

# **GIS TUTORIAL 1**

Lecture 1  
Introduction to GIS

# Outline

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- ▶ GIS overview
- ▶ GIS data and layers
- ▶ GIS applications and examples
- ▶ Software overview
- ▶ GIS tutorial 1 overview

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# **GIS OVERVIEW**

# What is GIS?

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- ▶ **Geographic Information Systems (GIS)** are computerized systems designed for the storage, retrieval and *analysis* of geographically referenced data
- ▶ GIS uses advanced analytical tools to explore at a scientific level the spatial relationships, patterns, and processes of cultural, biological, demographic, economic, geographic, and physical phenomena

# Tools for GIS

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## ▶ Hardware

- Computer
- Digitizer
- Scanner
- Printer/Plotter

## ▶ Software

- Desktop GIS
- Internet GIS
- CAD Software
- Database Software

## ▶ Multimedia (photos, videos, 3D models)

# Unique capabilities of GIS

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- ▶ GIS stores related geographic features in separate collections of files called map layers
- ▶ Map layers can be reused easily and assembled into any number of map compositions and overlaid for analysis

# GIS answers the following

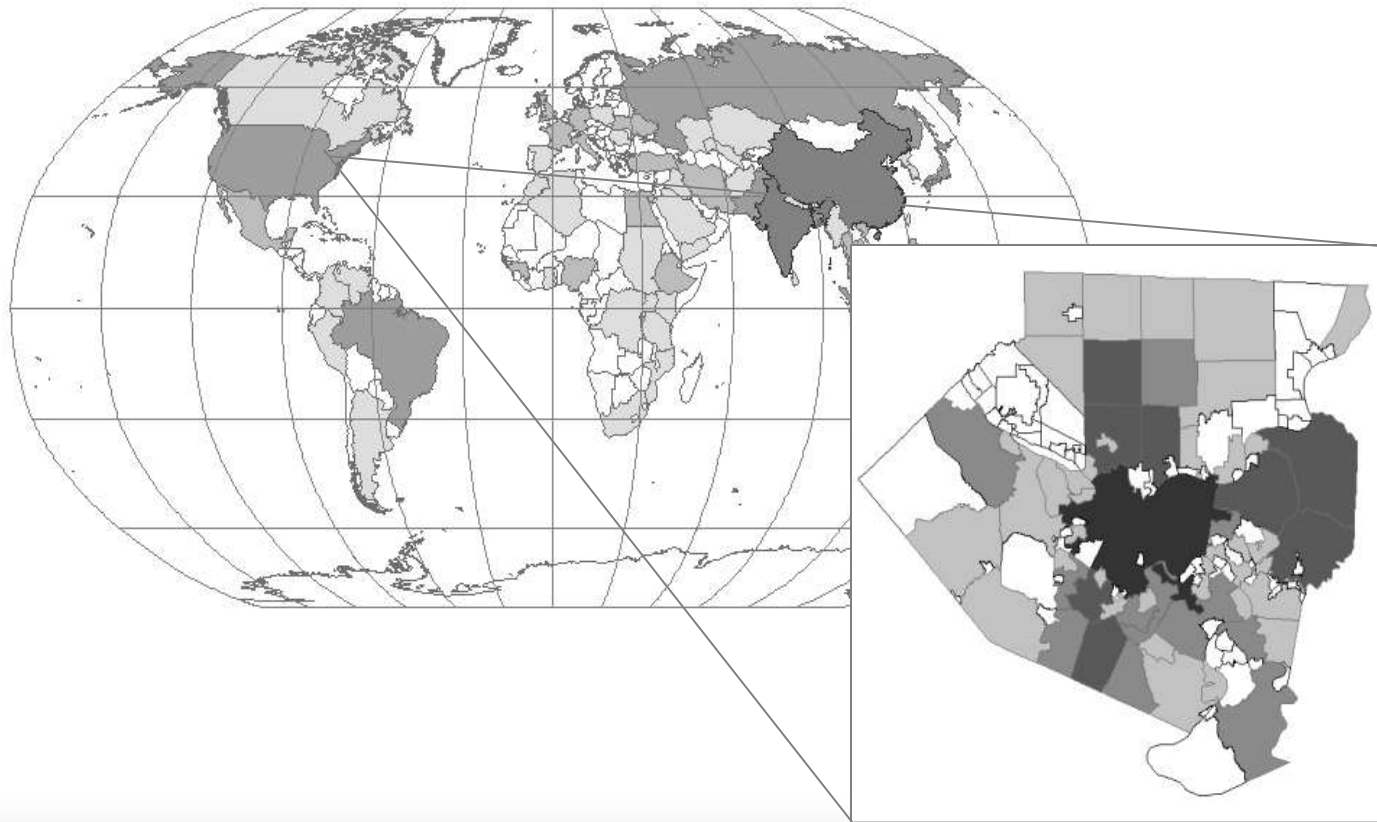
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- ▶ **Location:** What is at...? Where is it?
- ▶ **Condition:** Status of features?
- ▶ **Trends:** What has changed since...?
- ▶ **Patterns:** What spatial patterns exist?
- ▶ **Modeling:** What if...?

# Scale of GIS data

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Global to local



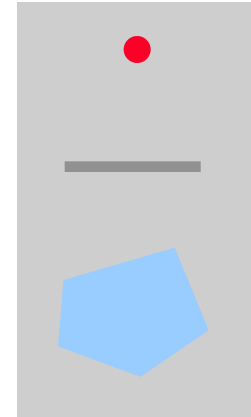


# Vector data

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## ► Map features

- Points, lines, polygons



## ► Feature attributes

- Every feature has attributes (e.g. name, area, population)

Shape	Name	Class	Pop2000	State
Point	New York	City	8,008,278	NY
Point	Los Angeles	City	3,694,820	CA
Point	Chicago	City	2,896,016	IL

# Raster Data

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Stored electronic image or picture taken as an aerial photograph or satellite image



Composed of a rectangular array of square cells, called pixels, with a number in each cell representing the solid color fill of that cell

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# **GIS DATA AND LAYERS**

# GIS example

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- ▶ Identify polluting companies and their proximity to populations in poverty, water features, or schools.
  
- ▶ Start with
  - Databases
  - Map layers

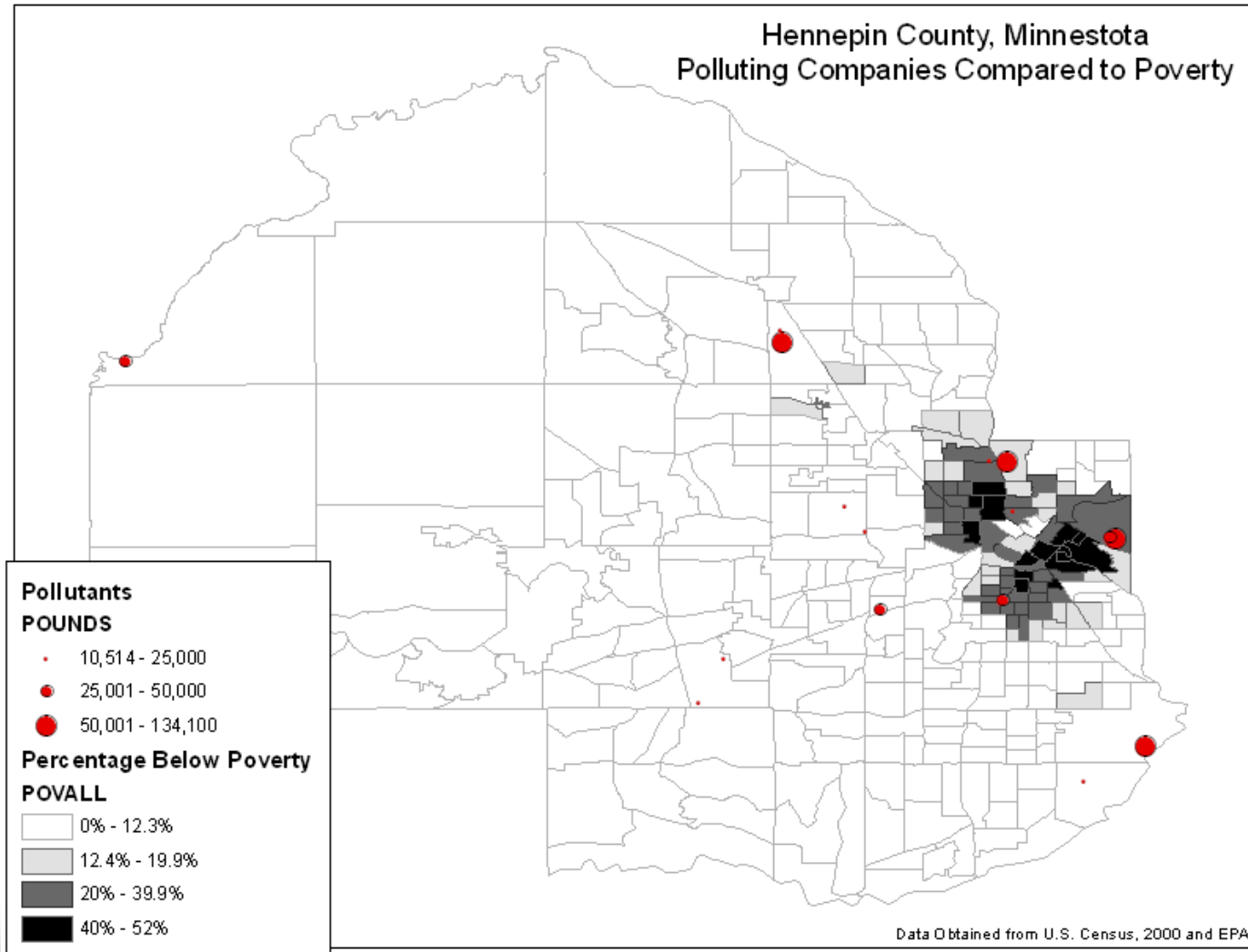
# Databases

Not easy to interpret

FID	Shape *	STFID	TRACT	MEDIHC	POVALL	POVU18	POV065	POVFAM
0	Polygon	27053000101	000101	39159	16	28	3	12
1	Polygon	27053000102	000102	36563	13	20	5	10
2	Polygon	27053000300	000300	48664	5	3	7	3
3	Polygon	27053000601	000601	40863	11	22	4	8
4	Polygon	27053000603	000603	50256	2	0	2	1
5	Polygon	27053001100	001100	41099	10	16	13	8
6	Polygon	27053001700	001700	34306	13	16	10	11
7	Polygon	27053002200	002200	28036	41	48	30	31
8	Polygon	27053002400	002400	35029	24	34	19	21

	A	B	C	D	E
1	CITY	SIC_CODE	LATITUDE	LONGITUDE	POUNDS
2	MINNEAPOLIS	26 Paper And Allied Products	44.98244	-93.21470	134100
3	BROOKLYN PARK	30 Rubber And Misc. Plastics Products	45.08788	-93.39455	69380
4	MINNEAPOLIS	49 Electric, Gas, And Sanitary Services	45.02357	-93.27372	66074
5	SAINT PAUL	45 Transportation By Air	44.87071	-93.19908	65000
6	ROCKFORD	30 Rubber And Misc. Plastics Products	45.07797	-93.74738	45304
7	EDEN PRAIRIE	30 Rubber And Misc. Plastics Products	44.87286	93.39926	41600
8	MINNEAPOLIS	34 Fabricated Metal Products	44.94958	-93.27600	34364
9	MINNEAPOLIS	34 Fabricated Metal Products	44.94389	-93.34222	32115
10	MINNEAPOLIS	34 Fabricated Metal Products	44.98259	-93.21810	26140

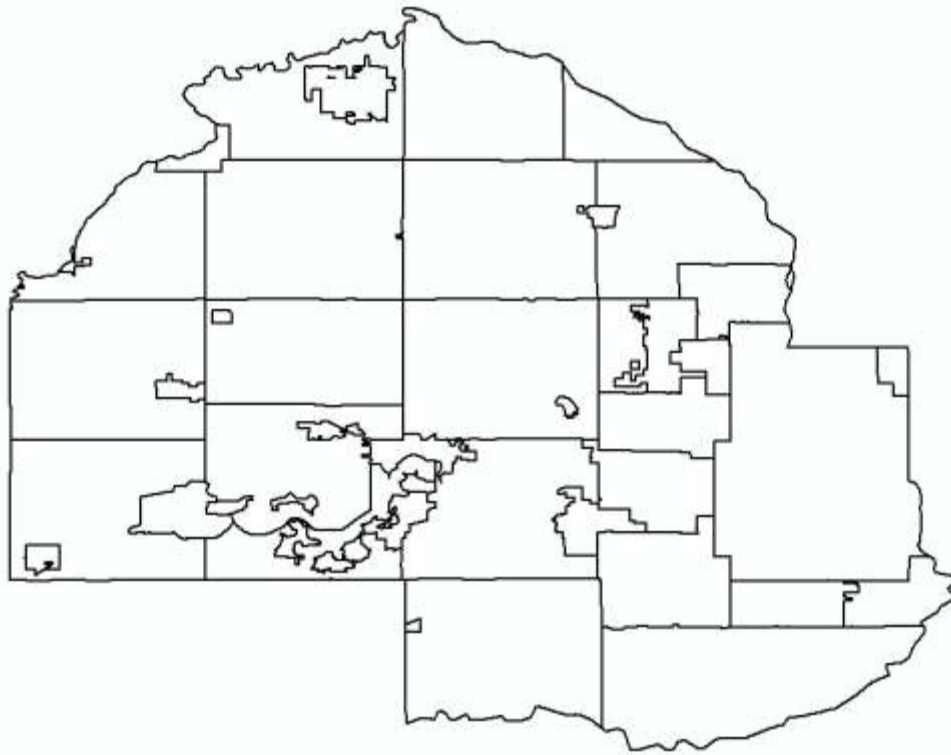
# Data shown as GIS layers



# Additional layers

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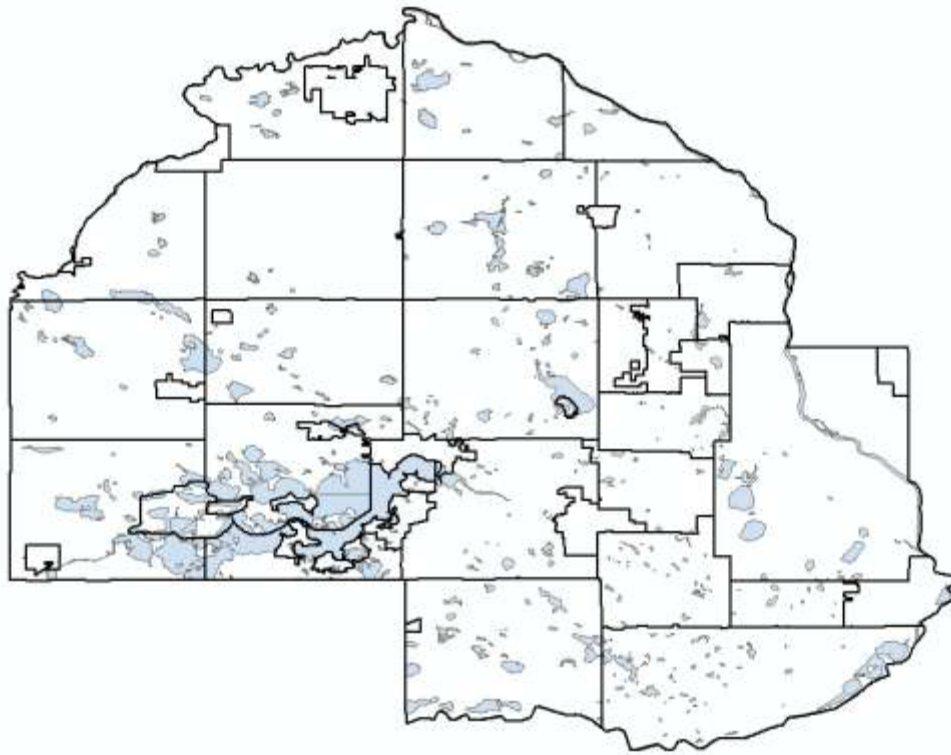
Political features (municipalities)



# Additional layers

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Physical features (lakes, rivers, etc.)

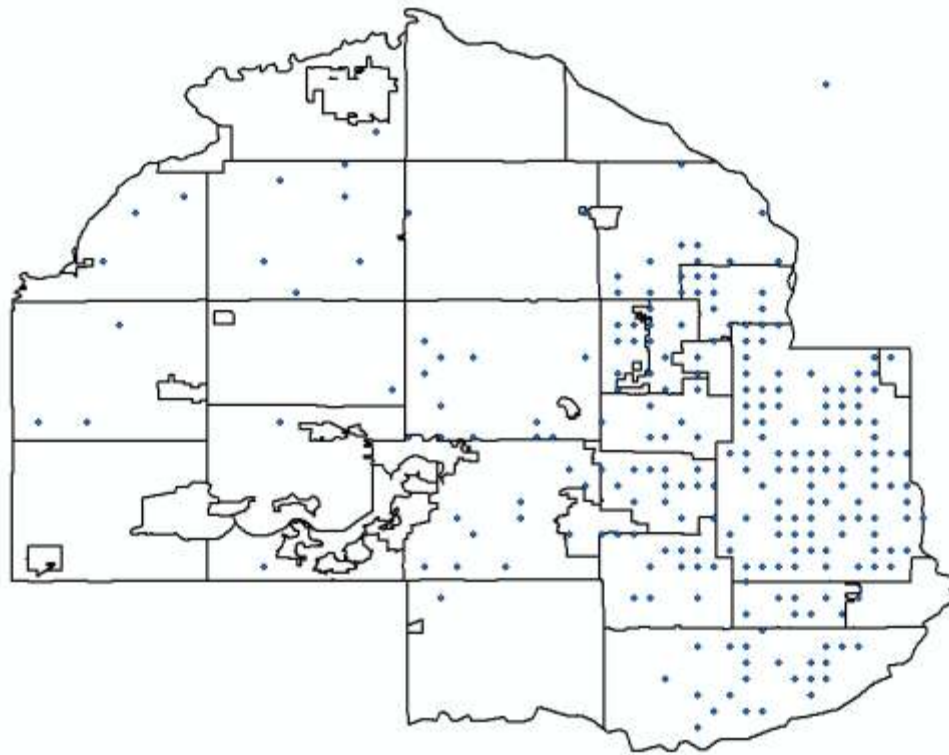




# Additional layers

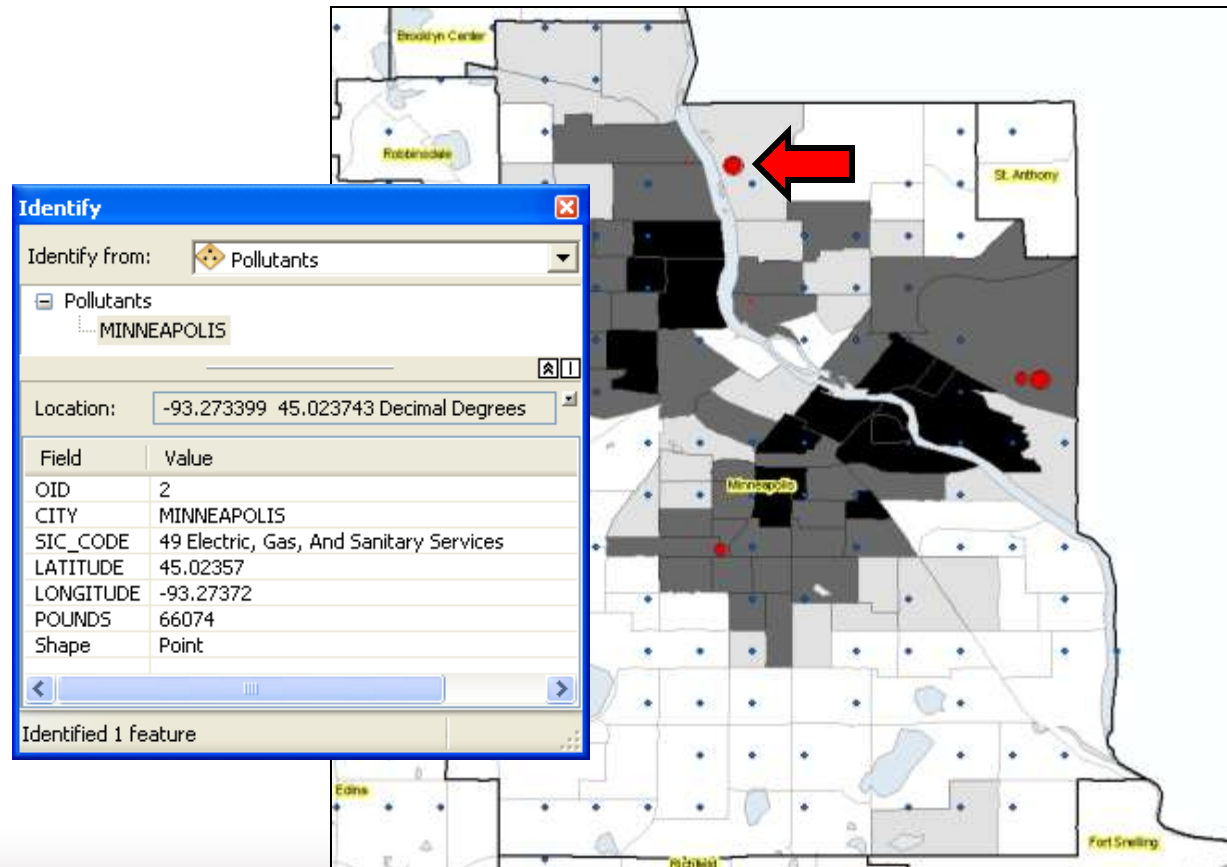
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Administrative data (schools)



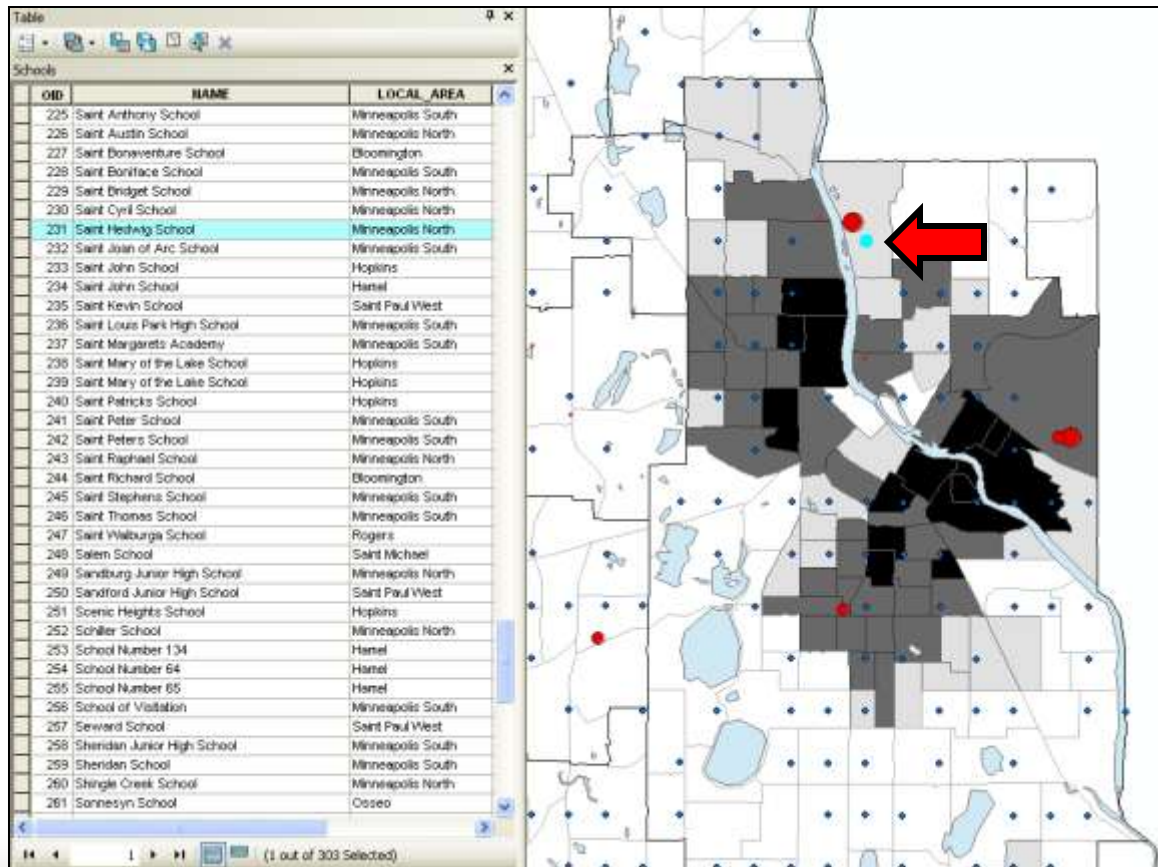
# Maps and tables are interactive

## Identify features



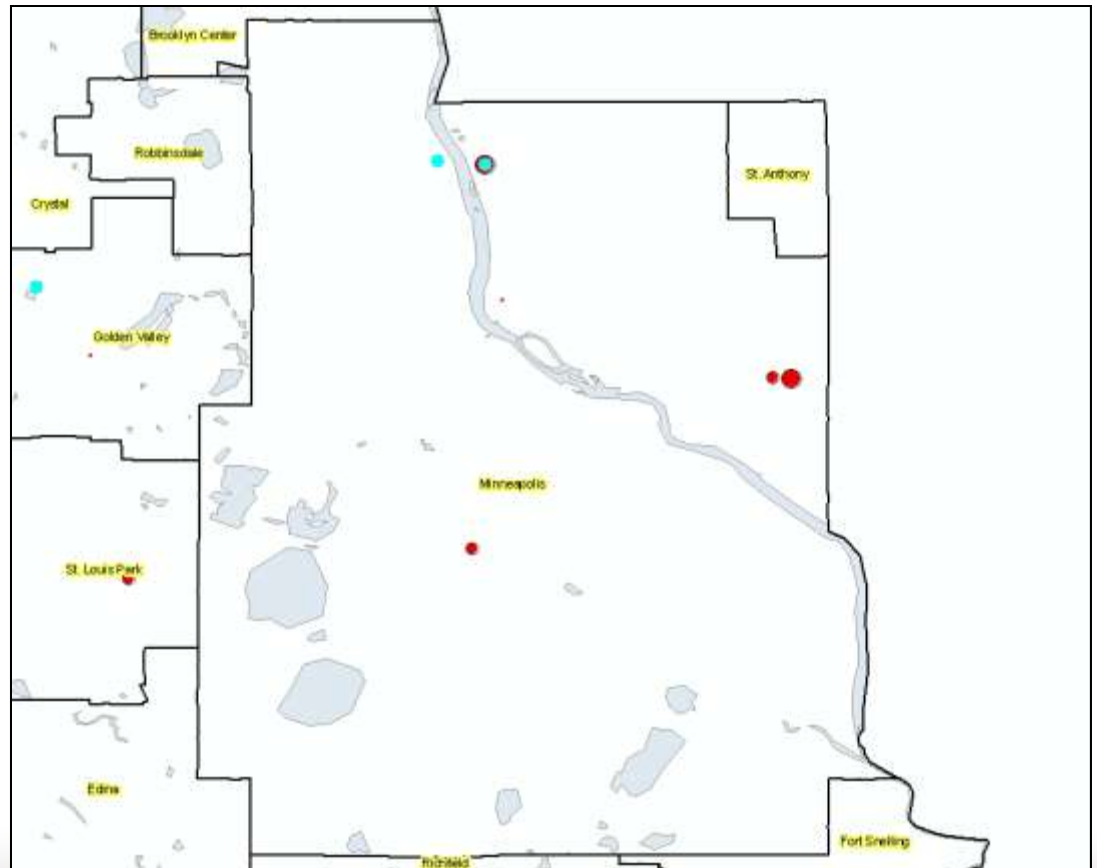
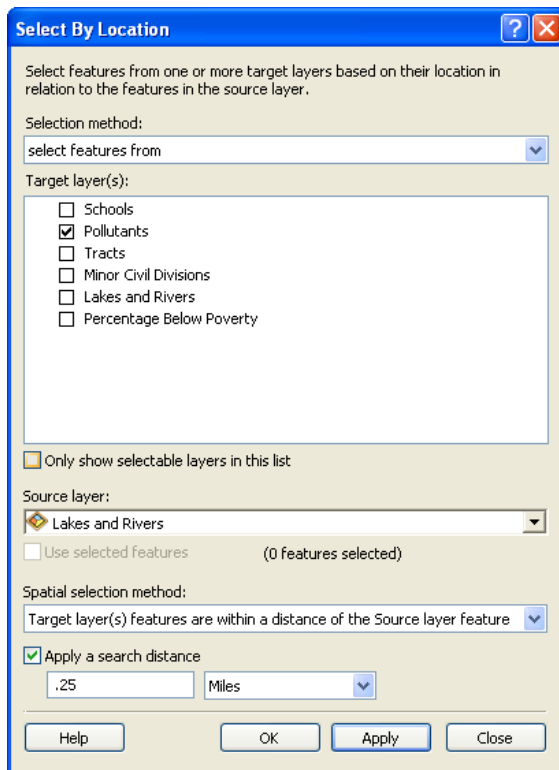
# Maps and tables are interactive

## Select features



# Advanced GIS functions

## Proximity selections

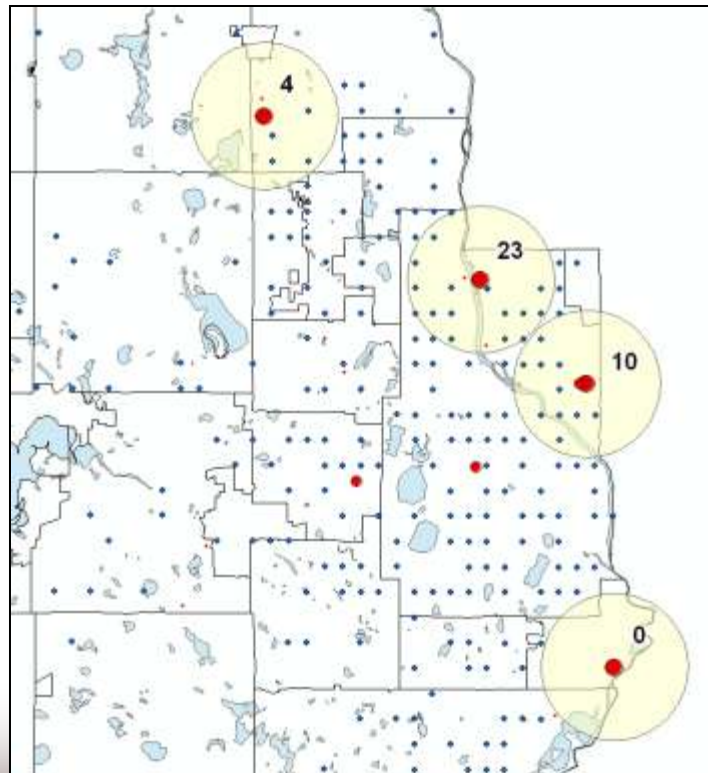


# Advanced GIS functions

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## ► Buffers

- Select top polluting companies and show the number of schools within 2 miles of these companies.



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# **GIS APPLICATIONS AND EXAMPLES**

# GIS applications

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<b>A/E/C</b>	Civil engineering, surveying.
<b>Business</b>	Site location, delivery systems, marketing, media and press, real estate.
<b>Defense/intelligence</b>	Military operations, geospatial intelligence
<b>Government</b>	Federal, state, local, economic development, elections, urban and regional planning.
<b>Health</b>	Public health, health and human services, hospitals, managed care, research.
<b>Natural resources</b>	Agriculture, archaeology, climate change, conservation, environmental management, forestry, marine and coast, mining, petroleum, water resources.
<b>Public safety</b>	Computer-Aided Dispatch, emergency/disaster management, EMS, homeland security, law enforcement, fire protection, wildfire management
<b>Transportation</b>	Aviation, highways, logistics, railways, ports and maritime, public transit
<b>Utilities/communications</b>	Electric, gas, pipeline, telecommunications, water/wastewater

# GIS examples

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- ▶ Instructor should add examples specific to their industry or teaching here

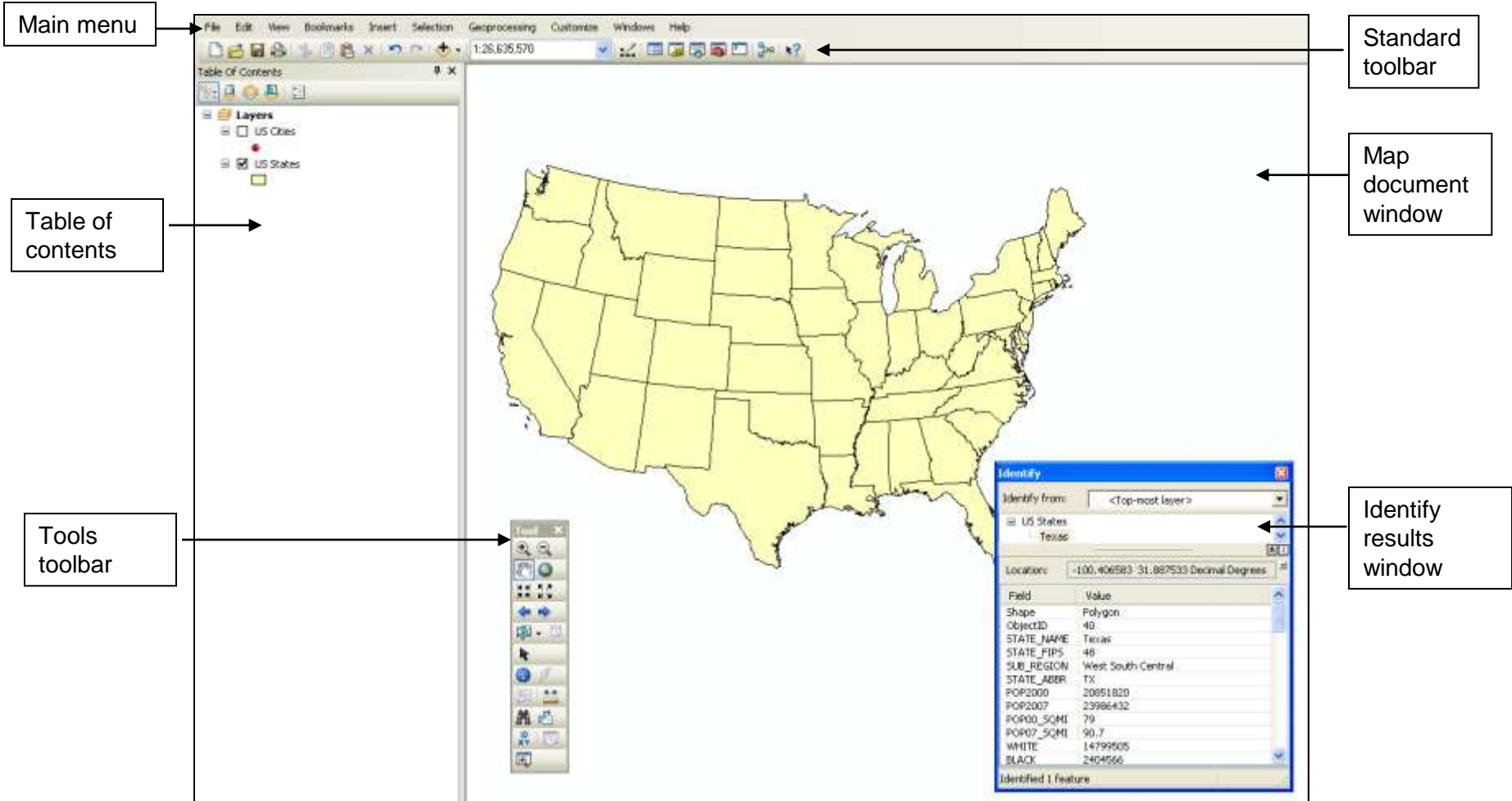


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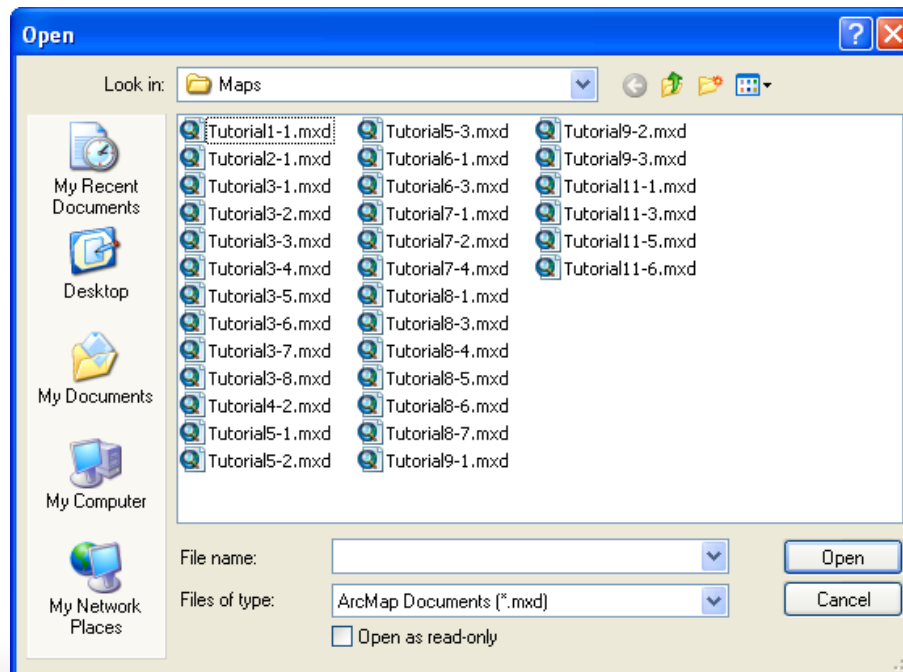
# **SOFTWARE OVERVIEW**

# ArcMap (Desktop GIS)



# Map documents

- ▶ (.mxd) extension
- ▶ “Points” to layers
- ▶ Saves layer colors, symbology, etc.



# Tutorial 1-1.mxd

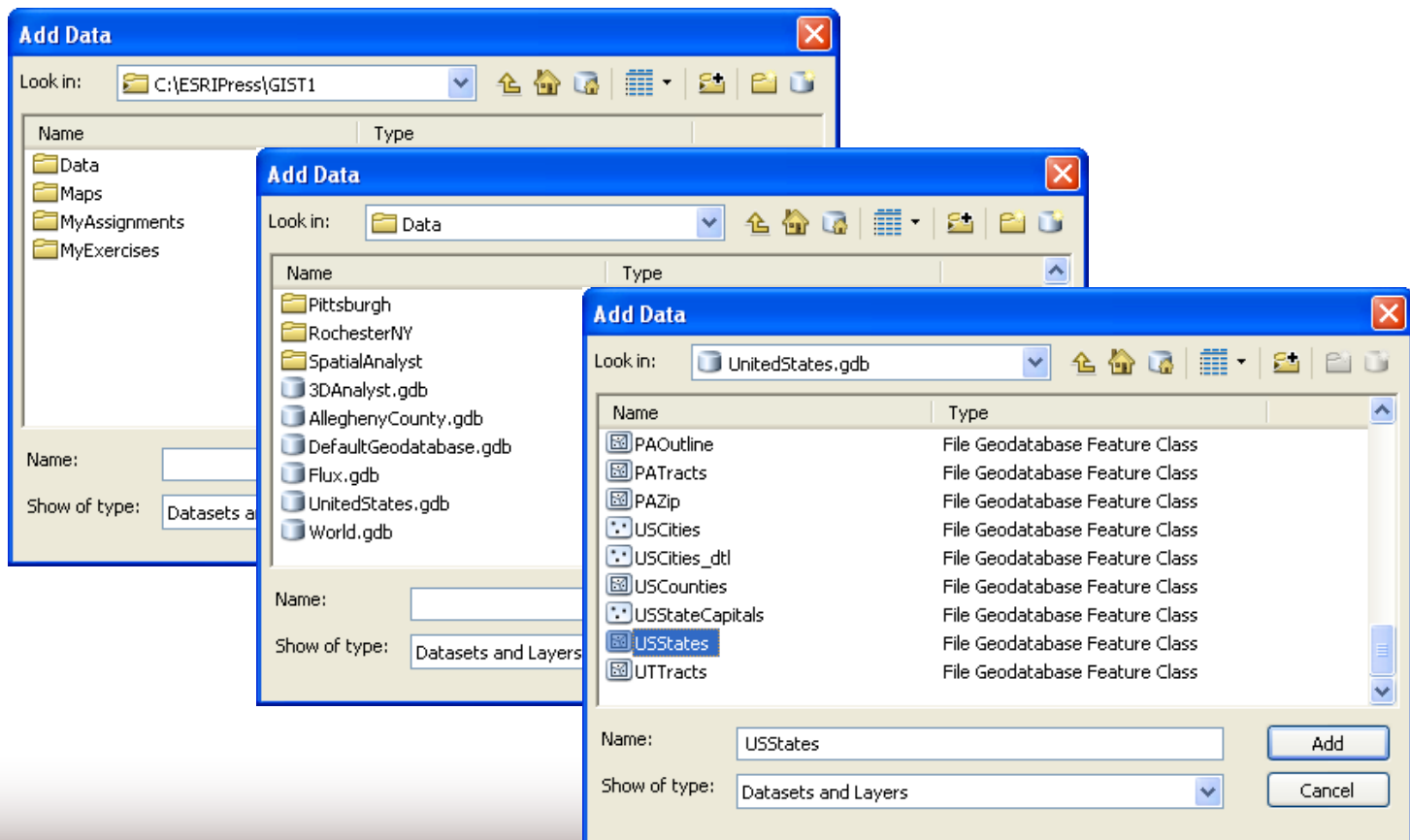
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- ▶ Two layers
  - USCities (red points, restricted to major cities)
  - USStates (yellow polygons)



# Adding map layers

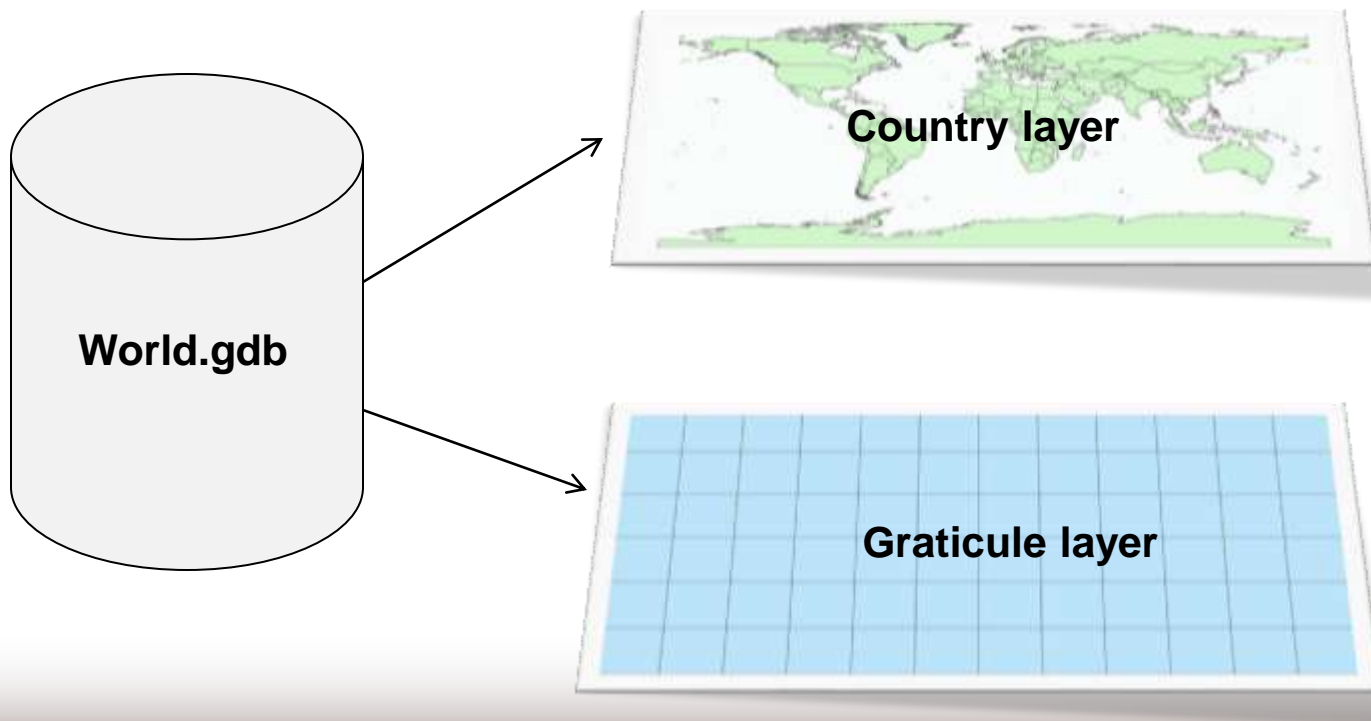
Separate files added to a map document 



# Geodatabases

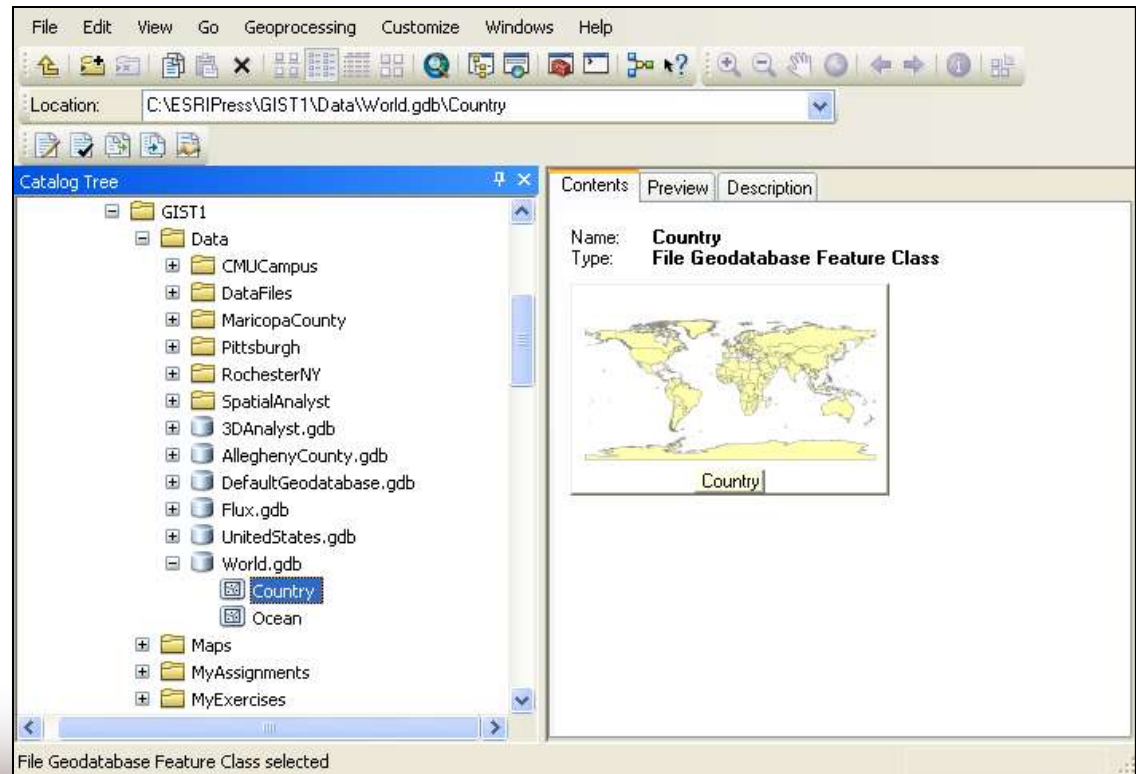
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The geodatabase is a "container" used to hold a collection of datasets (GIS features, tables, raster images, etc).



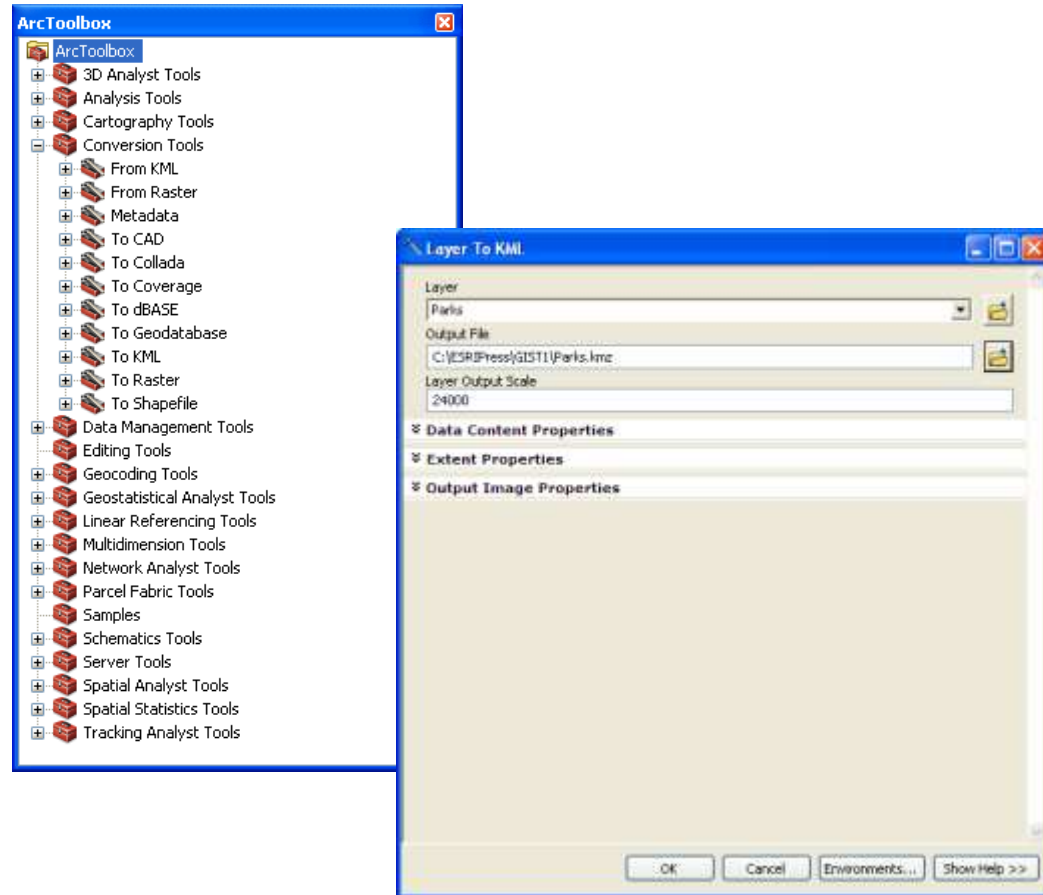
# ArcCatalog

Arranges and manages geographic information in workspace folders and geodatabases.

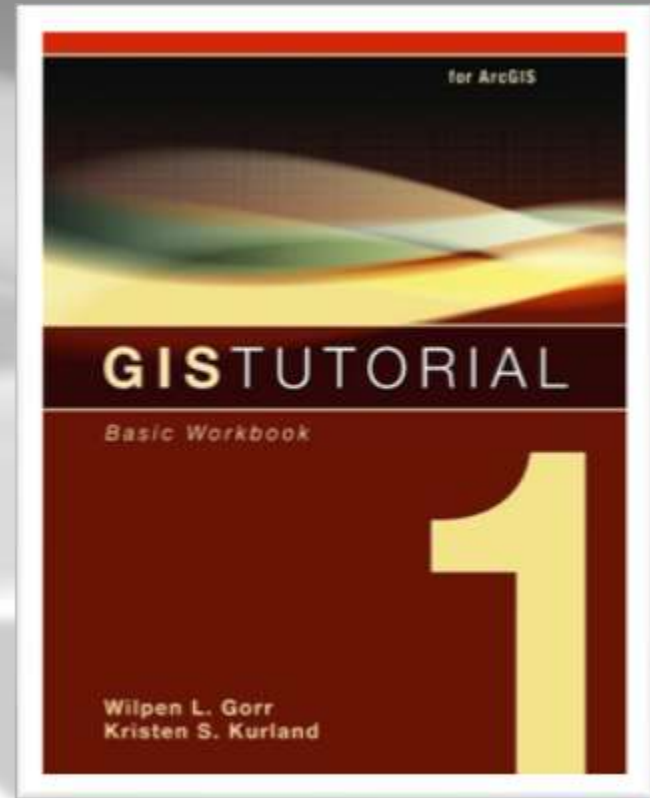


# ArcToolbox

Advanced tools  
with form-based  
input by users







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# GIS TUTORIAL 1 OVERVIEW

# Part I Using and making maps

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- ▶ Chapter 1: Introduction
  - Learn the basics of working with existing GIS data and maps
- ▶ Chapter 2: Map design
  - Learn how to create choropleth and point maps
- ▶ Chapter 3: GIS outputs
  - Learn how to build and export maps using GIS data

# Part II Working with spatial data

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- ▶ **Chapter 4: File geodatabases**
  - Learn how to create geodatabases and import data into them
- ▶ **Chapter 5: Spatial data**
  - Explores the basic data types used within GIS and then shows how to use the Internet to gather GIS data
- ▶ **Chapter 6: Digitizing**
  - Learn how to digitize vector data and transform data to match real-world coordinates
- ▶ **Chapter 7: Geocoding**
  - Learn how to map address data as points through the geocoding process
- ▶ **Chapter 8: Geoprocessing**
  - Perform spatial analysis using geoprocessing tools

# Part III Learning advanced GIS applications

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## ▶ Chapter 9: Spatial analysis

- Perform spatial analysis using geoprocessing tools and analysis workflow models

## ▶ Chapter 10: ArcGIS 3D analyst

- Introduces ArcGIS 3D Analyst, allowing users to create 3D scenes, conduct fly-through animations, and conduct line-of-sight studies

## ▶ Chapter 11: ArcGIS spatial analyst

- Introduces ArcGIS Spatial Analyst for creating and analyzing raster maps, including hillshades, density maps, site suitability surfaces, and risk index surfaces

# Chapter structure

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## ▶ Tutorials

- Multiple tutorials in every chapter
- Include step-by step exercises

## ▶ Your turns

- Reinforce the skills learned in the step-by-step exercises

## ▶ Advanced assignments

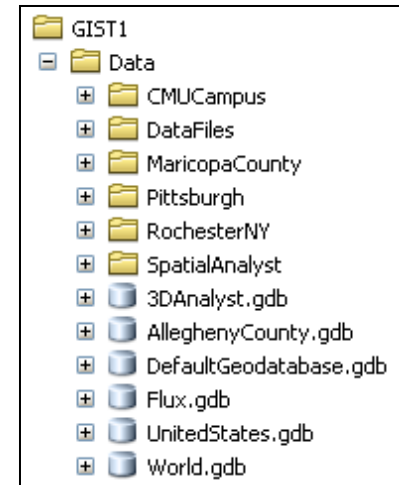
- Found at the end of each chapter.
- Provokes critical problem-solving skills

# GIS tutorial data

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## ► Data

- \ESRIPress\GIST1\Data\
  - Map layers, geodatabases, data tables, etc.

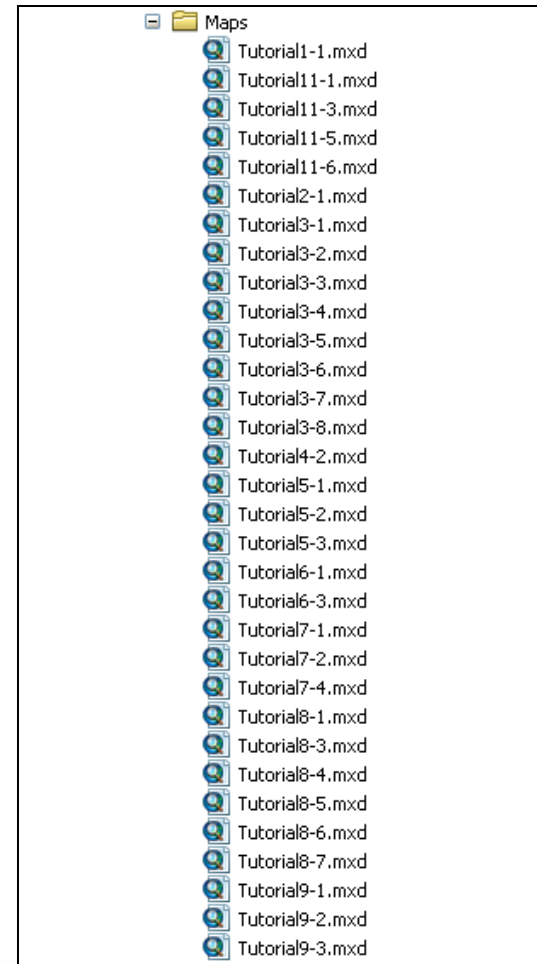


# GIS tutorial data

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## ► Maps

- \ESRIPress\GIST1\Maps\
  - Map documents
  - Starting place for tutorials

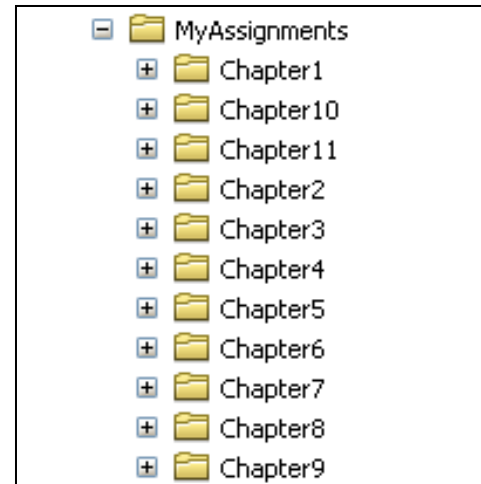


# GIS tutorial data

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## ► MyAssignments

- \ESRIPress\GIST1\MyAssignments\
  - Location to save end of chapter assignments



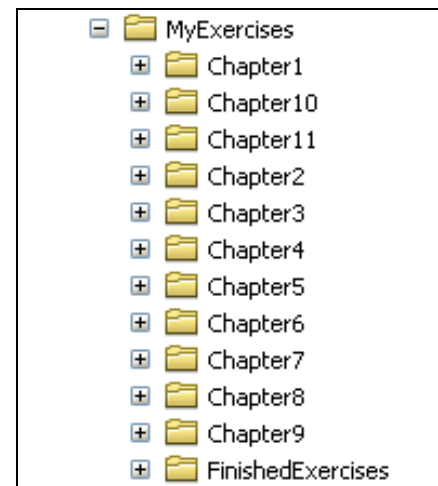


# GIS tutorial data

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## ► MyExercises

- \ESRIPress\GIST1\MyAssignments\
  - Location to save tutorial exercises
  - Finished exercises are solutions to tutorial exercises



# Summary

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- ▶ GIS overview
- ▶ GIS data and layers
- ▶ GIS applications and examples
- ▶ Software overview
- ▶ GIS Tutorial 1 overview