# **GIS TUTORIAL 1**

Lecture 1 Introduction to GIS

## Outline

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

Lecture 1

## **GIS OVERVIEW**

# What is GIS?

- 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**

#### Hardware

- Computer
- Digitizer
- Scanner
- Printer/Plotter

#### Software

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

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

# **Unique capabilities of GIS**

 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

- 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

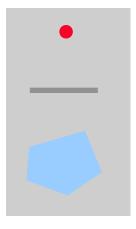
#### Global to local



#### **Vector data**

#### 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**

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

Lecture 1

# **GIS DATA AND LAYERS**

#### **GIS** example

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

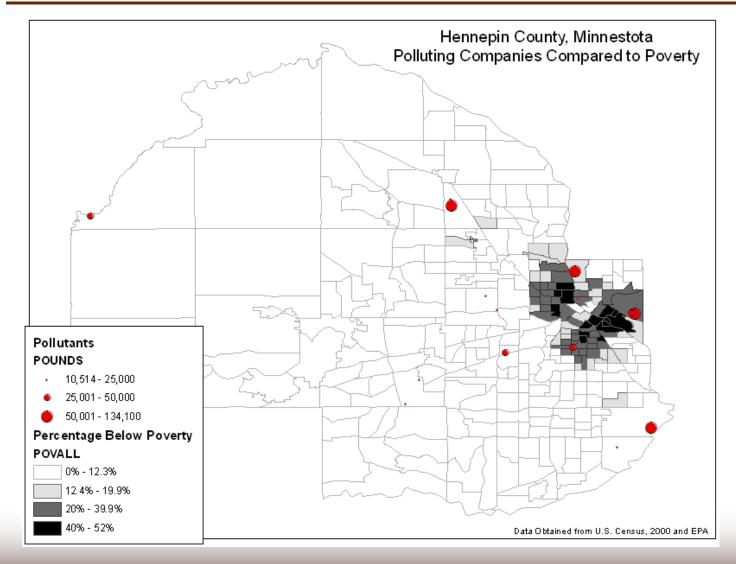
#### Databases

#### Not easy to interpret

FID	Shape *	STFID	TRACT	MEDINC	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

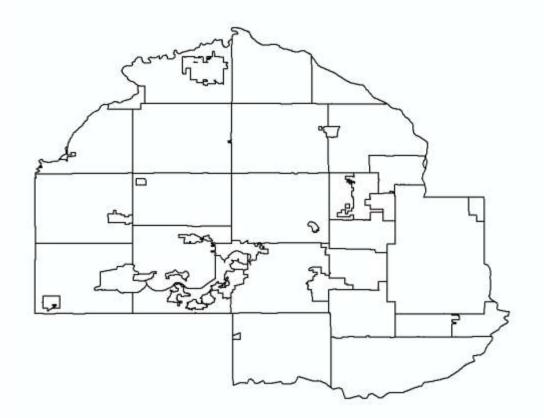
	А	В	С	D	E
1	CITY	SIC_CODE	LATITUDE	LONGITUDE	POUNDS
2	MINNEAPOLIS	26 Paper And Allied Products	44.98244	-93.21470	134100
3	BROOKLYN PARK	30 Rubber And Misc. Plastics Products	45.08788	-93.39455	69380
4	MINNEAPOLIS	49 Electric, Gas, And Sanitary Services	45.02357	-93.27372	66074
5	SAINT PAUL	45 Transportation 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



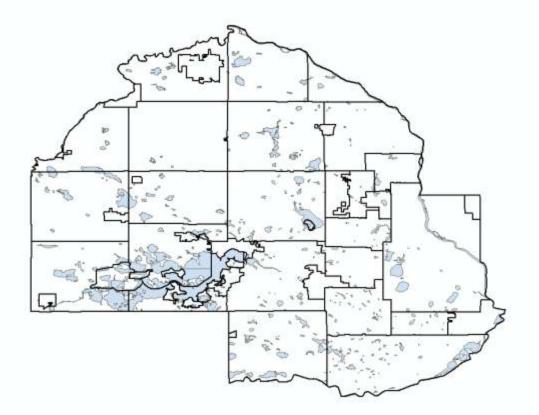
#### **Additional layers**

Political features (municipalities)



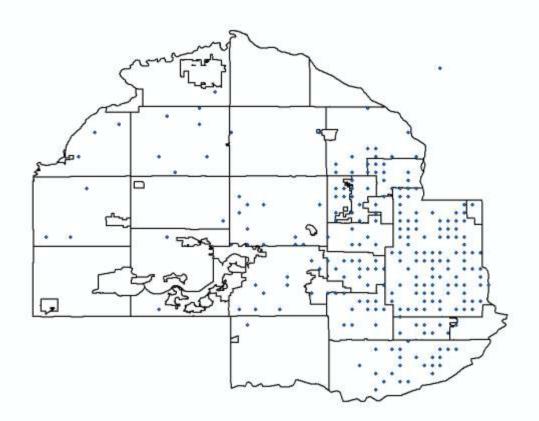
#### **Additional layers**

Physical features (lakes, rivers, etc.)



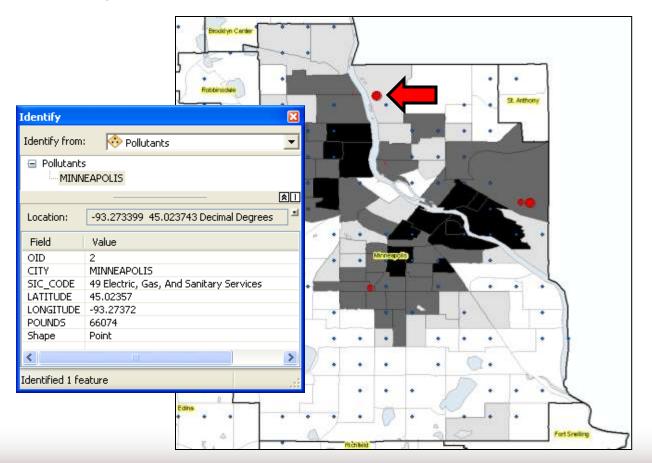
#### **Additional layers**

Administrative data (schools)



#### Maps and tables are interactive

#### **Identify features**



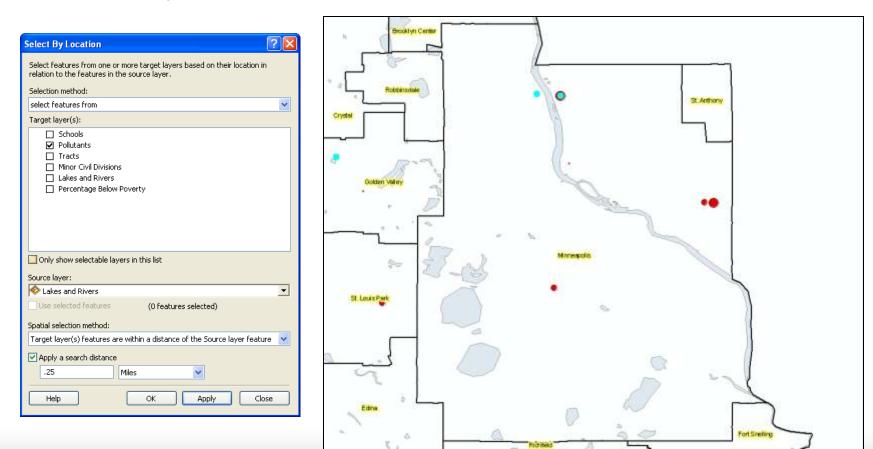
#### Maps and tables are interactive

#### **Select features**

		图· 唐母口名×		
d	nols			×
1	OID	HAME	LOCAL AREA	10
1	22	Saint Anthony School	Minneapolis South	
	228	Saint Austin School	Minneapolic North	
٦	221	Saint Bonaventure School	Boomington	
1	225	Saint Boniface School	Minneapolis South	
٦	225	9 Saint Bridget School	Minneapolis North	
1	230	3 Saint Cyril School	Minneapolis North	
		Saint Heatwig School	Minneapoils North	
٦		2 Saint Joan of Arc School	Minneapolis South	
1	233	Saint John School	Hopkins	-10
1	234	Saint John School	Hamel	
1	235	5 Saint Kevin School	Saint Paul West	
1	236	Saint Louis Park High School	Minneapolis South	
1		Saint Margarets Academy	Minneapolis South	
1		5 Saint Mary of the Lake School	Hopkins	
٦		Saint Mary of the Lake School	Hopkins	
1	24	Saint Patricks School	Hopkins	
٦	241	Saint Peter School	Minneapolis South	
1	243	2 Saint Peters School	Minneapolis South	
1		3 Saint Raphael School	Minneapolis North	
1	24	Saint Richard School	Bloomington	
1	24	5 Saint Stephens School	Minneapolis South	
١		Saint Thomas School	Minneapolis South	-12
1	-	Saint Weburge School	Rogers	-12
1		Salen School	Saint Michael	
1		3 Sandburg Junior High School	Minneapolis North	-11
1		5 Sandford Junior High School	Saint Paul West	-11
1		Senic Heights School	Hopkins	-11
-		2 Schiller School	Minneapolis North	100
-		School Number 134	Hamel	-11
-		4 School Number 1,94	Hanel	-11
-		School Number 65	Hamel	-11
-		School Number 55 School of Visitation	Minneapolis South	_
-				-
-		7 Serverd School	Saint Paul West	-
-		8 Sheridan Junior High School	Minneapolis South	-11
-		9 Sheridan School	Minneepolis South	-81
-		Shingle Creek School	Minneapolis North	-
	261	Sannesyn School	Obseo	19

## **Advanced GIS functions**

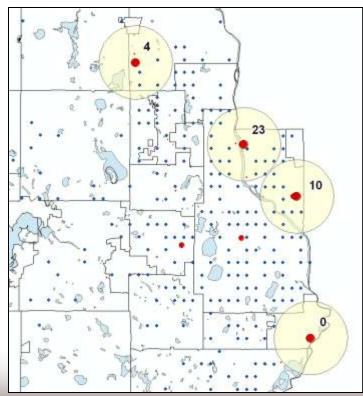
#### **Proximity selections**



# **Advanced GIS functions**

#### 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

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

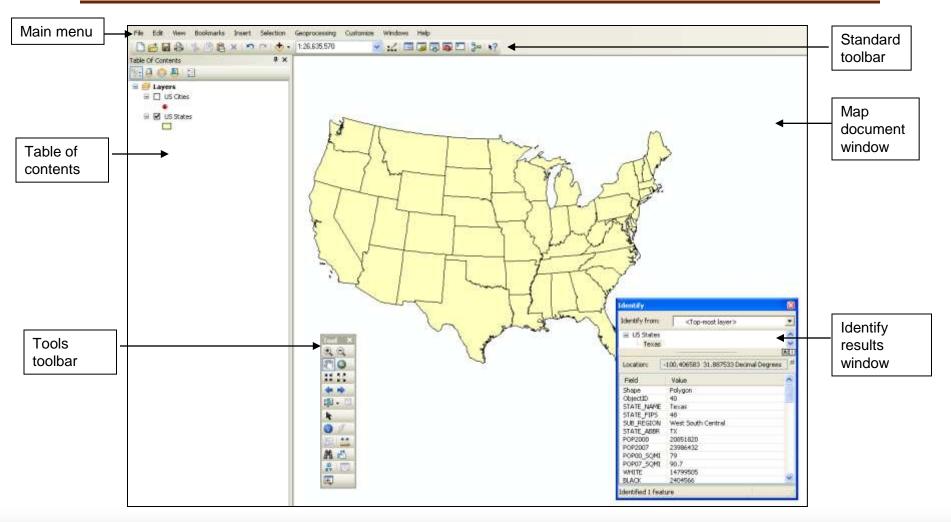


Instructor should add examples specific to their industry or teaching here

Lecture 1

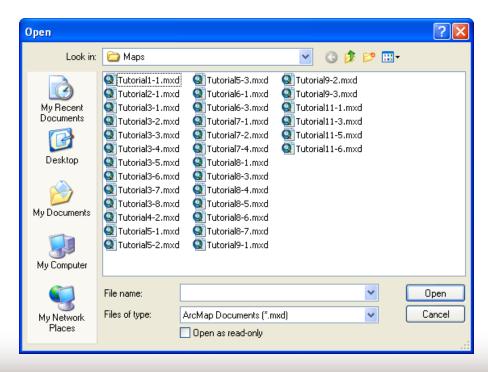
# **SOFTWARE OVERVIEW**

# ArcMap (Desktop GIS)



# Map documents

- (.mxd) extension
- "Points" to layers
- Saves layer colors, symbology, etc.



# **Tutorial 1-1.mxd**

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







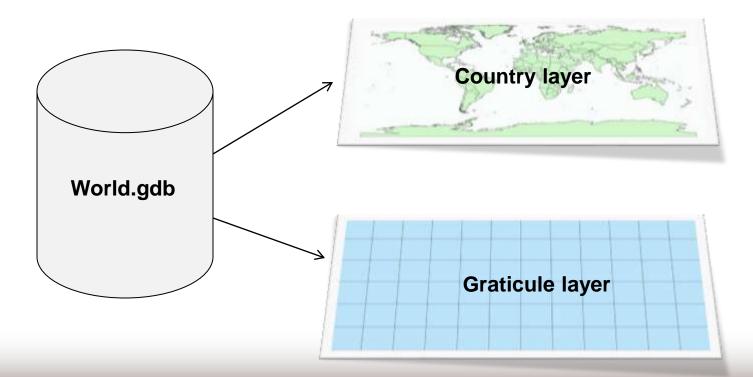
# **Adding map layers**

#### Separate files added to a map document

Add Data			
Look in: 🔁 C:\ESRIPres	s\GIST1 💽 📤 🏠 🕻	a   🏥 •   🖴   🖴 🗊	
Name	Туре		
Data Maps MyAssignments MyExercises	Add Data Look in: 🔁 Data	✓ ▲ 🏠 🗔	
	Name	Type Add Data	
	SpatialAnalyst 3DAnalyst.gdb AlleghenyCounty.gdb	Look in: DuitedStates.gdb	✓     ▲     ▲     ▲     ▲       Type     ▲       File Gendatabase Feature Class
Name: Datasets a	<ul> <li>DefaultGeodatabase.gdb</li> <li>Flux.gdb</li> <li>UnitedStates.gdb</li> <li>World.gdb</li> </ul>	PAOutline PATracts PAZip USCities	File Geodatabase Feature Class File Geodatabase Feature Class File Geodatabase Feature Class File Geodatabase Feature Class
	Name:	USCities_dtl USCounties	File Geodatabase Feature Class File Geodatabase Feature Class
	Show of type: Datasets and Layers	USStateCapitals	File Geodatabase Feature Class File Geodatabase Feature Class File Geodatabase Feature Class
		Name: USStates	Add
		Show of type: Datasets and La	ayers Cancel

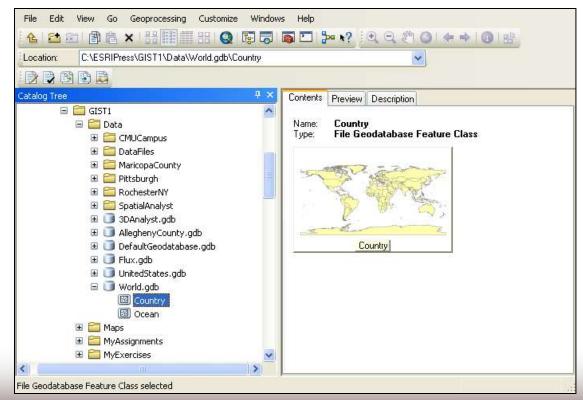
#### Geodatabases

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



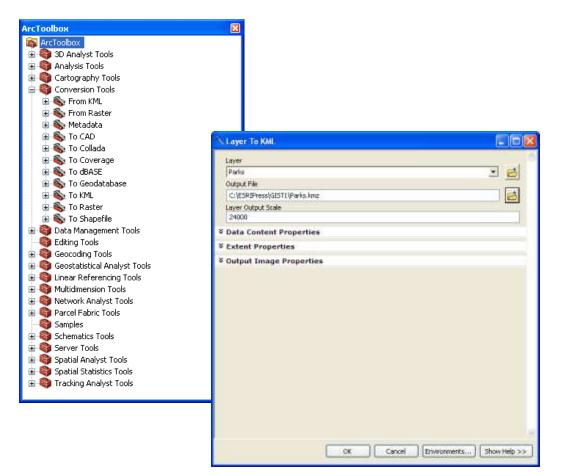


# Arranges and manages geographic information in workspace folders and geodatabases.



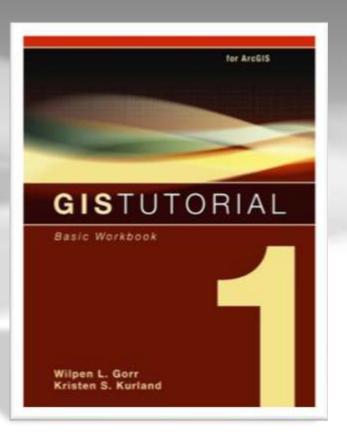
### ArcToolbox

Advanced tools with form-based input by users



# GIS TUTORIAL 1 OVERVIEW

Lecture 1



#### Part I Using and making maps

- 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

- 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

#### 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**

#### Tutorials

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

#### Your turns

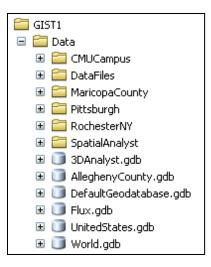
Reinforce the skills learned in the step-by-step exercises

#### Advanced assignments

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

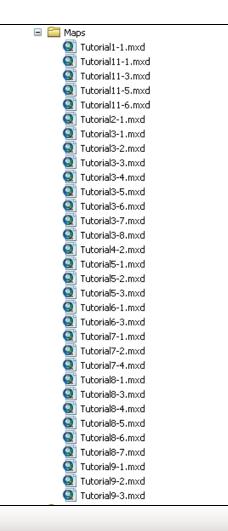
#### Data

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

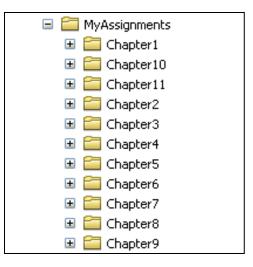


#### Maps

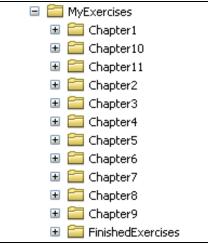
- ESRIPress\GIST1\Maps\
- Map documents
- Starting place for tutorials



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



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



# Summary

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