Designing a GIS class

Using the GIS Tutorial Series of books from Esri Press

Introductions

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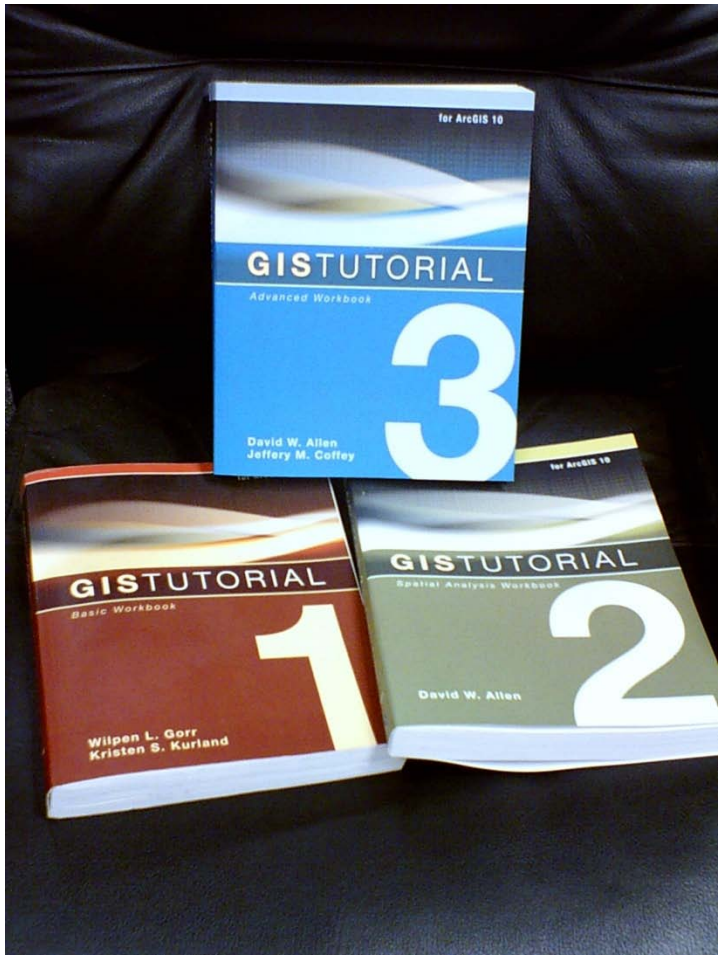
GIS Tutorial Series

This series of books was designed as a comprehensive set of tutorials and hands-on exercises to complement any GIS certificate or degree program.

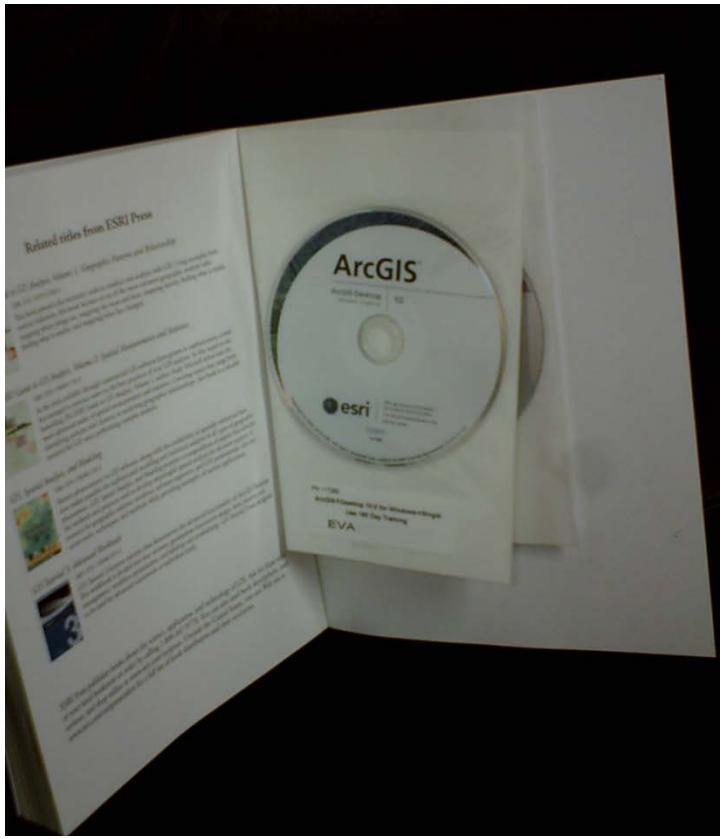
For today's session, we'll look at the structure of these books, the teaching aids available, and how they can be integrated into a GIS program.



GIS Tutorial Series

Each book contains a 180 day trial license of ArcEditor which can be installed by the students on their home computers.

The book also contains a DVD with all the necessary data required to complete all the tutorials and exercises in the book.



GIS Tutorial 1

The first tutorial covers a lot of GIS topics with a light touch. It's a good introduction to all the basic capabilities of ArcGIS.

Part 1 Using and making maps

Chapter 1: Introduction to ArcGIS
Chapter 2: Map design
Chapter 3: GIS outputs

Part 2 Working with spatial data

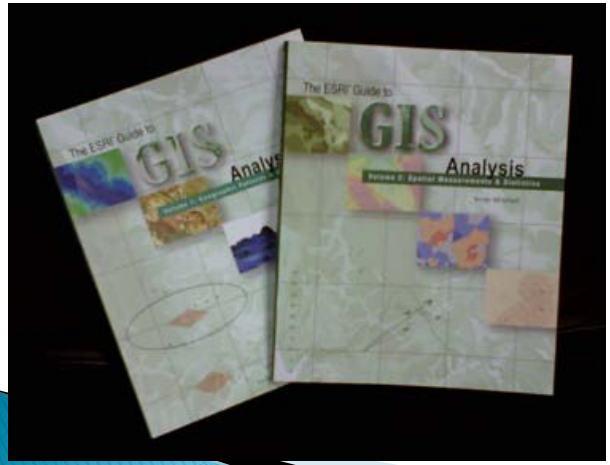
Chapter 4: File geodatabases
Chapter 5: Spatial data
Chapter 6: Digitizing
Chapter 7: Geocoding
Chapter 8: Geoprocessing

Part 3 Learning advanced GIS applications

Chapter 9: Spatial analysis
Chapter 10: ArcGIS 3D Analyst
Chapter 11: ArcGIS Spatial Analyst

GIS Tutorial 2

The second tutorial focuses primarily on using the geoprocessing tools of ArcGIS to perform spatial analysis. It follows the chapters in the two books by Andy Mitchell, the Esri Guide to GIS Analysis, Volumes 1 and 2.



Chapter 1: Mapping where things are

Chapter 2: Mapping the most and least

Chapter 3: Mapping density

Chapter 4: Finding what's inside

Chapter 5: Finding what's nearby

Chapter 6: Mapping change

Chapter 7: Measuring geographic distribution

Chapter 8: Analyzing patterns

Chapter 9: Identifying clusters

Independent projects

GIS Tutorial 3

The third tutorial is the most advanced of the three. Part 1 begins with a blank slate and has students design and build their own datasets from scratch.

Parts 2 and 3 cover advanced topics in ArcEditor and ArcInfo. These include Python scripting, ModelBuilder, and creating custom menus.

The final part of the book covers advanced cartographic techniques including custom legends, labeling, and custom symbols.

Part 1 Designing a framework for the complex geodatabase

Chapter 1: Designing the geodatabase schema

Chapter 2: Creating a geodatabase

Chapter 3: Populating a geodatabase

Part 2 Working with data

Chapter 4: Working with features

Chapter 5: Working with topology

Part 3 Optimizing the workflow

Chapter 6: Customizing the interface

Chapter 7: Automating processes

Part 4 Using advanced techniques for labeling and symbolizing

Chapter 8: Developing labels and annotation

Chapter 9: Exploring cartographic techniques

GIS Tutorial Series

For this session, we're going to focus on GIS Tutorial 2.

Well look at the structure of the book and how it is designed to be used in a GIS class.

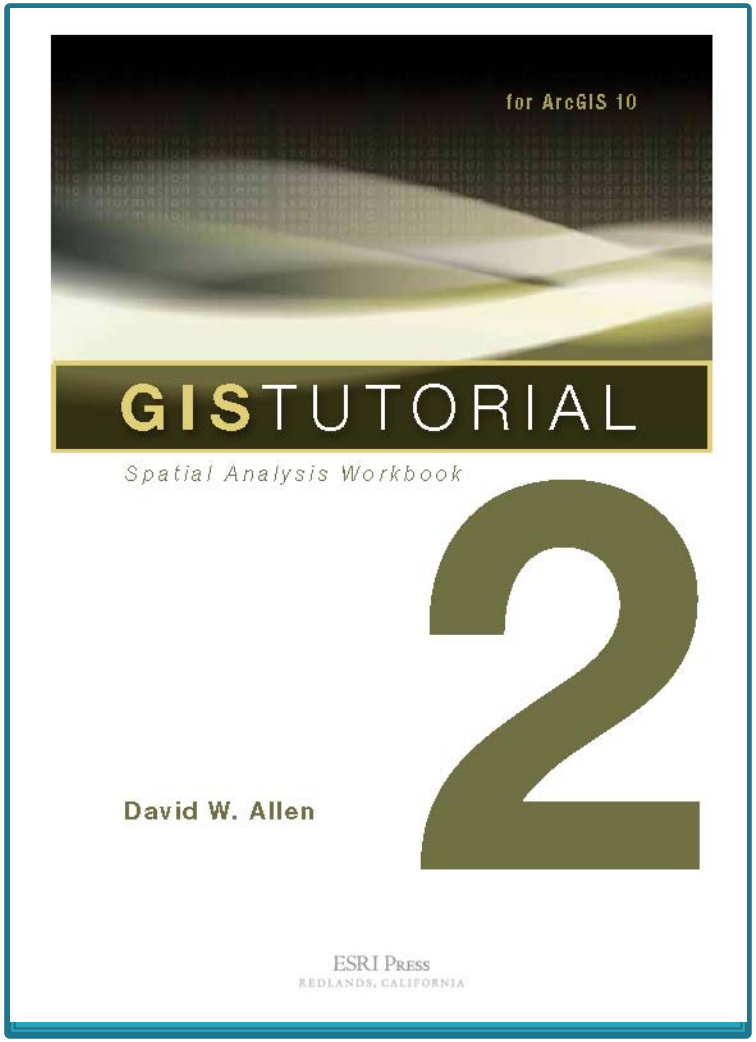


Table of Contents

The chapter headings match the chapters in the Mitchell books exactly. This allows you to use the Mitchell books as a reference text, with this book being the hands-on tutorials.

Each chapter includes several tutorials, which can be worked with the students in class. Following each is an exercise that students work on their own to reinforce the topics covered in the tutorial.

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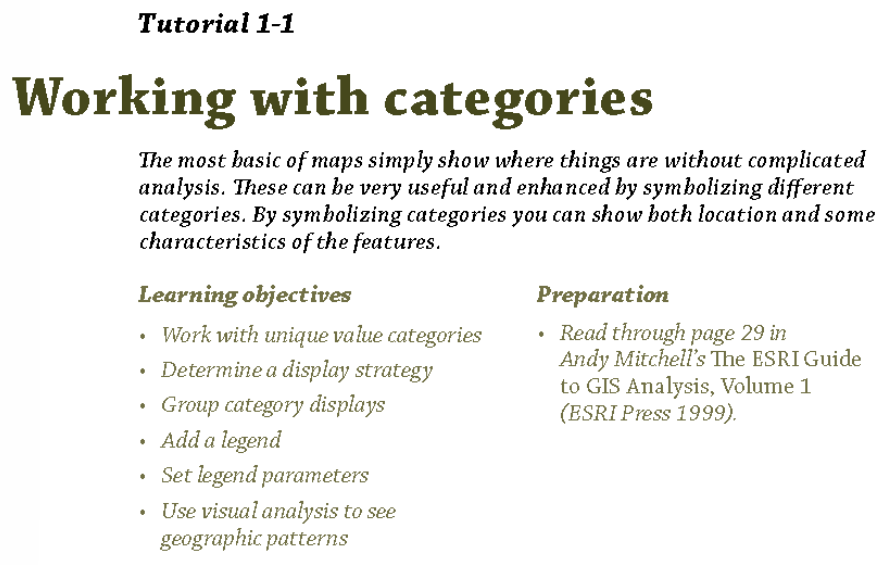
Anatomy of a tutorial

Each tutorial begins with a title and basic description of what will be covered.

Next is a set of learning objectives. These can be used to document progress, and as a good index when students refer back to sections of the book.

There is also a reading assignment from the Mitchell book, if it is being used as the text for the course.



Tutorial 1-1

Working with categories

The most basic of maps simply show where things are without complicated analysis. These can be very useful and enhanced by symbolizing different categories. By symbolizing categories you can show both location and some characteristics of the features.

Learning objectives

- *Work with unique value categories*
- *Determine a display strategy*
- *Group category displays*
- *Add a legend*
- *Set legend parameters*
- *Use visual analysis to see geographic patterns*

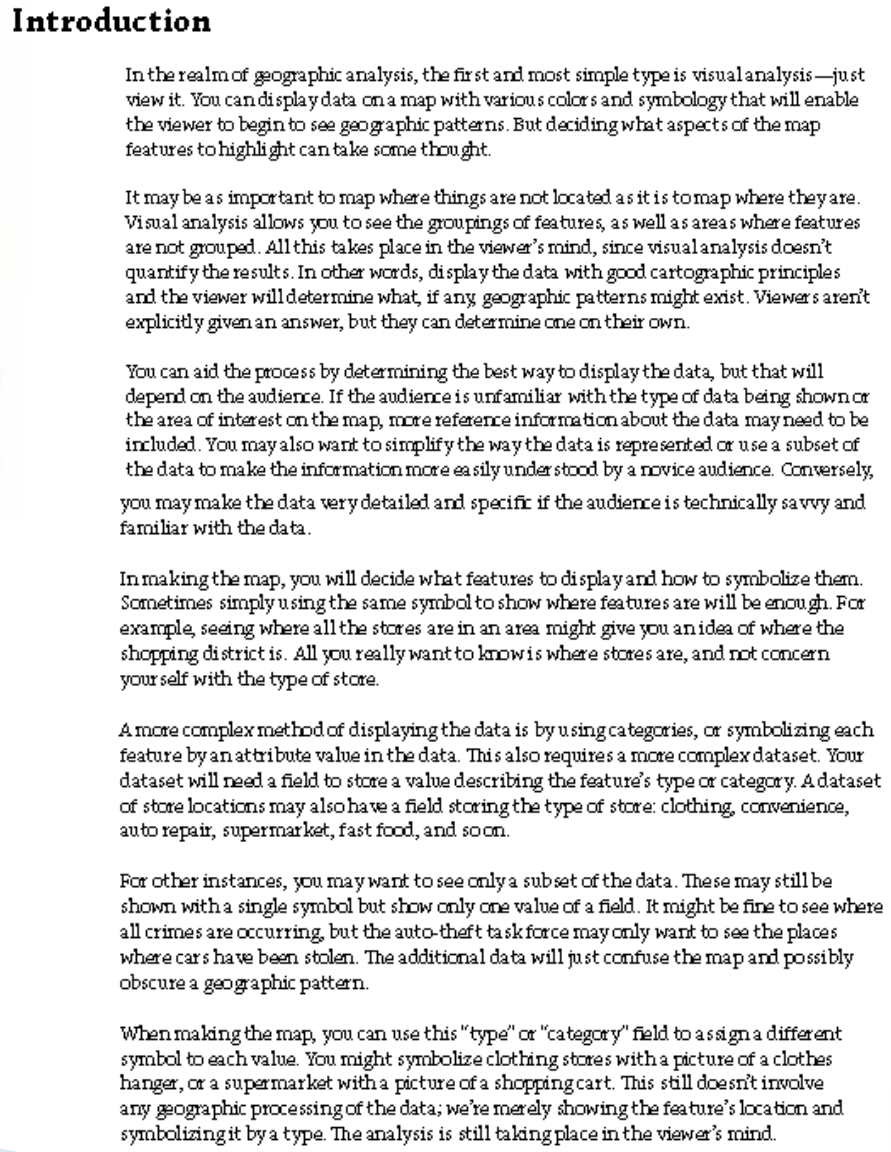
Preparation

- *Read through page 29 in Andy Mitchell's* The ESRI Guide to GIS Analysis, Volume 1 *(ESRI Press 1999).*

Anatomy of a tutorial

Following is an introduction of the topic. In the event that you are not using the Mitchell books as a supplemental text for the course, these introductions provide a good substitute.

The Mitchell books, however, provide more real-world examples as well as diagrams sample maps to reinforce the topic.



Introduction

In the realm of geographic analysis, the first and most simple type is visual analysis—just view it. You can display data on a map with various colors and symbology that will enable the viewer to begin to see geographic patterns. But deciding what aspects of the map features to highlight can take some thought.

It may be as important to map where things are not located as it is to map where they are. Visual analysis allows you to see the groupings of features, as well as areas where features are not grouped. All this takes place in the viewer's mind, since visual analysis doesn't quantify the results. In other words, display the data with good cartographic principles and the viewer will determine what, if any, geographic patterns might exist. Viewers aren't explicitly given an answer, but they can determine one on their own.

You can aid the process by determining the best way to display the data, but that will depend on the audience. If the audience is unfamiliar with the type of data being shown or the area of interest on the map, more reference information about the data may need to be included. You may also want to simplify the way the data is represented or use a subset of the data to make the information more easily understood by a novice audience. Conversely, you may make the data very detailed and specific if the audience is technically savvy and familiar with the data.

In making the map, you will decide what features to display and how to symbolize them. Sometimes simply using the same symbol to show where features are will be enough. For example, seeing where all the stores are in an area might give you an idea of where the shopping district is. All you really want to know is where stores are, and not concern yourself with the type of store.

A more complex method of displaying the data is by using categories, or symbolizing each feature by an attribute value in the data. This also requires a more complex dataset. Your dataset will need a field to store a value describing the feature's type or category. A dataset of store locations may also have a field storing the type of store: clothing, convenience, auto repair, supermarket, fast food, and so on.

For other instances, you may want to see only a subset of the data. These may still be shown with a single symbol but show only one value of a field. It might be fine to see where all crimes are occurring, but the auto-theft task force may only want to see the places where cars have been stolen. The additional data will just confuse the map and possibly obscure a geographic pattern.

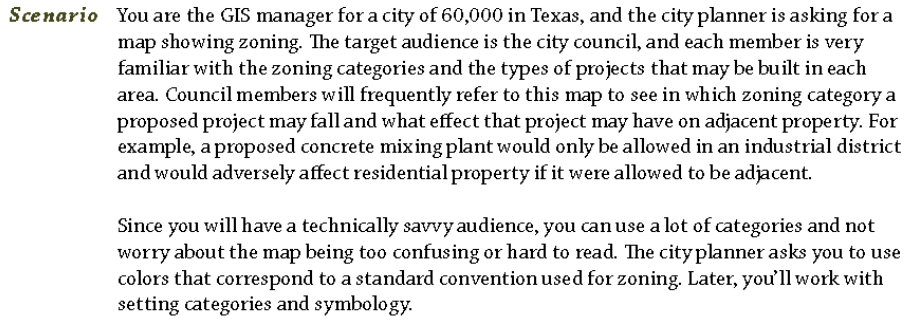
When making the map, you can use this "type" or "category" field to assign a different symbol to each value. You might symbolize clothing stores with a picture of a clothes hanger, or a supermarket with a picture of a shopping cart. This still doesn't involve any geographic processing of the data; we're merely showing the feature's location and symbolizing it by a type. The analysis is still taking place in the viewer's mind.

Anatomy of a tutorial

A scenario is provided which sets up the tutorial and describes the underlying basis for the analysis being done.

These are helpful when the student is not familiar with the type of data or processes being used.

It also reinforces the idea that analysis is done for a specific purpose, and knowing that purpose helps to interpret the results.



Scenario You are the GIS manager for a city of 60,000 in Texas, and the city planner is asking for a map showing zoning. The target audience is the city council, and each member is very familiar with the zoning categories and the types of projects that may be built in each area. Council members will frequently refer to this map to see in which zoning category a proposed project may fall and what effect that project may have on adjacent property. For example, a proposed concrete mixing plant would only be allowed in an industrial district and would adversely affect residential property if it were allowed to be adjacent.

Since you will have a technically savvy audience, you can use a lot of categories and not worry about the map being too confusing or hard to read. The city planner asks you to use colors that correspond to a standard convention used for zoning. Later, you'll work with setting categories and symbology.

Anatomy of a tutorial

A description of the data is provided so that the student will understand the inputs and outputs of the processes.

This is a condensed version of the metadata for each data set and highlights what will be necessary for this particular tutorial. Full metadata is provided for each dataset, which can be viewed in ArcCatalog.

Data The first layer is a zoning dataset containing polygons representing every zoning case ever heard by the city council. An existing field carries a code representing the zoning category assigned to each area. This was already set as the "value field" to define the symbology, so you will only deal with how the categories are shown. This data was created by the city, and a list of the zoning codes and what they mean, called a data dictionary, is provided later in the chapter. You also may find similar datasets from other sources with zoning classifications, and it is important to get their data dictionaries as well.

Anatomy of a tutorial

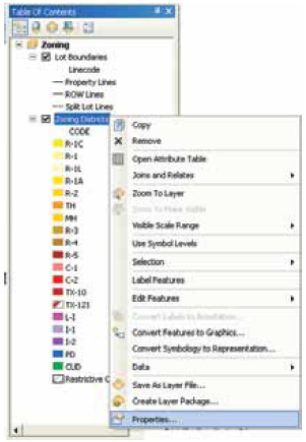
A title is given to each segment of the tutorial, with descriptions of the processes and step-by-step instructions.

Illustrations show exactly what the student will be seeing, and in some instances the particular point of interest is highlighted.

Change a category label

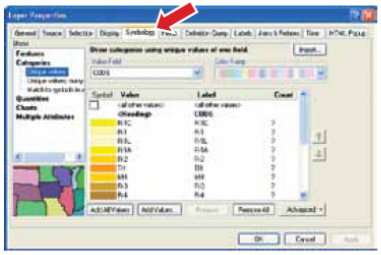
The layer came with the code values displayed for each category. While this may be fine for someone who works with these codes every day and recognizes the underlying meaning, someone not familiar with them will want a more descriptive label. These can be changed in the symbol properties of the layer.

1 In the table of contents, right-click the Zoning Districts layer and click Properties.



2 Click the Symbology tab. Note that the Categories selection is set to Unique values and the Value Field is set to CODE. This means that every unique value of the field CODE will be represented in the legend.

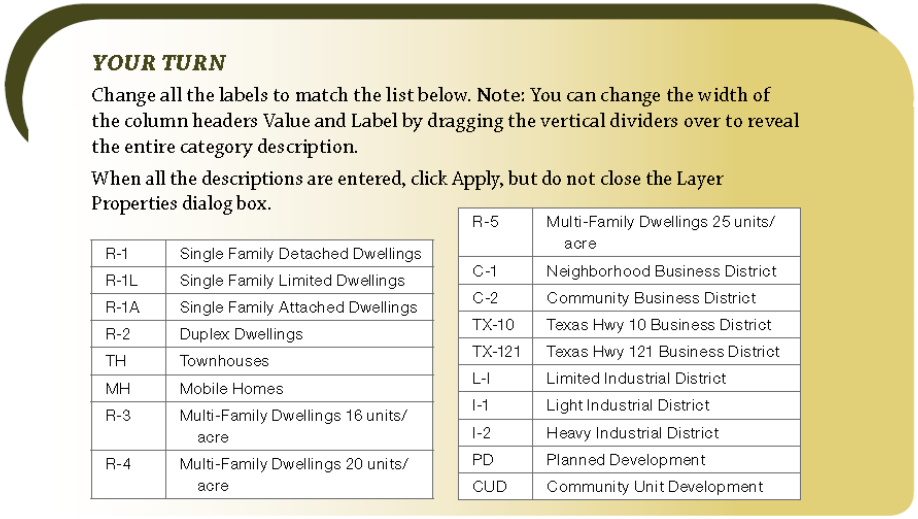
To a city planner or someone experienced with zoning districts, these codes would tell the whole story. But for the layperson, they can be difficult to interpret. You will change them to match the simplified list provided by the city planner.



Anatomy of a tutorial

Tutorials may also include a "Your Turn" box. This is an additional set of tasks that repeat a previous task that the students will work without the step-by-step instructions.

This gives the students an opportunity to try the tasks while the instructor is still available to help.



YOUR TURN

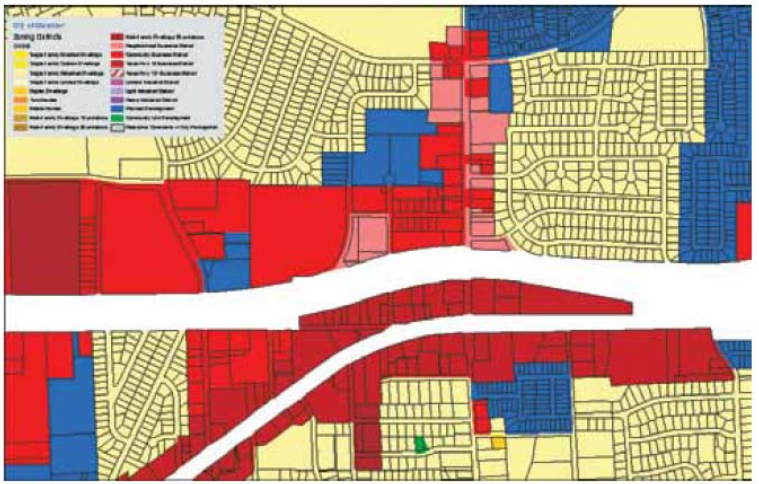
Change all the labels to match the list below. Note: You can change the width of the column headers Value and Label by dragging the vertical dividers over to reveal the entire category description.

When all the descriptions are entered, click Apply, but do not close the Layer Properties dialog box.

R-1	Single Family Detached Dwellings
R-1L	Single Family Limited Dwellings
R-1A	Single Family Attached Dwellings
R-2	Duplex Dwellings
TH	Townhouses
MH	Mobile Homes
R-3	Multi-Family Dwellings 16 units/ acre
R-4	Multi-Family Dwellings 20 units/ acre
R-5	Multi-Family Dwellings 25 units/ acre
C-1	Neighborhood Business District
C-2	Community Business District
TX-10	Texas Hwy 10 Business District
TX-121	Texas Hwy 121 Business District
L-I	Limited Industrial District
I-1	Light Industrial District
I-2	Heavy Industrial District
PD	Planned Development
CUD	Community Unit Development

Anatomy of a tutorial

At the end of the tutorial, the final product is shown. The student is instructed to save their final map to the "MyAnswers" folder.



8 Save your map document as **Tutorial 1-1.mxd** in the \GIST2\MyExercises folder. If you are not continuing on to the exercise, exit ArcMap.

Anatomy of a tutorial

Following the tutorial is an exercise that the students will work independently. It includes a brief scenario and any additional information about the data that students might need to know.

The process follows the concepts shown in the tutorial, and an outline is provided as an aide. Note that there are not step-by-step instructions at this point.

Exercise 1-1

The first tutorial showed how to use categories to help the map viewer determine the zoning for a piece of property. The user looks at the property on the map, notes the color, then matches that color in the legend to determine the associated zoning code. You also helped the viewer better understand zoning codes by providing a text translation of the otherwise cryptic values.

In this exercise, you will repeat the process using land-use codes, which show how property is currently being used as opposed to zoning codes, which show the future use of land. These are also somewhat cryptic, so you will change the labels to a simple description. You will also add the legend to the map layout, then resize and move the legend to an appropriate place on the map.

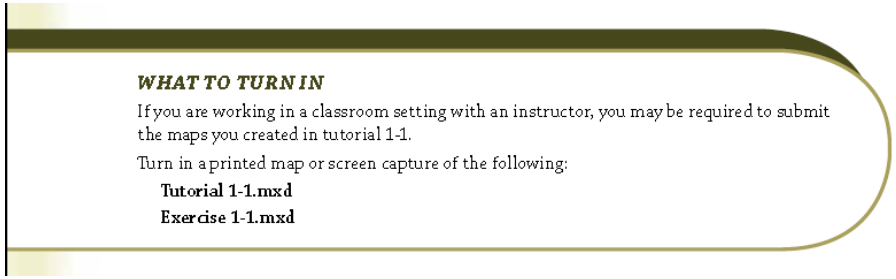
- Continue with the map document you created in this tutorial or open Tutorial 1-1.mxd from the \GIST2\Maps folder.
- Turn off the Zoning Districts layer.
- Add the layer file LandUseCodes.lyr from the \GIST2\Data folder.
- Change the labels for the Land Use values to match the ones at right.
- Make any necessary changes to the legend for it to display all the values.
- Create a layer file for the new symbology.
- Save the results as **Exercise 1-1.mxd** in the \GIST2\MyExercises folder.

A1	Single Family Detached
A2	Mobile Homes
A3	Condominiums
A4	Townhomes
A5	Single Family Detached Limited
AFAC	Airport Facilities
APR	Airport Private Land
AROW	Airport ROW
B1	Multi-Family
B2	Duplex
B3	Triplex
B4	Quadruplex
B5	High Density Multi-Family
CITY	City Property
CITYV	Vacant City Property
CITYW	City Water Utilities Property
CRH	Church
ESMT	Easement
F1	Commercial
F2	Industrial
GOV	Government (State or Federal)
POS	Public Open Space
PRK	Park
PROW	Private Right-of-way
ROW	Right-of-way
SCH	School
UNK	Unclassified
UTIL	Utilities
VAC	Vacant

Anatomy of a tutorial

Students are asked to turn in either a printed map or a screen capture of the tutorial and exercise when they are completed.

Instructors may decide if they would like either or both of these turned in.



WHAT TO TURN IN

If you are working in a classroom setting with an instructor, you may be required to submit the maps you created in tutorial 1-1.

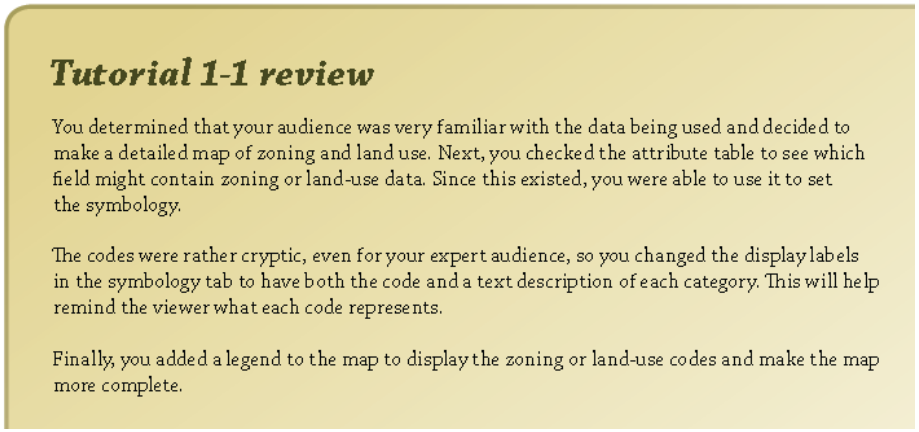
Turn in a printed map or screen capture of the following:

Tutorial 1-1.mxd

Exercise 1-1.mxd

Anatomy of a tutorial

Each tutorial includes a review. This goes back over the main topics of the tutorial.



Tutorial 1-1 review

You determined that your audience was very familiar with the data being used and decided to make a detailed map of zoning and land use. Next, you checked the attribute table to see which field might contain zoning or land-use data. Since this existed, you were able to use it to set the symbology.

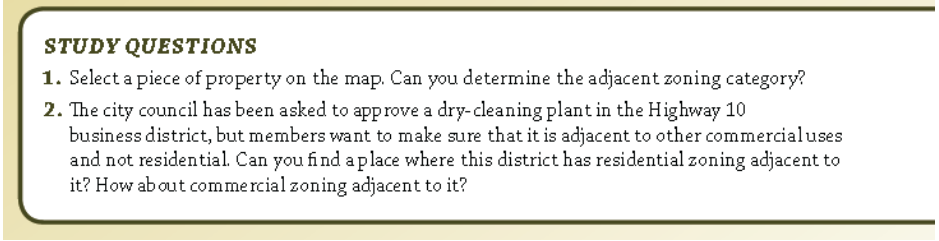
The codes were rather cryptic, even for your expert audience, so you changed the display labels in the symbology tab to have both the code and a text description of each category. This will help remind the viewer what each code represents.

Finally, you added a legend to the map to display the zoning or land-use codes and make the map more complete.

Anatomy of a tutorial

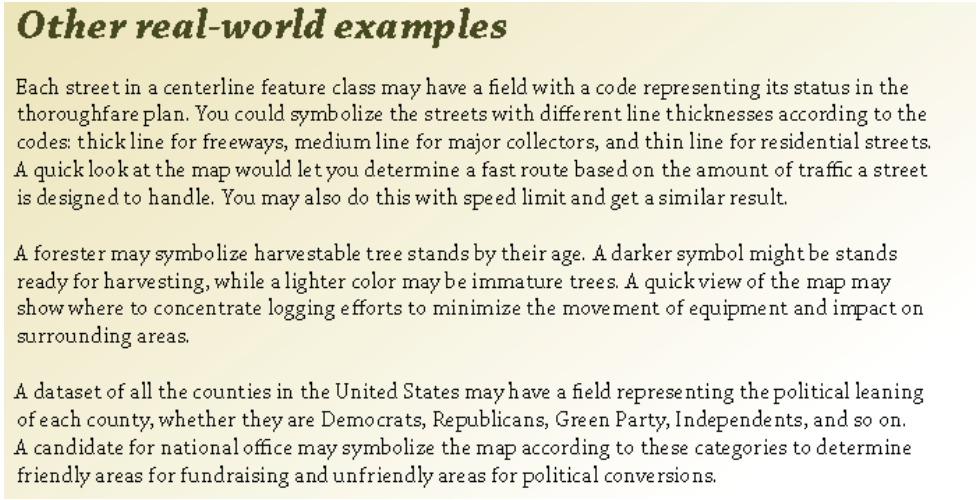
Tutorials also include a set of study questions to help encourage student discussion about the subject.

The section finishes with some examples of how this topic might be applied to other scenarios. This is also a good spark for student discussion.



STUDY QUESTIONS

1. Select a piece of property on the map. Can you determine the adjacent zoning category?
2. The city council has been asked to approve a dry-cleaning plant in the Highway 10 business district, but members want to make sure that it is adjacent to other commercial uses and not residential. Can you find a place where this district has residential zoning adjacent to it? How about commercial zoning adjacent to it?



Other real-world examples

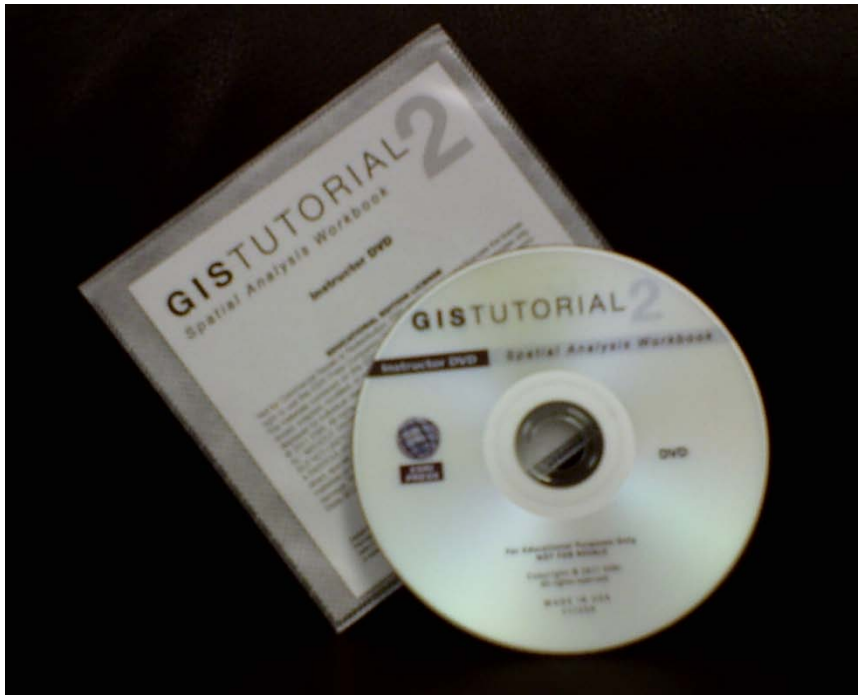
Each street in a centerline feature class may have a field with a code representing its status in the thoroughfare plan. You could symbolize the streets with different line thicknesses according to the codes: thick line for freeways, medium line for major collectors, and thin line for residential streets. A quick look at the map would let you determine a fast route based on the amount of traffic a street is designed to handle. You may also do this with speed limit and get a similar result.

A forester may symbolize harvestable tree stands by their age. A darker symbol might be stands ready for harvesting, while a lighter color may be immature trees. A quick view of the map may show where to concentrate logging efforts to minimize the movement of equipment and impact on surrounding areas.

A dataset of all the counties in the United States may have a field representing the political leaning of each county, whether they are Democrats, Republicans, Green Party, Independents, and so on. A candidate for national office may symbolize the map according to these categories to determine friendly areas for fundraising and unfriendly areas for political conversions.

Instructor DVD

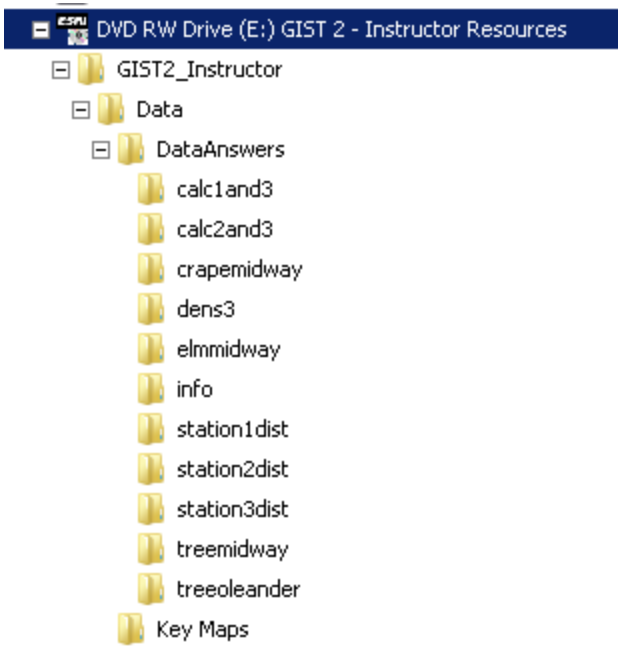
Materials are provided to instructors that allow them to prepare and manage their classrooms for the use of these books.



Instructor DVD

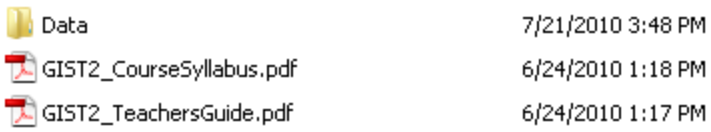
Materials are provided to instructors that allow them to prepare and manage their classrooms for the use of these books.

This includes completed versions of all the tutorials and exercises, with completed maps.



Instructor DVD

The materials also include a sample syllabus, and a Teacher's Guide



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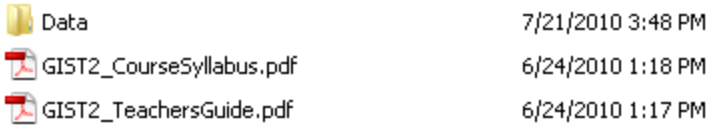
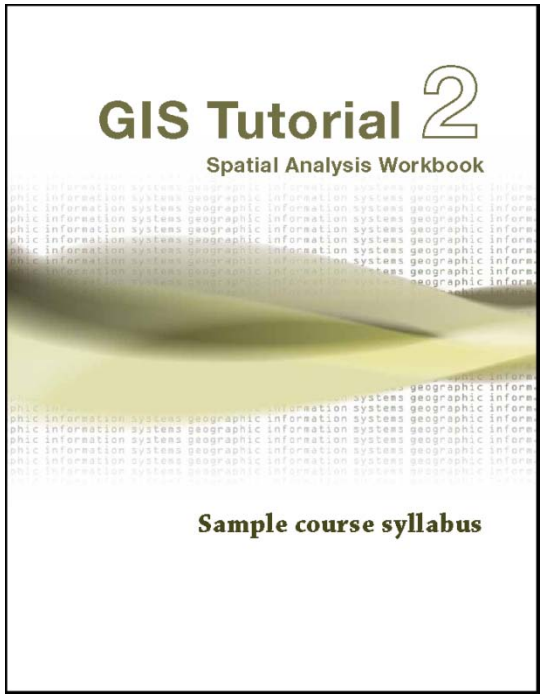
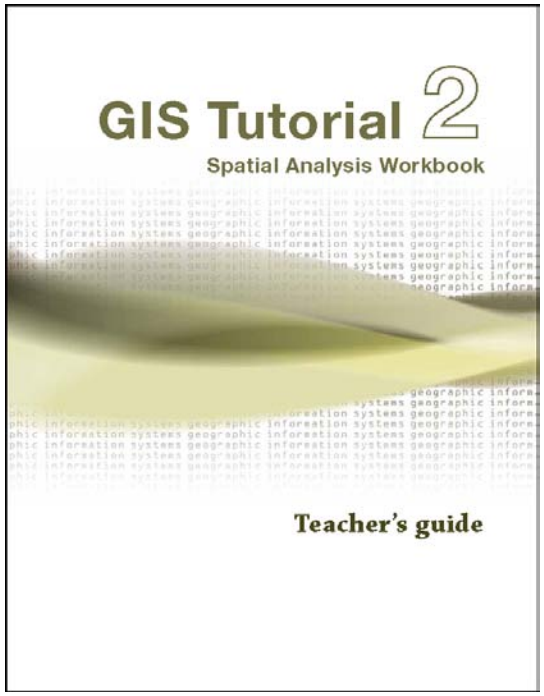
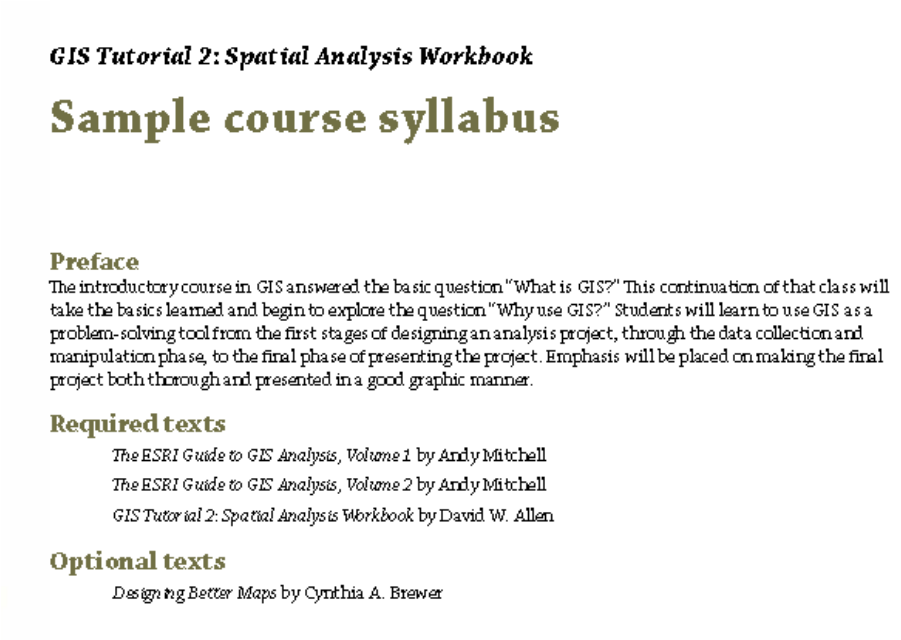






Sample syllabus

The sample syllabus contains the basic outline of how the book can be used in class, as well as a template for other class requirements. Each instructor can modify this syllabus to meet their course needs, and add any local information that may be necessary.



GIS Tutorial 2: Spatial Analysis Workbook

Sample course syllabus

Preface

The introductory course in GIS answered the basic question "What is GIS?" This continuation of that class will take the basics learned and begin to explore the question "Why use GIS?" Students will learn to use GIS as a problem-solving tool from the first stages of designing an analysis project, through the data collection and manipulation phase, to the final phase of presenting the project. Emphasis will be placed on making the final project both thorough and presented in a good graphic manner.

Required texts

The ESRI Guide to GIS Analysis, Volume 1 by Andy Mitchell

The ESRI Guide to GIS Analysis, Volume 2 by Andy Mitchell

GIS Tutorial 2: Spatial Analysis Workbook by David W. Allen

Optional texts

Designing Better Maps by Cynthia A. Brewer

Teacher's Guide

The teacher's guide starts with instructions on what it contains.

GIS Tutorial 2: Spatial Analysis Workbook

Introduction to teacher's guide

This teacher's guide can be used to lay out class sessions for each tutorial and exercise. It includes learning objectives, time estimates for completing the tutorials and exercises, grading criteria, and study questions. It can help you determine how much material can be covered in each class and how much can be covered through the course of the semester.

It is recommended that you use ArcGIS 10 or higher in your classroom. All tutorials can be worked with the student license of ArcEditor and an evaluation copy of the ArcGIS Spatial Analyst and ArcGIS Network Analyst extensions.

Format

Each chapter has a suggested reading from *The ESRI Guide to GIS Analysis, Volumes 1 and 2*, by Andy Mitchell. This material can be read in class or assigned at the end of the previous class as homework.

Each chapter lists learning objectives outlining what topics will be covered. Next is an introduction to each topic to prepare students for the class work, followed by a step-by-step tutorial, an exercise, a review, study questions, and other real-world examples. This basic information can be used as-is or modified to include information from other sources.

The tutorial is a step-by-step account of how to perform the specific techniques, along with illustrations to give the students a visual reference for the commands. Each tutorial includes a scenario illustrating how the techniques described might be used in the real world. Walk through the tutorial with the students while projecting the ArcGIS session on a screen, answering any questions along the way. It is most effective to work through the tutorial with an interactive whiteboard device. It is important that students understand the concepts as well as the steps involved in the analysis. You may want to have the students record each step in the tutorial with a description of the process so that they will have a more detailed outline to follow while doing the exercise.

At the end of the tutorial, the students will want to save the completed work in the MyExercises folder to avoid overwriting the initial map document. It may also be helpful for them to create subfolders for each chapter that will contain any screen captures and map documents for the tutorials and exercises. This will make it easier for them to track their work for each chapter.

The exercise has a brief introduction and a general outline of the process. Students should be able to take the techniques they learned in the tutorial and apply them to the exercise on their own to complete the requested map. If the students don't have time to do an exercise either in class or as homework, you can walk them through the provided key map to quickly demonstrate the concepts.

Depending on your classroom facilities, you may have the students either print the final maps or export them to PDF files to turn in.

After each tutorial, take the class through the review, study questions, and other examples, introducing additional topics related to the techniques learned. Finally, assign the reading for the next chapter.

Answers

The KeyMaps folder on the Instructor DVD contains a completed version of each tutorial and exercise in both MXD and PDF formats (e.g., /KeyMaps/Tutorial 5-7.mxd). All the necessary completed datasets are also included in this folder. A sample syllabus used by the author is also included on the Instructor DVD.

Teacher's Guide

Information is provided for each tutorial:

- Class Preparation
- Learning Objectives
- Estimated time to complete Tutorial and Exercise
- Grading criteria
- Study questions (and answers)
- Names of the completed maps

Tutorial 1-1: Working with categories

Class preparation

Read through page 29 in *The ESRI Guide to GIS Analysis, Volume 1*.

Learning objectives

Work with unique value categories
Determine a display strategy
Group category displays
Add a legend
Set legend parameters
Use visual analysis to see geographic patterns

Estimated time to complete tutorial

30 to 45 minutes

Estimated time to complete exercise

30 to 45 minutes

Grading criteria

Completed tutorial: Extra points for additional cartographic skills such as cleaning up the legend or adding additional information and descriptions to the face of the map.

Completed exercise: All of the zoning categories should be shown with their textual descriptions, not the two-letter code. Extra points for additional cartographic skills such as cleaning up the legend or adding additional information and descriptions to the face of the map.

Study questions

1. Select a piece of property on the map. Can you determine the adjacent zoning category?
   Display the completed exercise. Select any piece of property. Then look at the color of an adjacent piece of property and try to match that color against the legend to determine the zoning category.

2. The city council has been asked to approve a dry-cleaning plant in the Highway 10 business district, but members want to make sure that it is adjacent to other commercial uses and not residential. Can you find a place where this district has residential zoning adjacent to it? How about commercial zoning adjacent to it?
   Look on the legend to find the color that represents TX-10 (maroon) and Residential (yellow). Find this on the map, then check for places where these two colors are adjacent. Commercial zoning is shown in red—look for adjacent property with this color, too.

GIS Tutorial Series

As a whole, these books cover all the major subject matter for any GIS program.