

**Esri Developer Summit**

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# Accessing Your Enterprise Geodatabase through SQL

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# Assumptions

- **Intermediate knowledge of SQL and relational databases**
- **Intermediate knowledge of the geodatabase**
- **We'll hold all questions until the end**

*Please turn off cell phones*



# Agenda

- **RDBMS support in ArcGIS**
- **Geodatabase and its system tables**
- **Demo - Querying geodatabase schema**
- **Leveraging spatial functions**
- **Demo - Spatial analysis using SQL**
- **Editing geodatabase feature classes from SQL**
- **Discovery functions**
- **Demo - Editing versioned and non versioned feature class**
- **Summary of dos and don'ts**

# ArcGIS Supports Multiple Implementation Patterns

- Leveraging Common Computing Architecture



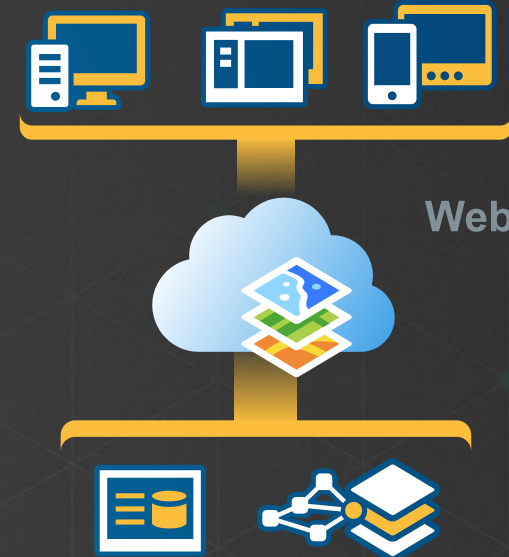
File Based



Database Centric



Server Centric



Web Centric

Web GIS

# Accessing data in a DBMS

- **You can access spatial or non-spatial data in a DBMS to use in ArcGIS**
- **Geodatabase**
  - Supported on DB2, Informix, Oracle, PostgreSQL, SQL Server
- **Database**
  - Simple feature access
  - Supported on ALTIBASE, Dameng , DB2, Informix, Netezza, Oracle, PostgreSQL, SAP HANA, SQL Server, Teradata

## **A geodatabase is built on top of database functionality**

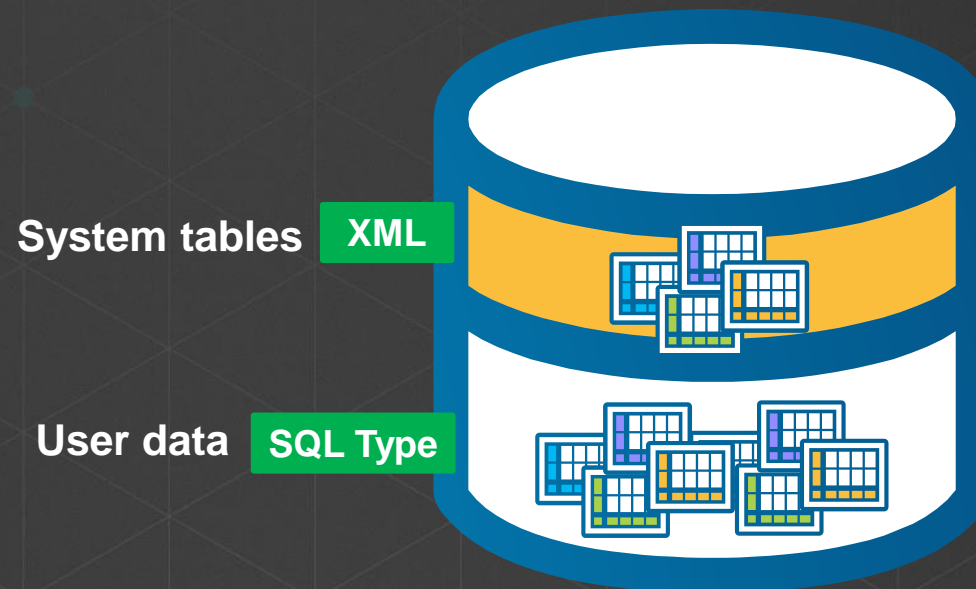
- **When you want to do more with your data**
- **Store business rules with the data so they're available to everyone who accesses the data**
- **Advanced data modeling like transportation or utility networks**
- **Store and work with detailed cartography**
- **Multiple editors working on the same data at the same time without impacting each other.**

# Geodatabase is based on relational principles

- **The geodatabase is built on a relational database**
  - **Functionality consistent across each enterprise DBMS**
- **Database provides:**
  - **Storage of geographic data in tables**
  - **Extended functionality and data integrity**
- **Application logic provides:**
  - **GIS integrity and behavior**
  - **Business rules, topology, networks, etc.**

# Geodatabase schema

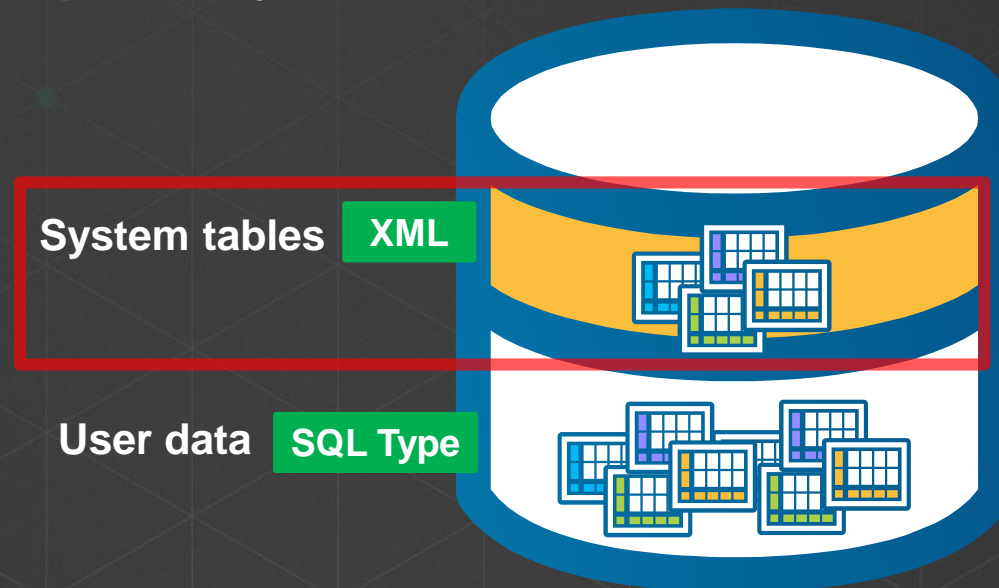
- There are two sets of tables
  - Dataset tables (user-defined)
  - Geodatabase system tables (schema is controlled by ArcGIS)



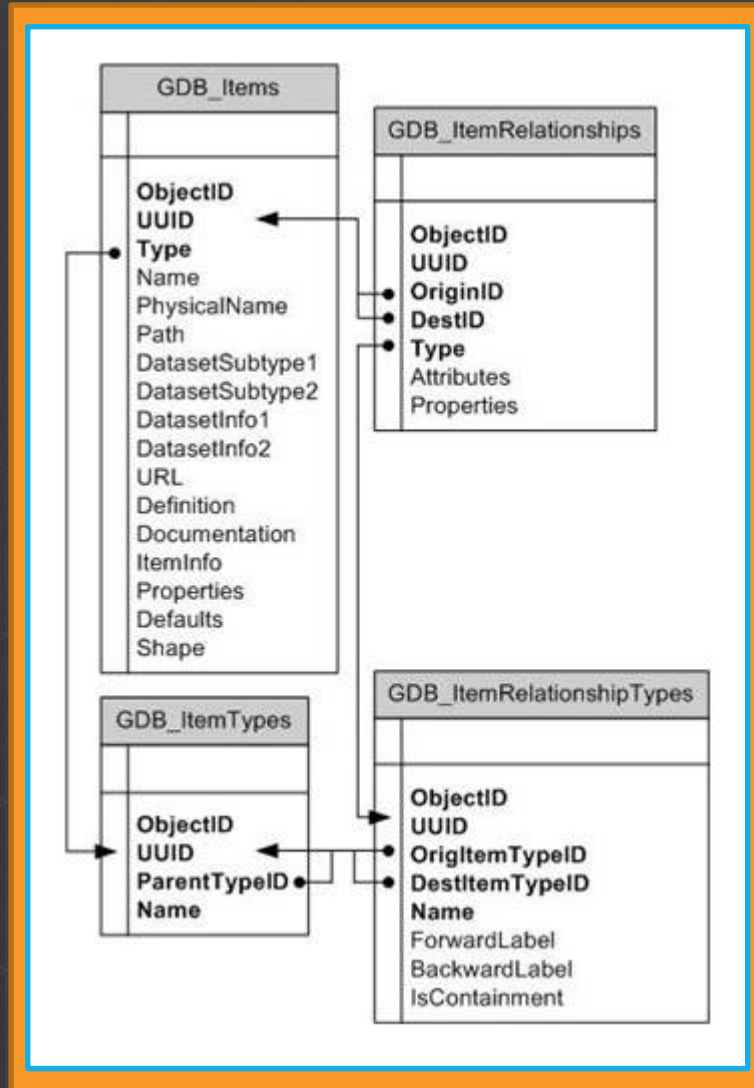


# Geodatabase system tables

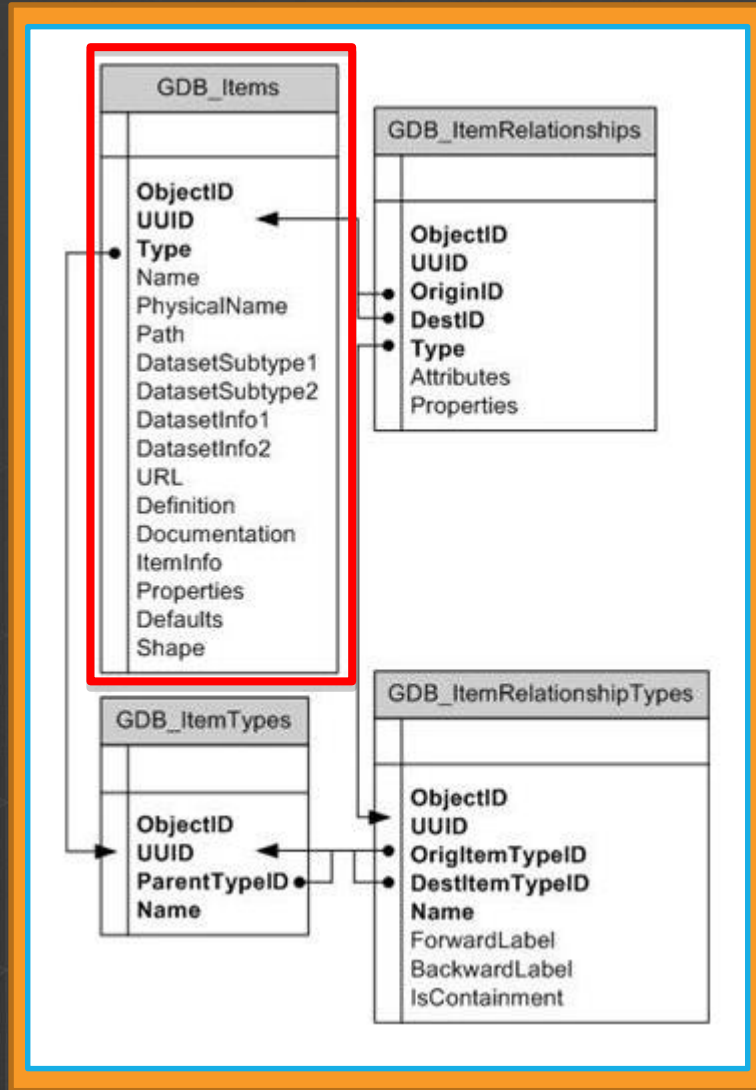
- System tables store definitions, rules and behavior for datasets
- Tracks contents within a geodatabase
- 4 main system tables
- Geodatabase schema is stored primarily within an XML field



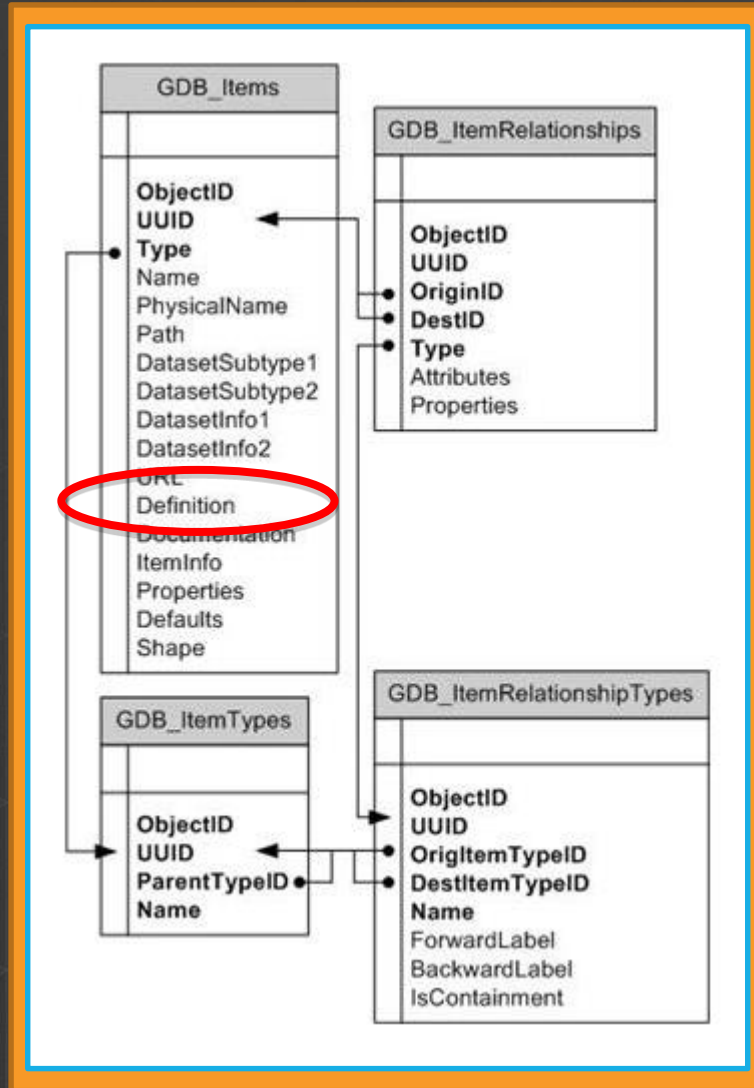
# Geodatabase schema



# Geodatabase schema

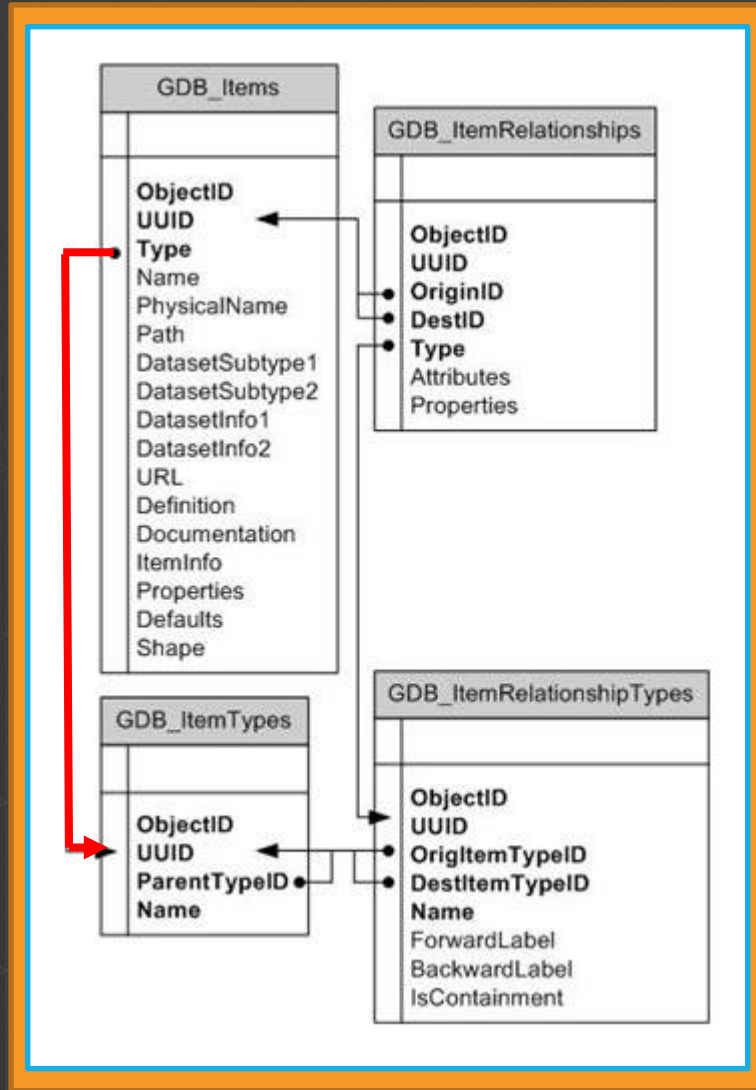


# Geodatabase schema

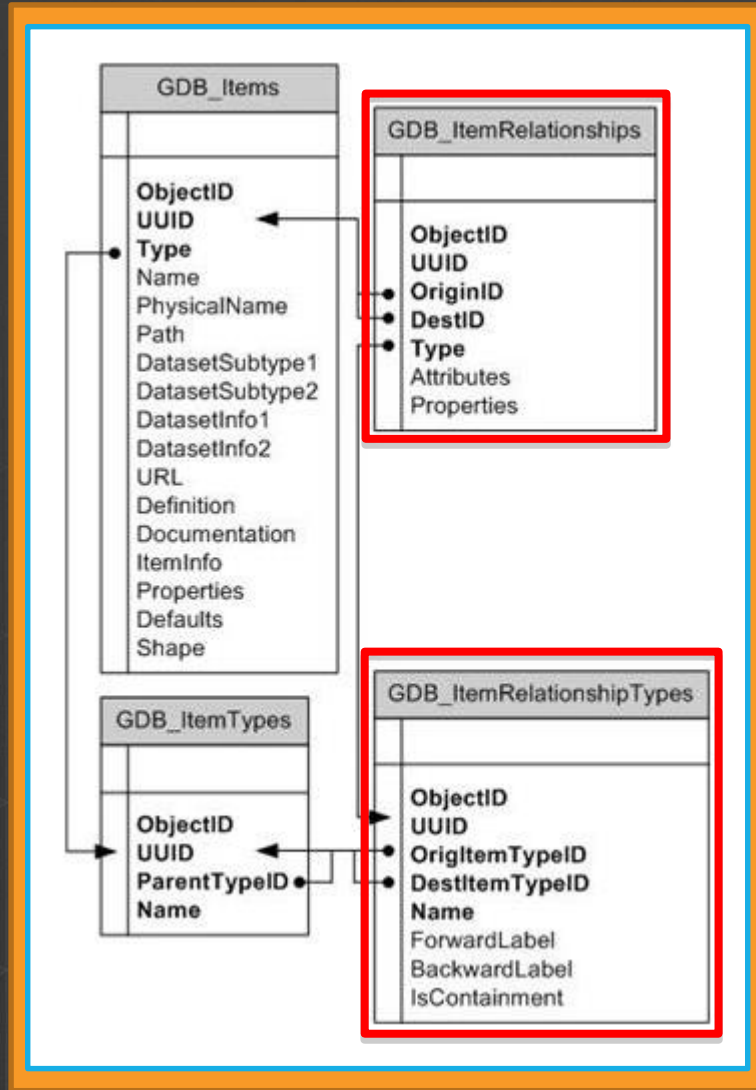


- SQLServer, PostgreSQL and DB2 are native xml types.
- Oracle and Informix use ArcSDE xml

# Geodatabase schema



# Geodatabase schema

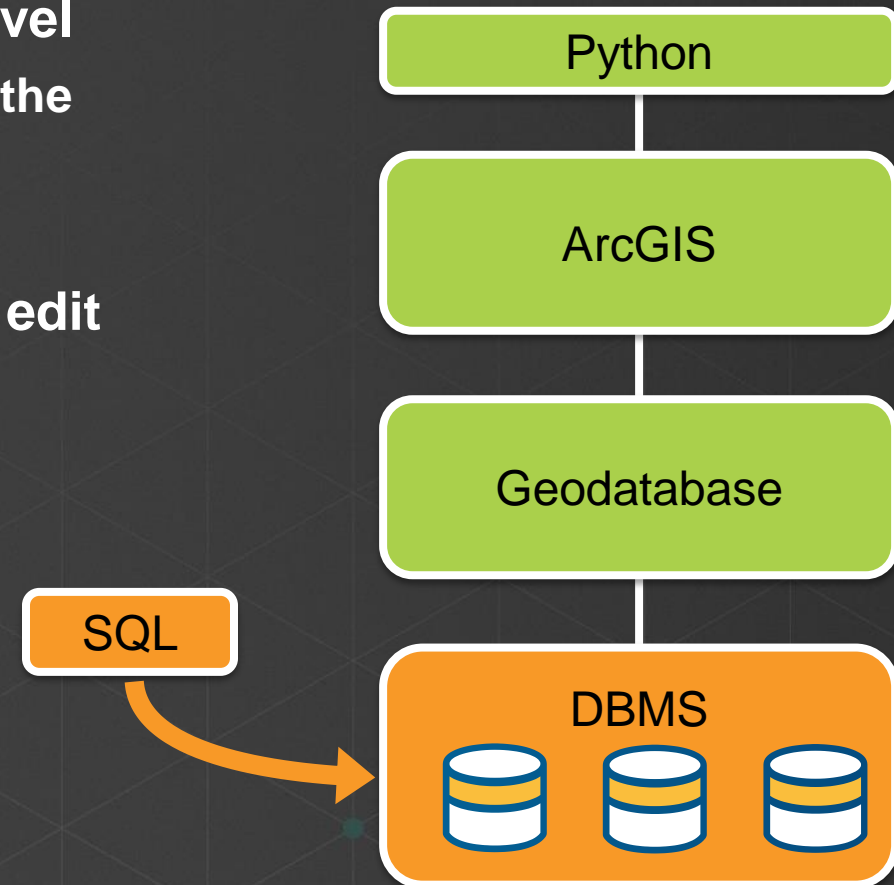


# Accessing your geodatabase using SQL

- **Access schema and properties of existing datasets**
  - Use SQL statements to query the *definition* field on the *gdb\_items* table
    - Oracle and Informix use *Gdb\_Items\_vw*
- **Editing tables/feature classes, whether versioned or not**
  - Use versioned views with versioned classes
  - Use archive views with archived classes
- **Create tables with SQL that contain spatial or raster types**
- **Leverage SQL functions to evaluate attributes and spatial relationships, perform spatial operations, and return and set spatial properties.**

# Accessing your geodatabase using 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...





# Querying the geodatabase schema

- Look at system tables
- Query geodatabase contents



# Querying geodatabase user-data

- **Why use SQL when I have a GIS?**
  - **Use power of dbms engine to query and analyze your data**
  - **DBMS spatial methods for performing spatial analysis**
  - **Bridge between GIS and Business Intelligence / Insights**
  - **Sometimes you want a single result, and not a map**

# What is a spatial type?

- **A type that stores geometry data in a single spatial attribute**
  - Geometry type, coordinates, dimension, spatial reference
- **Spatial index**
  - Improves spatial searches
- **Relational and geometry operators and functions**
  - Constructors – creates new geometry
  - Accessor – return property of a geometry
  - Relational – perform spatial operations
  - Geometry – transform from one geometry to another

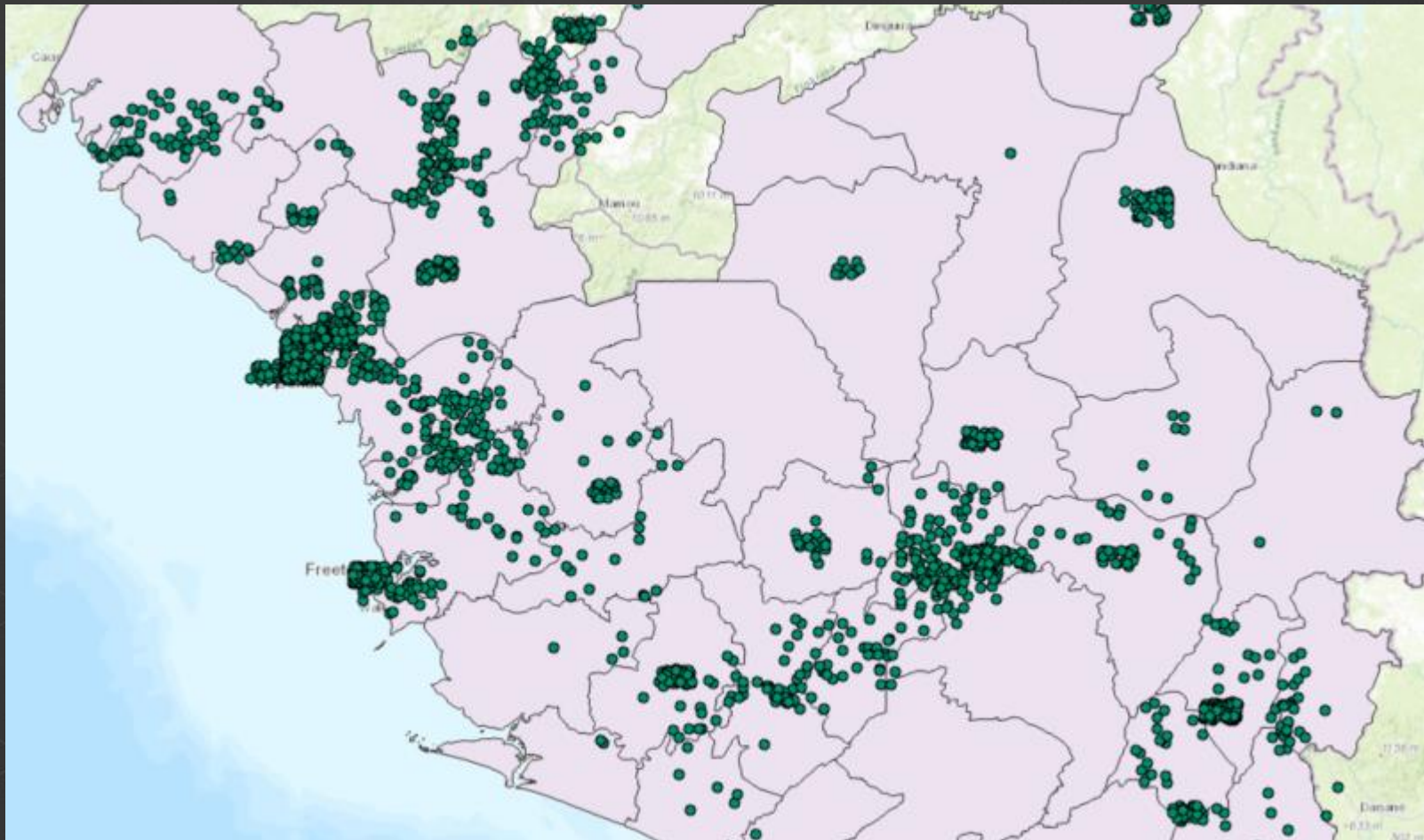
# Benefits of a spatial type

- **With SQL and a spatial type you can**
  - Create tables with a spatial attribute
  - Read and analyze spatial data
  - Insert, update and delete **simple** features
- **Enhances efficiency**
  - Data and methods are stored in the database
  - Applications access native dbms type
- **Access using common APIs and SQL**
  - Standard functions
  - Well-known interchange formats

# Viewing database data in ArcGIS

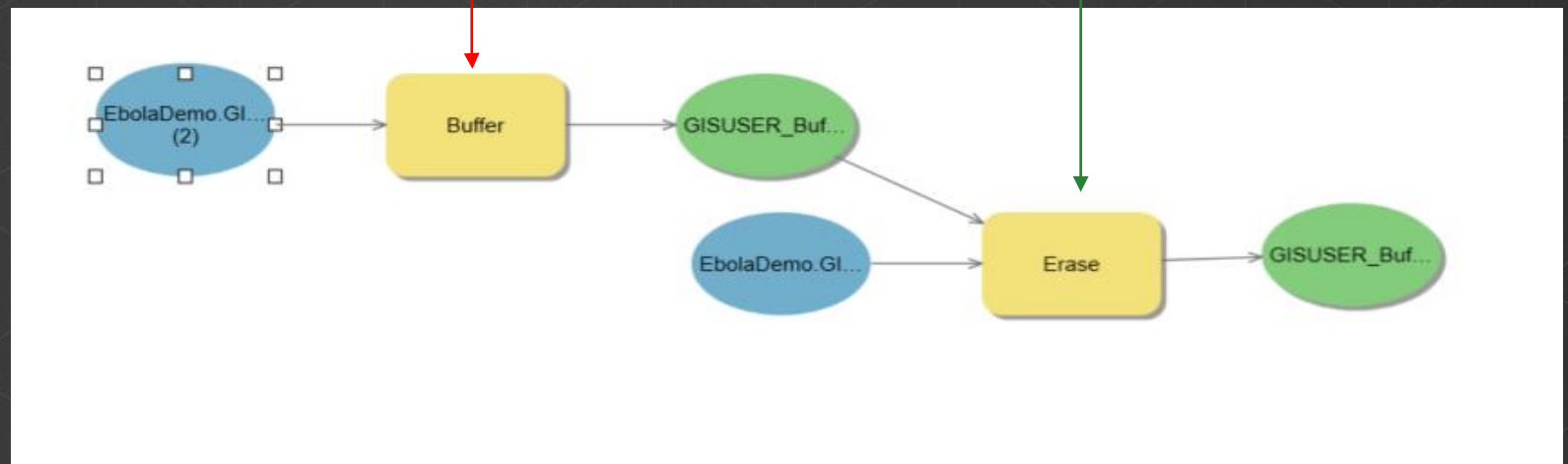
- Simple SQL query

```
SELECT OBJECTID, Shape FROM GisUser.EbolaCases
```



# Viewing database data in ArcGIS

```
SELECT GLOBAL_ADM
,Shape = diff.Shape.STIntersection(Boundaries)
,Boundaries
FROM (
  -- Difference Polygons (1 for each buffer)
  SELECT GLOBAL_ADM
  ,Shape = Boundaries.STDifference(Buffers)
  ,Buffers
  ,Boundaries
  FROM (
    -- Treatment Center Buffers Western Sierra Leone
    SELECT etc.OBJECTID
    ,a2.GLOBAL_ADM
    ,Buffers = etc.Shape.STBuffer(.025)
    ,Boundaries = a2.Shape
    FROM GisUser.EBOLA_TREATMENT_CENTERS etc
    JOIN GisUser.CASES_AT_ADMIN2_LEVEL a2
    ON a2.Shape.STIntersects(etc.Shape) = 1
    WHERE a2.GLOBAL_A_3 = 'SIERRA LEONE'
    AND a2.GLOBAL_A_2 = 'WESTERN AREA'
  ) buffers
)
```



# DBMS Analytics

- Querying geodatabase data
- Spatial methods



# Creating geodatabase feature classes using SQL

- Use SQL to create and populate tables

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

- Need to register the table with the geodatabase to participate in geodatabase functionality
- Once registered, you cannot modify table schema (e.g. add a field) through SQL
  - DML is okay, DDL is not okay



# Editing geodatabase feature classes using SQL

- What can you edit?
  - Simple features (points, lines, polygons)
  - Without geodatabase behavior
  - Use the *Is\_Simple* function to determine whether your data can be edited
- Editing non-versioned tables
  - Edit tables directly
- Editing versioned tables
  - Edit special *versioned view* instead of tables

# The ObjectID field

- Every geodatabase feature class or table has an ObjectID field
  - Unique, not null integer
- Value is generated and maintained by ArcGIS
- Non-versioned inserts
  - Use *RowID\_Name* to determine name of ObjectID field
  - Use *Next\_RowID* function to obtain next ObjectID value
- Versioned inserts
  - ObjectID obtained automatically by versioned view
- Never *update* an ObjectID field

# Editing versioned tables and feature classes

- **Versioning**
  - Supports concurrent editing with long transactions
  - Undo/redo experience
  - No locking or data extraction required
- **All changes written to delta tables**
  - Adds (a) table and Deletes (d) table
- **Edits are assigned an identifier (state\_id)**
- **A version references a lineage of state\_ids**

# Versioned views

- **Specialized view to work with versioned data using SQL**
  - **Uses stored procedures, triggers and functions to access and edit versioned tables**
- **Result set is based on versioned query**
- **Created on a single versioned table, contains all columns**
- **Created automatically when feature class or table is versioned**
- **Versioned must be reconciled through ArcGIS**

# Discovery Functions

- **Is\_simple** – returns false/true or not registered with Geodatabase
- **Is\_Versioned** - returns false/true or not registered with Geodatabase
- **Version\_View\_Name** - returns the name of the versioned view defined on that table
- **Is\_Archive\_Enabled** - determines if the specified table has been enabled for archiving.
- **Archive\_View\_Name** – returns name of the archive view on a nonversioned, archive-enabled table
- **Is\_Replicated** - returns false/true
- **Geometry\_Columns** - returns the name of all spatial columns in the table that is not registered with Geodatabase
- **GlobalID\_Name** - returns the name of the global ID field in the table.
- **RowID\_Name** returns the name of a table's ObjectID (or RowID) field

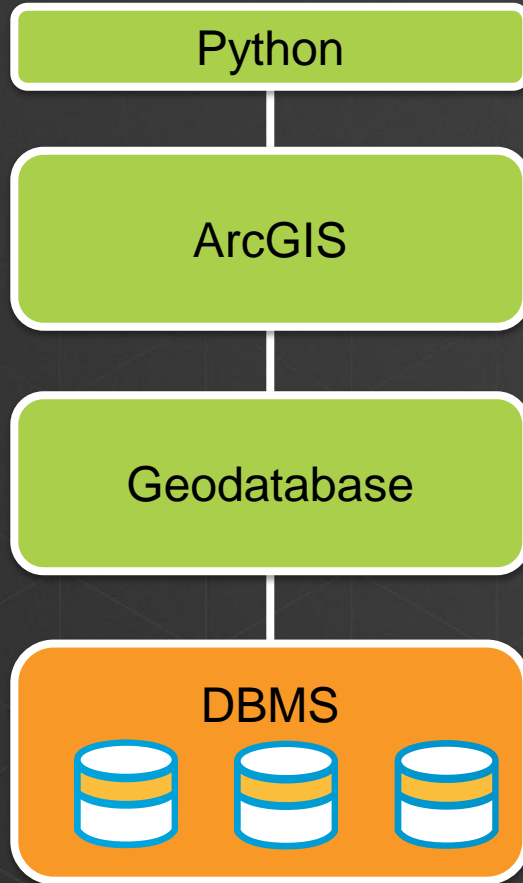
Demo

# Editing

Discovery functions  
Non-versioned edits  
Versioned view edits



# Guidelines for using SQL and the geodatabase



- **Understand the geodatabase system tables and their structure**
- **Avoid changing data that affects geodatabase software level behavior**
- **Geodatabase awareness**
  - You have it
  - The database does not

# Guidelines for using SQL and the geodatabase

- **Do perform spatial operations**
- **Do query spatial and attribute information**
- **Do INSERT, UPDATE and DELETE geometries**
  - **As long as you pay attention to behavior**
- **Do INSERT, UPDATE and DELETE attribute data**
  - **As long as you pay attention to behavior**
- **Do write efficient SQL**



# Guidelines for using SQL and the geodatabase

- DO NOT update the objectid (row\_id) value
- DO NOT modify geometries for feature classes participating in
  - Topologies, geometric networks, network datasets, terrains, parcel fabrics, geodatabase replication, schematic datasets, feature-linked annotation...
- DO NOT update attributes that define geodatabase behavior
  - Enable/Disabled attributes, ancillary attributes, weight attributes...
- Use *Is\_Simple* to check

# Resources

- **Comprehensive documentation covering**
  - Accessing dataset properties
  - Editing geodatabase data
  - Esri spatial and raster type reference
- **Get started at:**
  - <http://desktop.arcgis.com/en/desktop/latest/manage-data/using-sql-with-gdbs/sql-and-enterprise-geodatabases.htm>
- **Ebola Project:**
  - <http://ebolaresponse.maps.arcgis.com/home/>
  - <http://home.ebolaresponse.opendata.arcgis.com/>

## Online survey

- Please give us your feedback in the Esri Events app:

<http://www.esri.com/events/eventsapp>

