DevSummit DC
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Geodatabase Programming with SQL

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Assumptions

- Basic knowledge of SQL and relational databases
- Basic knowledge of the Geodatabase
- We'll hold all questions till end

Please turn off cell phones

Roadmap

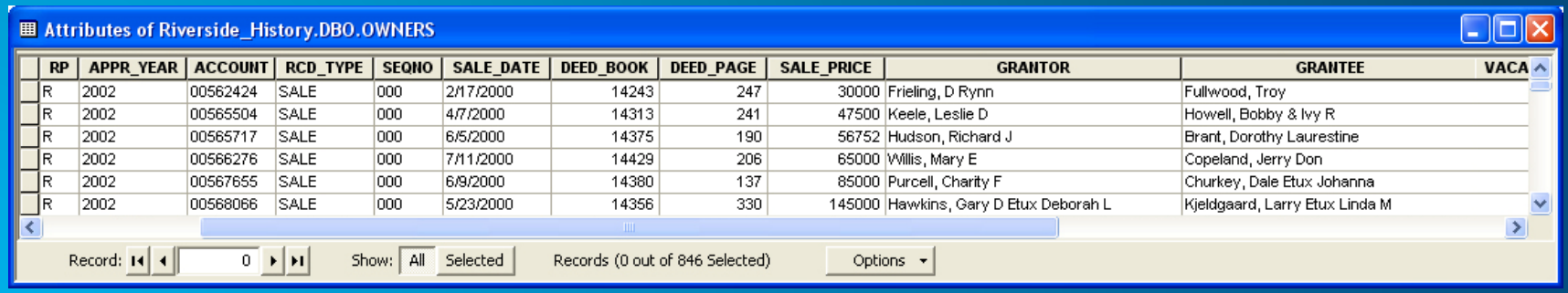
- Using databases in ArcGIS
- Building on databases with the geodatabase
- Accessing the schema of a geodatabase through SQL
- Editing a geodatabase through SQL

Databases

- You might have spatial or nonspatial data in a database that you want to use in ArcGIS
  - Oracle, SQL Server, DB2, Informix, PostGreSQL, Netezza
- You can connect directly to a supported database and view the data in the tables by making a connection from the Catalog tree in ArcGIS for Desktop
- To filter what data appears in ArcMap, you can use a query layer
- Use SQL to access the data within the database

What can you access in a Database?

- Rows and Tables
  - Containing zero to many rows
  - One to many columns
  - All rows in the table have the same schema
- Can perform table management tasks
  - View and modify schema
  - Add and remove rows
  - Perform queries



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R	2002	00565504	SALE	000	4/7/2000	14313	241	47500	Keele, Leslie D	Howell, Bobby & Ivy R	
R	2002	00565717	SALE	000	6/5/2000	14375	190	56752	Hudson, Richard J	Brant, Dorothy Laurestine	
R	2002	00566276	SALE	000	7/11/2000	14429	206	65000	Willis, Mary E	Copeland, Jerry Don	
R	2002	00567655	SALE	000	6/9/2000	14380	137	85000	Purcell, Charity F	Churkey, Dale Etux Johanna	
R	2002	00568066	SALE	000	5/23/2000	14356	330	145000	Hawkins, Gary D Etux Deborah L	Kjeldgaard, Larry Etux Linda M	

What can you access in a Database? …

- A table with a column that stores a spatial type
  - We call this a feature class
- Each row represents a feature
- The fields in each row represent various characteristics or properties of the feature
- One of the fields holds the feature geometry which is stored as a spatial type

Parcels

OBJECTID *	SHAPE *	PROPERTY_I *	Res	Zoning_simple	SHAPE_Length	SHAPE_Area
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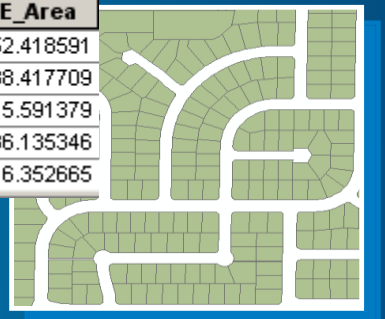


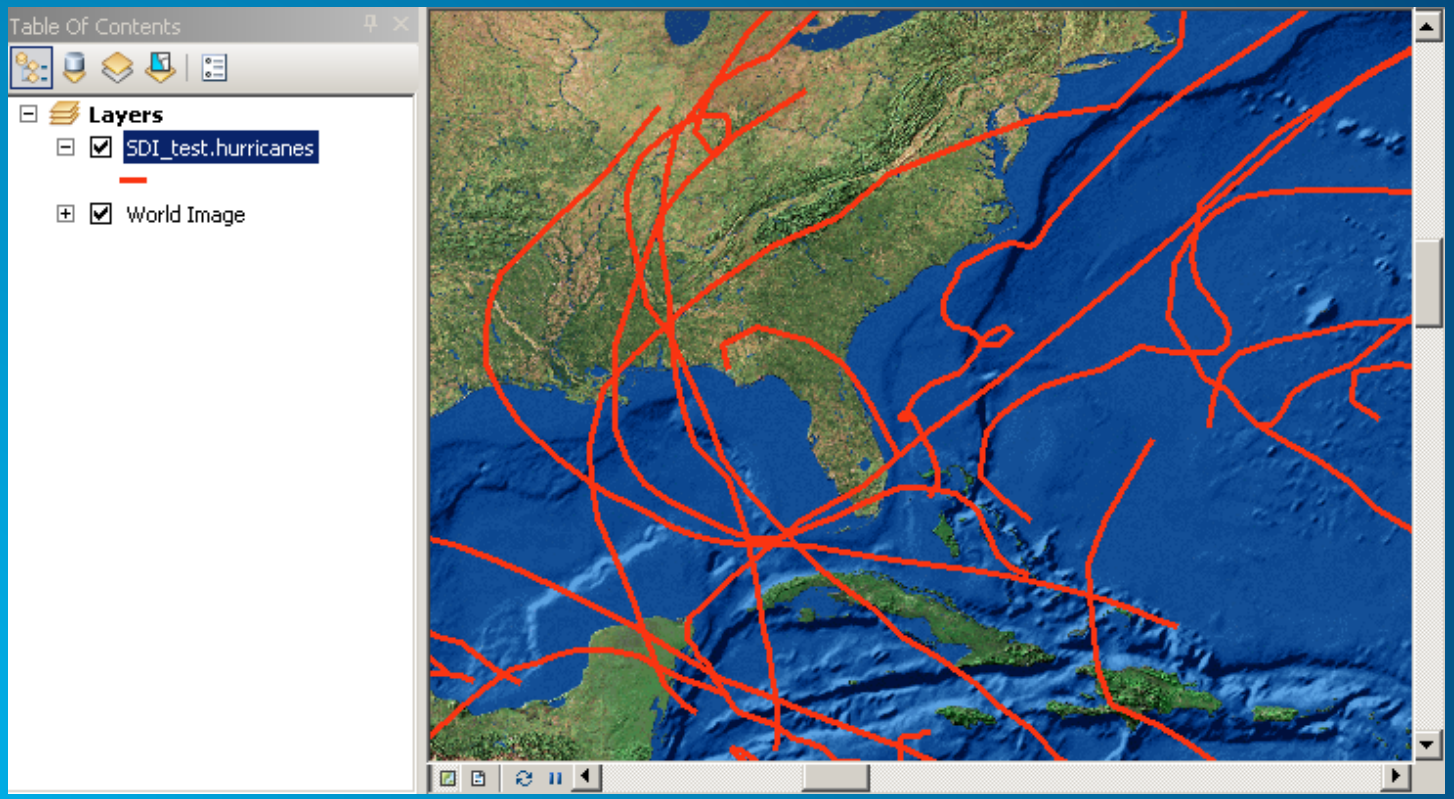
Viewing database data in ArcGIS

- Tables (with and without a spatial type) are viewed in ArcGIS through a query layer
  - Define the layer yourself or let ArcGIS discover how to define it
- Query Layer is a layer that is defined by a SQL query
  - Provide data integration with geodatabases as well as from databases
  - Can quickly integrate spatial and nonspatial information into GIS projects independently of where and how that information is stored

Viewing database data in ArcGIS

- **Simple SQL query**

```
SELECT * FROM dbo.HurricaneTracks_2005 hurricane
```



Viewing database data in ArcGIS

- **Most complex SQL query that uses casting, derived columns and spatial operators**

```
SELECT county.id, county.State_name, county.NAME county_name,
county.POP1990 population, CAST(county.POP1990 as
decimal)/CAST(states.POP1990 as decimal)*100 PctStatePop,
county.Shape FROM dbo.HurricaneTracks_2005 hurricane, dbo.counties
county, dbo.states states WHERE hurricane.NAME = 'KATRINA' AND
hurricane.Shape.STIntersects(county.shape) = 1
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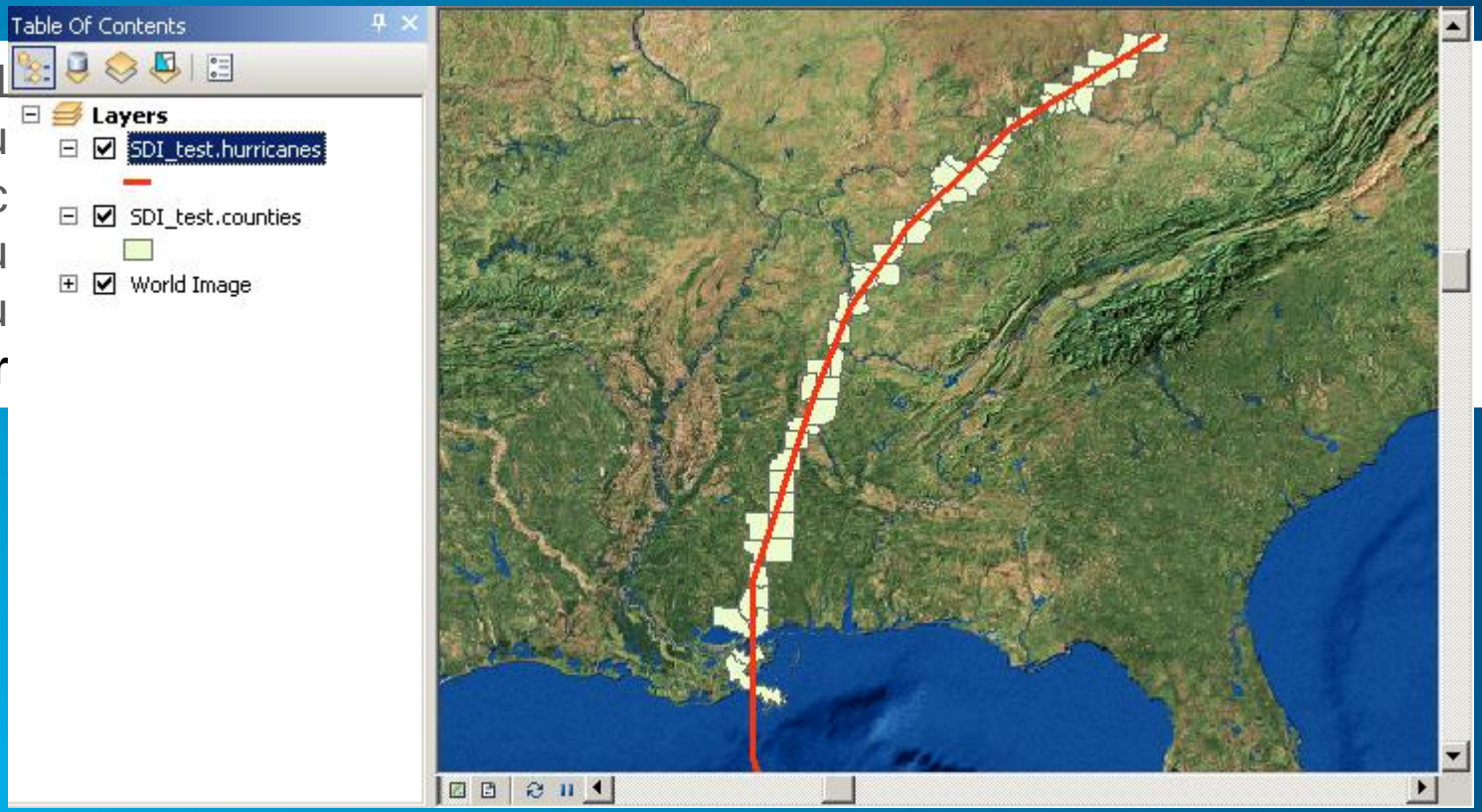


Other Database Tasks

- Connecting to a database
- Supported data types
- Viewing data and query layers
- Administer the database (e.g. grant access)
- Create new tables and alter schema

Building on top of Database Functionality

Cases where you want to do more with your data

- Store business rules with the data so they're available to everyone who accesses the data
- Advanced data modeling such as with transportation or utility networks
- Store and work with detailed cartography
- Multiple editors working on the same data at the same time without impacting each other

What is the Geodatabase?

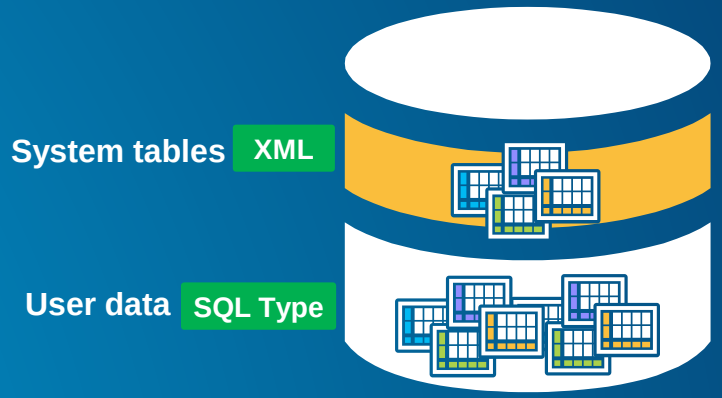
- A physical store of geographic data
  - Scalable storage model supported on different platforms
- Core ArcGIS information model
  - A comprehensive model for representing and managing GIS data
  - Implemented as a series of simple tables
- A transactional model for managing GIS workflows
- Set of components for accessing data

Geodatabase is based on relational principles

- The geodatabase is built on an extended relational database
- Leverages key DBMS principles and concepts to store geographic data as tables in a DBMS
- The core of the geodatabase is a standard relational database schema
  - a series of standard database tables, column types, indexes, and other database objects

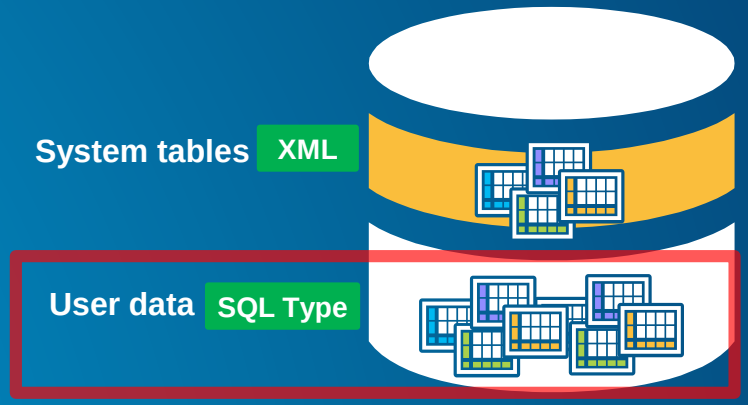
Geodatabase Schema

- There are two sets of tables:
  - Dataset tables (user-defined tables)
  - Geodatabase system tables



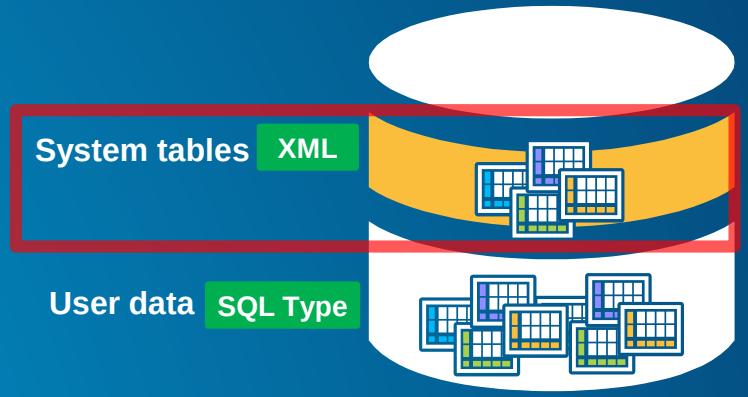
User-defined tables

- Stores the content of each dataset in the geodatabase
- Datasets are stored in 1 or more tables
- Spatial Types enhance the capabilities of the geodatabase
  - SQL access to geometry
  - Industry standard storage model and API

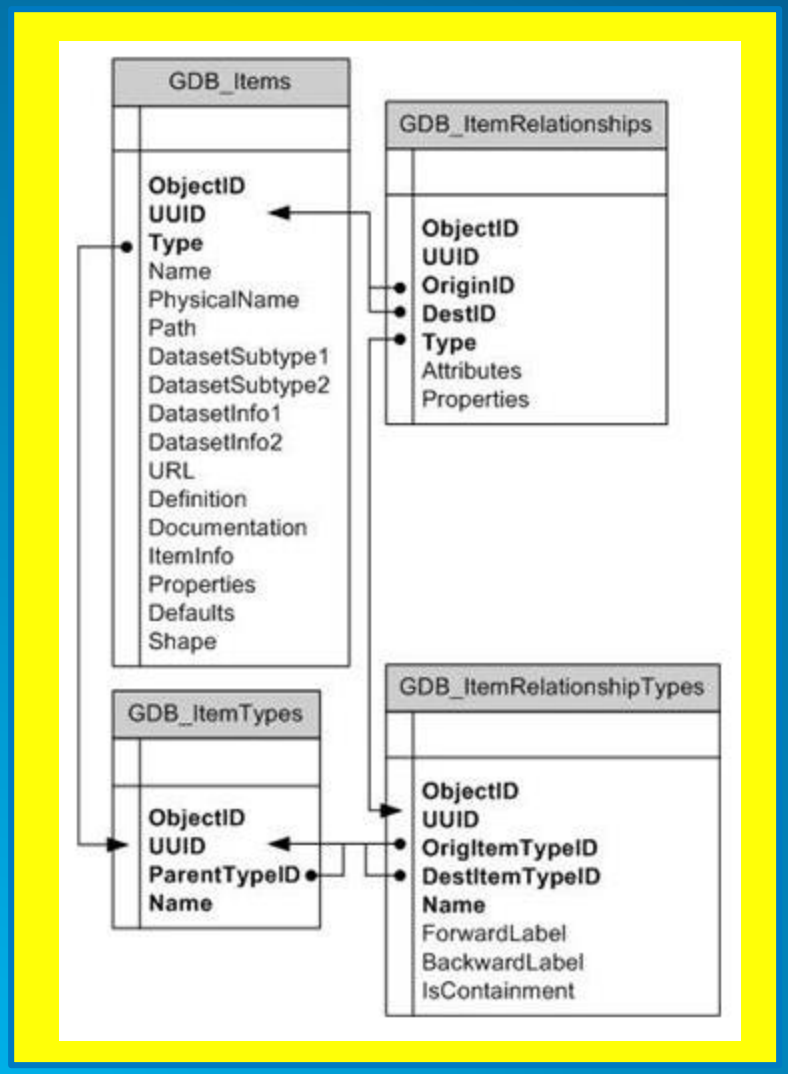


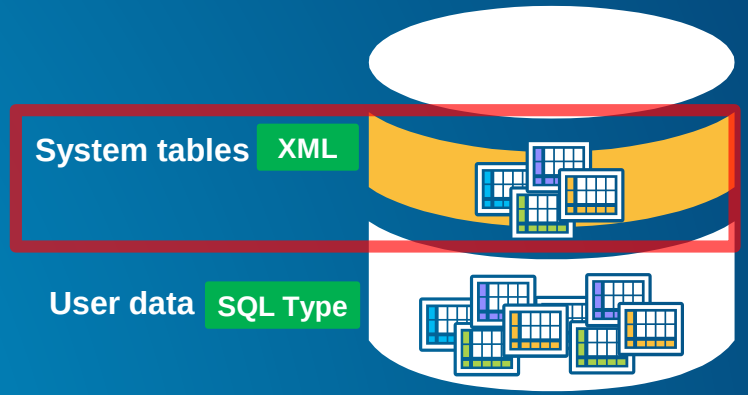
Geodatabase system tables

- System tables store definitions, rules, and behavior for datasets
- Tracks contents within a geodatabase
- 4 main system tables
- Geodatabase schema is stored primarily within an XML field



Geodatabase Schema…





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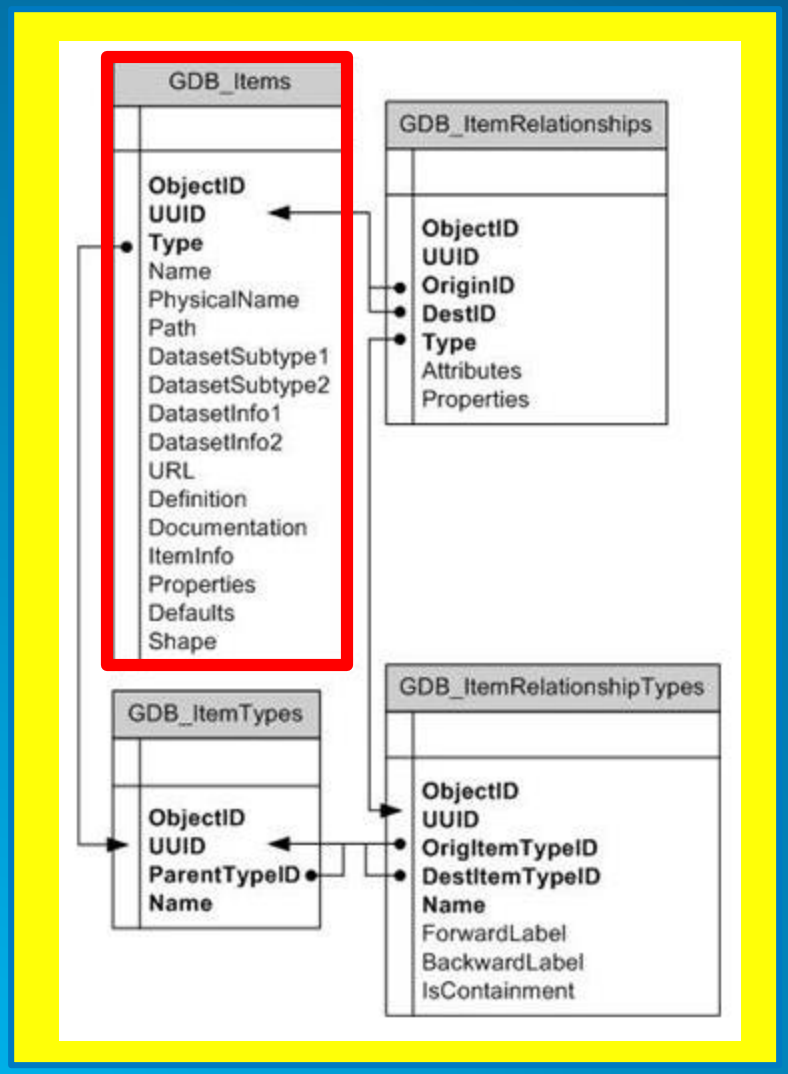

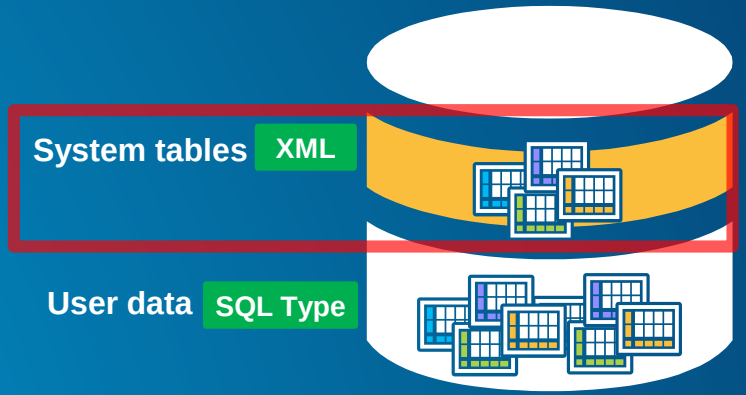

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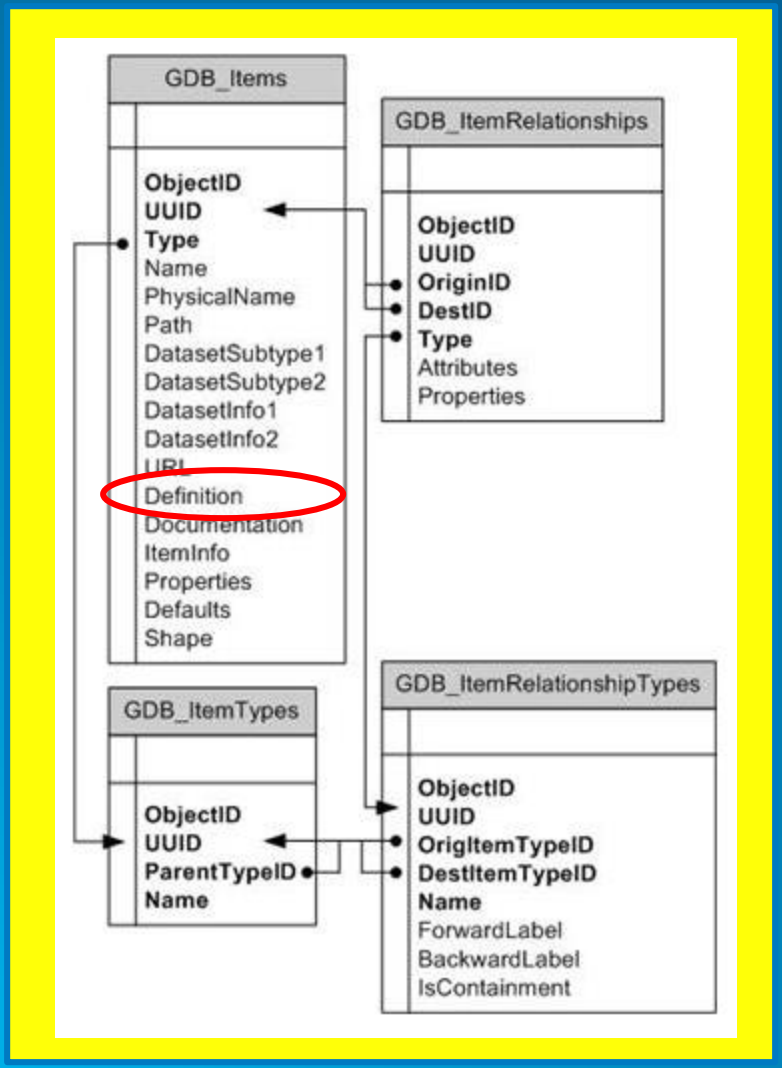

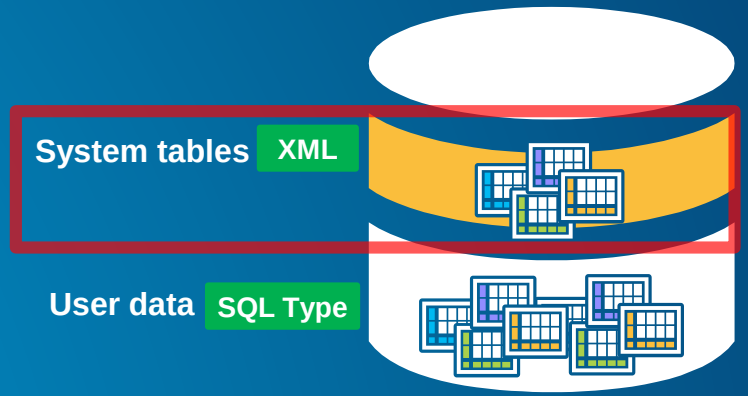

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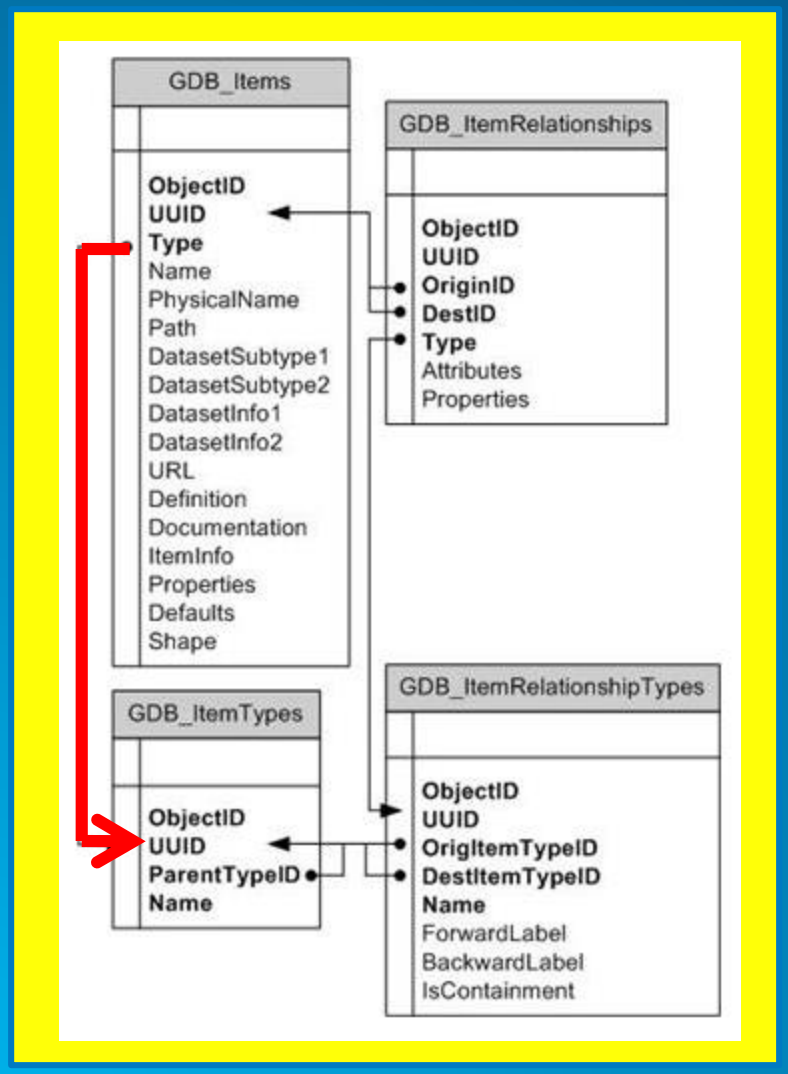

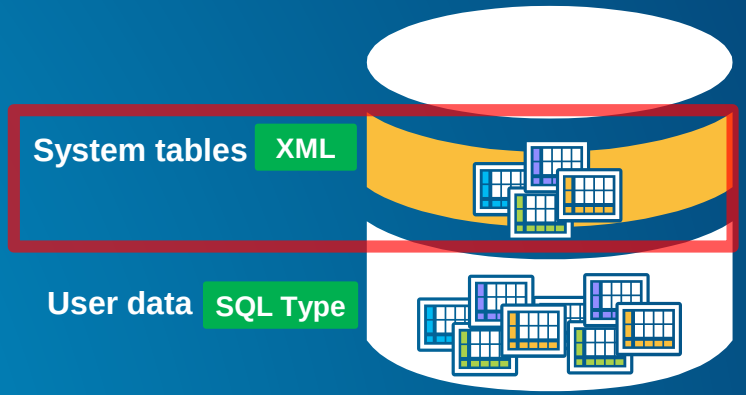

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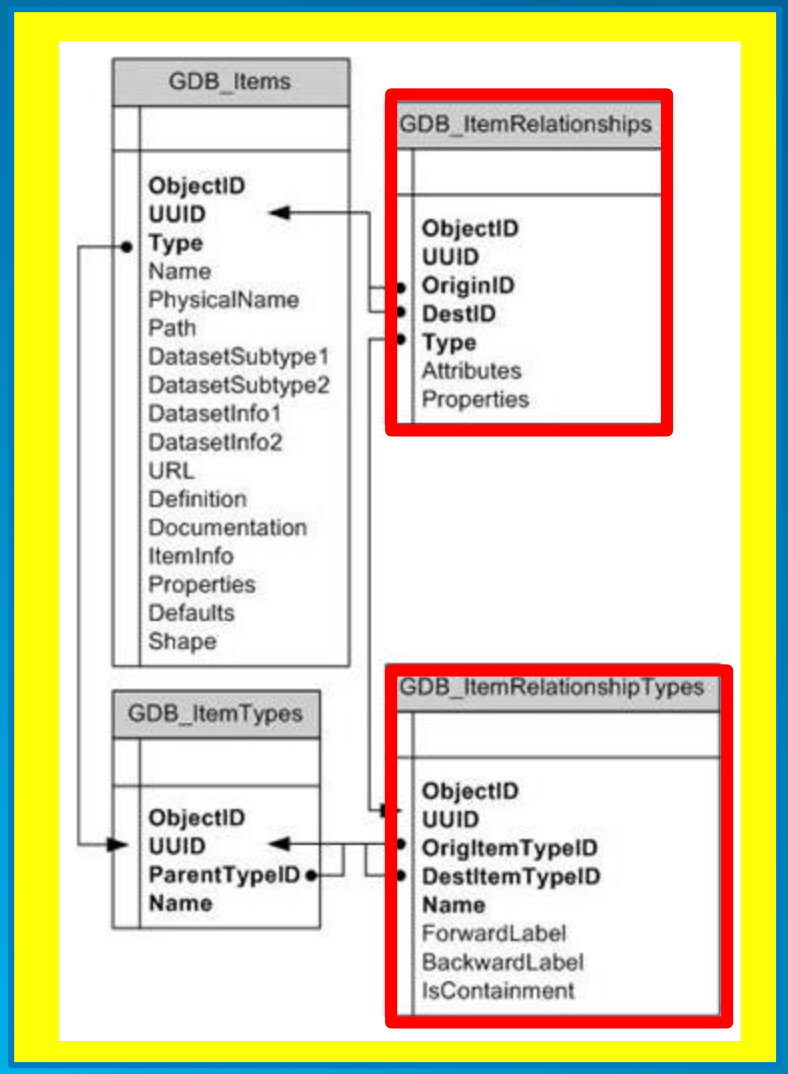
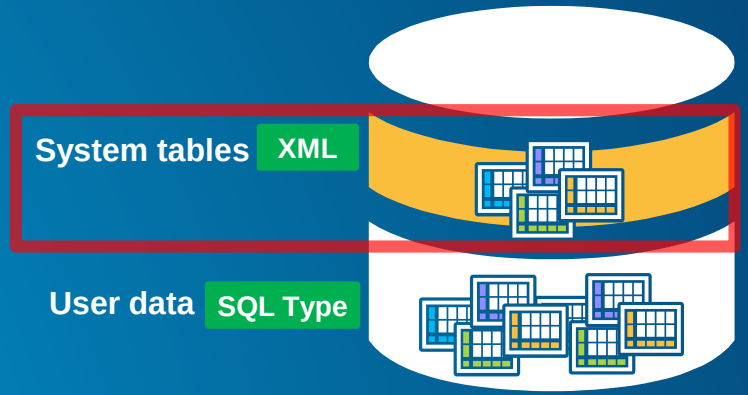


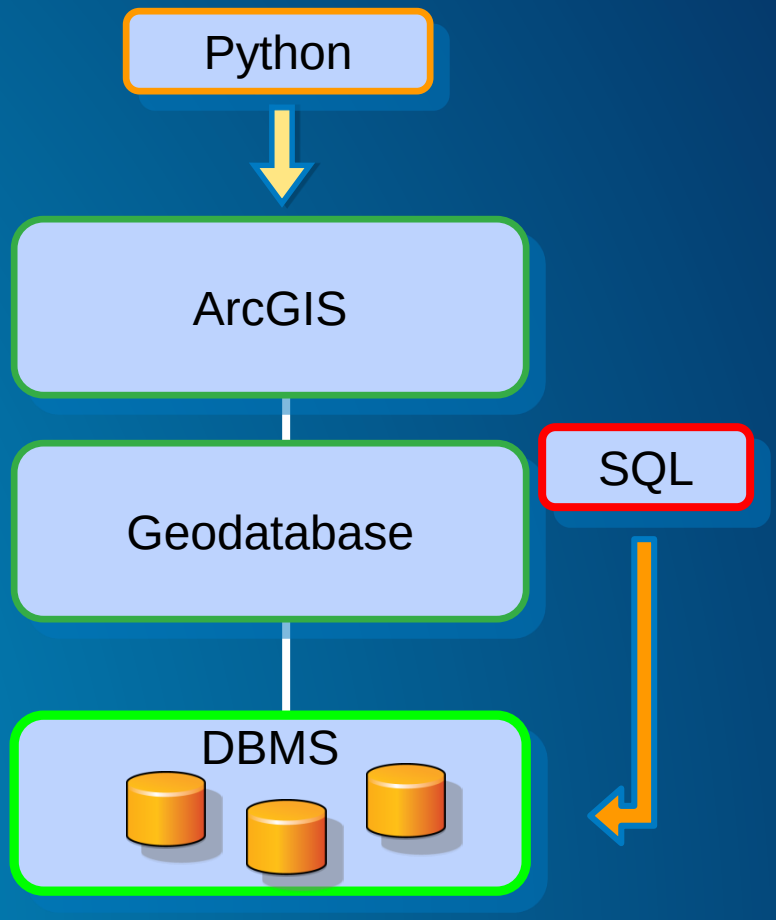


Accessing Geodatabase through SQL

- **Access schema and properties of existing datasets**
  - **Use SQL statements to query the *definition* attribute on the *gdb_items* table**
- **Editing tables/feature classes, whether versioned or not**
  - **Via versioned views with versioned classes**
- **Create tables with SQL containing spatial or raster types**
- **Leverage SQL functions to evaluate attributes and spatial relationships, perform spatial operations, and return and set spatial properties**

Accessing Geodatabase through SQL

- With SQL, you access the data at the DBMS level
  - Bypass behaviors and functionality enforced by the geodatabase or ArcGIS clients
- Need to be aware of what you can and cannot edit
  - Relationship classes
  - Geometric networks
  - Topology…



Demo

Accessing a geodatabase through SQL

- Resolving
  - Coded Value Domains
  - Feature Dataset Relationships
  - Domain References

What is a spatial type?

- A spatial type (ST) is a type that stores geometry data in a single spatial attribute
  - Geometry type, coordinates, dimension, spatial reference
- Spatial Index
  - Access path for quick retrieval
- Relational and geometry operators and Functions
  - Constructors
  - Accessor
  - Relational
  - Geometry

What are the benefits of a spatial type?

- **Efficiency**
  - Spatial data and methods are stored in the database
  - Applications access native dbms type
- **Accessed using common API's and SQL**
  - C, C++, C#, Java, OLEDB
  - Adheres to standards for SQL access

What are the benefits of a spatial type?

- Using SQL with a spatial type you can
  - Create tables with a spatial attribute
  - Read and analyze the spatial data
  - Insert, update, and delete simple geometry data

Spatial Type

SQL

Parcels

OBJECTID *	SHAPE *	PROPERTY_I *	Res	Zoning_simple	SHAPE_Length	SHAPE_Area
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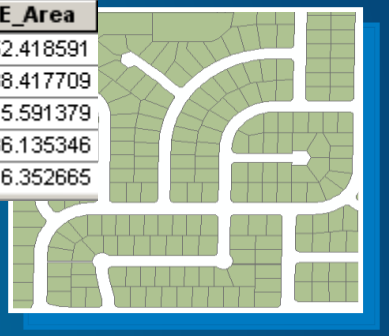


Accessing geodatabase through SQL

- **Can use SQL to create, insert and update tables**
  - **Need to register the table with the geodatabase to participate in geodatabase functionality**

```
CREATE TABLE hazardous_sites
  (oid INTEGER NOT NULL, site_id INTEGER,
   name VARCHAR(40), location sde.st_geometry)
```

- **Cannot modify schema of registered tables (i.e add a field) or create geodatabase items (i.e domains) through SQL**

Accessing Geodatabase through SQL

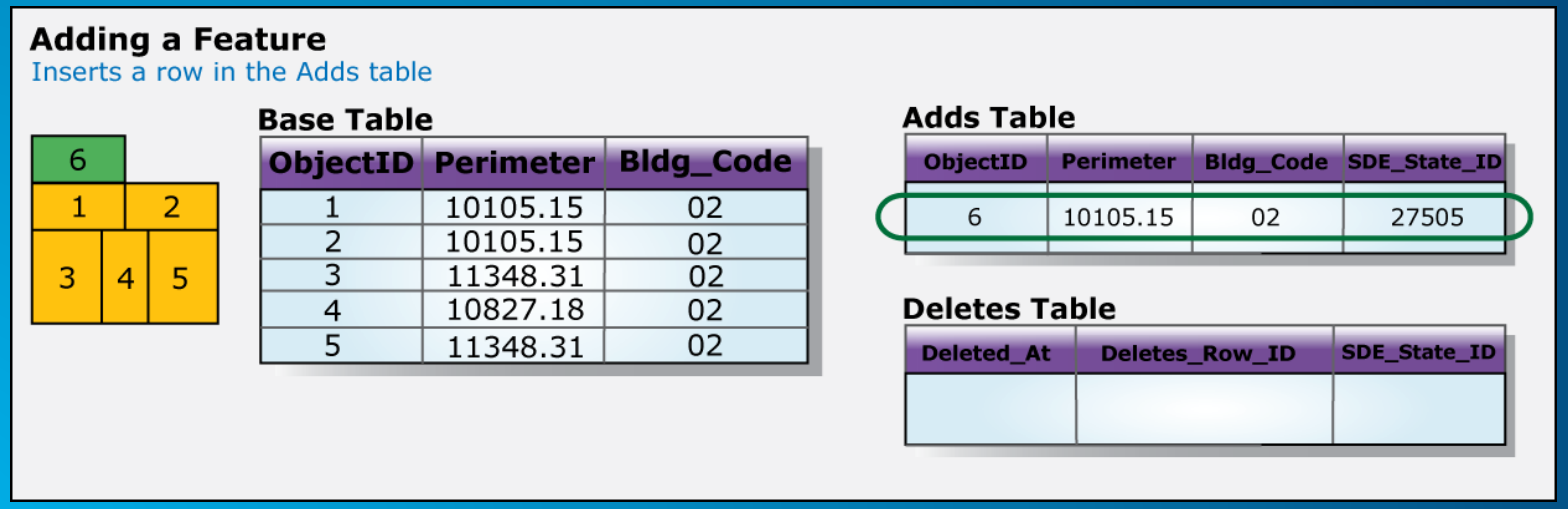
- **Editing feature classes with SQL and spatial type**
  - **Simple features (Points, lines, polygons)**
  - **Without geodatabase behavior**
  - **Use the Is_Simple function to determine whether your data can be updated**
- **Editing tables/feature classes**
  - **Use SQL SELECT statements**
  - **Directly editing the database tables (no delta tables)**
  - **Non-versioned editing in ArcGIS terminology**
- **Editing versioned tables/feature classes**
  - **Requires versioned views**

Editing tables/feature classes

- Use SQL to update, insert and delete data from tables that are not versioned
- Can leverage DBMS functionality
  - Unique indexes, constraints, referential integrity, default values, triggers
- Requires a unique identifier (ObjectID) when inserting
  - Used to uniquely identify rows in tables in a geodatabase
  - Obtained from classes sequence or procedure
  - Object ID is used by ArcGIS to do such things as display selection sets and perform identify operations on features

Editing versioned tables/feature classes

- Changes tracked on delta tables (Adds and Deletes tables)
- Support concurrent editing with long transactions (hours/days)
- Undo/redo editing experience
- No locking or data extraction required



Editing versioned tables and feature classes

- Use versioned views
  - Created when data registered as versioned with ArcGIS 10.1 and later
  - Conditions where no view is present; use the “Enable SQL Access” command.
- Must use several stored procedures/commands installed with the geodatabase
  - Create a new version (create_version)
  - Set which version to access (set_current_version)
  - Perform edits within the new version (edit_version)
- Unlike non-versioned editing, ObjectID values for new records are automatically generated
  - Changes are made to the delta tables
  - Versions must be reconciled through ArcGIS

Demo

Accessing a geodatabase through SQL

- **Editing**
  - **Versioned and Non Versioned Classes**
  - **Working with Views**

What's new in ArcGIS 10.3?

- Nine tools added to the Geodatabase Administration toolset for enterprise geodatabase management
  - Replace functionality previously performed using ArcSDE administration command line utilities.
- Configure Geodatabase Log File Tables
- Create Raster Type
- Delete Schema Geodatabase
- Diagnose Version Metadata
- Diagnose Version Tables
- Export Geodatabase Configuration Keyword
- Import Geodatabase Configuration Keyword
- Repair Version Metadata
- Repair Version Tables

Summary

- **GDB is open to SQL Devs**
- **Through SQL use XML field in the GDB_Items table**
- **Can also edit data through SQL**