Introduction to ArcGIS I

سیستمی زانیاری جیۆگرافی

Prepared By:
Vian Hama-Amen Qadir
Civil Engineer_GIS Specialist

Explore GIS concept…

Spatial: is answering where something has a location on the earth.

GIS چی یە؟

سیستمێکە کە شوێنەکان Location دەبەستێتەوە بەو زانیاری یانەی کە هەیانە attribute information وە بۆ پیشان دانی بەو شێوە و ڕەنگەی کە ئەتەوێت و دروست کردنی پەیوەندی لە نێوانیاندا وە شیکاری کردن لە سەری بۆ بینینی ئەم شیکاریانە بە ڕوانگەیەك کە ناتوانرێت لە خشتەیەکی سادە یان نەخشەیەکی سەر کاغەزدا ببینرێت.

GIS Geographic Information Systems

A Definition of GIS

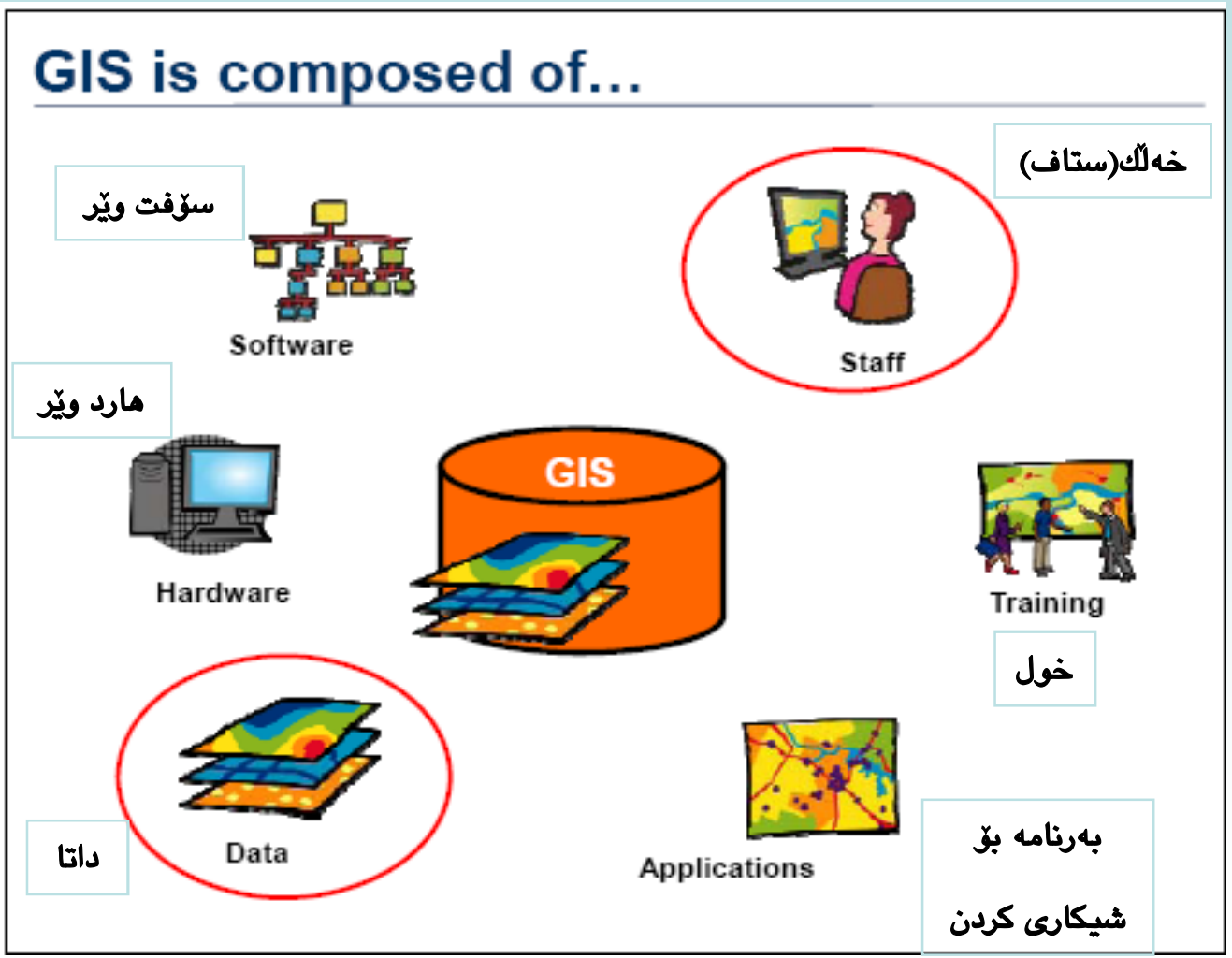
A Geographic Information System (GIS)

links locational and attribute information and enables a person to visualize patterns, relationships, and trends. This process gives an entirely new perspective to data analysis that cannot be easily seen in a table or list format or on a paper map.

- Exploring data using GIS turns data into information into knowledge
- All about GIS system http://esri .com

سیستمی زانیاری یە جیۆگرافی یەکان لە چی پێك دێت؟

- **GIS** بریتی یە لە یەك گرتنی ئەم ٥ پێك هاتەیە:



١. خەڵك (ستاف)
٢. داتا
٣. سۆفت وێر
٤. هارد وێر
٥. شیکاری کردن

بۆ **پلان دانان**

GIS Function

کاری GIS چی یە؟

GIS Function

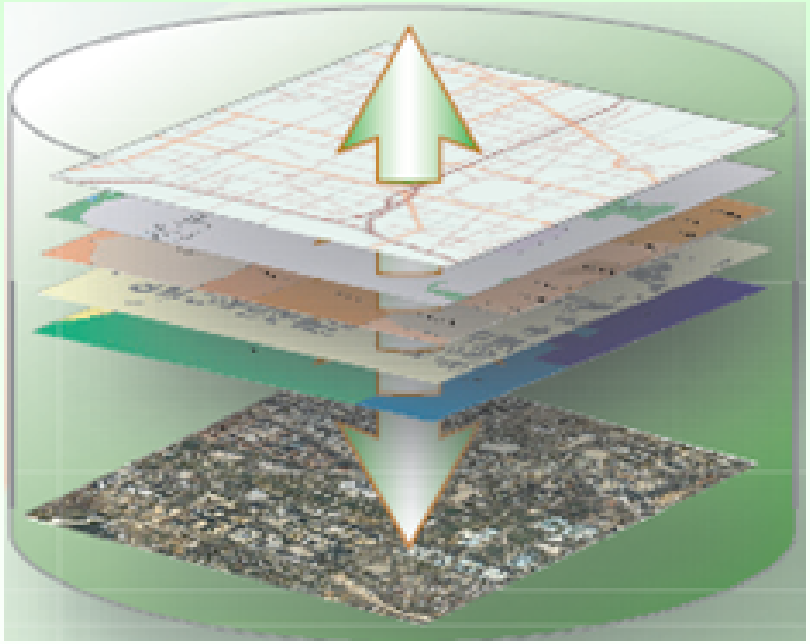
- Capture کۆکردنەوەی داتا
- Store (RDBMS) خەزن کردن
- Query گەڕان
- Analyze شیکاری کردن
- Display پیشاندان
- Output نەخشەی کۆتایی

GIS** is Model Geographic information using **RDBMS

***RDBMS** = Relational Database Management System*

GIS Extract Layers from Reality

Here we modify the reality in Layers

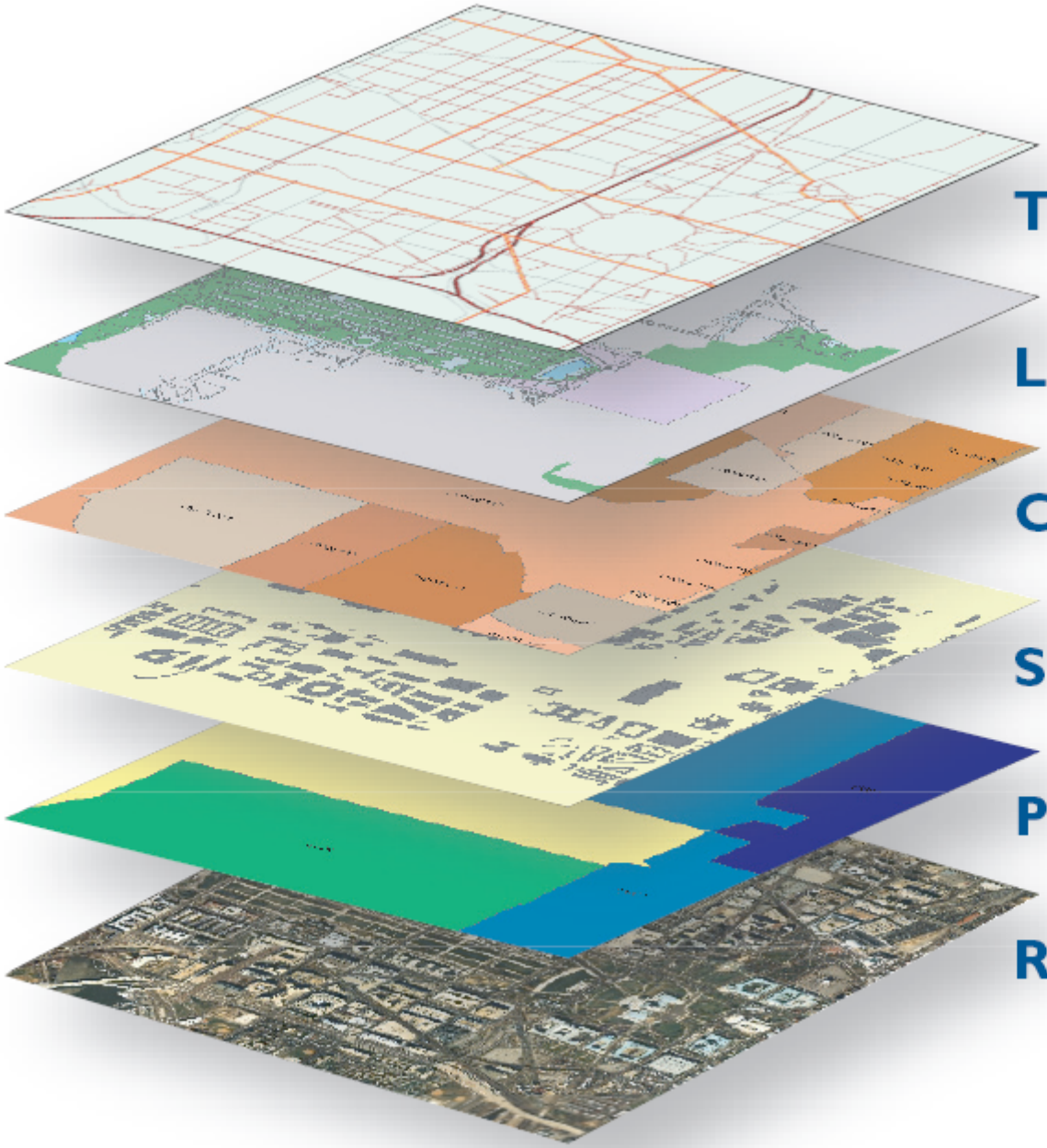


Layers

Reality

Existing nature

واقع حال


Transportation
Land Use
Census Tracts
Structures
Postal Codes
Raster Imagery

A Complete GIS

Visualization

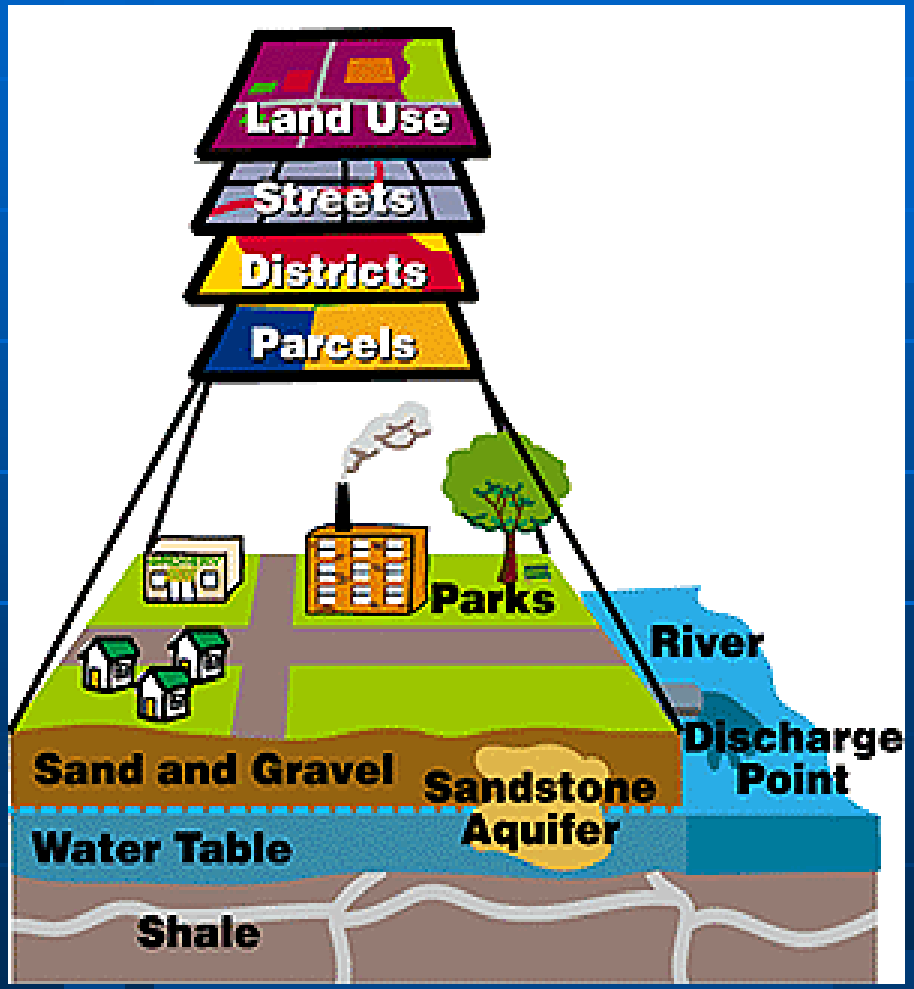
- GIS is used to display spatial data as a map

Database Management

- GIS is used to store data in (RDBMS) and organize spatial data

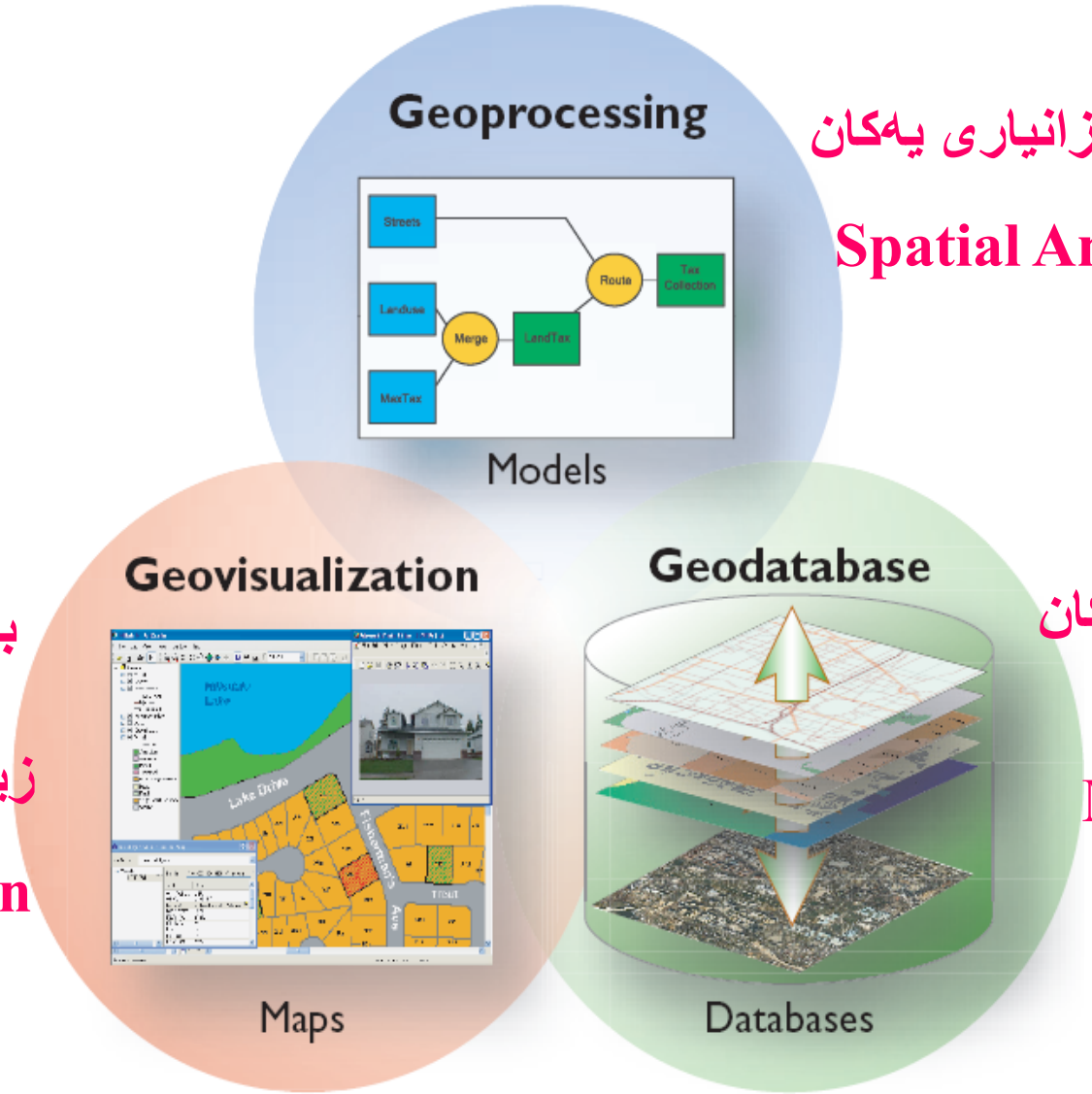
Spatial Analysis

- GIS is used to analyze and interpret spatial data



THE THREE VIEWS OF A GIS:

سێ ڕوانگەی هەیە GIS



شیکاری زانیاری یەکان

Spatial Analysis

بینین لە ڕێگەی نەخشە

زیرەکەکانی GIS

Visualization

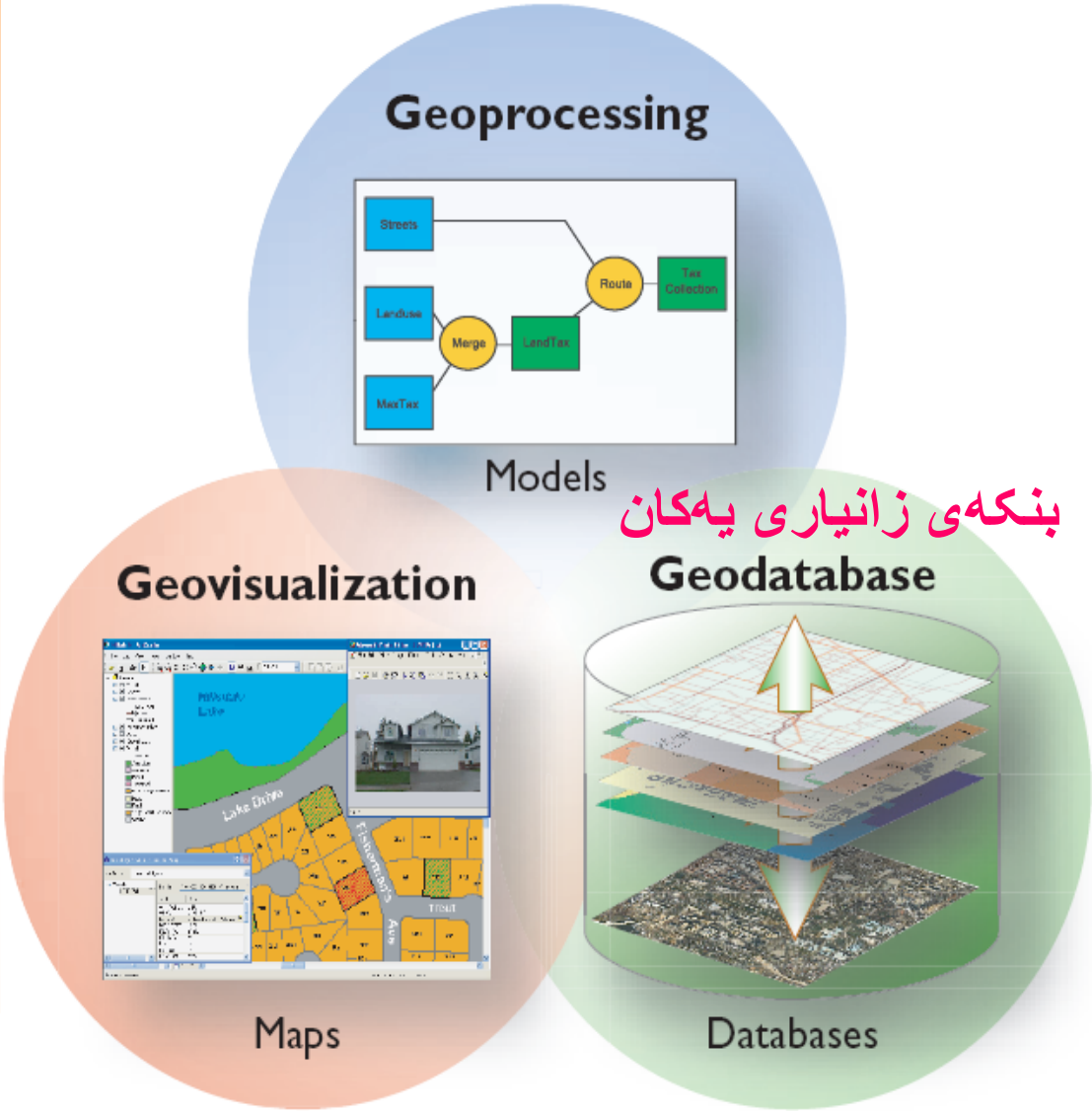
بنکەی زانیاری یەکان

Database Management

THE THREE VIEWS OF A GIS:

1. The Geodatabase view (بنکەی زانیاری یەکان) :

A GIS is a spatial database containing datasets that represent geographic information (features, raster, topologies, networks, and so forth).

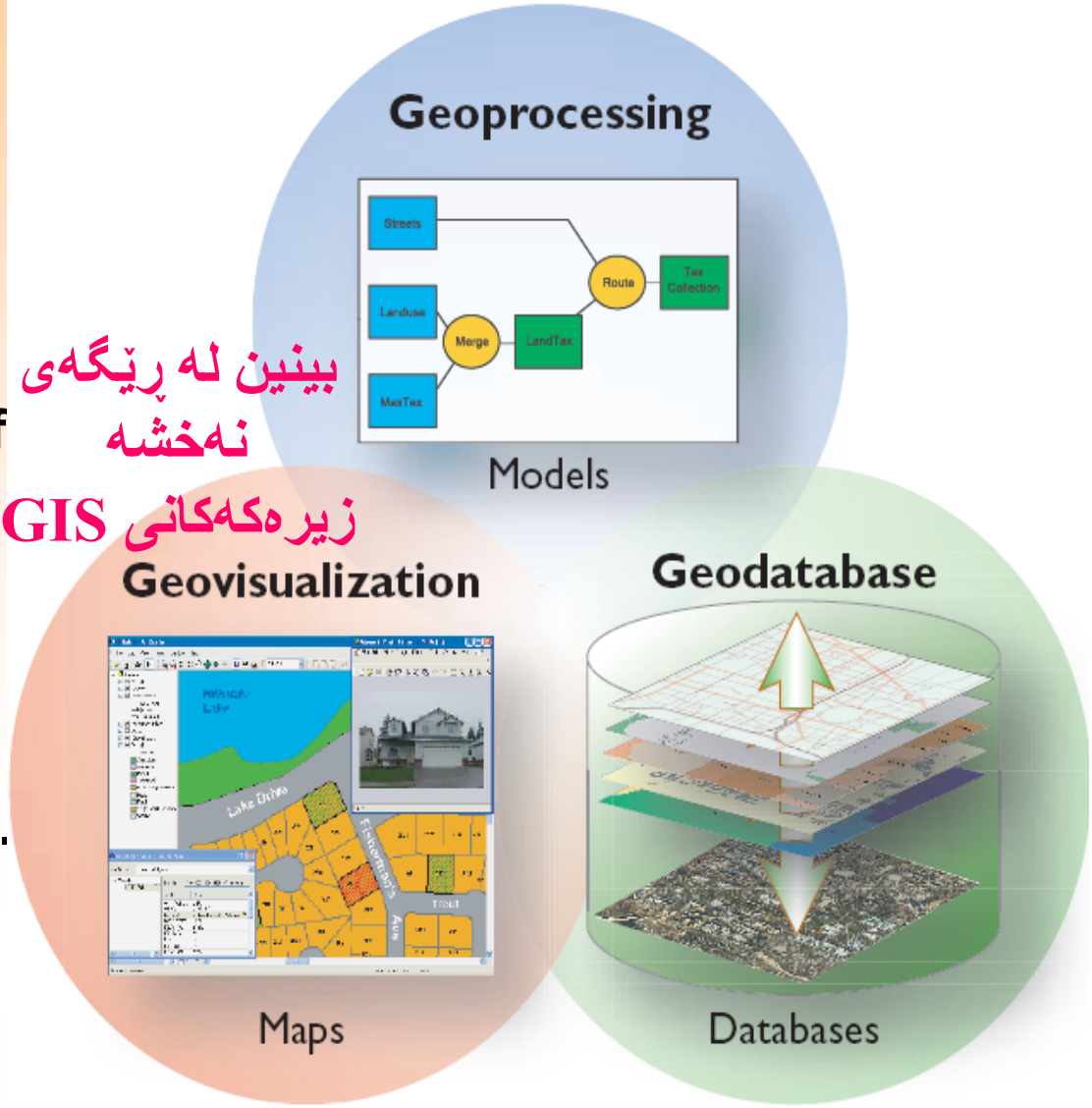


THE THREE VIEWS OF A GIS:

2. The Geovisualization view (نەخشە زیرەکەکان):

A GIS is a set of **intelligent maps** and other views that show features and feature relationships on the earth's surface. Various map views of the underlying geographic information can be constructed and used as "windows into the database" to support queries, analysis, and editing of the information.

بینین لە ڕێگەی نەخشە زیرەکەکانی GIS



THE THREE VIEWS OF A GIS:

3. The Geoprocessing view (شیکاری زانیاری یەکان) :

A GIS is a set of information transformation tools that derive new geographic datasets from existing datasets.

These geoprocessing functions take information from existing datasets, apply **analytic functions**, and write results into **new derived datasets.**

Sources of Spatial Data

Digitized and Scanned Maps

- Purchased, donated, free (Internet)
- Created by user

Databases

- Tables of data

GPS

- Global Positioning System
- Accurate locations

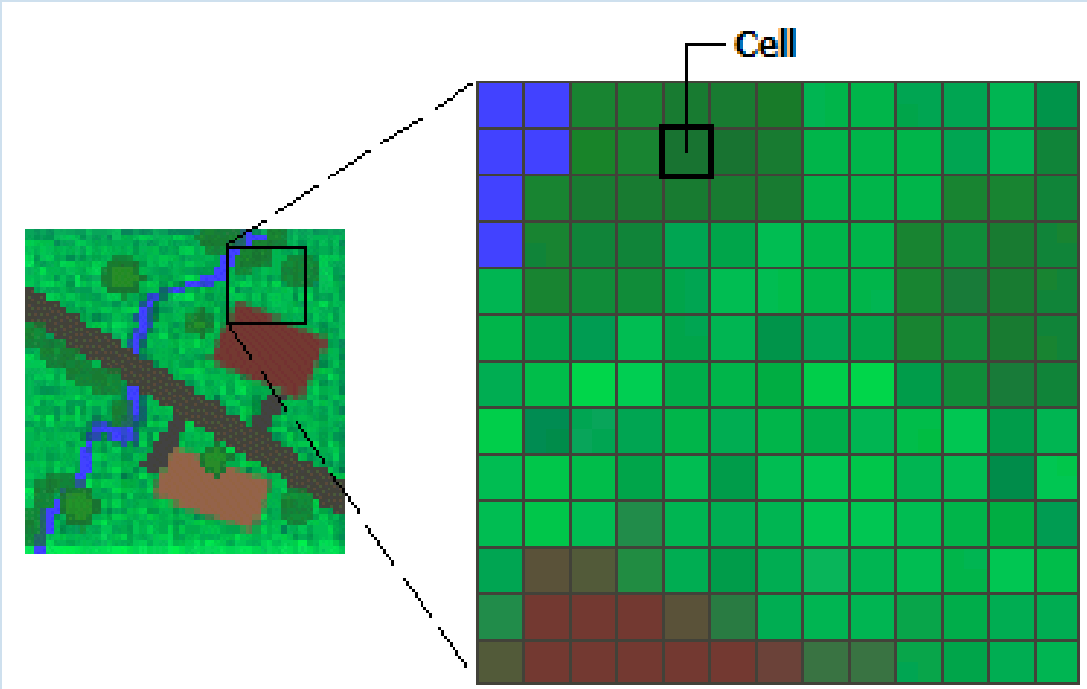
Field Sampling of Attributes

Remote Sensing and Aerial Photography

سەرچاوەکانی(داتای شوێنی)
GIS
کۆدەکرێتەوە لە ناو
داتابەیس دا databases

ArcGIS Family of Products

- # Rasters and images:
  - **What is raster data?**
    - In its simplest form, a raster consists of a matrix of cells (or pixels) organized into rows and columns (or a grid) where each cell contains a value representing information, such as temperature.
  - Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps.



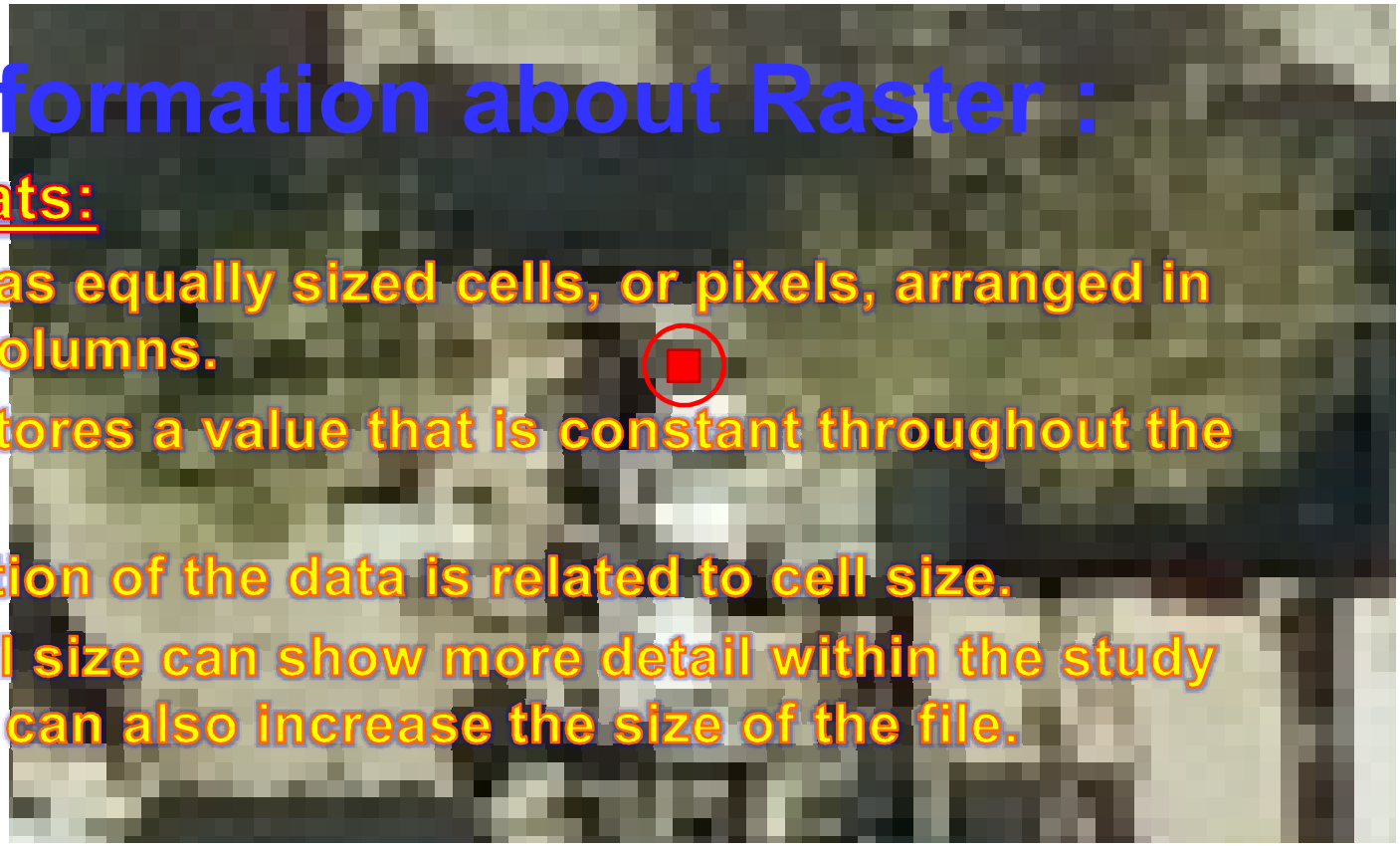
- # Raster datasets:

- **Several storage options:**
  - Individual raster datasets, raster catalogs, raster attribute.
  - A raster catalog is a container for raster datasets.
  - More than one raster dataset can be spatially appended (mosaicked) together into a larger, single, continuous raster dataset.

➢ Mosaicking allows you to take two or more raster datasets and combine them into a single, seamless raster dataset.

This illustration shows how six adjacent raster datasets are mosaicked together into one raster dataset.

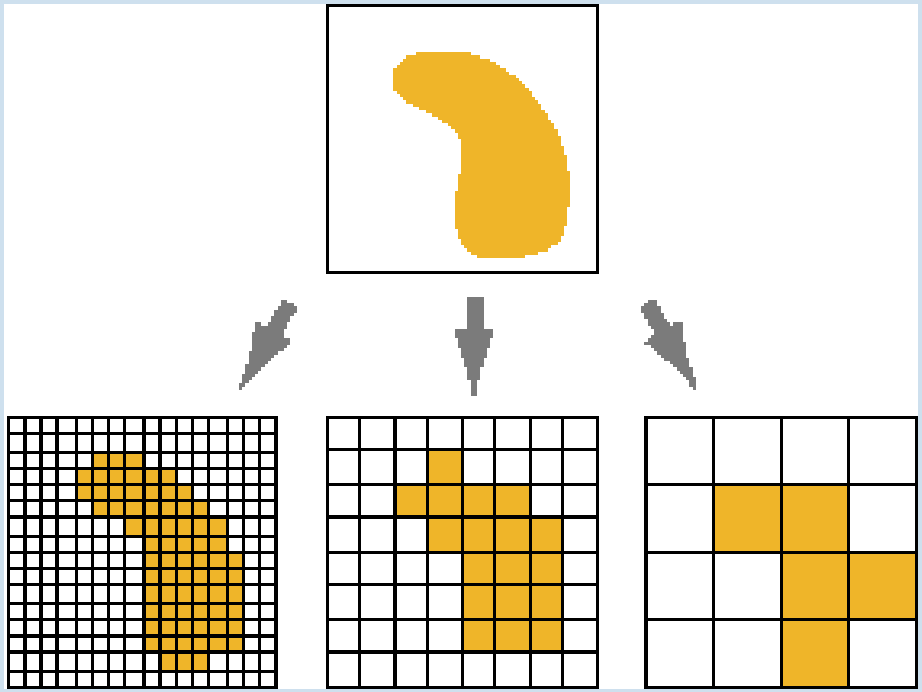
- **Some information about Raster :**
  - **Raster formats:**
    - Store data as equally sized cells, or pixels, arranged in rows and columns.
    - Each cell stores a value that is constant throughout the entire cell.
    - The resolution of the data is related to cell size.
    - Smaller cell size can show more detail within the study area, but it can also increase the size of the file.



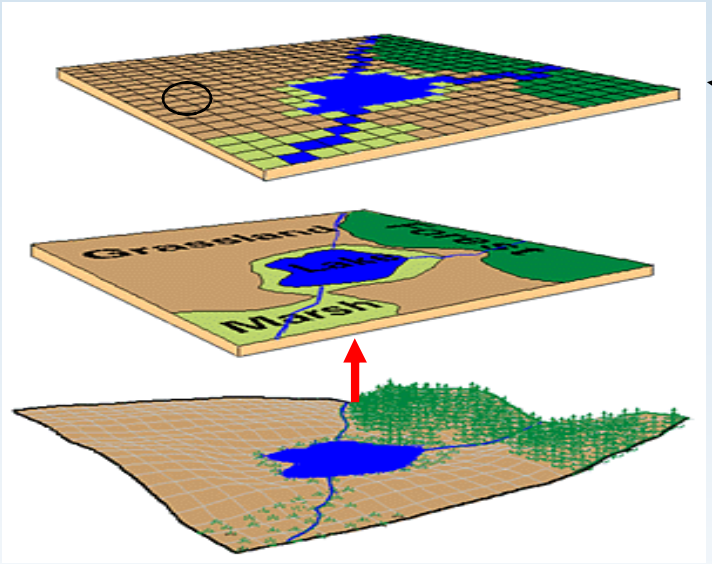
  - **ArcGIS** supports display and conversion of many raster file formats including several popular image formats.
  - Every (almost) image is actually composed of three separate layers, or more layers. Each layer stores the amount of reflectance from a different wavelength of the electromagnetic spectrum (e.g., ultraviolet, visible, infrared).
  - By assigning different colors to each layer, analysts can evaluate factors such as land cover type and vegetation density.

Cell sizes in Raster and images:

- The cell size determines how coarse or fine the patterns or features in the raster will appear. The smaller the cell size, the smoother or more detailed the raster will be.
- If a cell size is too large, information may be lost.
- In the diagram below, you can see how this simple polygon feature will be represented by a raster dataset at various cell sizes.



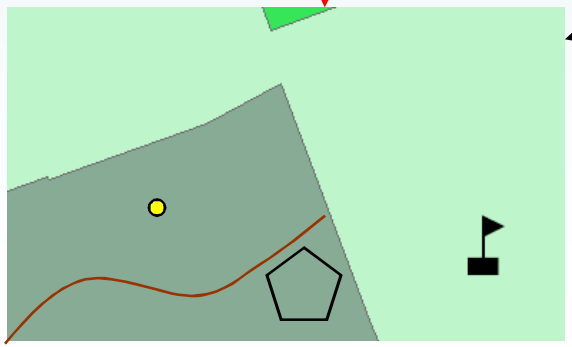
Two Ways to Visualize Data
"The World" in GIS



Real world

Raster -- Grid

- "**Pixels**"
- A location and value
- Satellite images and aerial photos are already in this format

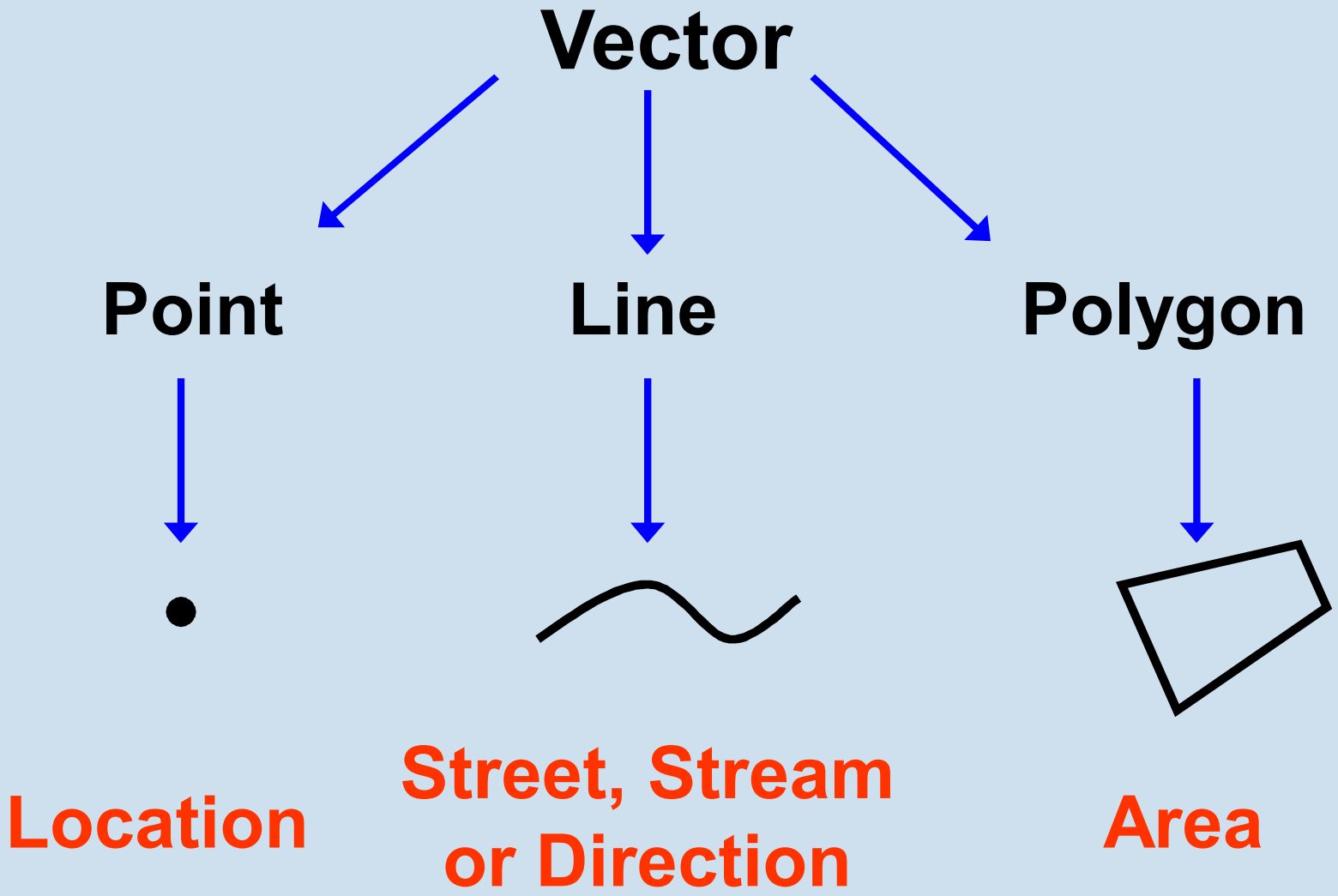


Vector -- Linear

- "Features" Like: house, road, lake, etc. represented by: **Points**, **lines**, and **polygons**
- Attribute information inside the database has:

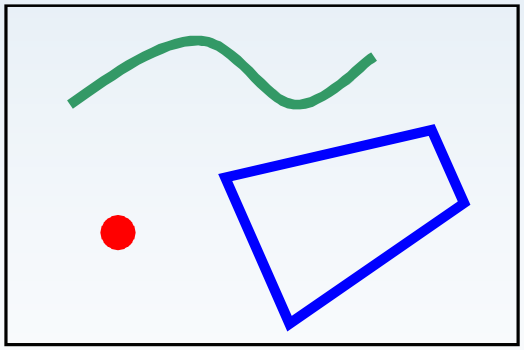
  size, type, length, etc.

- **Represent real feature by Vector**



- **Components of Geographic Data**

Geometry **Attribute** **Behavior(Rules)**



OID	NO	Name	Length	Area
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Ex.: Streets and Highways may not intersect

Or, ….Area Boundary Must Be Covered By Boundary Of…….

• Elements of geographic information

Rich GIS behavior for representing and managing geographic information is based on four fundamental types of geographic representation:

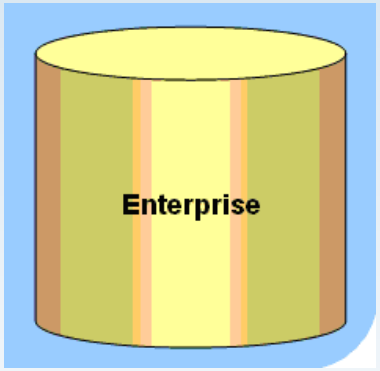
- **Features (points, lines, and polygons)**
- **Attributes**
- **Imagery**
- **Continuous surfaces (such as elevation)**

All types of geographic information—features, rasters, and attributes—can participate in spatial and attribute relationships.

- **How can we represent geographic information**

The four types of geographic information (features, attributes, rasters and surfaces) are actually managed using three primary GIS data structures:

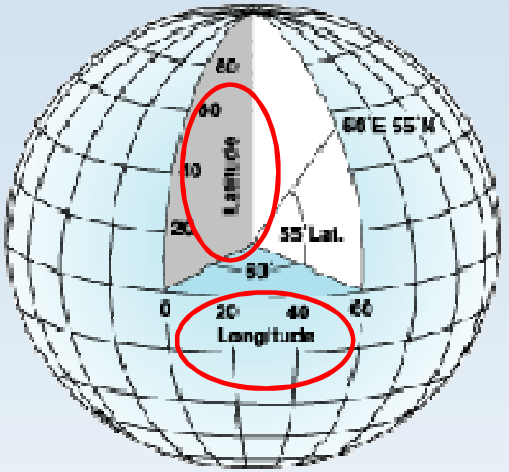
- **Feature classes**
- **Attribute tables**
- **Raster datasets**



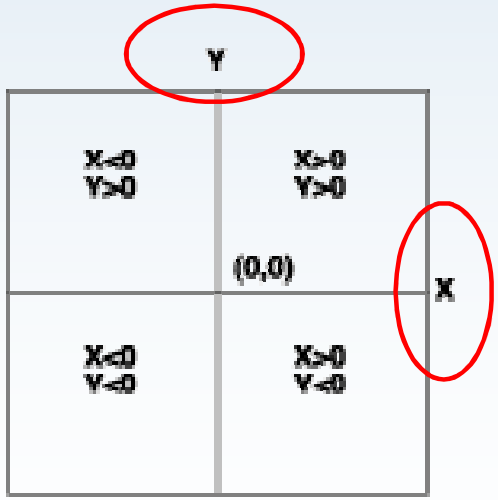
All these are fundamental datasets in the Geodatabase.

• Types of Coordinate Systems

Geographic coordinate systems :
A global or spherical coordinate system such as latitude-longitude.

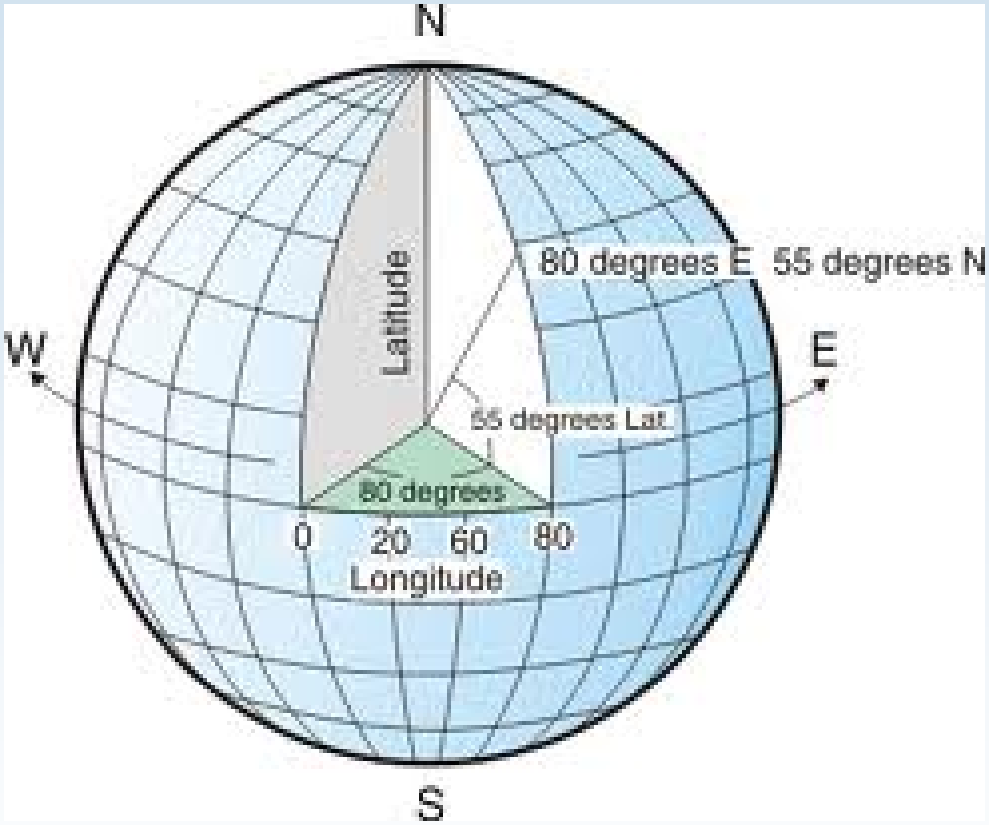


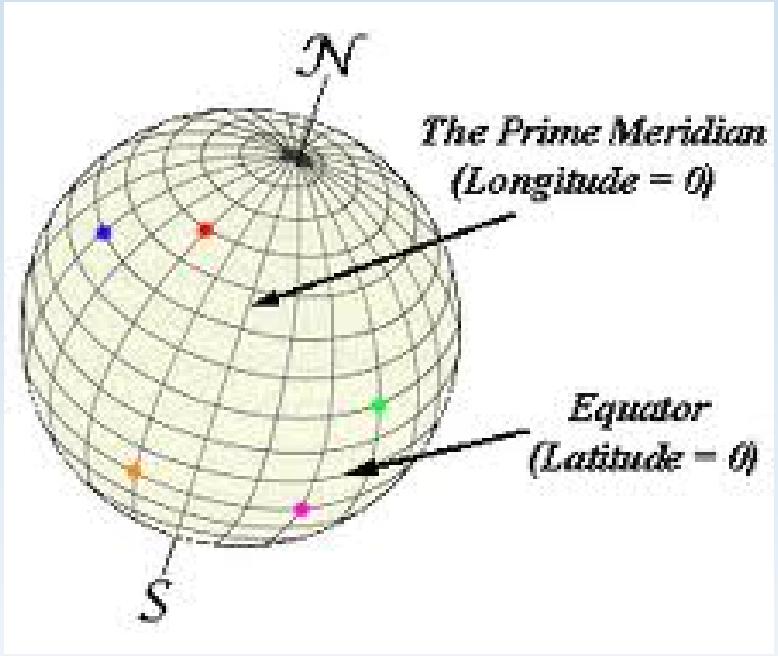
Projected coordinate systems (map projections) :
A mechanisms to project maps of the earth's spherical surface onto a two-dimensional coordinate plane such as transverse Mercator.

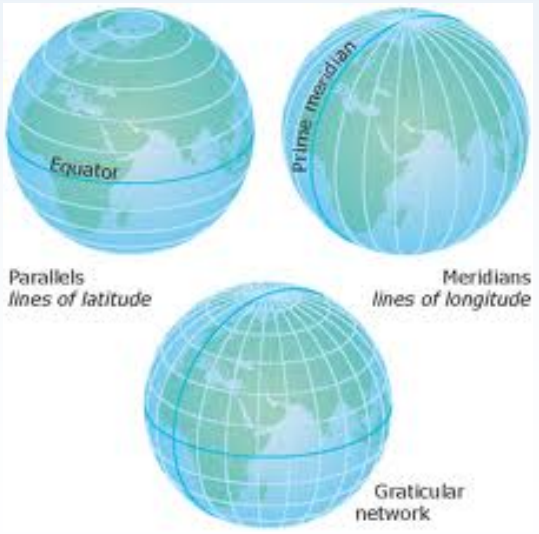


- **Why Need Coordinate System ?**
  - Within ArcGIS, every geographic dataset has a coordinate system, which is used to integrate it with other geographic data layers within a common coordinate framework such as a map
  - Coordinate systems enable you to integrate datasets within maps.
  - to perform various integrated analytic operations such as overlaying data layers.

- ***Geographic coordinate systems***

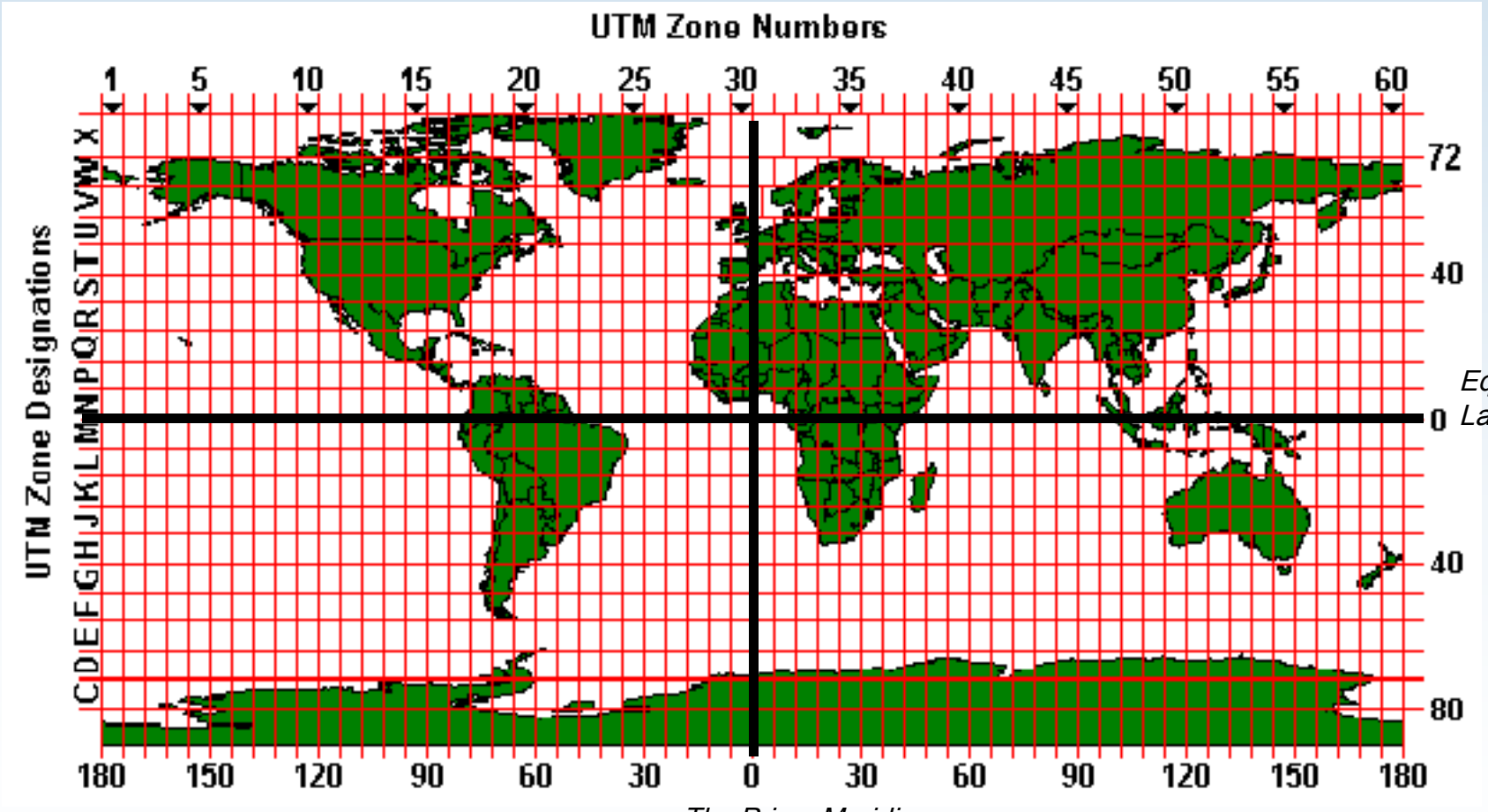






- ***Projected coordinate systems***

  UTM Universal Transverse Mercator

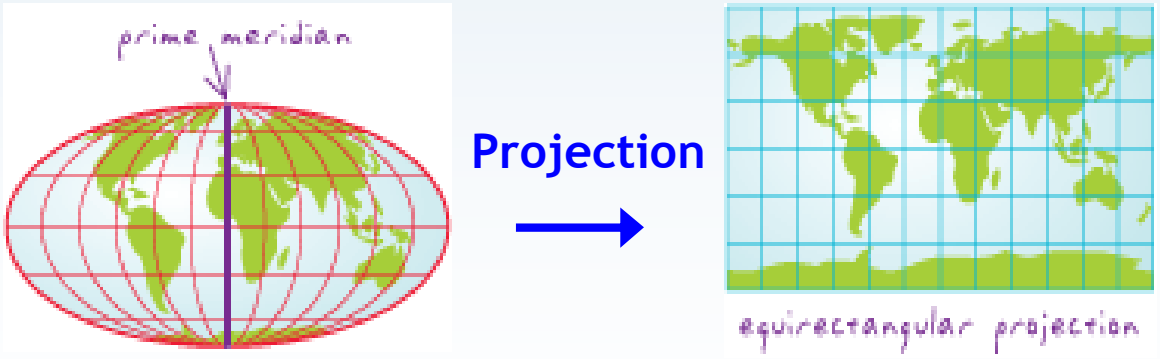


• Map Projection

Because the earth is round and maps are flat we need to get information from a curved surface to a flat which is called a **map projection**, or simply a projection.

This process of flattening the earth will cause distortions in one or more of the following spatial properties:

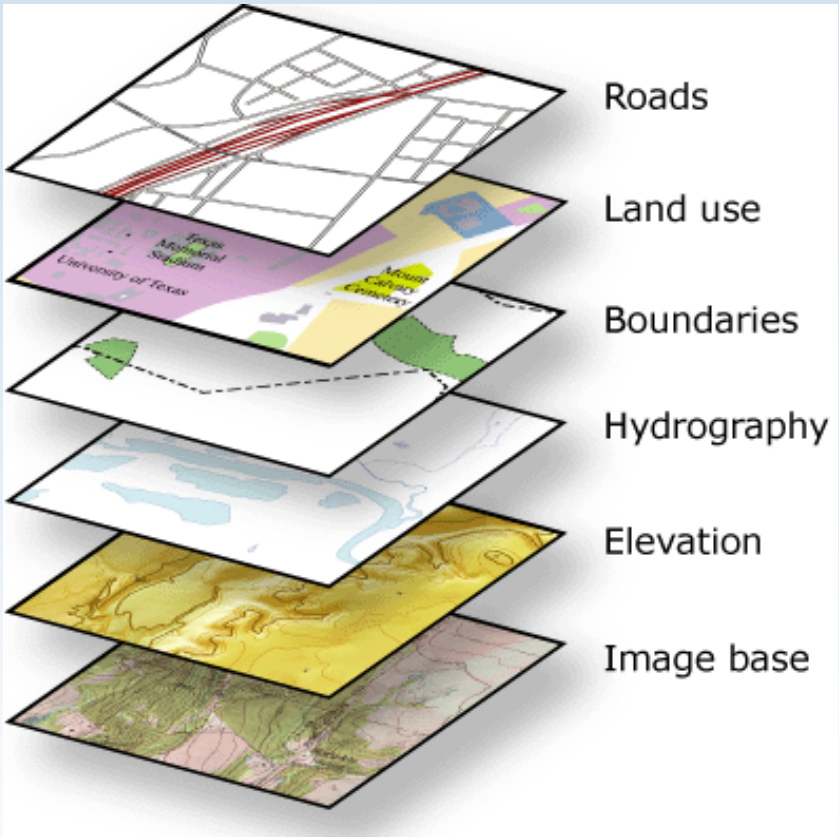
- Distance
- Area
- Shape
- Direction



- **Maps convey geographic information through Map Layers:**

Map Layers:

- Are thematic representations of geographic information such as transportation, water, and elevation.
- Help convey information through:
  1. Features(points, lines, and polygons).
  2. Symbols, colors, and labels to describe the objects.
  3. Aerial photography or satellite imagery.
  4. Continuous surfaces such as elevation represented by contour lines.

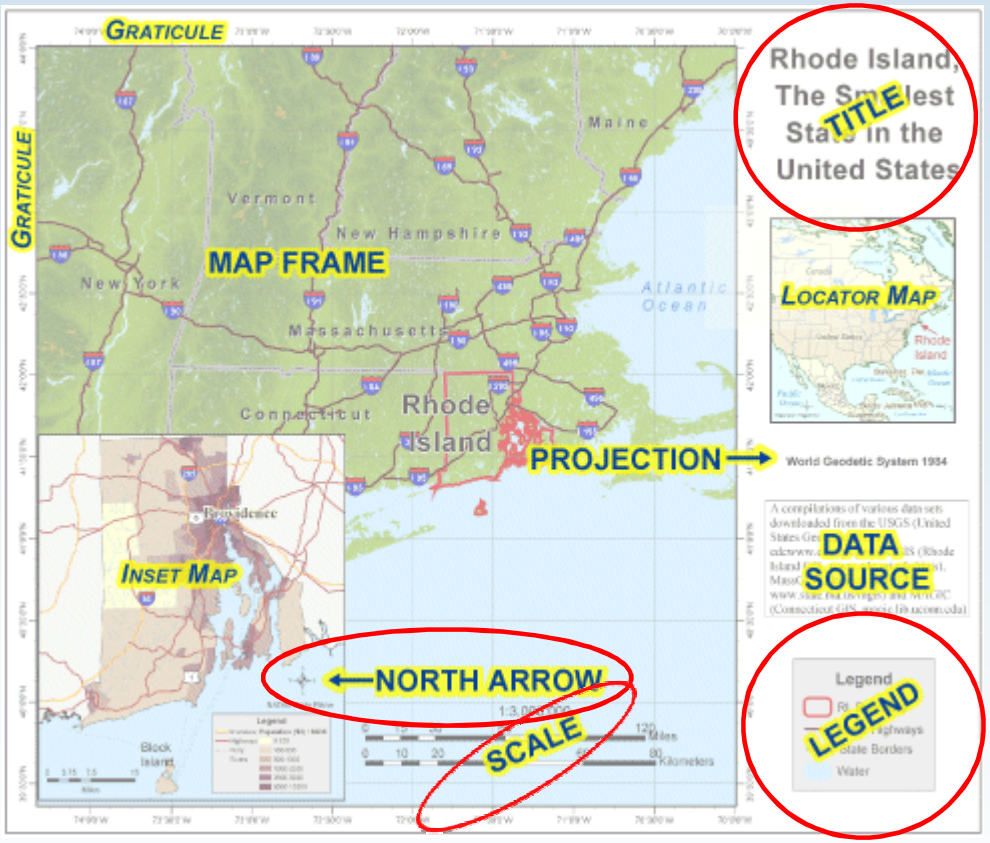


Within the map frame, geographic entities are presented as a series of map layers.

- **Maps convey geographic information through Map Layout:**

Map Layout and composition:

- An integrated series of map elements laid out and arranged on a page.
- Common map elements which aid reading and interpretation:
  1. North arrow.
  2. Scale bar.
  3. Title.
  4. Symbol legend.
  5. Additional elements such as graphs, charts, pictures, and text.



This layout illustrates how map elements are arranged on a page

- **Maps convey geographic information through Spatial relationships:**

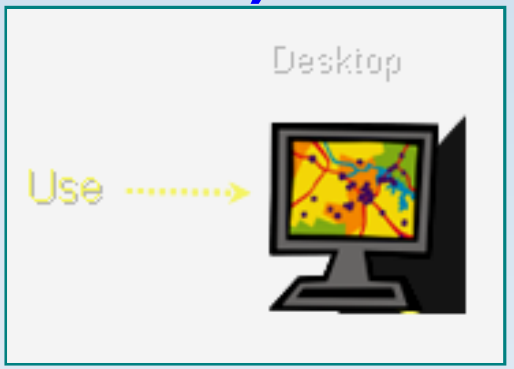
Spatial relationship examples:

- Which geographic features **connect** to others (for example, Water pipelines connects with valves.)?
- Which geographic features are **adjacent** to others (for example, The city park is adjacent to the university.)?
- Which geographic features are **contained** within an area (for example, The building footprints are contained within the parcel boundary.)?
- Which geographic features **overlap** (for example, The railway crosses the freeway.)?
- Which geographic features are **near** others (**proximity**) (for example, The Courthouse is near the Governorate building.)?
- The feature geometry **is equal** to another feature (for example, The city park is equal to the vacant land polygon.).
- What is the **difference** in elevation of geographic features (for example, The Governorate building is uphill from the water.)?
- Which feature **is along** another feature (for example, The bus route follows along the street network.)?.

- **How Maps convey geographic information through spatial relationships ?**
  - Map readers can understand and analyze geographic relationships.
  - Relationships that are based on location are referred to as spatial relationships.
  - Within a map, You as a map reader, can understand relationships and derive information from the relative position and shape of the map elements, such as the streets, contours, buildings, lakes, railways, and other features.
  - In a GIS, such relationships can be modeled by applying rich data types and behaviors (for example, topologies and networks) and by applying a comprehensive set of spatial operators to the geographic objects (such as buffer and polygon overlay).

- **ArcGIS Desktop Products(Software)**

1- ArcMap
2- ArcCatalog
3- ArcToolbox



the ArcGIS Desktop includes a suite of integrated applications, including ArcMap, ArcCatalog, and ArcToolbox.

By using these applications you can perform any GIS task, simple to advanced, including mapping, geographic analysis, data editing, data management, visualization, and geoprocessing.

- **ArcGIS Desktop Products**

1- ArcMap
2- ArcCatalog
3- ArcToolbox

ArcCatalog: the application for browsing, storing, organizing, and distributing data.

ArcMap: the application for editing, analyzing, and creating maps from your data.

ArcToolbox: The ArcToolbox window is the central place where you find, manage, and execute geoprocessing tools.

- **Licenses**

ArcView → ArcEditor → ArcInfo

More Functionality →

- **What are ArcView, ArcEditor, and ArcInfo?**

ArcGIS Desktop is the information authoring and usage tool for GIS professionals. It is scalable as three separate software products(**Licenses**) to meet the needs of many types of users.

ArcView: provides comprehensive mapping and analysis tools along with simple editing and geoprocessing.

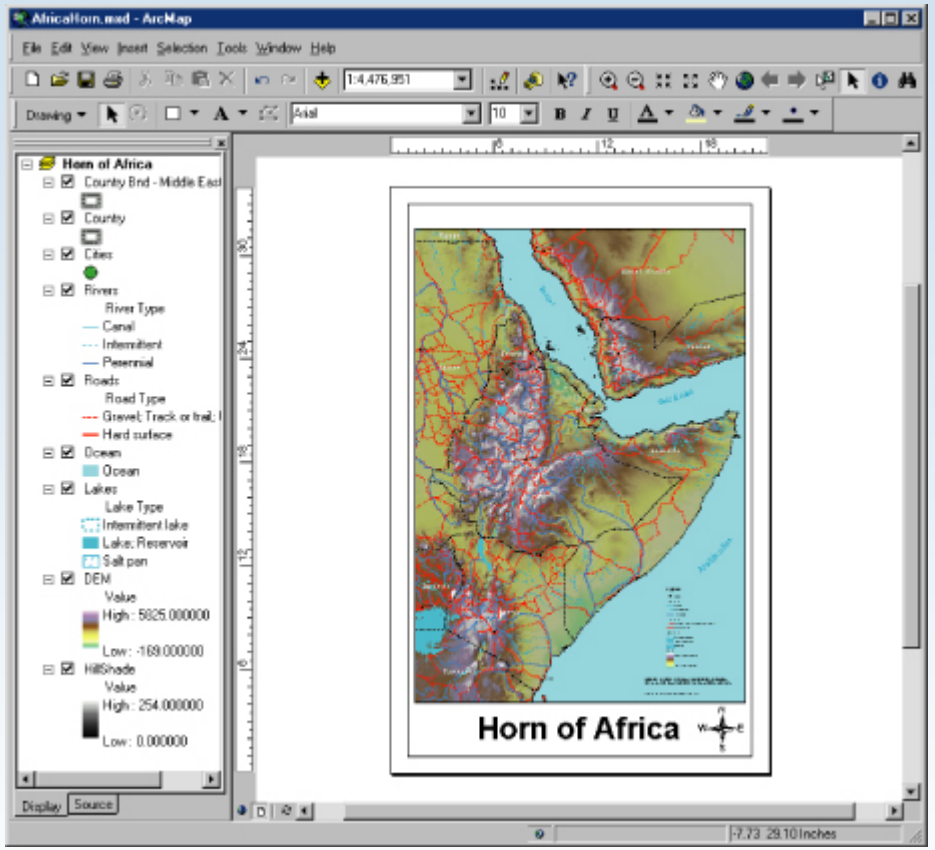
ArcEditor: includes advanced editing capabilities for shapefiles and geodatabases in addition to the full functionality of ArcView.

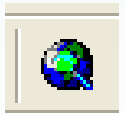
ArcInfo: is the flagship ArcGIS Desktop product. It builds on the functionality of ArcEditor with advanced geoprocessing. It also includes the legacy applications for ArcInfo Workstation.

• ArcGIS Desktop Products

ArcMap:

- ArcMap is the central application in ArcGIS Desktop.
- It is the GIS application used for all map-based tasks, including cartography, map analysis, and editing.
- In this application, you work with maps. Maps have a page layout containing a geographic window, or a data frame, with a series of layers, legends, scalebars, North arrows, and other elements.
- ArcMap offers different ways to view a map's geographic data and layout views in which you can perform a broad range of advanced GIS tasks.

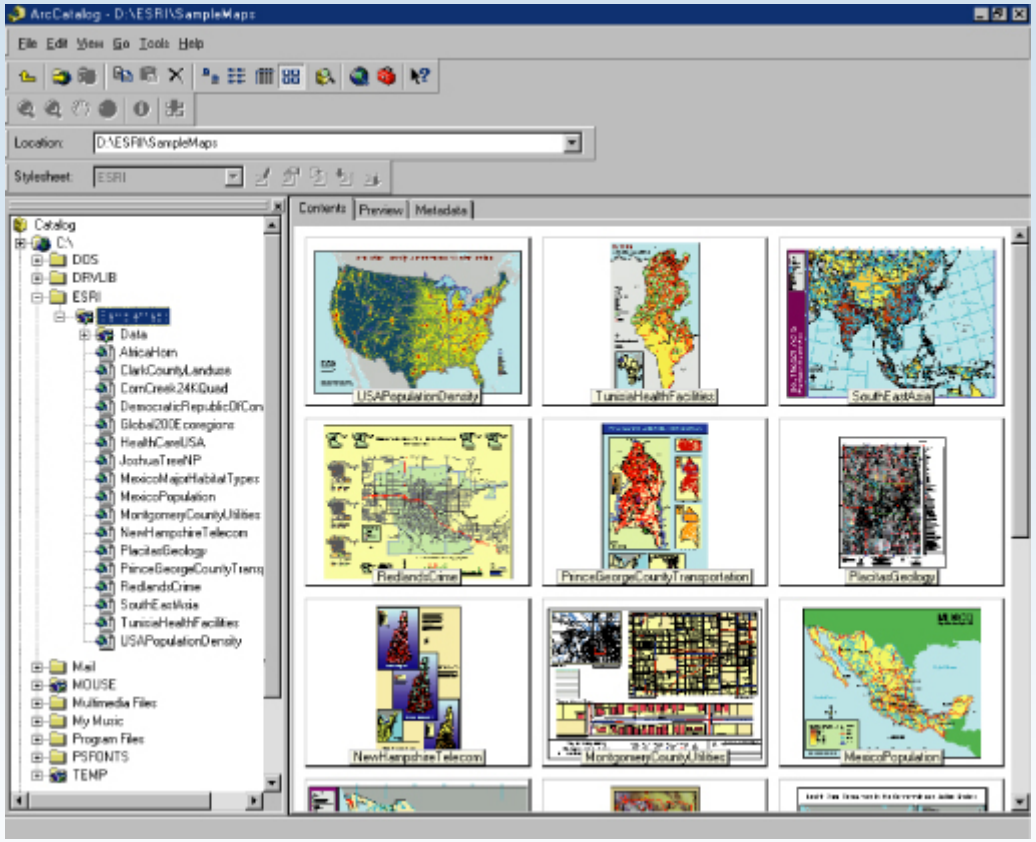


ArcMap  is used for mapping and editing tasks as well as map-based analysis.

• ArcGIS Desktop Products

ArcCatalog:

- ArcCatalog application helps you organize and manage all of your GIS information (maps, globes, datasets, models, metadata, services, and so on). It includes tools to:
  - Browse and find geographic information.
  - Record, view, and manage metadata.
  - Define geodatabase schemas and designs.
  - Administer an ArcGIS Server.
  - Search for and discover GIS data on local networks and the Web.

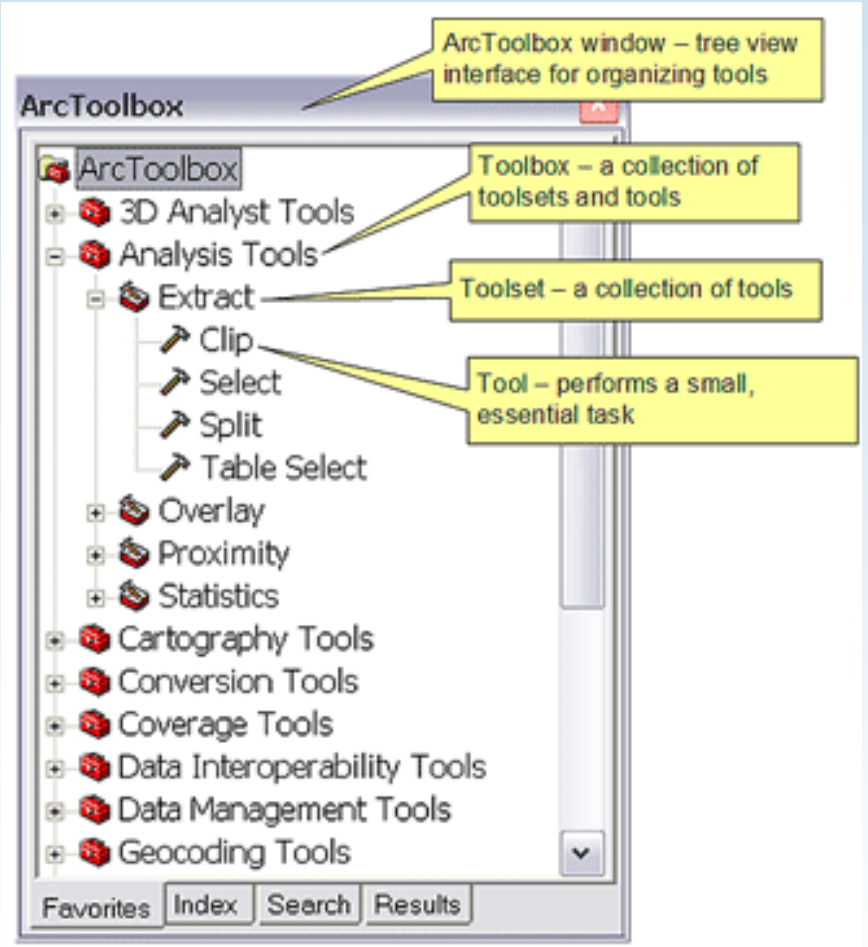


ArcCatalog  is used for managing your spatial data holdings, defining your geographic data schemas, and recording and viewing metadata.

• ArcGIS Desktop Products

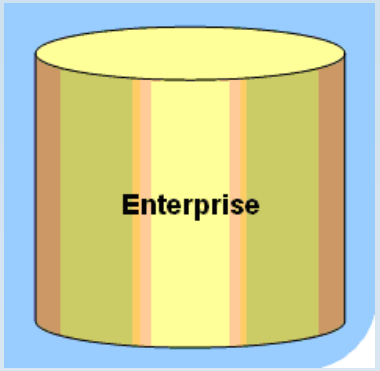
ArcToolbox:

- ArcMap The ArcToolbox window is the central place where you find, manage, and execute geoprocessing tools.
- Tools can also be managed and executed from ArcCatalog.
- The ArcToolbox window contains toolboxes, which in turn contain tools and toolsets (a toolset is just an organizational device, like a system folder).
- Tools must be contained in a toolbox—they cannot exist outside a toolbox.



In any ArcGIS desktop application, you open the ArcToolbox window with the Show/Hide ArcToolbox Window button  on the Standard toolbar.

• Geodatabase



- **Introduction:** The geodatabase is a collection of geographic datasets of various types.

- **What is the geodatabase?**
  - An ArcGIS geodatabase is a storage model used to collect geographic datasets of various types held in a common file system folder, a Microsoft Access database, or a multiuser relational database (such as Oracle, Microsoft SQL Server..etc) SQL: structured query language

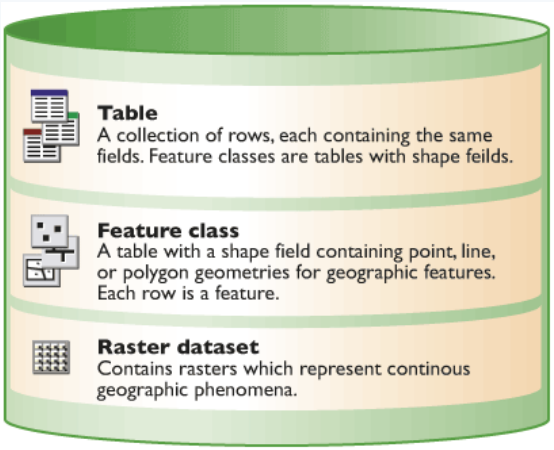
- **Fundamental datasets in the geodatabase:**

  A key geodatabase concept is the dataset. It is the primary mechanism used to organize and use geographic information in ArcGIS. The geodatabase contains three primary dataset types:

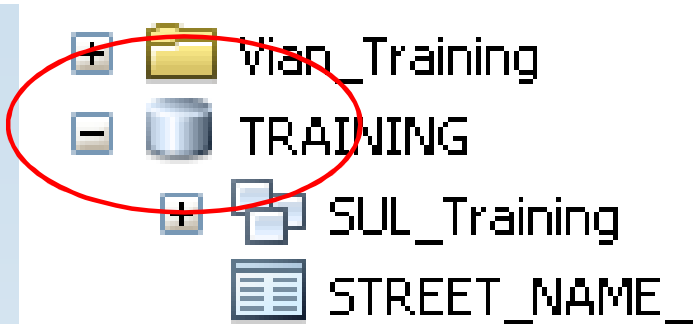
Feature classes

Raster datasets

Tables

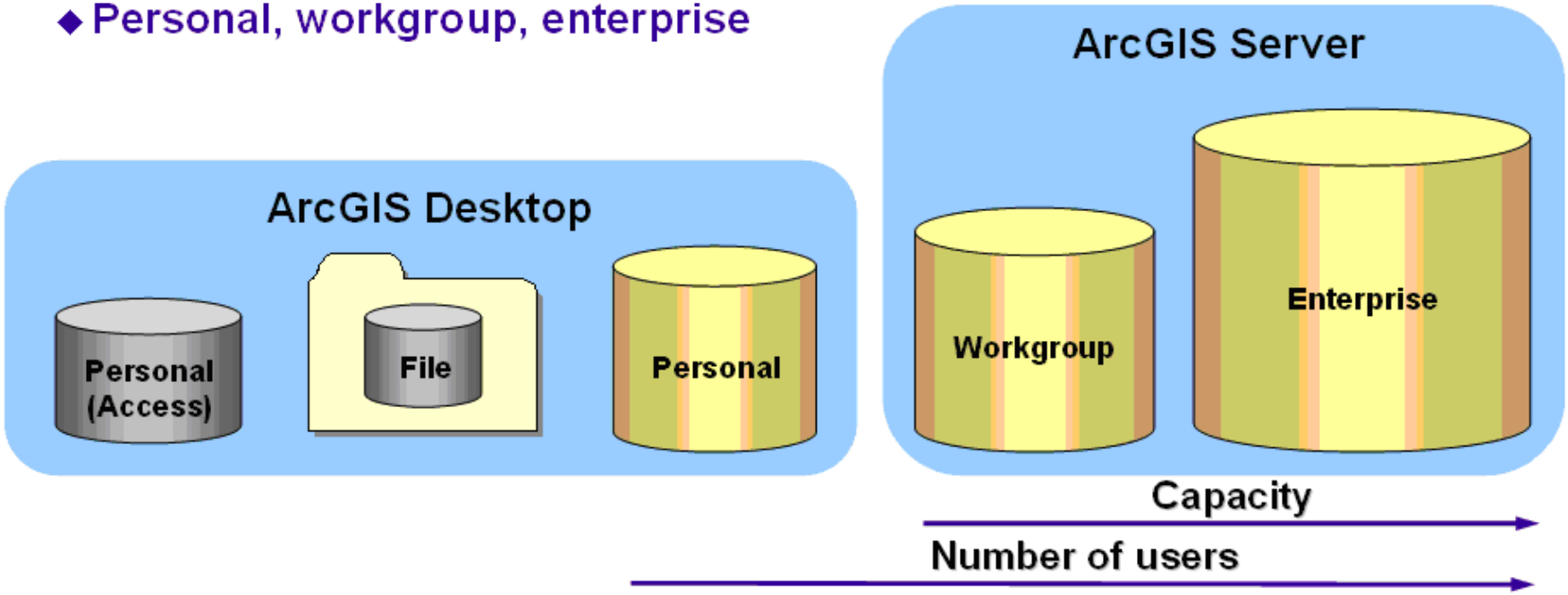


- **Geodatabase Options:**



Geodatabase options at ArcGIS 9.2

- Personal for Microsoft Access
- File
- ArcSDE technology at three levels:
  - Personal, workgroup, enterprise



- **What is a Feature Class, Feature dataset, Raster datasets, Tables ?**
  - **A feature:**

    is a spatial object (means an object has a location on the Earth), an object represents an entity and the entity is anything natural (Tree, River or Mountains) or manmade (Poles, Manholes, Streets or Buildings).
  - **Feature Class:**

    Is a container of features which have the same attribute and geometry and have spatial reference.
  - **Feature dataset:** is a set of thematically related feature classes (typically used to manage a topology, network, or terrain) and share the same spatial reference.
  - **Raster datasets:**

    In raster datasets, each cell (which is also known as a pixel) has a value. Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps.
  - **Tables:**

    Tables manage information attributes. This means they store information. In a geodatabase, tables usually store information about a geographic entity.

- **Table** A collection of rows and columns.
  - Tables provide the primary storage mechanism for geographic datasets.
  - It is one of the three key dataset types in GIS along with feature datasets and raster datasets.
  - Used to store descriptive information (attributes).
  - The same fields (Columns) appear in each row.

- **Table Formats & Sources:**
  1. Text files (comma or tab delimited)
  2. Excel spread sheets
  3. dBase tables
  4. Geodatabase tables in personal, file ArcSDE geodatabases

- **ESRI** (http://esri.com), along with its user community, has invested a significant amount of time to develop a series of **geodatabase data model** templates that provide a jump start for your geodatabase designs. These designs are described and documented at http://support.esri.com/datamodels.
- **Geodatabase templates:** you can find at the mentioned web site geodatabase templates as well as useful documentation on geodatabase design for many industries and applications. These models typically are a good starting point for users, they can be extended to meet their specific needs and requirements. **You can** build a test geodatabase, load some data into it, then test and refine the design for use within your GIS.

- **Difference between Object Class & Feature Class**

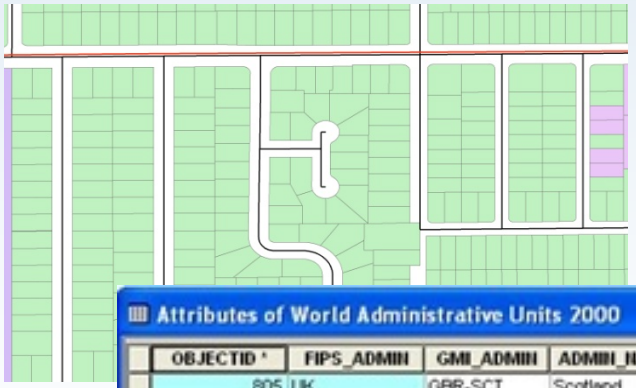
  - **Objects and Object Classes(Table)**
    - Objects are entities with properties and behavior.
    - An object is an instance of an object class.
    - All objects in an object class have the same properties and behavior.
    - An object can be related to other objects via relationships.

A row stores an Object

A table stores an ObjectClass

- **Difference between Object Class & Feature 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 with
      - Geometry attribute types



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

Attributes of World Administrative Units 2000

OBJECTID *	FIPS_ADMIN	GMI_ADMIN	ADMIN_NAME	FIPS_CNTRY	GMI_CNTRY	CNTRY_NAME	POP_ADMIN	TYPE_ENG	TYPE_LO	SQKM	SQM
805	UK	GBR-SCT	Scotland	UK	GBR	United Kingdom	5160818	Division		78561.87	3
806	UK	GBR-WLS	Wales	UK	GBR	United Kingdom	2912776	Division		20629.99	
807	GG	GEO-ABK	Abkhazia	GG	GEO	Georgia	-99999	Autonomous R		8606.67	
808	GG	GEO-AJR	Ajaria	GG	GEO	Georgia	-99999	Autonomous R		2835.08	
809	GG	GEO-TBL	Tbilisi	GG	GEO	Georgia	-99999	Autonomous R		58406.03	2
810	GH02	GHA-ASH	Ashanti	GH	GHA	Ghana	2858833	Region	Region	24892.94	
811	GH03	GHA-BAH	Brong-Ahafo	GH	GHA	Ghana	1613508	Region	Region	39824.51	1
812	GH04	GHA-CNT	Central	GH	GHA	Ghana	1567148	Region	Region	10000.42	

Record: 0 Show: All Selected Records (0 out of 2587 Selected) Options

- **Methods of collecting data**

1. **Digitizing data**
2. **Collecting data in the field**
3. **Survey or coordinate geometry (COGO) measurements**

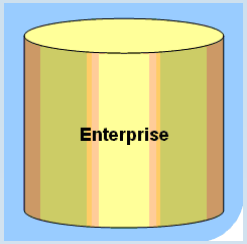
Data integrity using DBMS storage system:

the degree to which the data in a database is accurate and consistent according to data model and data type.

Data Integration: Involves transforming data and maintaining it's integrity.

- To help ensure data integrity, the **geodatabase** provides many integrity techniques (the Allow Nulls field property, domains, subtypes, relationships, and default values)
- As well as the **RDBMS** provides its own data integrity features.
- **ESRI** recommends using geodatabase features, they are more forgiving and more powerful.

•Geodatabase elements



Geodatabase

Feature dataset

Spatial reference

Feature classes

Polygon
Line
Point
Annotation
Route
Dimension

Relationship classes

Geometric networks

Topology

Network datasets

Next page

Tables

Raster datasets

Raster catalogs

Additional geodatabase elements

Survey datasets
GPS Datasets
Network datasets
Terrain datasets
Schematics
Representations

Toolboxes

Tool
Model
Script

Behavior

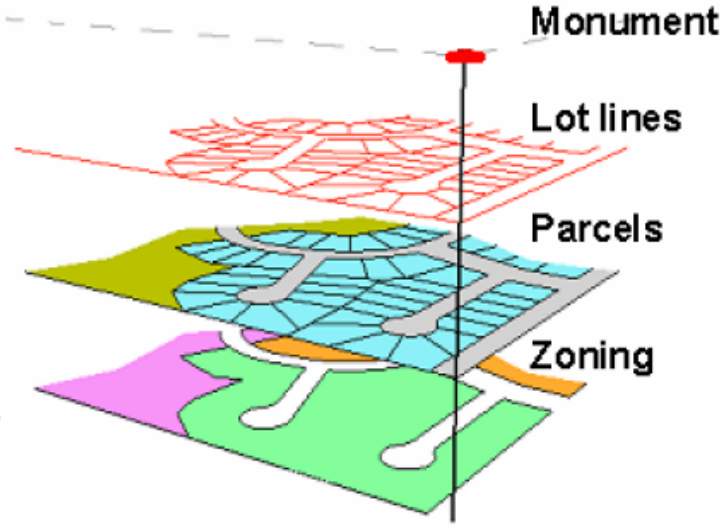
Attribute defaults
Attribute domains
Split/Merge policy
Connectivity rules
Relationship rules
Topology rules

• Topology:

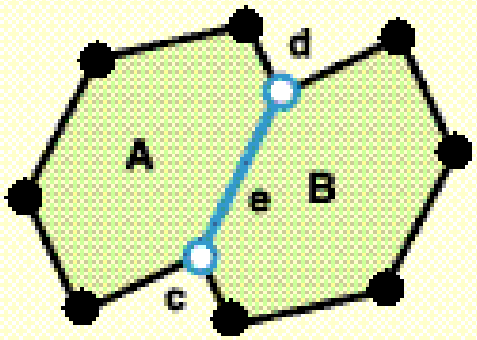
one of the Geodatabase elements is

- A GIS topology is a set of rules and behaviors that model how points, lines, and polygons share coincident geometry.
- Geodatabase topologies help you to better manage your data integrity.
- A topology serves as a description of how the features can be **spatially** related.

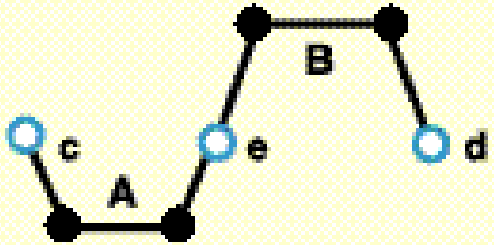
- **Topology:**
  - is the spatial relationship between features.
  - It models:
    - Connectivity
    - Adjacency
    - coincidence
  - Topology is a collection of rules that enables the geodatabase to more accurately model geometric relationships.



  - Topology can be used to model how the geometry from a number of feature classes can be integrated.
  - Topology is also used for analyzing spatial relationships in many situations.
  - You can never apply topology rules unless your feature class(es) is/are stored in a **feature dataset**.



Polygons A and B have shared nodes c and d and shared edge e.



Lines A and B have endpoint nodes c, d, and e.
Lines A and B share node e.

Some examples about adjacent features:-

- Area features can share boundaries (polygon topology).
- Line features can share endpoints (edge-node topology).
- Line features can share segments with other line features. For example, parcels can nest within blocks.
- Area features can be coincident with other area features.
- Line features can share endpoint vertices with other point features (node topology).
- Point features can be coincident with line features (point events).

Introduction to ArcGIS I

سیستمی زانیاری جیۆگرافی

Thanks a lot

Prepared By:
Vian Hama-Amen Qadir
Civil Engineer_GIS Specialist
E_mail:vianneamen@hotmail.com
Mob_No. :07701521630

For more information refer to
http://esri.com
Or
http://support.esri.com