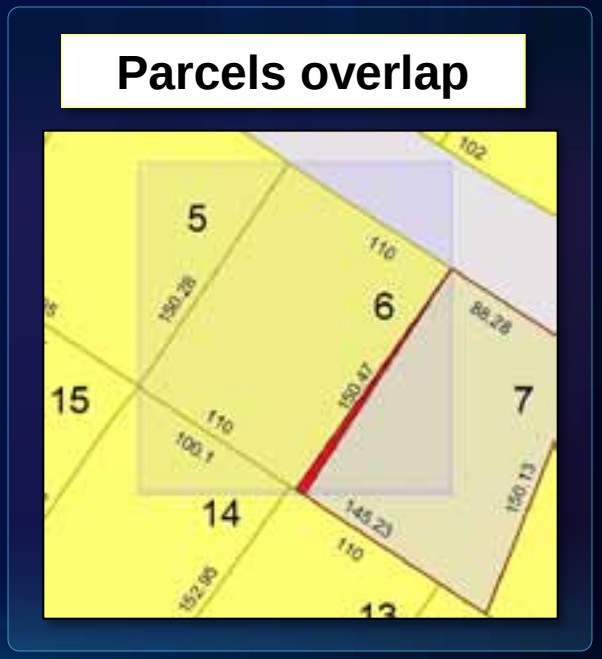


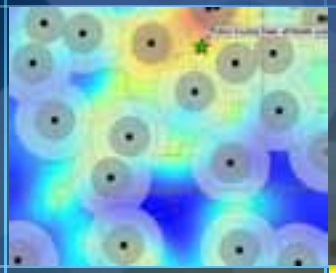
Editing with a Topology

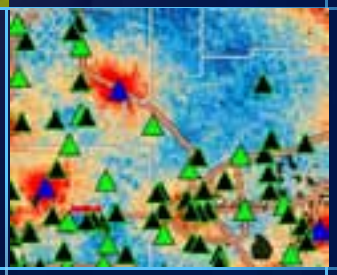
- Editing creates a dirty area
  - Area has been edited and may contain errors
  - Can be symbolized

- 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







Exploring a Geodatabase

- Topology
- Geometric Network

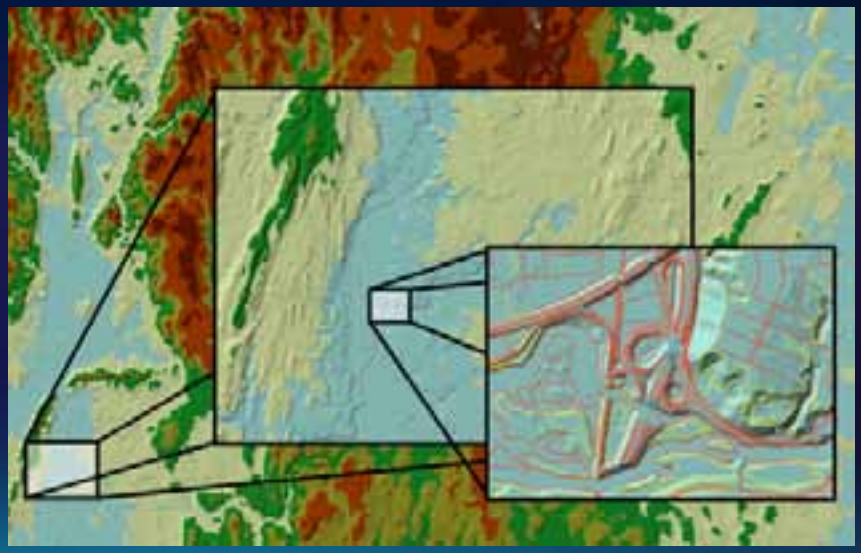
Session Path

- 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

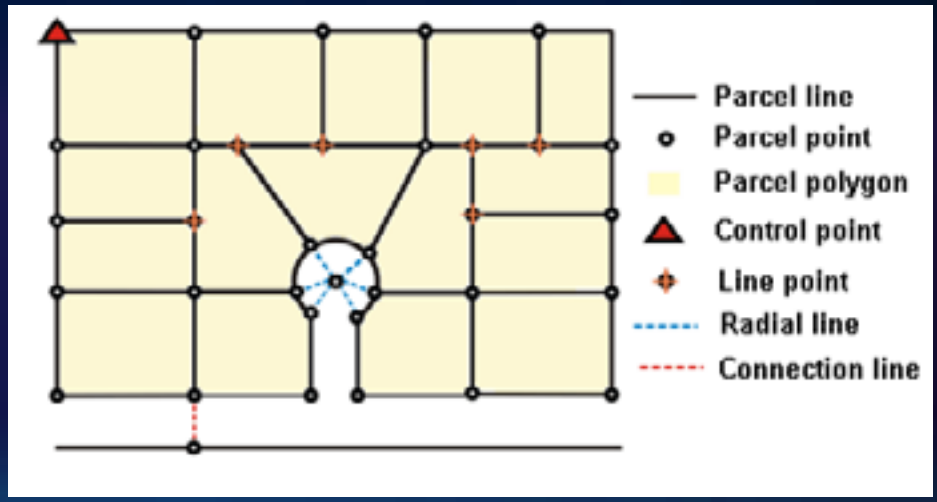


Cartographic Representations

- 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
http://blogs.esri.com/Dev/blogs/geodatabase/default.aspx

- 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?

Other Sessions

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**