INTRODUCTION TO GIS

Sandeep Talasila, GISP

GEOSPATIAL REVOLUTION

- https://www.youtube.com/watch?v=ZdQjc3oYPOk
  Penn State Public Broadcasting

GEOSPATIAL TECHNOLOGY

Technology that is used to collect, create, manipulate, and store geographic information.

- Geographic Information Systems (GIS)

- Global Positioning System (GPS)

- Remote Sensing

WHAT IS GIS?

- *A GIS is a computer-based system to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information*. – Paul Bolstad

- *A geographic information system (GIS) is a framework for gathering, managing, and analyzing data*. – ESRI

WHO USES GIS?

- Education
- Health
- Public Safety
- Natural Resources
- Transportation
- Utilities – Electric, Gas, Water, Telecommunications
- Government
- Real Estate
- …

EARLY GIS – SPATIAL ANALYSIS

Frere de Montizon's Population Map of France in 1830
1 dot = 10,000 people

Original map by John Snow showing the clusters of cholera cases (indicated by stacked rectangles) in the London epidemic of 1854. The contaminated pump is located at the intersection of Broad Street and Cambridge Street (now Lexington Street), running into Little Windmill Street.
https://commons.wikimedia.org/wiki/File:Snow-cholera-map-1.jpg

BRIEF HISTORY
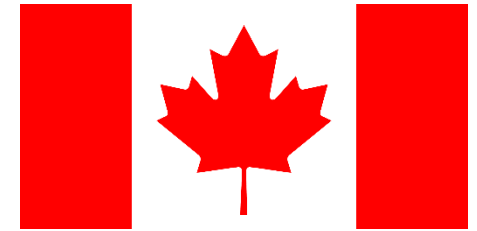
- Invented in Canada in the late 1960's and developed into the Canada Geographic Information System

- First published use of term Geographic Information System was in August 1968 by Roger Tomlinson

- In 1964-65, Howard Fisher created one of the first computer mapping software programs known as SYMAP at the Northwestern University.

- In 1970's – 80's, software development & commercial GIS

- ESRI, MapInfo, ERDAS, GeoMedia, CARIS, MOSS, GRASS, QGIS, and many more

ASKING SPATIAL QUESTIONS

Location
- What is at …?
- What exists at a particular location?

Condition
- Where is it?
- Find location where certain conditions are satisfied.

Trends
- What has changed since?
- Differences in an area over time.

Patterns
- What spatial patterns exist?
- Spatial relationships between geographic data.

Modeling
- What if …?
- Predict cause and effects of new scenarios.

G = GEOGRAPHIC

- Pertaining to the location

- Geographic features are represented as geometric objects or pixels

- Data Models: Vector and Raster

Vector
- Boundaries
- Streets
- Parcels & Structures

Raster
- Land Use
- Elevation

Real World

Source: ESRI
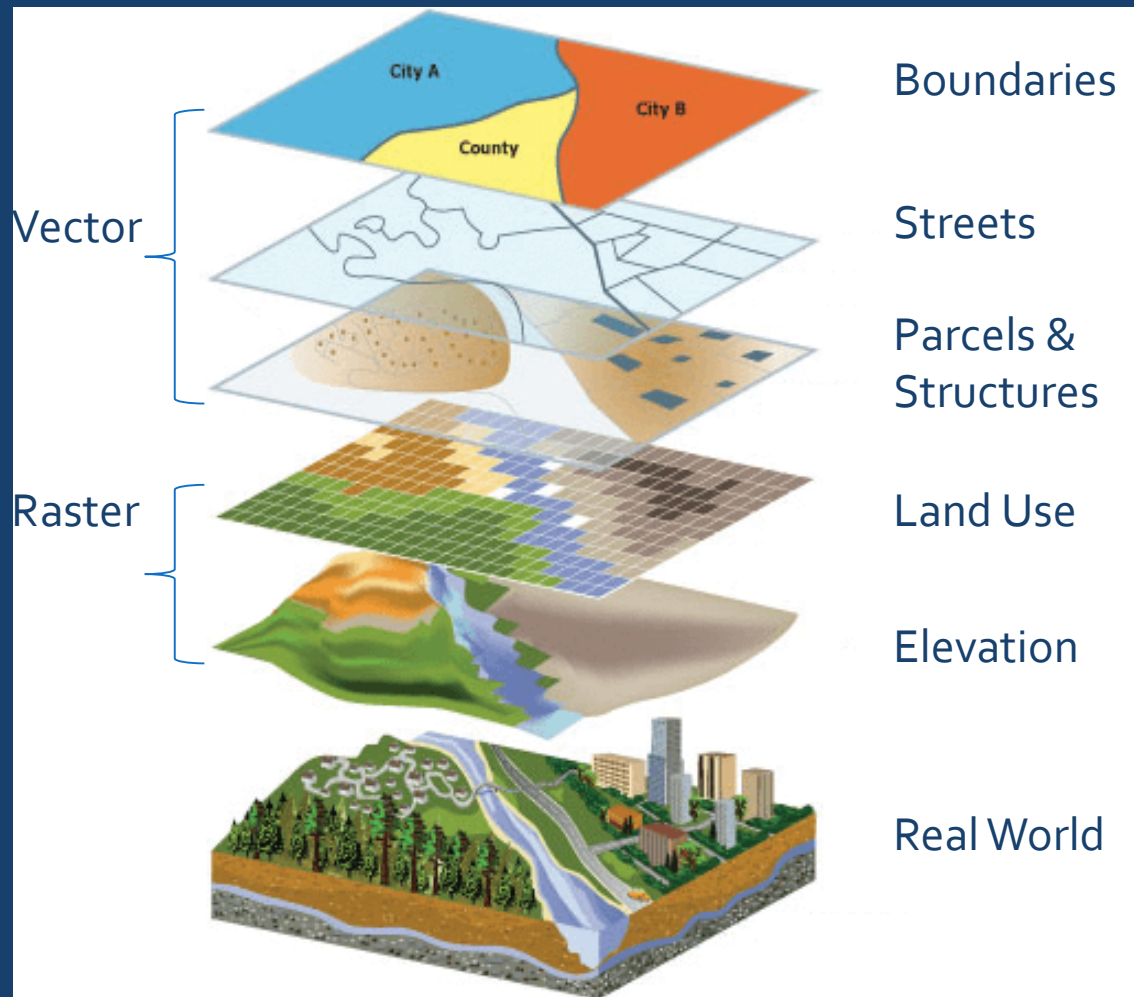
I = INFORMATION

- Referred as attribute data

- Contain information about the geographic data arranged in rows and columns

- Example: A map of counties in USA, the attributes include County Name, county FIPS, state FIPS, area,…
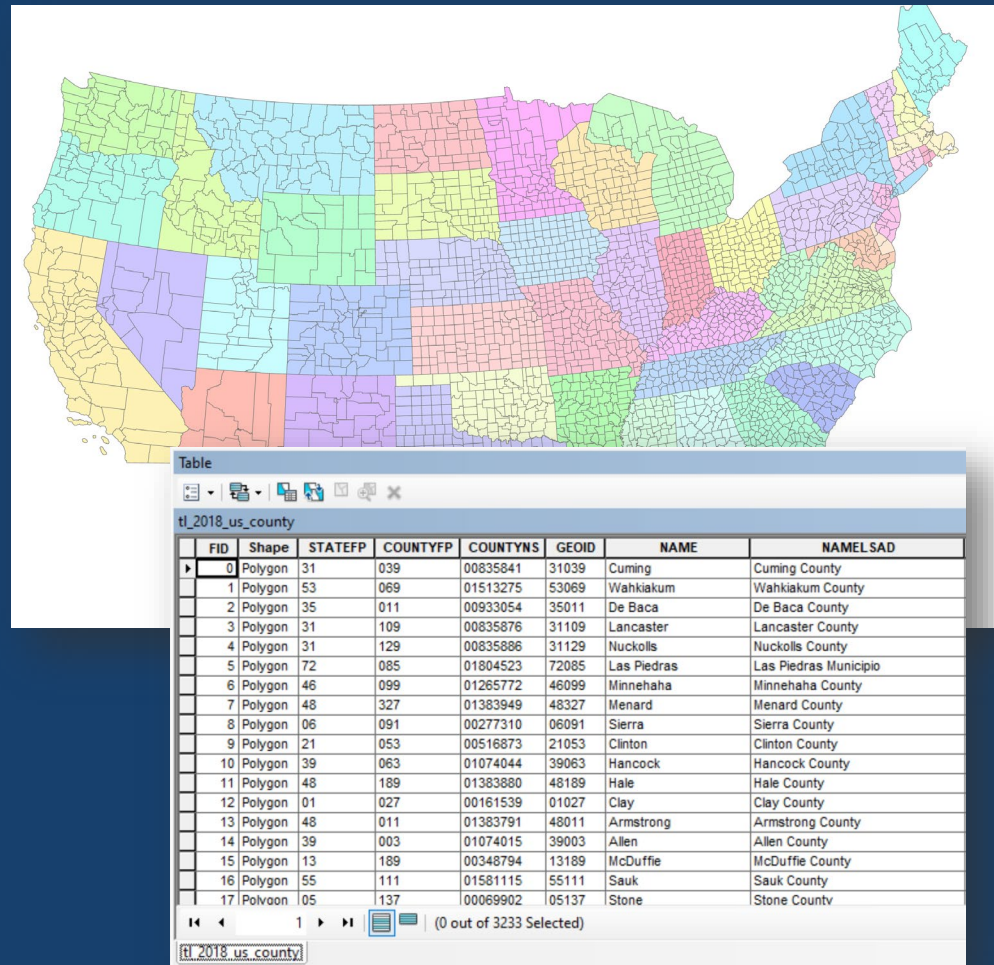
S = SYSTEMS

- Hardware and Software

ArcGIS

GRASS GIS

QGIS

Caliper Maptitude
Geographic Information System

GeoMedia

SAGA
System for Automated Geoscientific Analyses

Many more...

COMPONENTS OF GIS
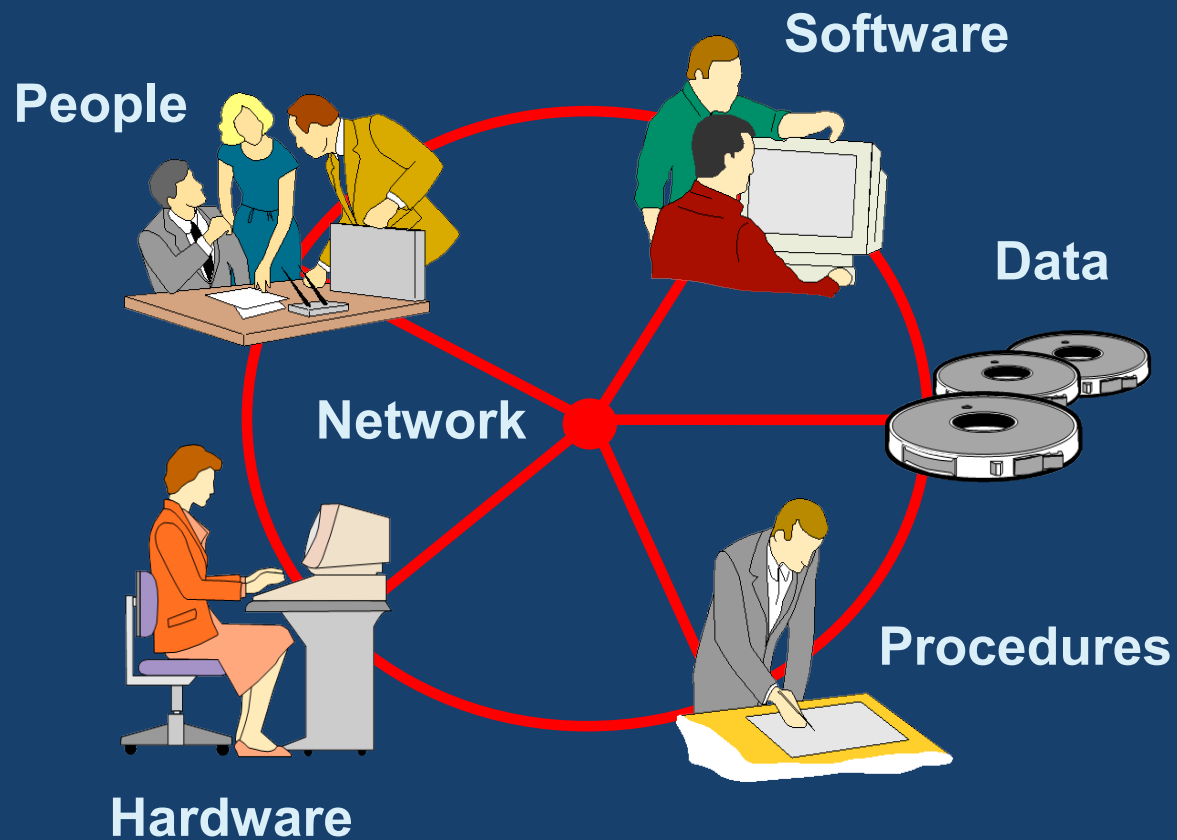
FUNCTIONS OF A GIS

- Capture

- Store

- Query

- Analyze

- Display

- Output

CAPTURING DATA

Paper maps

Coordinates
480585.5, 3769234
483194.1, 3768432
485285.8, 3768391
484327.3, 3768565
483874.7, 3769823

GIS Data
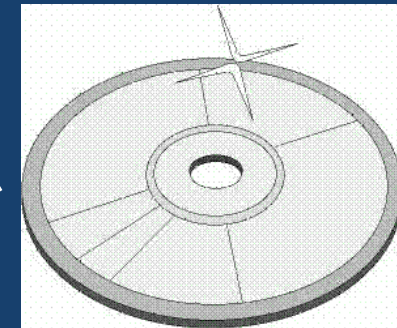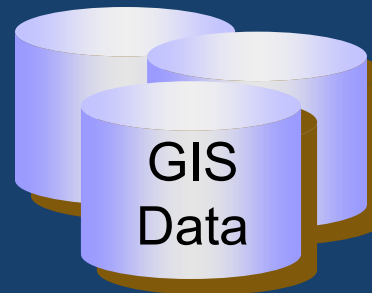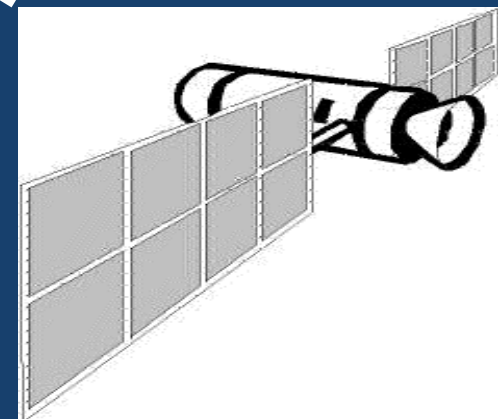
Digital data

GPS

STORING DATA

The "Paper Map World" (analog)

POINTS — Dot of ink

LINES — Dragged flow of ink

AREAS — Dragged and filled flow of ink
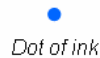
The "GIS Map World" (digital)

X, Y coordinates (Vector)

Cell Col, Row (Raster)
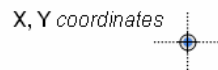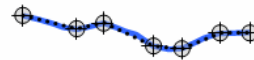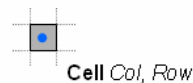
(Vector)
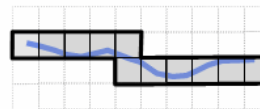
(Raster)
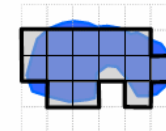
(Vector)

(Raster)

POINTS are stored as individual X, Y coordinates (Vector) or as individual Column, Row cell entries in a grid (Raster)

LINES are stored as a set of mathematically connected X, Y coordinates (Vector) or as a set of connected grid cells (Raster)

AREAS are stored as a set of mathematically connected X, Y coordinates defining the boundary (Vector) or as a set of contiguous cells defining the interior (Raster)

QUERY DATA

- Identifying specific features

- Identifying features based on conditions
  - Massachusetts counties with a population greater than 300,000
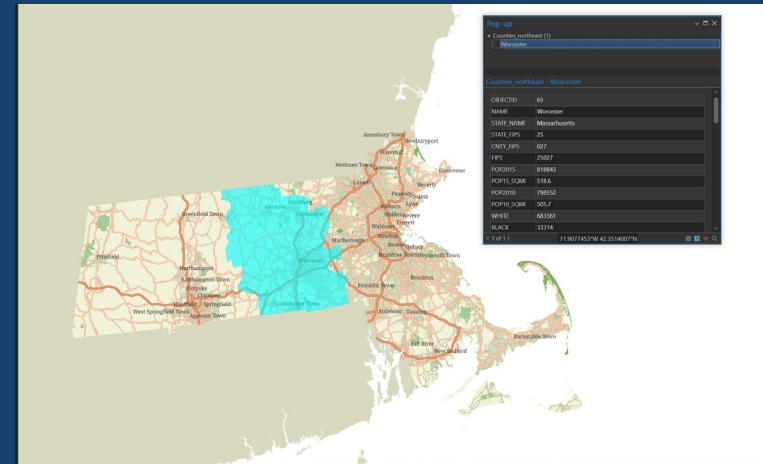
ANALYSIS

- Proximity
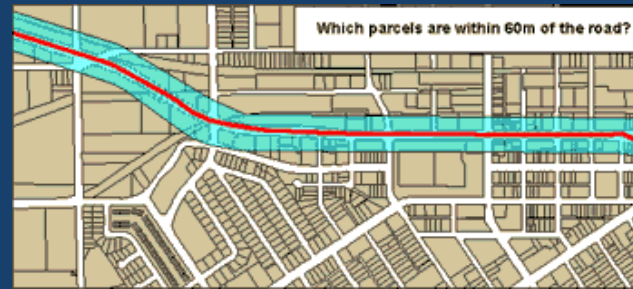
- Overlay
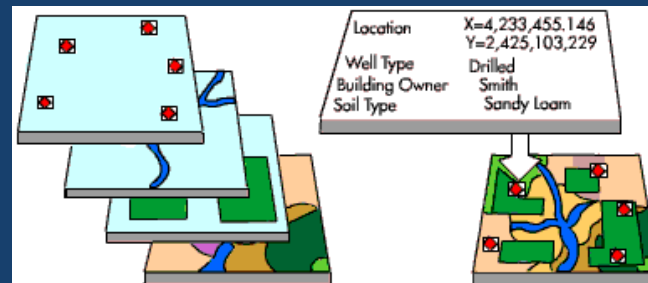
- Network
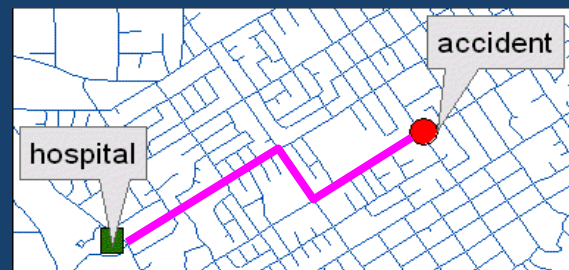
DISPLAY
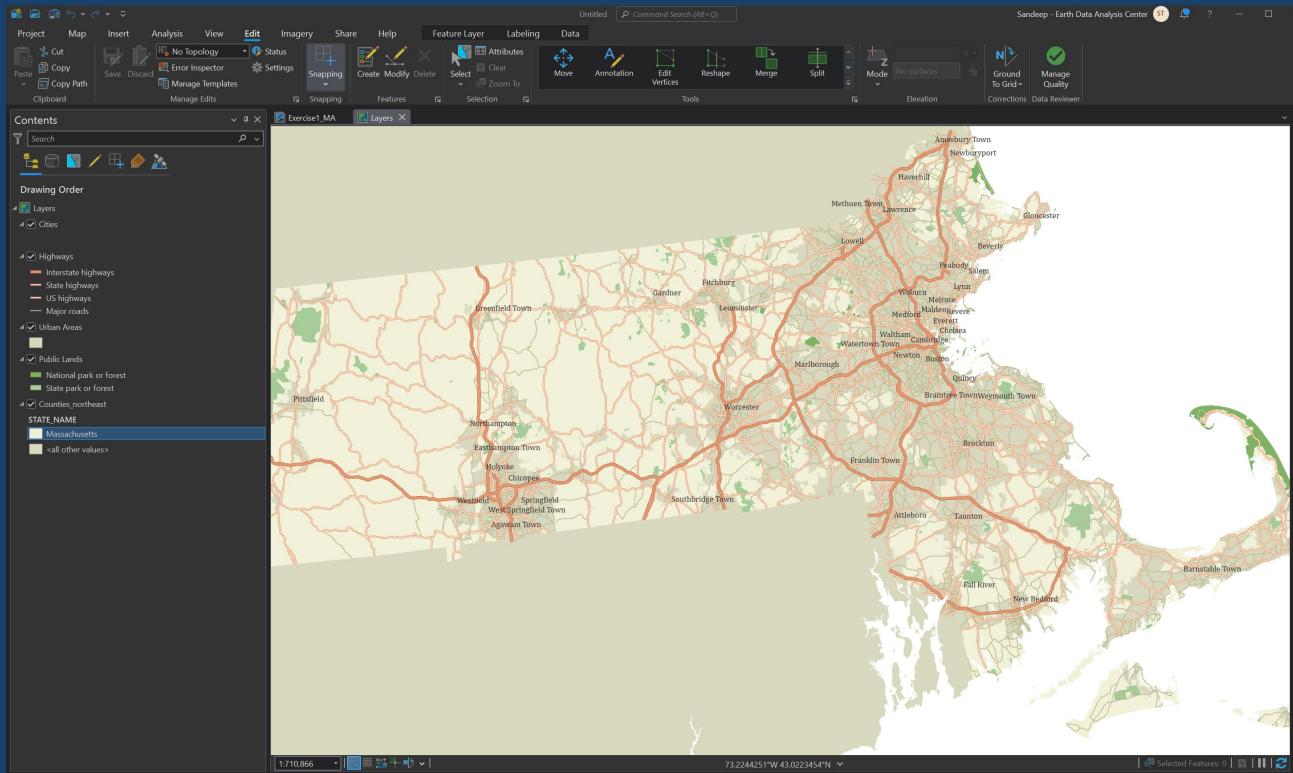
Maps
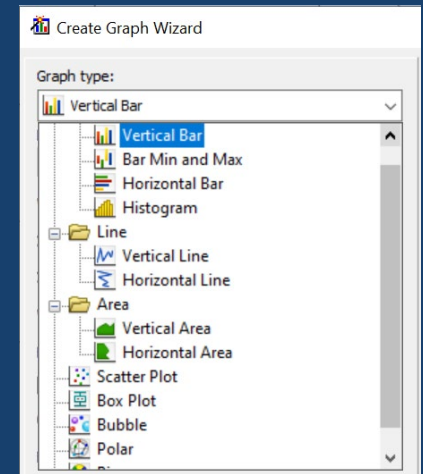
Graphs

Reports
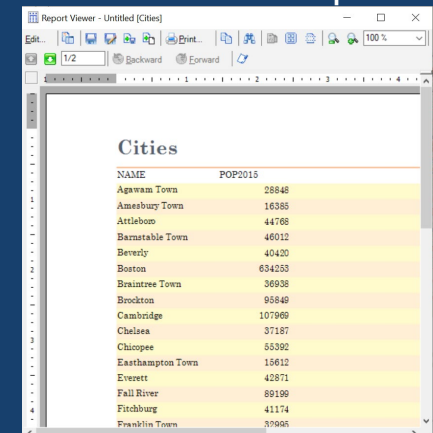
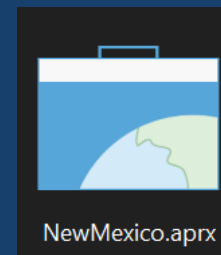# OUTPUT

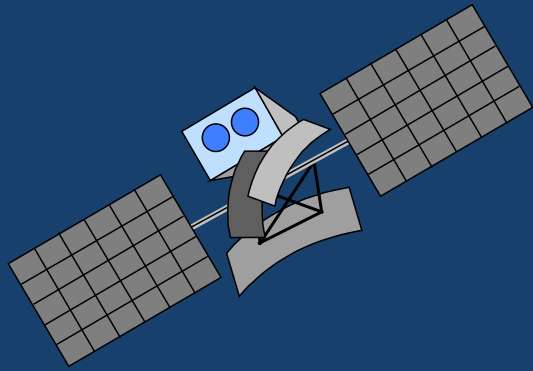## Paper map
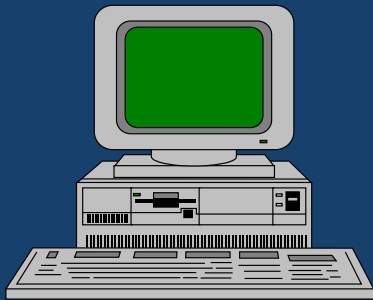

Internet

Image

MA.jpg

Project

NewMexico.aprx
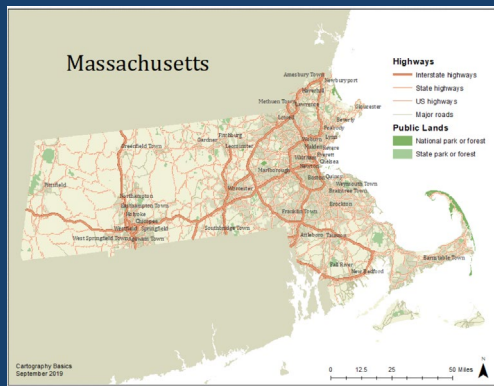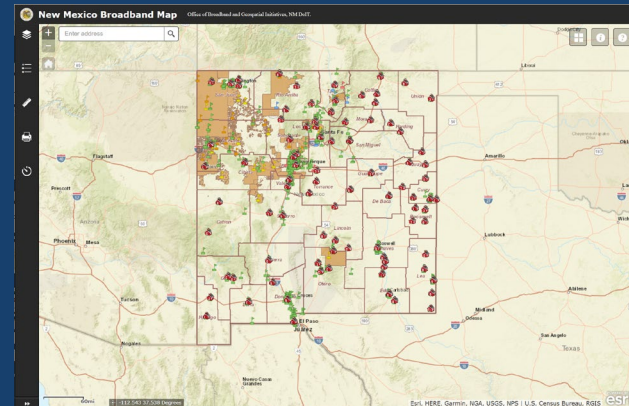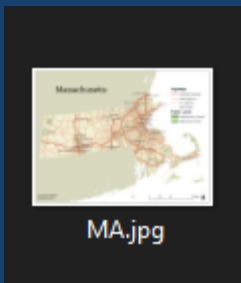
RELATED TECHNOLOGIES

- Computer Cartography
- Computer Graphics/Animation
- Computer-aided design (CAD)
- Database Management System (DBMS)
- Global Positioning System
- Remote Sensing
- Statistics

MODERN GIS

Cartography

Computer-Aided Design (CAD)

Surveying and Photogrammetry

Spatial Analysis

Remote Sensing

Spatial / Network Modeling

Database Analysis

} GIS

GIS EVOLUTION

Computing Software/
Hardware Cost and
Degree of Operational Difficulty

Computing Software/
Hardware Power and
Availability/Quality of GIS Data

Time

CATEGORIES OF GIS USERS

Data Flow

Doers — GIS Professionals

Users — Analysts Using GIS as a Decision Support Tool
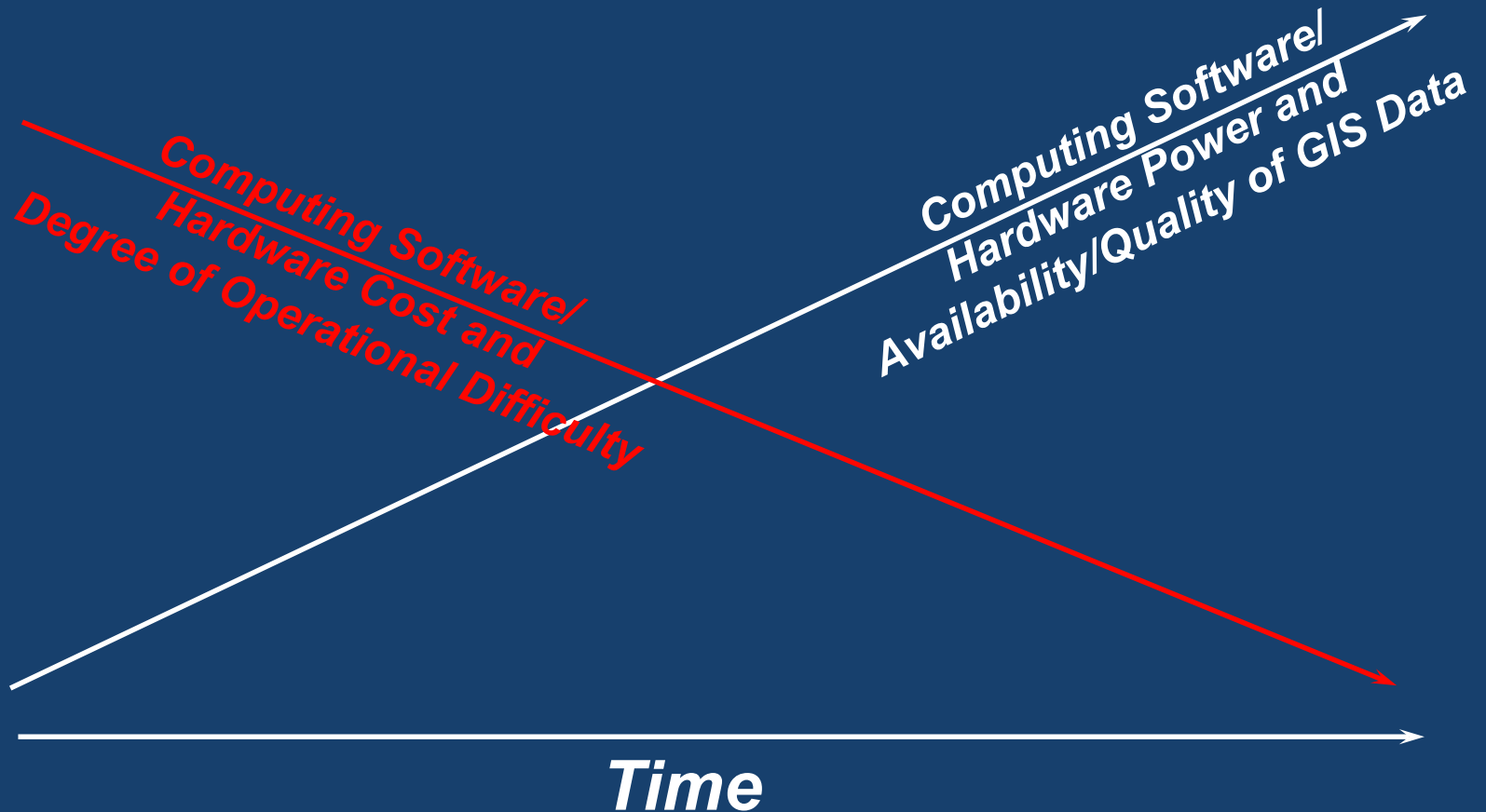
Viewers — Upper Level Management and "the masses"
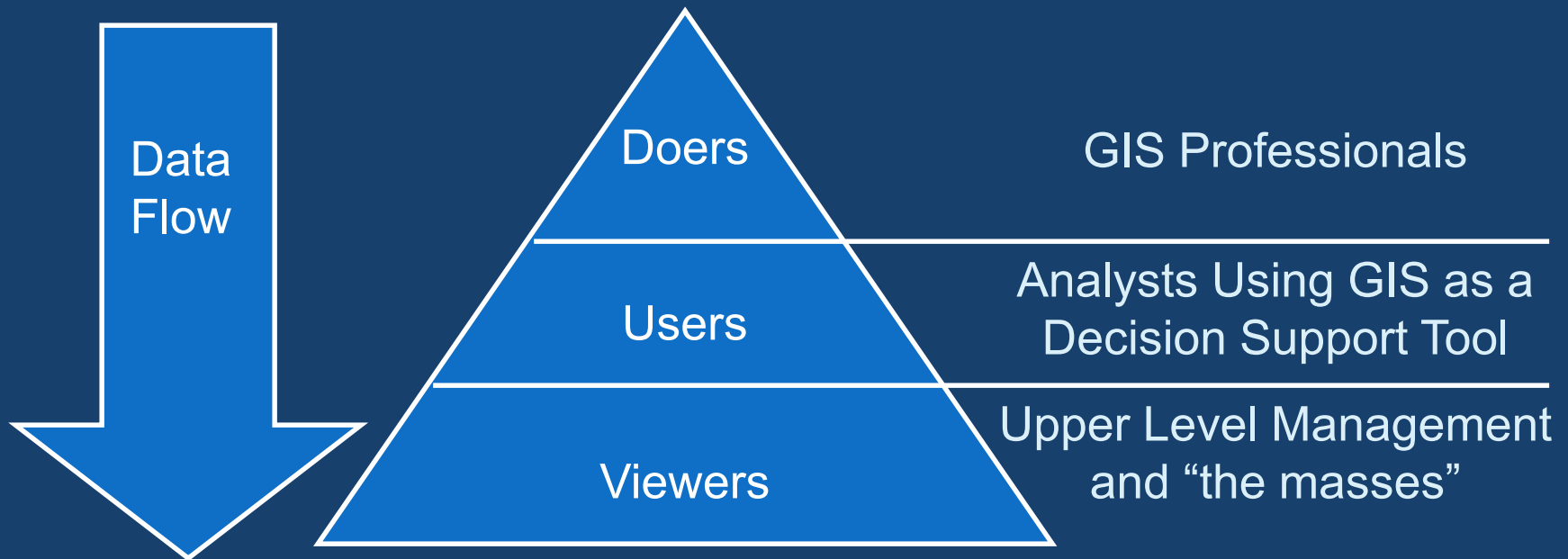
There are specialized software tools for each user group

ARCGIS

Introduction

ARCGIS

- Developed by ESRI

- Arc/INFO in 1981

- ArcView GIS in 1990's > ArcMap > ArcGIS in 2000's

- Products https://www.esri.com/en-us/arcgis/products/index

ArcGIS Online
Complete SaaS mapping platform

ArcGIS Pro
Next-generation desktop GIS

ArcGIS Enterprise
Flexible mapping server software

ArcGIS Living Atlas of the World
Data for the planet

ArcGIS Apps
Focused GIS applications

ArcGIS for Developers →
Develop your own apps
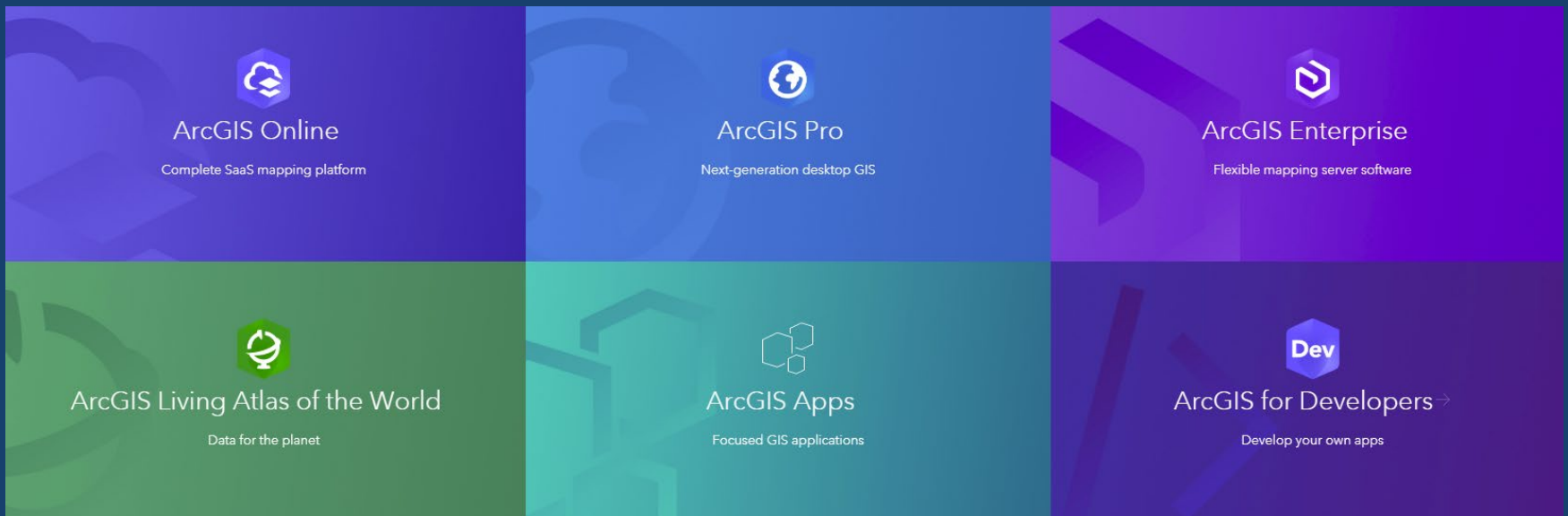
DATA MANAGEMENT

- DO NOT store projects and data in Documents folder

- Consistent File Structure

- Standardized Naming Conventions
  - No spaces in names

nm_roads.shp			
nm_rivers.shp			
bern_tracts.shp			
abq_hospitals.gdb			

GIS			
	GISdata		
		Basemap	
		Boundaries	
		Census	
		Elevation	
		General Background	
		Hydrology	
		Imagery	
		LandCover	
		Parcels	
		Topography	
		Transportation	
	Projects		
		Project A	
			Backups
			Data
			Documents
			MXDs
			Maps_images
			Reports
			Temporarygisfiles

METADATA

- At very least fill out data source, date, and a few comments about the project.

Edit Metadata
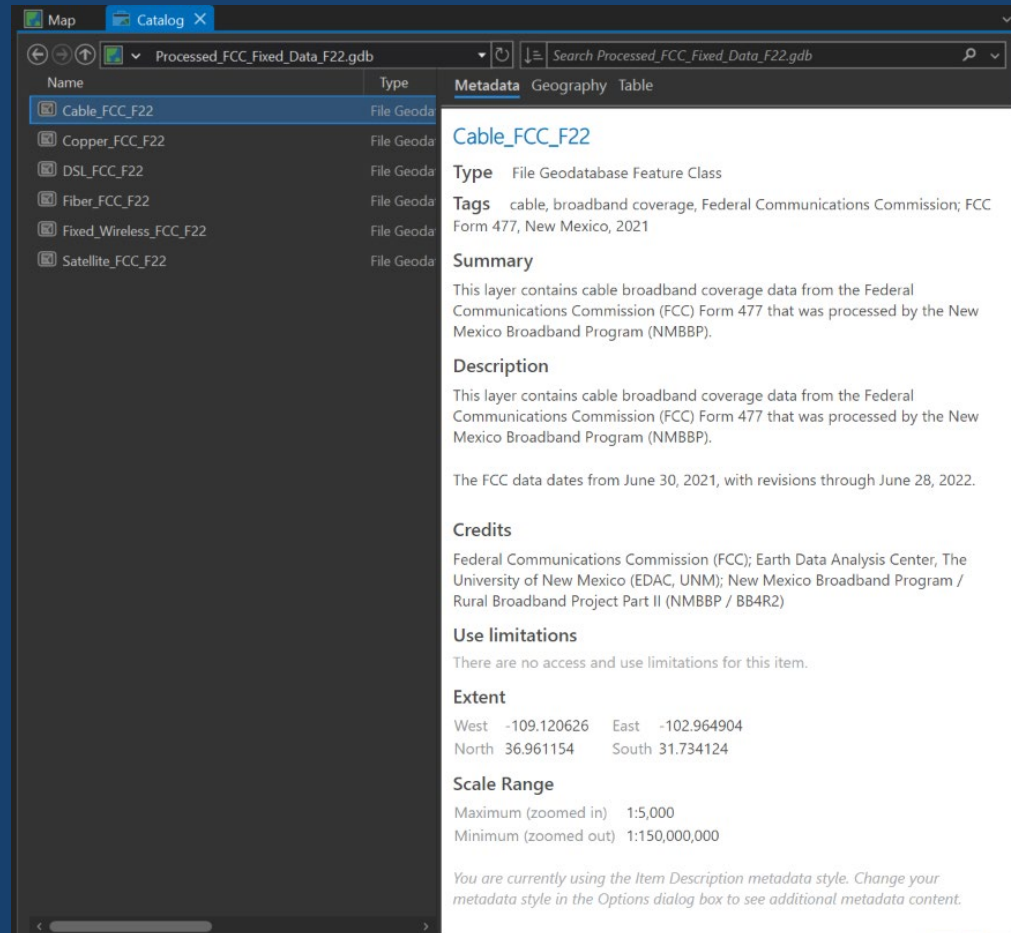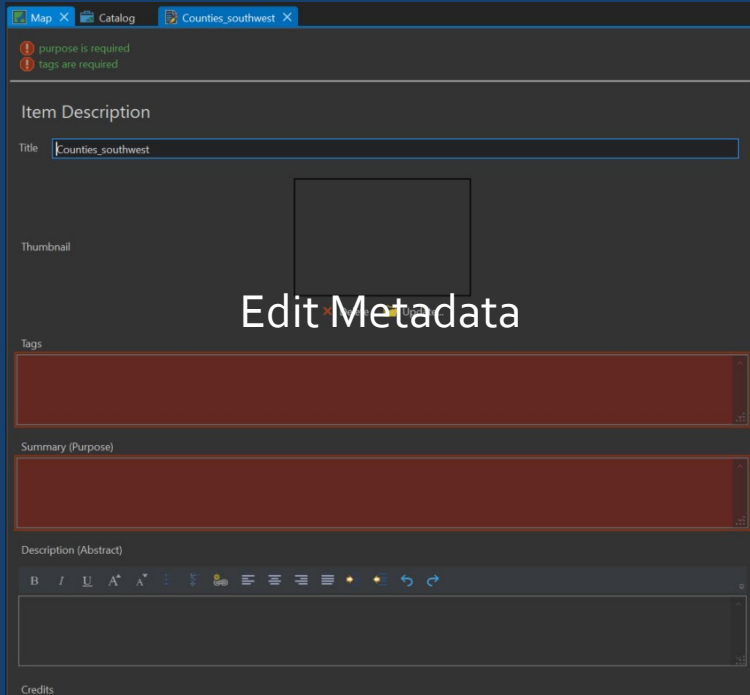
DATA MANIPULATION

- Only use ArcCatalog to copy, move or delete GIS data and not windows explorer
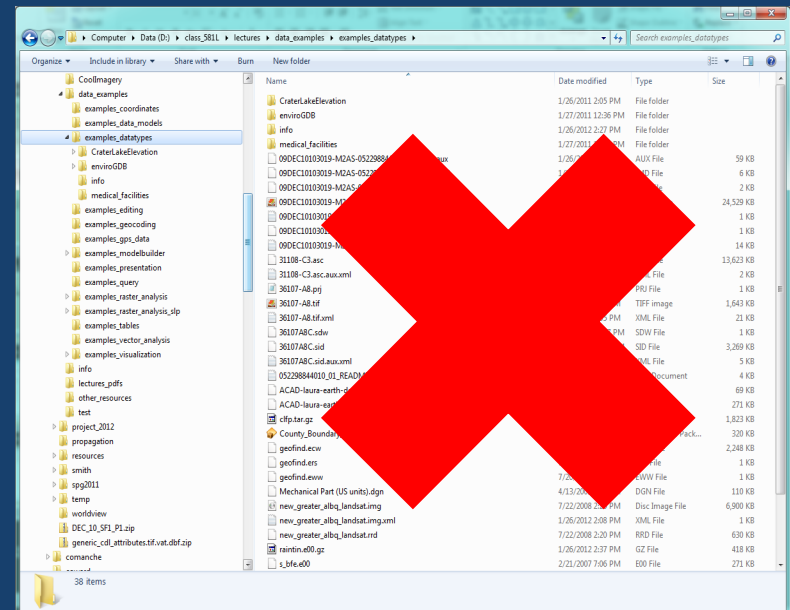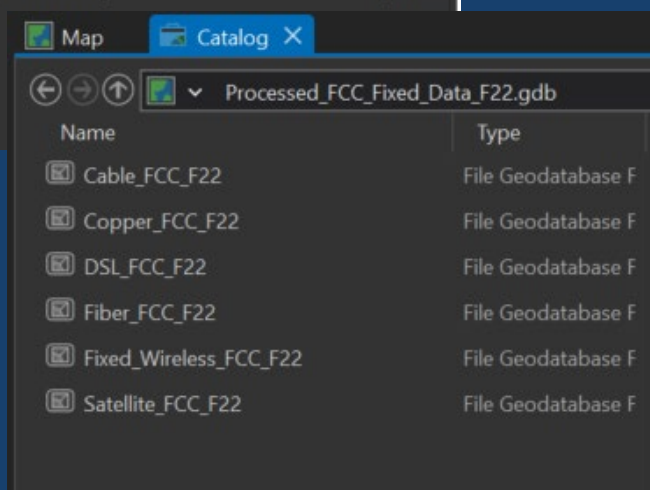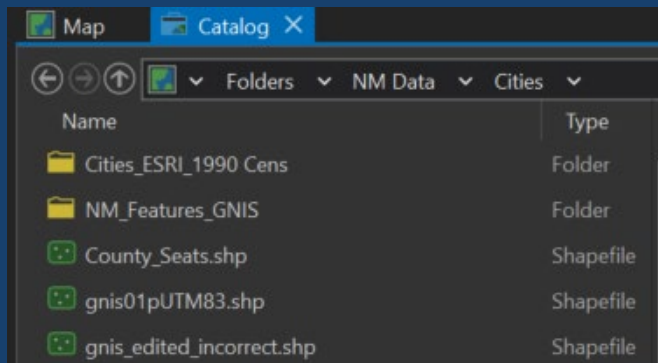
PROJECT MANAGEMENT
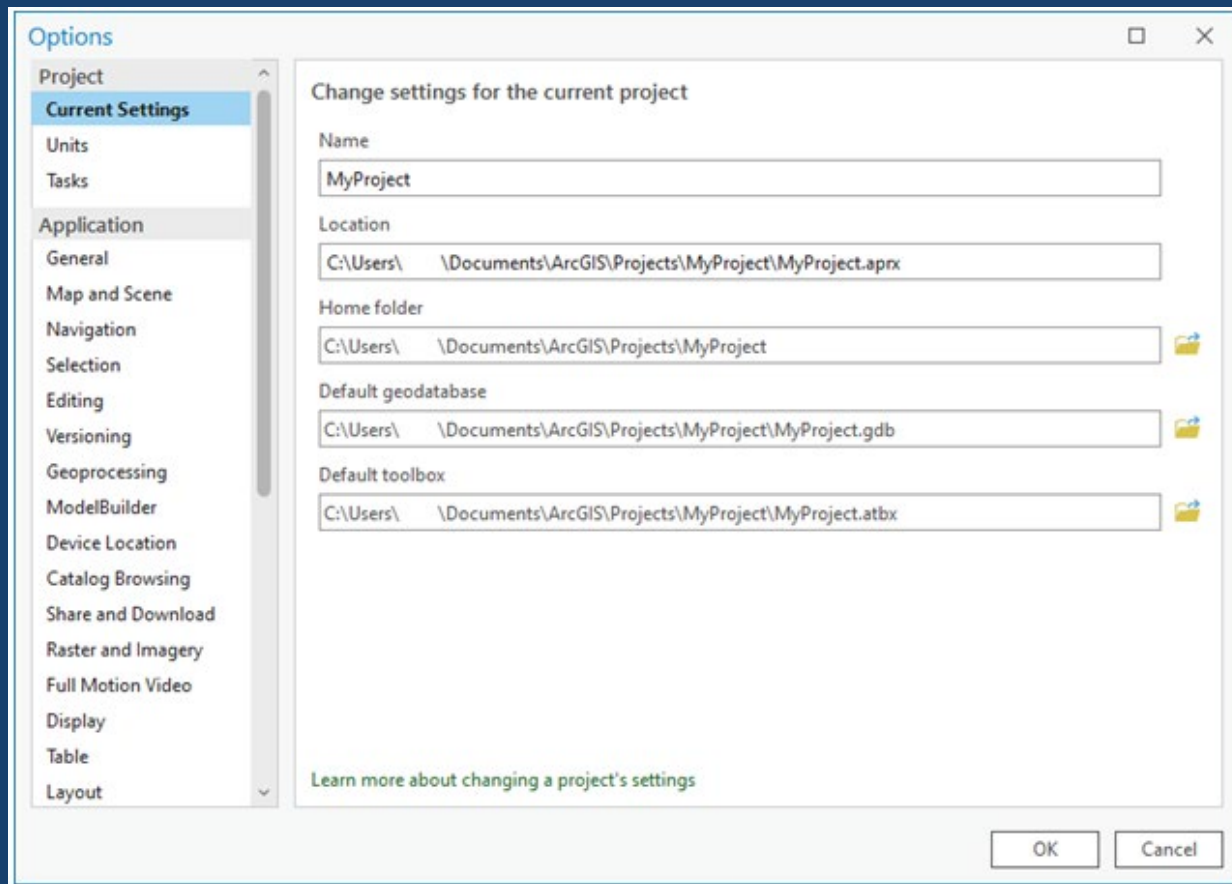
ARCGIS COMPONENTS

ArcCatalog vs ArcMap

ARCCATALOG

- Organizes and manages data

- <u>Always</u> use ArcCatalog to copy and move GIS data
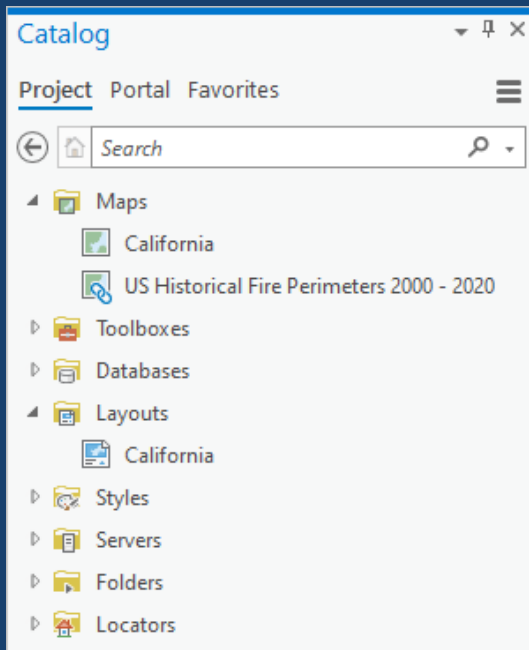
Catalog Pane in ArcGIS Pro
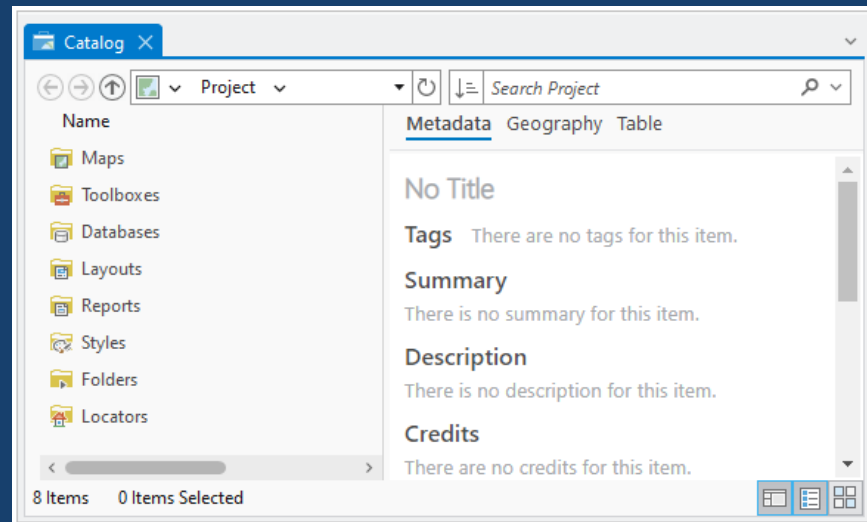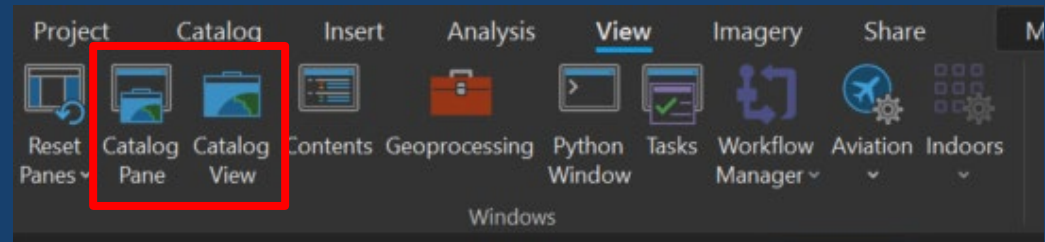
Catalog View in ArcGIS for Desktop

Images: esri.com

FOLDER CONNECTIONS

- Define Folder Connections to locate and save data
  - Right click on Folders in Catalog contents
  - Can be done in either the docked Catalog Pane or Catalog View

ARCGIS HELP

- https://pro.arcgis.com/en/pro-app/latest/help/main/welcome-to-the-arcgis-pro-app-help.htm

ESRI COMMUNITY

<https://community.esri.com/>

ARCGIS PRO DEMO

- Create a Project

- Create Template – Map, Catalog

- Components of ArcGIS Project

- Make folder connections in Catalog

- Explore data formats