

# INTRODUCTION TO GIS

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# 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



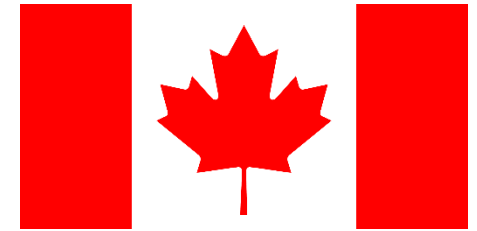
Frere de Montizon's Population Map of France in 1830  
1 dot = 10,000 people



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.

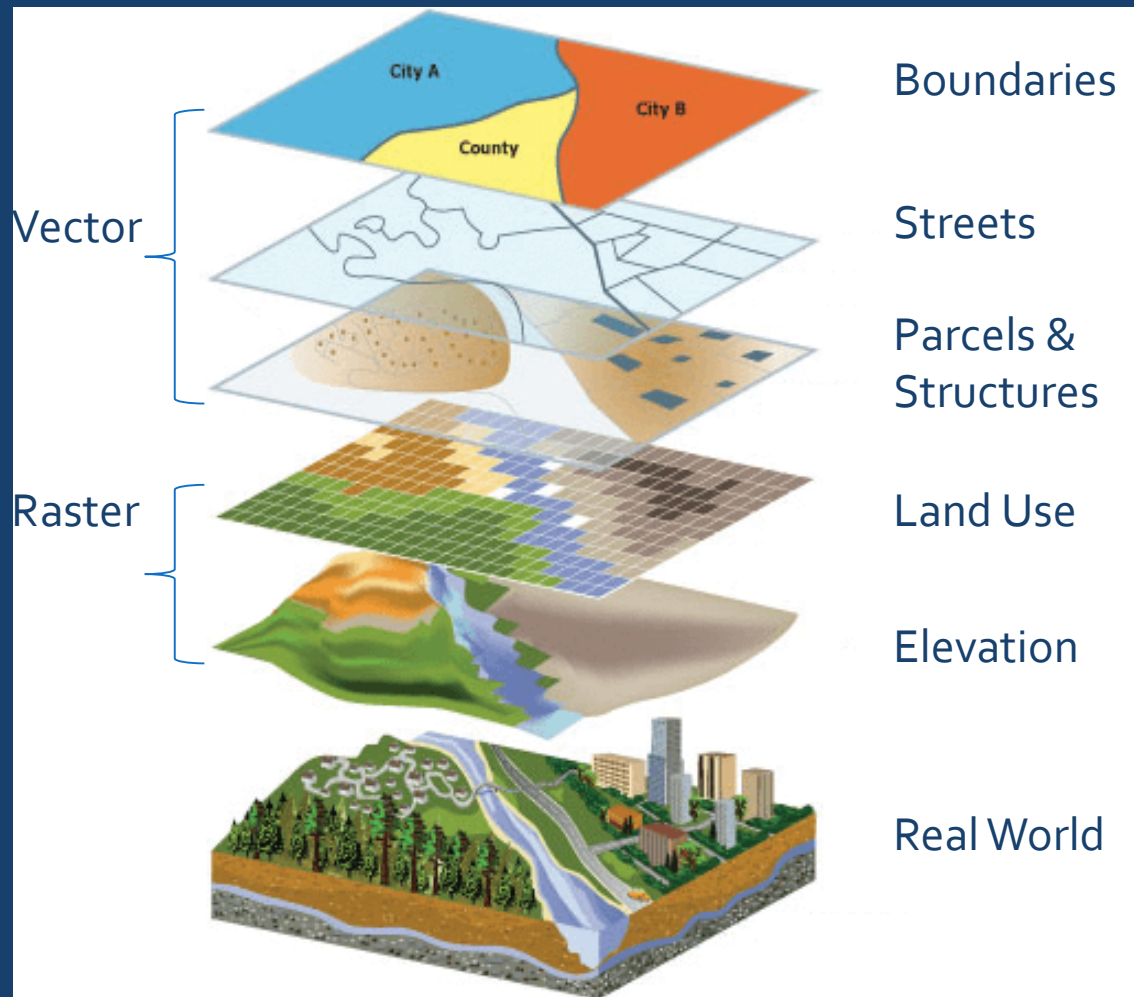
## Modeling

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



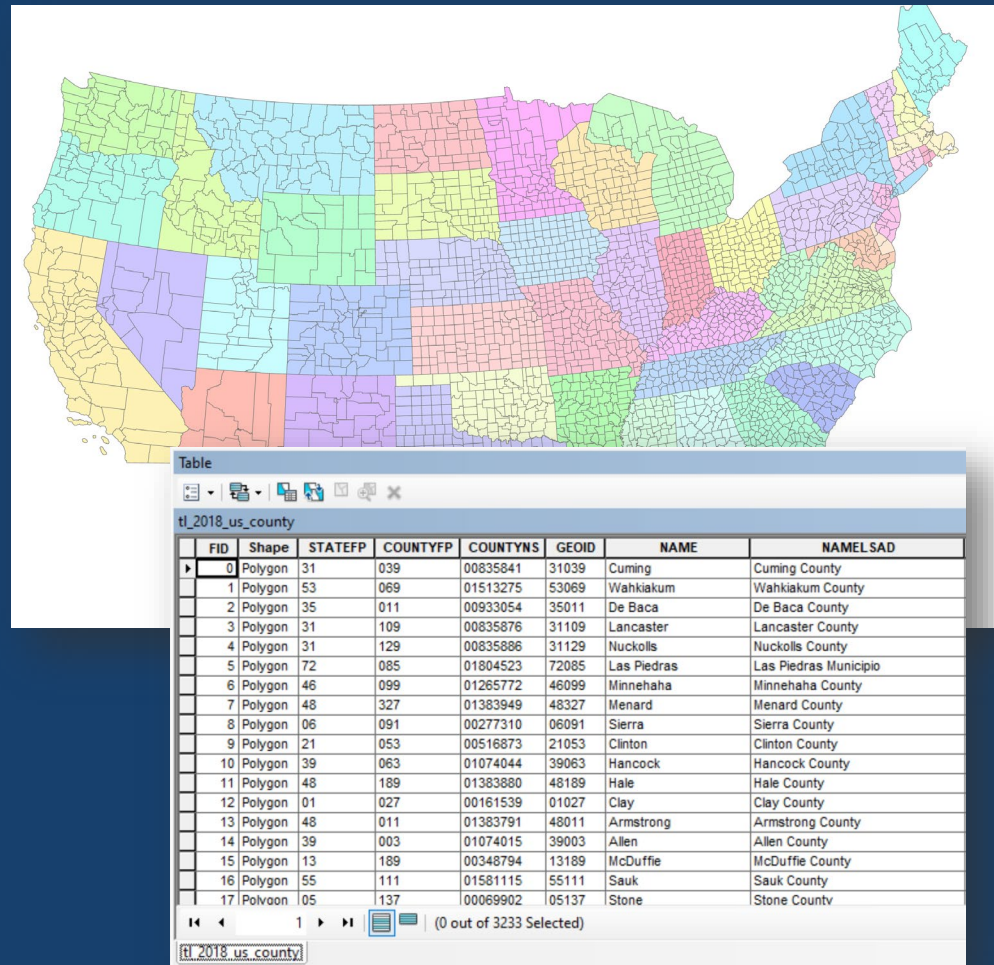
# G = GEOGRAPHIC

- Pertaining to the location
- Geographic features are represented as geometric objects or pixels
- Data Models: Vector and Raster



# 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,...



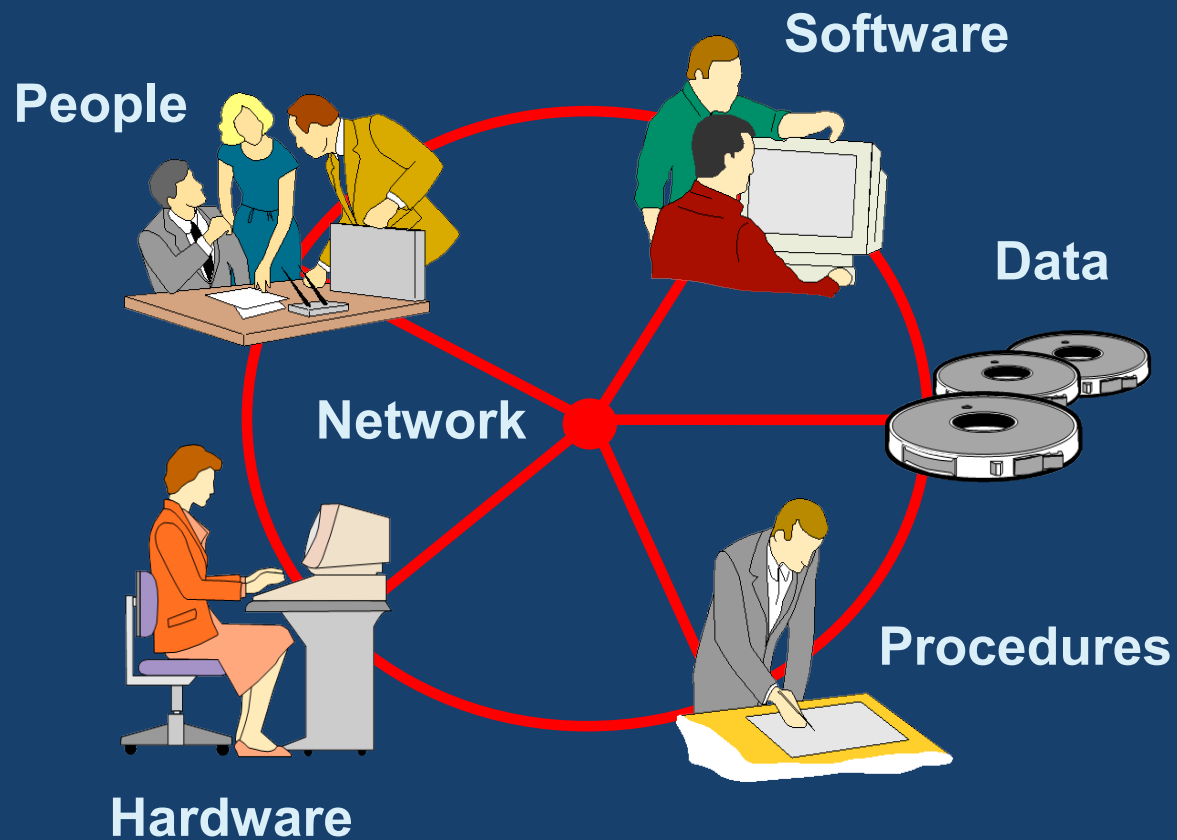
# S = SYSTEMS

- Hardware and Software



Many more...

# COMPONENTS OF GIS



# FUNCTIONS OF A GIS

- Capture
- Store
- Query
- Analyze
- Display
- Output

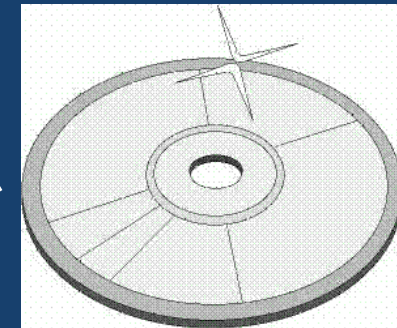
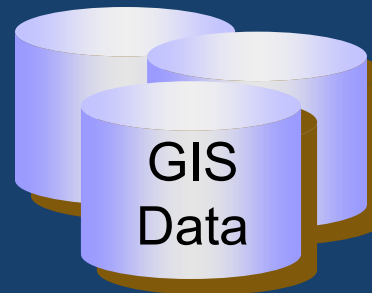
# CAPTURING DATA



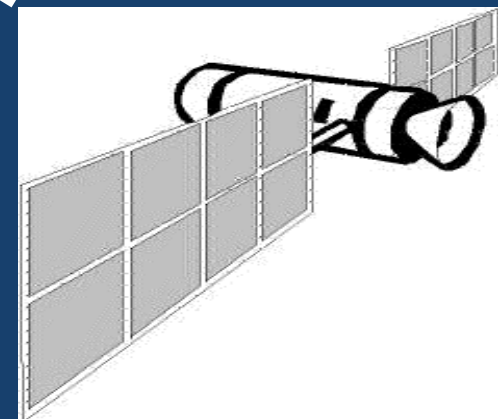
Paper maps

## Coordinates

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



Digital data

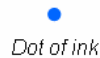


GPS

# STORING DATA

## The “Paper Map World” (analog)

### POINTS



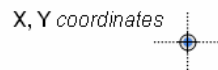
### LINES



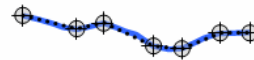
### AREAS



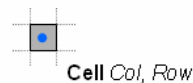
## The “GIS Map World” (digital)



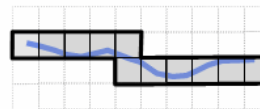
(Vector)



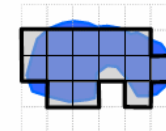
(Vector)



(Raster)



(Raster)



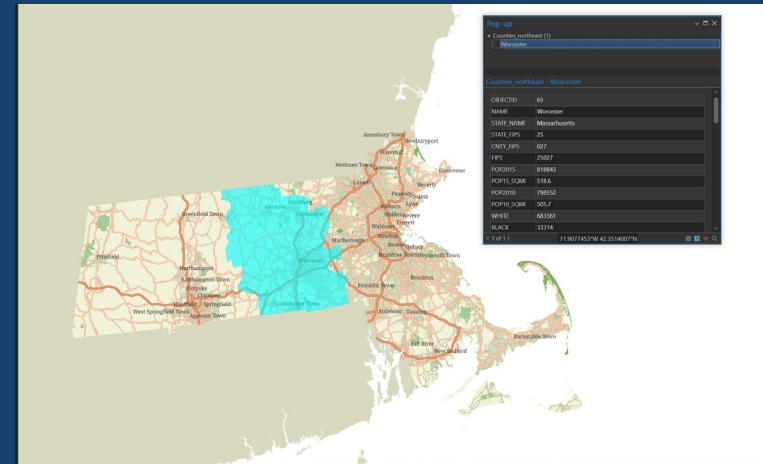
**POINTS** are stored as individual X, Y coordinates (Vector) or as individual Column, Row cell entries in a grid (Raster)

**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

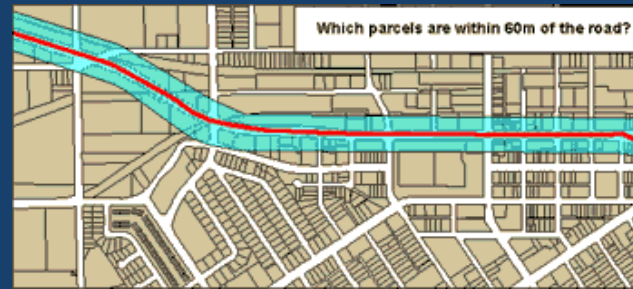
- Identifying specific features
- Identifying features based on conditions
  - Massachusetts counties with a population greater than 300,000



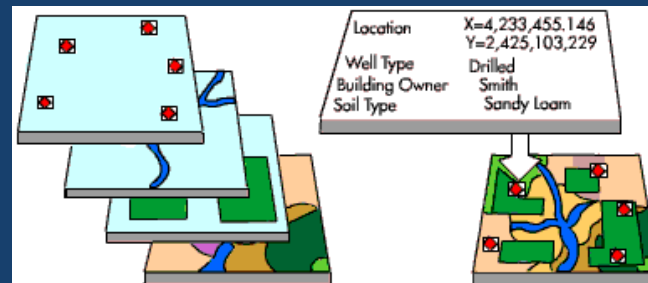


# ANALYSIS

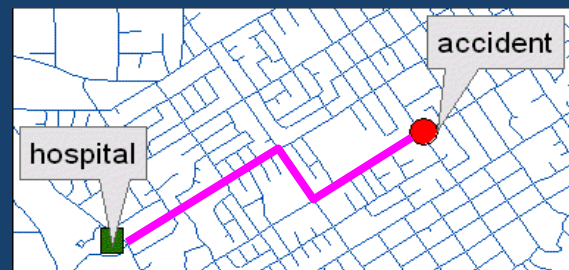
- Proximity



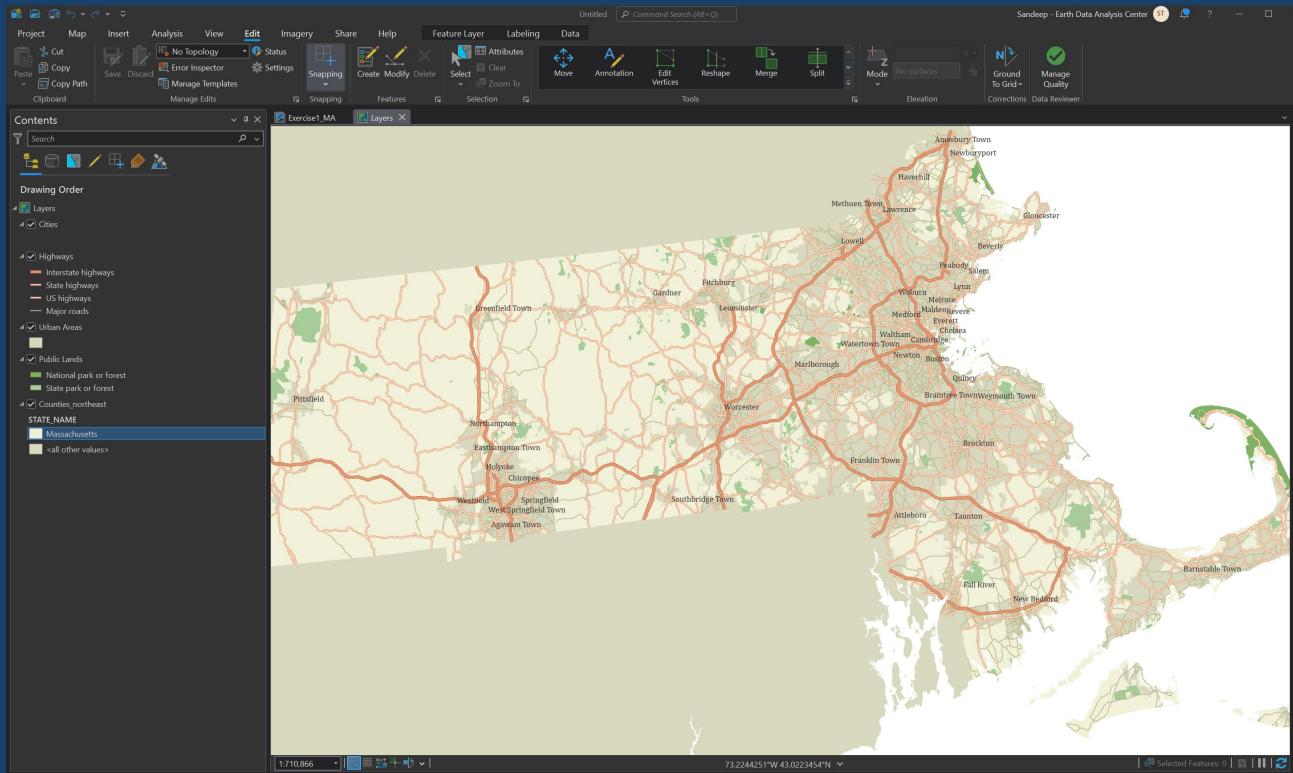
- Overlay



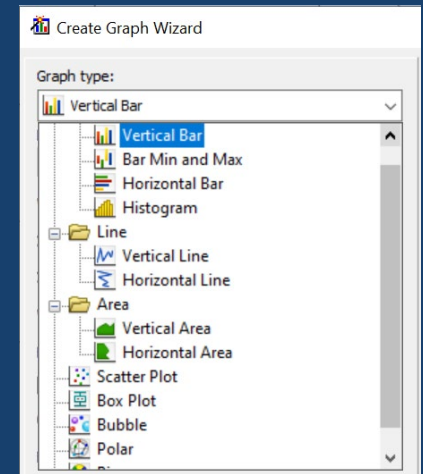
- Network



# DISPLAY

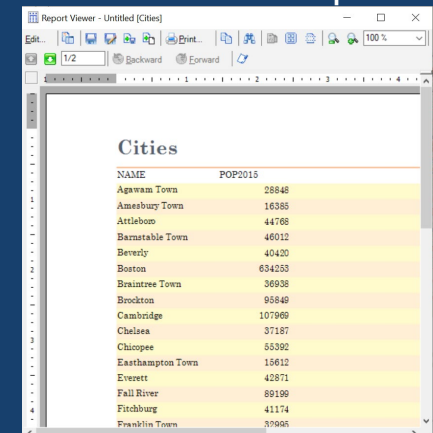


Maps



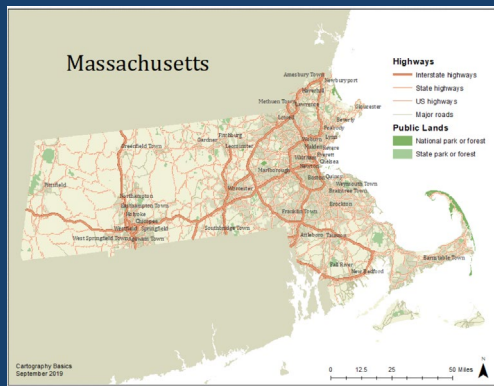
Graphs

Reports

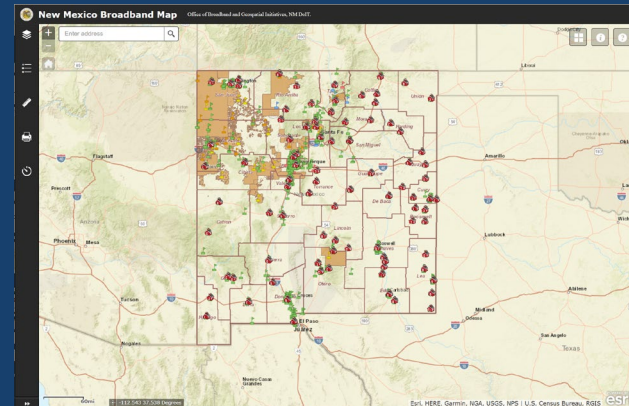


# OUTPUT

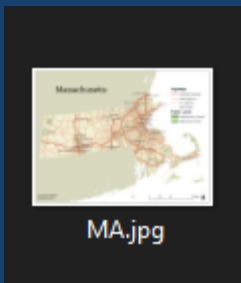
## Paper map



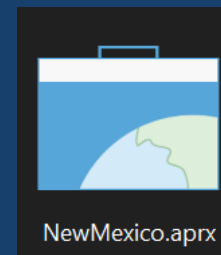
## Internet



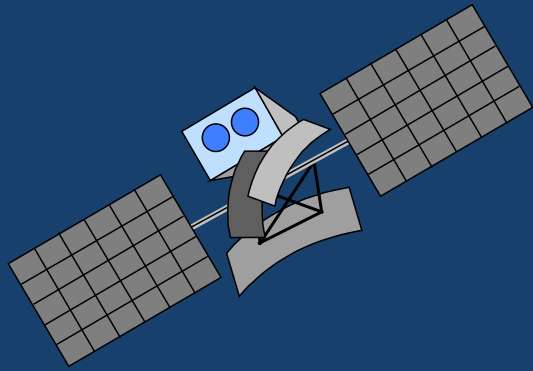
## Image



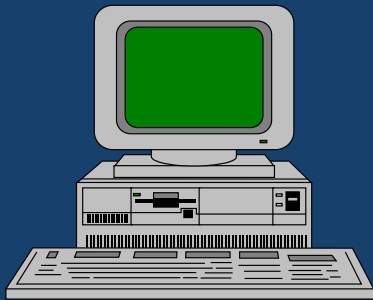
## Project



# 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

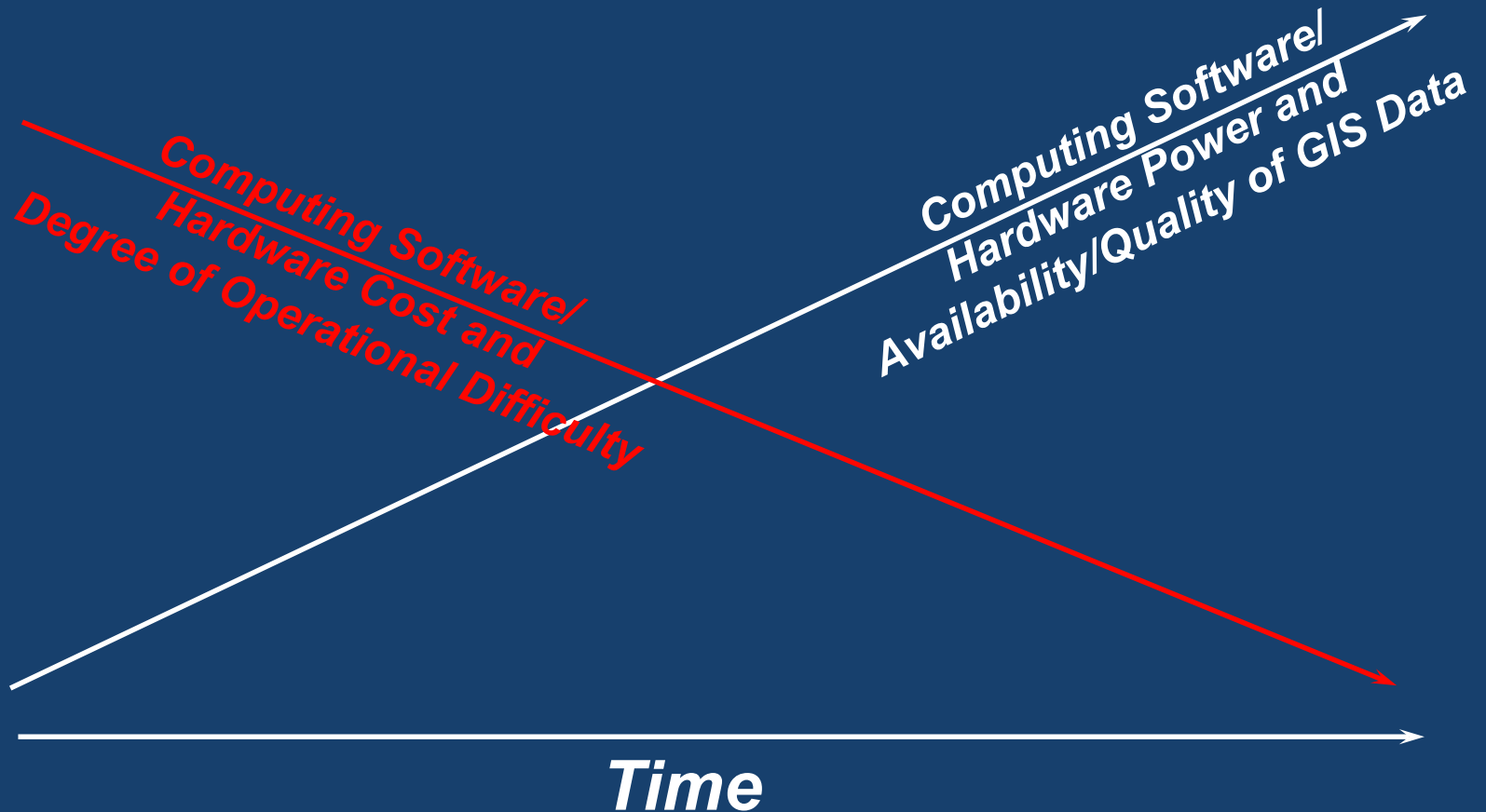
Spatial / Network Modeling

Database Analysis

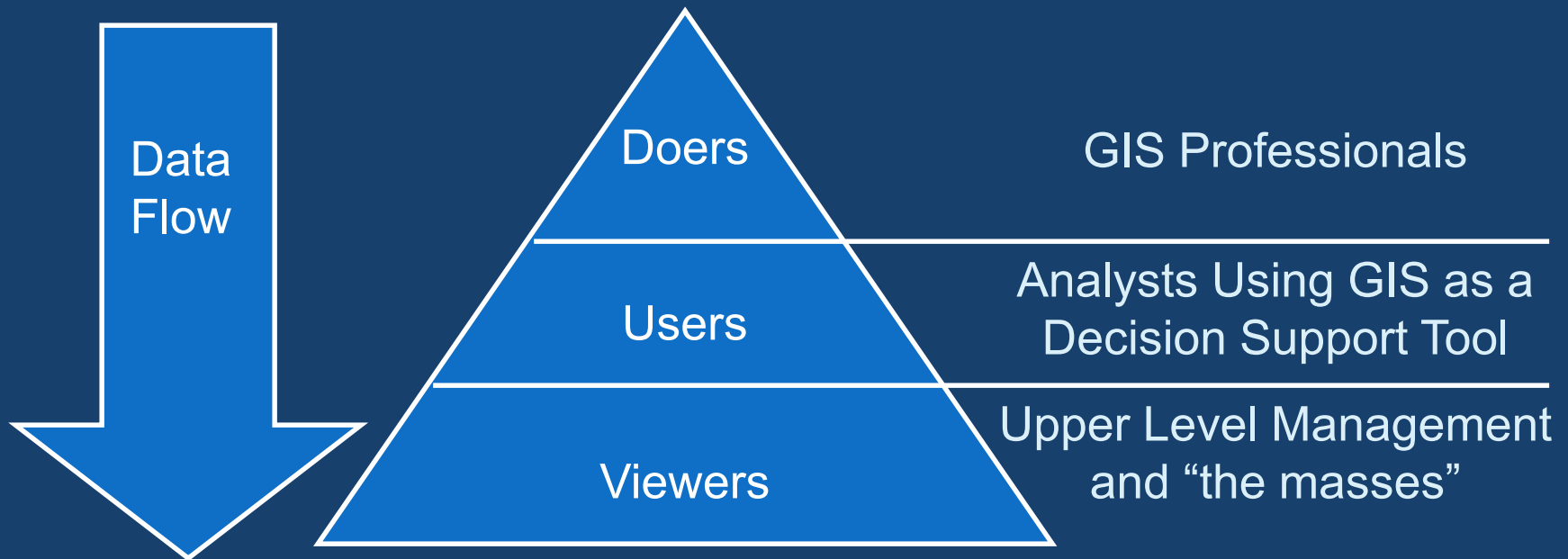


# GIS

# GIS EVOLUTION



# CATEGORIES OF GIS USERS



There are specialized software tools for each user group

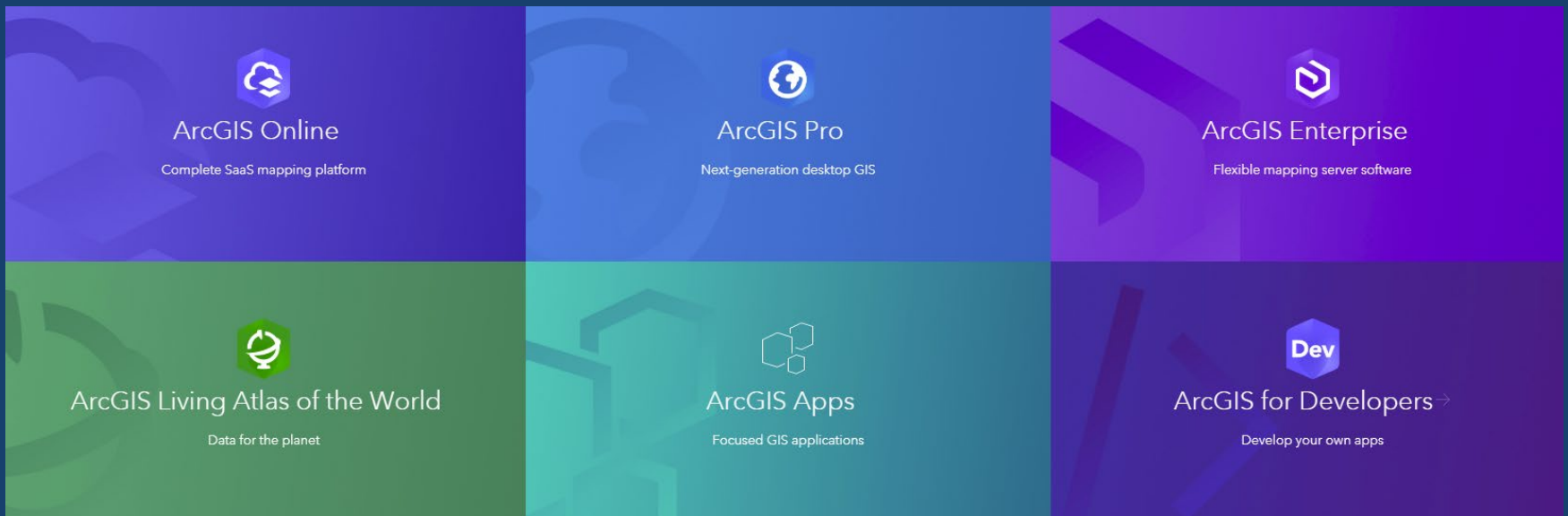
# ARCGIS

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>



# DATA MANAGEMENT

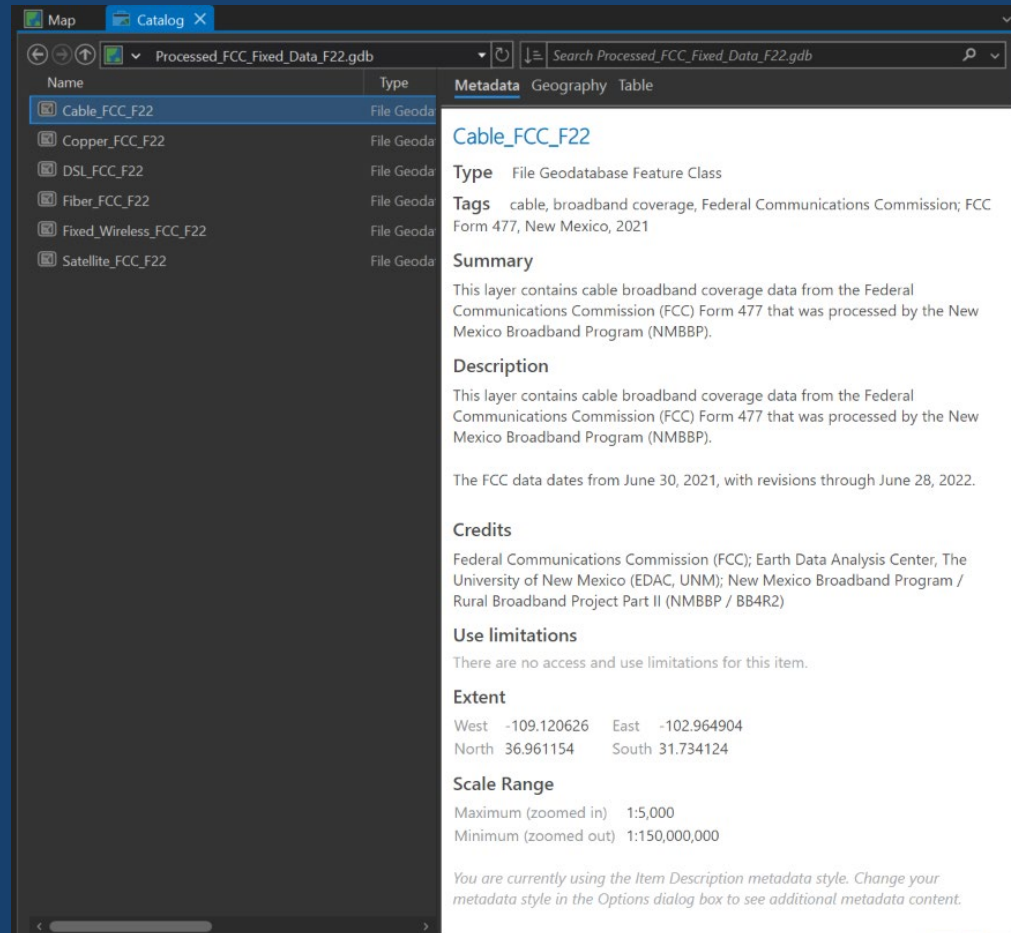
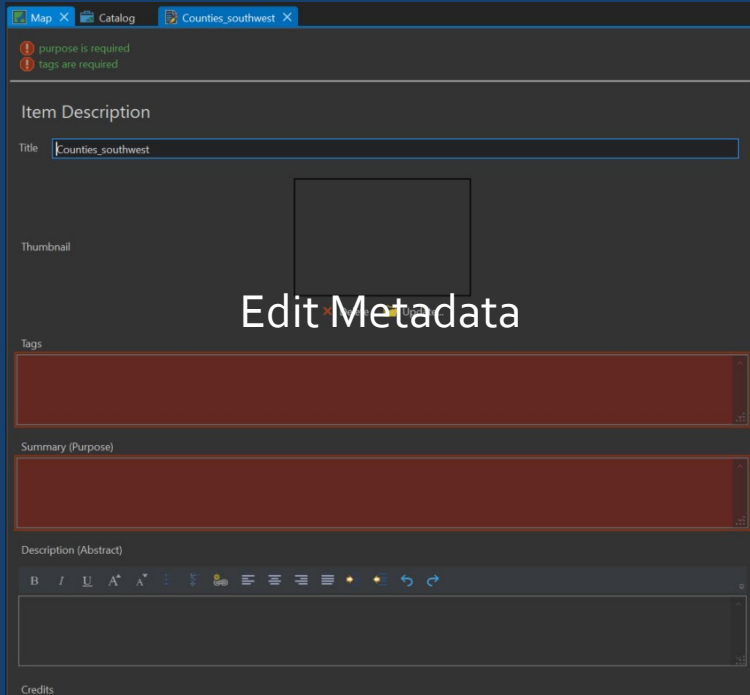
- DO NOT store projects and data in Documents folder
- Consistent File Structure
- Standardized Naming Conventions
  - No spaces in names

```
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

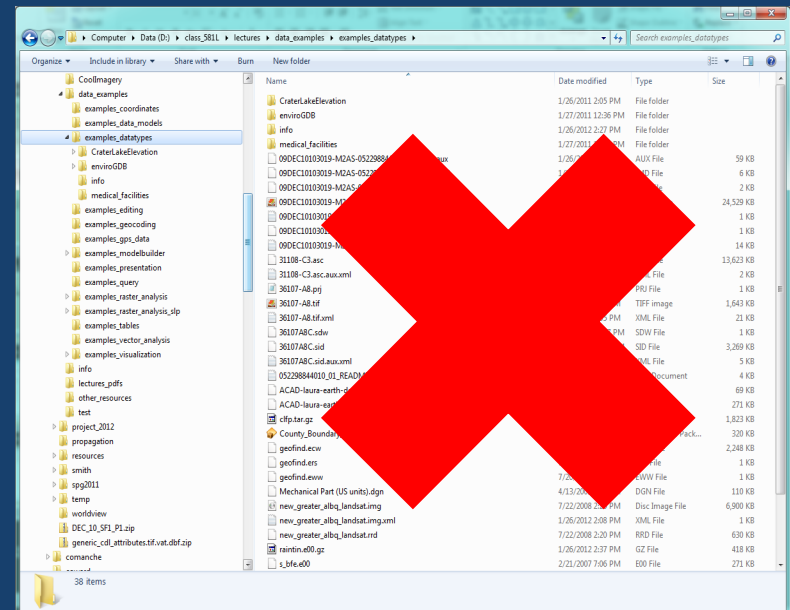
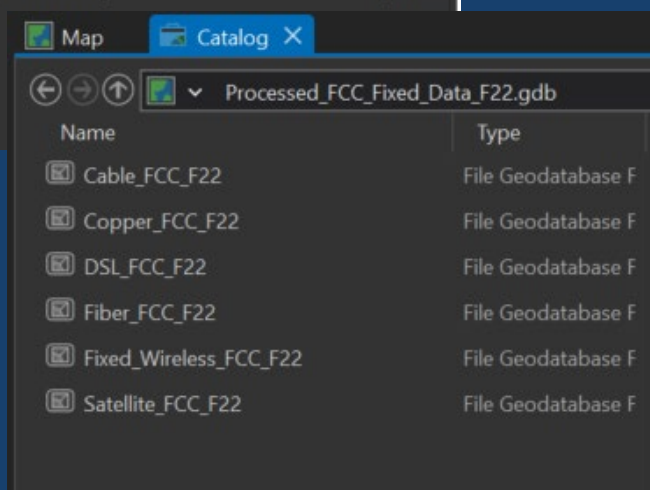
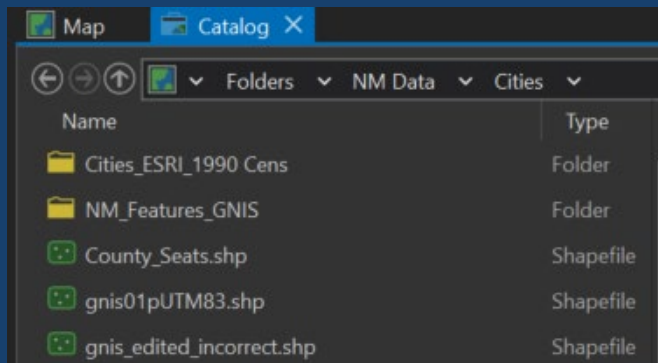
# METADATA

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

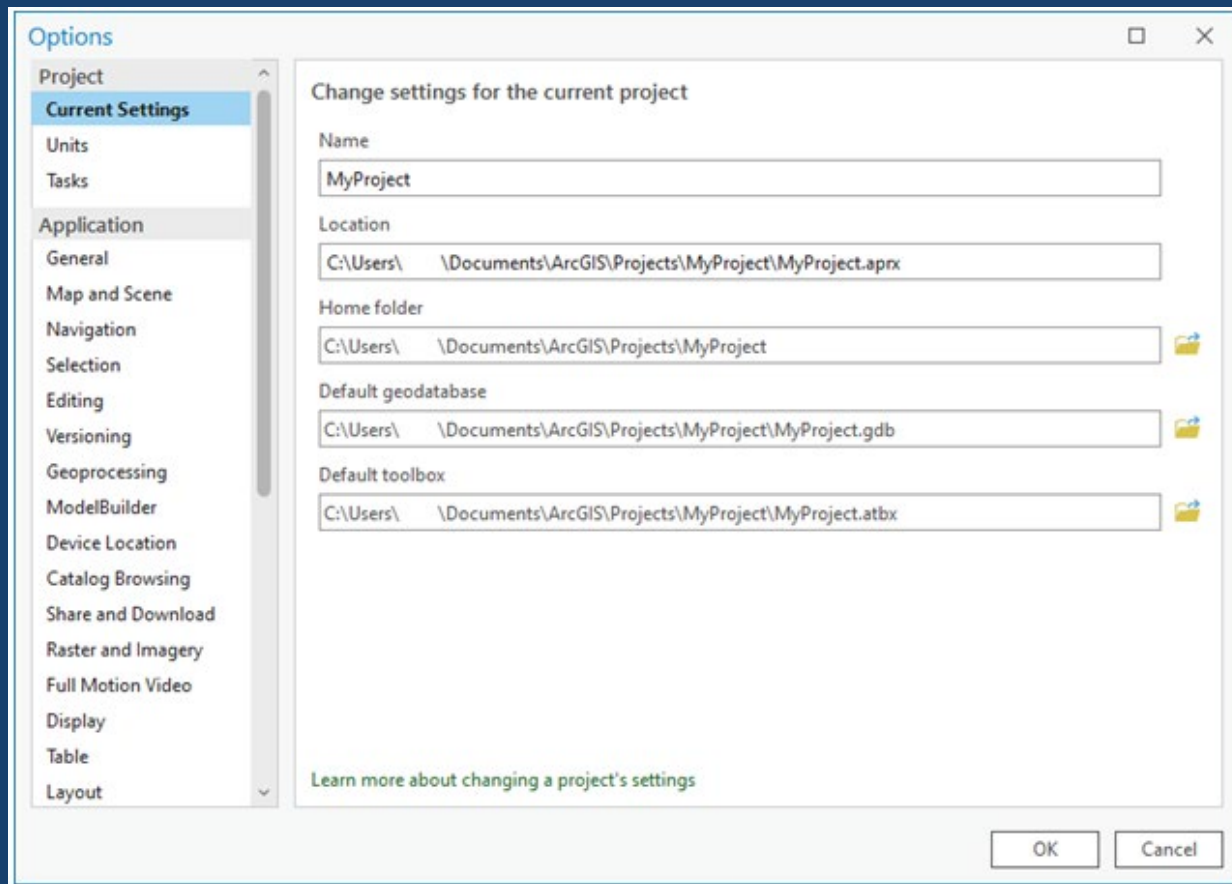


# DATA MANIPULATION

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



# PROJECT MANAGEMENT

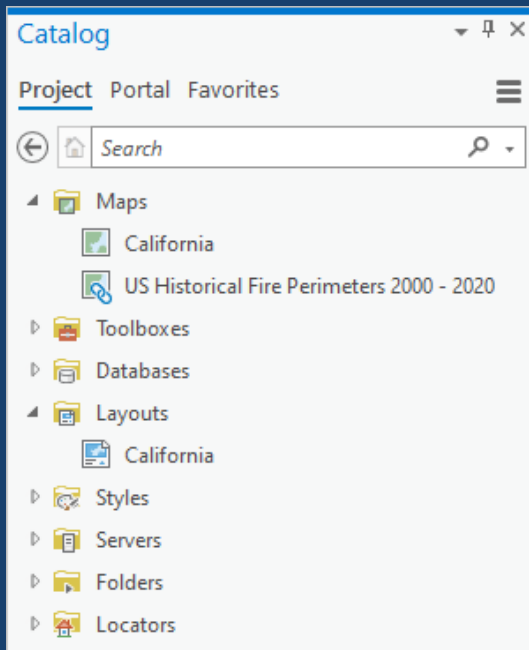


# ARCGIS COMPONENTS

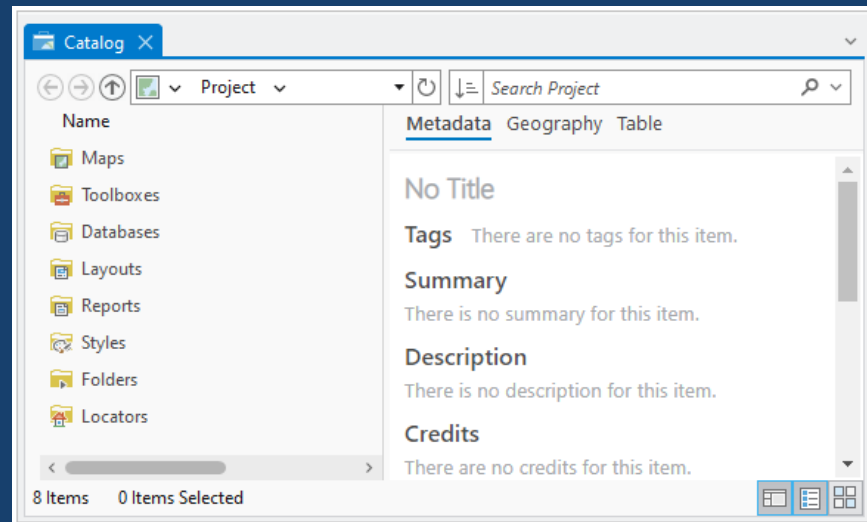
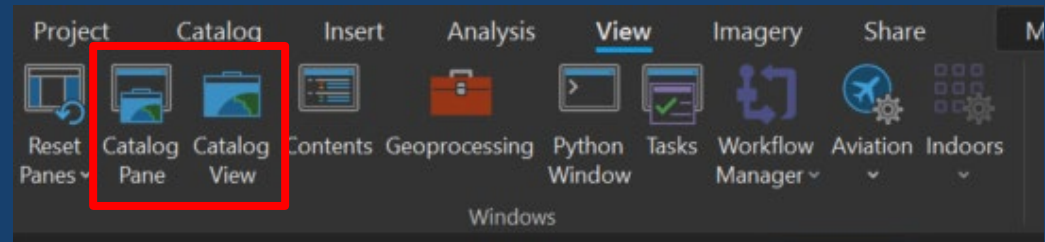
ArcCatalog vs ArcMap

# ARCCATALOG

- Organizes and manages data
- Always use ArcCatalog to copy and move GIS data



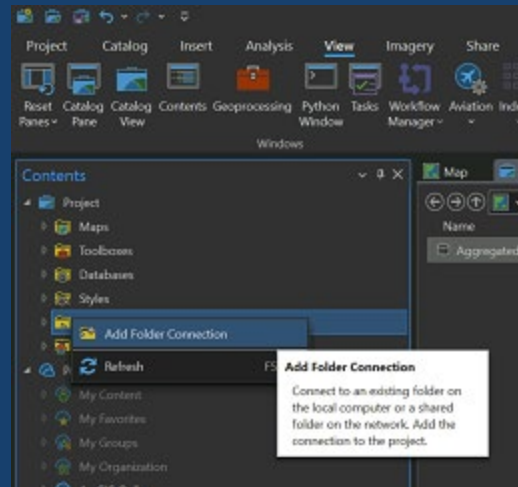
Catalog Pane in ArcGIS Pro



Catalog View in ArcGIS for Desktop

# 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>

The screenshot displays the ArcGIS Pro help page. At the top, there is a navigation bar with the Esri logo and menu items: Products, Industries, Support & Services, Stories, and About. Below this is a secondary navigation bar for ArcGIS Pro, including Overview, Extensions, Features, Resources (highlighted), Free Trial, and Pricing. A search bar is located below the navigation bars. The main content area is titled 'ArcGIS Pro help' and includes a sub-header 'ArcGIS Pro 3.3 | Other versions | Help archive'. The main text describes ArcGIS Pro as the essential application for creating and working with spatial data on a desktop. Below this is a section titled 'Create projects' which explains that projects organize GIS work and lists three key actions: creating a project, adding data, and configuring ArcGIS Pro. A sidebar on the left lists various help topics like Projects, Maps and scenes, Data, and more. A 'In this topic' section on the right lists specific links related to the current page.

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ArcGIS Pro Overview Extensions Features Resources Free Trial Pricing

Home Get Started Help Tool Reference Python SDK Migrate from ArcMap

Search ArcGIS Pro help

Help

> Projects  
> Maps and scenes  
> Data  
> Analysis and geoprocessing  
> Imagery and remote sensing  
> Metadata  
> Layouts  
> Reports  
> Presentations  
> Production  
> Workflows  
> Share your work

## ArcGIS Pro help

ArcGIS Pro 3.3 | [Other versions](#) | [Help archive](#)

ArcGIS Pro is the essential application for creating and working with spatial data on your desktop. It provides tools to visualize, analyze, compile, and share your data.

### Create projects

ArcGIS Pro organizes your GIS work into [projects](#). A project can contain maps, scenes, layouts, reports, charts, and other representations of spatial and nonspatial data. A project also contains connections to data resources such as system folders, databases, toolboxes, servers, styles, and your [active portal](#).

- [Create a project](#) from an ArcGIS Pro default template or from a [custom template](#) created by you or shared by colleagues.
- [Add data](#) to your project from a local or network drive, your active portal, or another connection.
- Add [web maps and web scenes](#) or import maps from ArcMap.
- Configure ArcGIS Pro by setting [project and application options](#) and [customizing the ribbon](#).

In this topic

- [Create projects](#)
- [Map and visualize your data](#)
- [Perform analysis and geoprocessing](#)
- [Manage and edit your data](#)
- [Use tasks to streamline your work](#)
- [Share your work](#)
- [Access learning resources](#)


# ESRI COMMUNITY

The screenshot shows the top portion of the Esri Community website. At the top left is the Esri logo and the word "Community". To the right are navigation links for "All Communities", "ArcGIS Ideas", and "Community Basics", followed by a search icon and a "Sign In" link. Below the navigation is a light blue banner with a message about a member spotlight. The main content area has a blue background with a topographic map pattern. It features the Esri logo and the text "Esri Community". Below this is a tagline: "A global community of Esri users where you can find solutions, share ideas, and collaborate to solve problems with GIS". Further down are statistics: "2,501 Members Online", "228K Posts", and "47.4K Solutions". A search bar is positioned below the statistics. At the bottom of the main content area is a call to action: "Are you a member yet? Join Our Community".




esri | Community

All Communities | ArcGIS Ideas | Community Basics | Search | Sign In

Check out our latest Member Spotlight featuring Brian Colson. For all future Member Spotlights and more, subscribe to the Community Blog here.

 Esri Community

A global community of Esri users where you can find solutions, share ideas, and collaborate to solve problems with GIS

 2,501 Members Online |  228K Posts |  47.4K Solutions

Search community places, groups or content

Are you a member yet? [Join Our 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