

Introduction to ArcGIS 8.2 Workshop
Lecture 2
Exercises 3 & 4

Tony Soeller & Kim Gerrard
Network & Academic Computing Services

Kay Collins
Main Library

U. C. Irvine

Introduction to ArcGIS Workshop

This workshop is intended to introduce you to the basic functionality of ArcGIS 8.2. The focus of this workshop is on the GIS utilities that are available to you so that you can learn how to glean information from existing GIS data and begin to construct your own data layers. In the workshop you will be accessing and using GIS data that are readily available. This is a two-session workshop that includes laboratory exercises.

Class 1: Exploring ArcGIS and GIS selections

- Explore GIS technology and what uniquely can be done with it
- Explore the capabilities of the ArcGIS module "**ArcMap**"
- Explore the relationships between features on maps and records in the underlying database
- Perform spatial and database selections to highlight and extract information

Class 2: Producing Results With ArcGIS

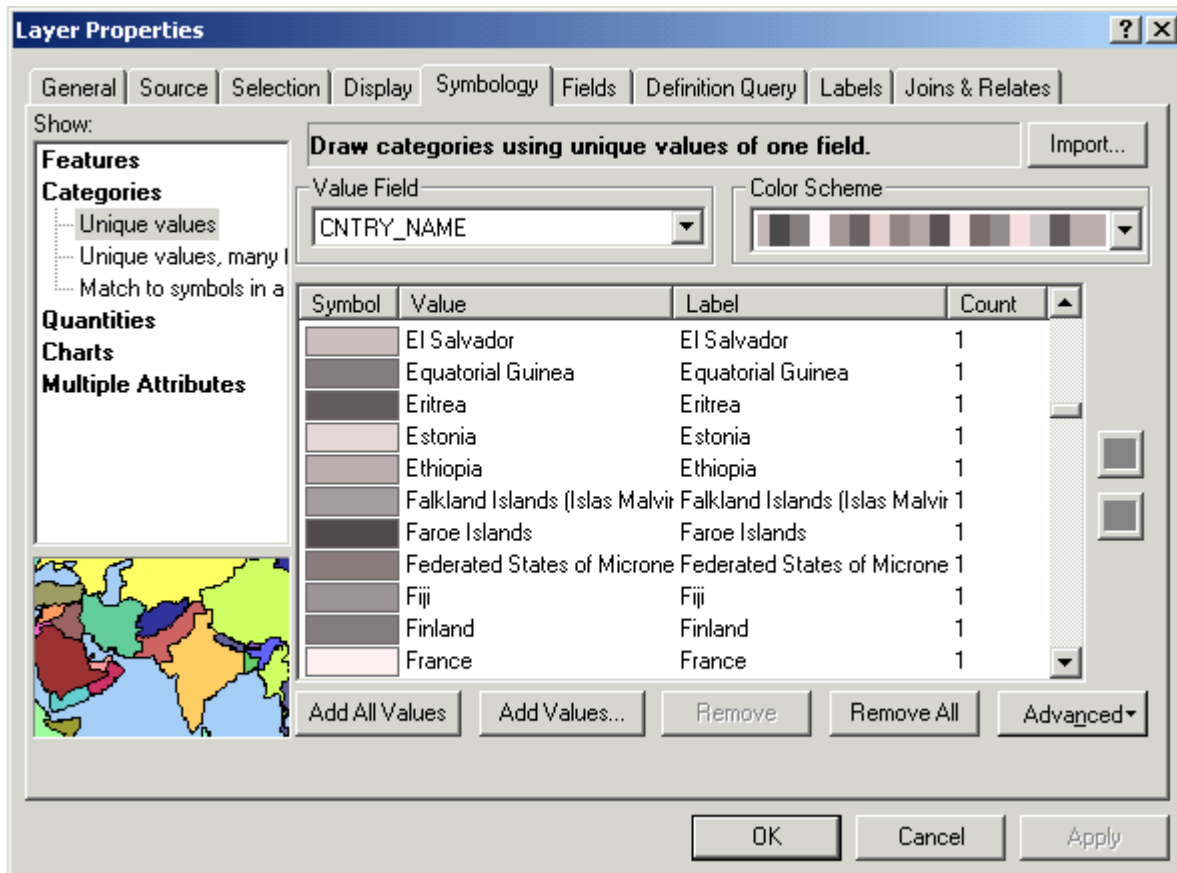
- Reveal information within **ArcMap** by symbolizing map features
- Explore the capabilities of the ArcGIS module "**ArcCatalog**"
- Access data on the Internet to create custom GIS data layers
- Design and generate a basic map using Census data
- Review sources of ArcGIS-related information

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Symbolizing Map Features within ArcMap

Within ArcMap you have complete control over how individual features within each layer of GIS data are symbolized. The following figure shows the **Symbology** tab for a layer wherein modifications to a layer's symbology is performed. On the left side, under **Show**, are five main methods of defining a layer's symbols. Notice in the center of the window, under **Symbol**, that there are unique colors (or shades or pattern symbols) that can be assigned to each unique polygon feature. In this example, unique features represent individual countries. For other feature types (points and lines) there are colors, shades and patterns from which to choose as well.



Generating Maps and Figures with ArcMap

Within ArcMap you can make professional quality maps. All of the tools are there for you to do so and, in fact, many private map companies as well as government mapping agencies use ArcMap to produce quality maps. Additionally, you can use ArcMap to produce figures that can be incorporated into reports. These figures can include maps, inset (locator) maps, as well as listings from the layer attribute tables and graphs generated from combinations of attribute table fields.

Joining and Relating External Data Tables to Existing GIS Spatial Data

You can join or relate external tables to the attribute tables associated with a GIS data layer. To do this the external table must have an attribute that is a geographic feature identifier. Examples of this are Zip Code number; Census Tract or Block Group number; county FIPS code; city or county or state or country name; and so on. *External data tables are best read in as dBASE-formatted files.*

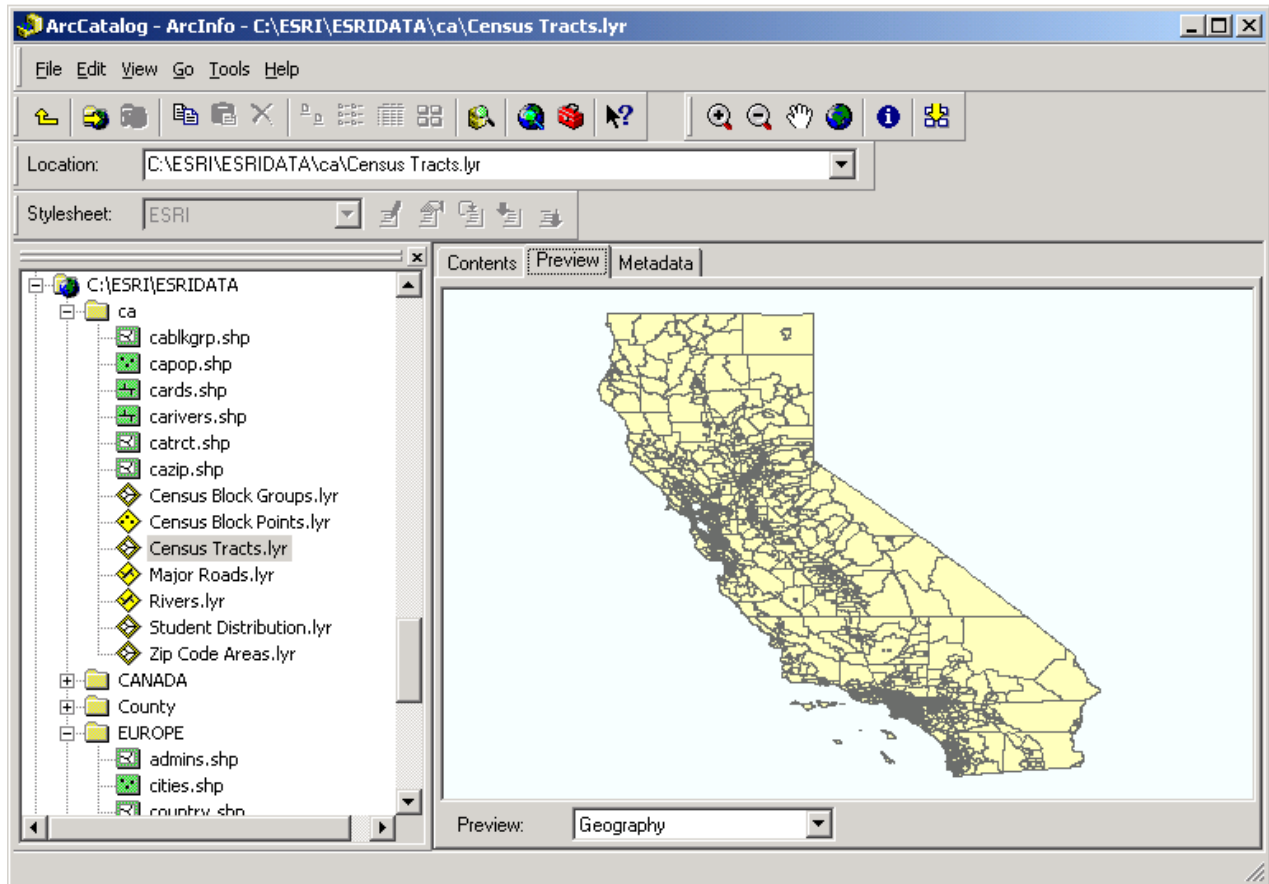
The name of the geographic feature identifier does not have to be the same as that in the attribute table. (For instance a field in the attribute table can be called ZIP and the field in the external table can be called ZIP_CODE.) However, both fields must be of the same data type (i.e., number and number, or text string and text string, etc.)

Working with ArcCatalog

ArcCatalog is the ArcGIS module used to catalog, preview and manager your GIS data. Typically, GIS projects will incorporate large collections of GIS data files. With a format similar to Microsoft's **Windows Explorer**, ArcCatalog is a handy utility for locating and controlling these data files. Using ArcCatalog you will "connect to a folder" that contains GIS data. Also, you can use ArcCatalog to view snapshots of your spatial data and even the attribute tables that underlie the spatial data. Whatever symbology is used in ArcMap for a specific layer, that same symbology can be saved for viewing the layer data within ArcCatalog.

Like ArcMap, ArcCatalog has the **Zoom In**, **Zoom Out**, **Pan**, **Full Extent**, and **Identify** tools for manipulating the display of and querying your GIS data.

The following figure shows a typical display of ArcCatalog with a preview of census tracts for California.



Unique to ArcCatalog is a utility for viewing and developing *metadata* for the GIS data that you have acquired or are creating. Metadata is information that describes, or characterizes, your GIS data. *Meta*, in this context, means “occurring later than or in succession to.” As such, metadata is usually information about your GIS data that has been compiled by someone – presumably the person who generated the data initially - after the data files are created. Metadata is a good thing. I recommend, when building GIS data files, that you invest the extra effort to describe your data and store those descriptions as metadata. Within ArcGIS, metadata that is associated with GIS data gets carried along with the GIS data without your intervention. So the metadata is saved, and can be updated as needed, with the GIS data.

Metadata can be quite simple or rather comprehensive in detail. For instance, you can create your GIS data then simply add your name, map source, map scale, and date of creation to the metadata for you GIS data. On the other extreme, some government agencies have metadata options that are so thorough (and, frankly, sometimes unnecessary depending on the data) that generating the metadata can be very time consuming. Because of this many people just avoid creating the metadata at all. But metadata is really a way of documenting your work, and its presence allows others who

later will use your data to be able to find who created the data and what were the sources of the data. This could be important particularly when the accuracy of data sources comes into question. Every professional journal or article has references that trace the history of the research. Metadata provides a similar reference mechanism for GIS data. But because metadata is not required, the developer of the specific GIS data is responsible for determining how thorough the metadata is to be.

Other Modules / Extensions That Are Available with ArcGIS

ArcToolbox is the third ArcGIS module available within ArcGIS. ArcToolbox offers specific tools for importing and converting GIS data. Additionally, several specific application *extensions* are included with your ArcGIS installation and are available for use within ArcMap. To activate one or more extensions in ArcMap go to **Tools / Extensions...** The extensions include the following:

3D Analyst
Spatial Analyst
Geostatistical Analyst
Streetmap
ArcPress

For immediate assistance, within ArcMap and ArcCatalog, you have access to the **ArcGIS Desktop Help** which is accessible from the menubar (**Help / ArcGIS Desktop Help**).

Self-paced Online Classes for ArcGIS

UCI users of ArcGIS 8.1 and ArcView 3.2a can attend self-paced online GIS classes through ESRI's Virtual Campus. These classes are useful for getting started with the GIS software to which we now have access. Classes available through the Virtual Campus are free to UCI faculty, staff and students. You can participate in each of the classes at your own pace and you do not have to finish the class in one sitting.

To request access to a class, please send mail to a NACS representative via nacs@uci.edu. Indicate the name of the class(es) you want to attend, your email address and your phone number. You will receive mail from ESRI with a password and instructions regarding how to access the class(es) you have selected.

The following classes are available for you to attend. I've placed a * next to those which I think are good for starters. I suggest attending the "Analyst" classes after first attending the introductory ArcGIS or ArcView classes. (Our software license includes the Spatial, 3D and Network Analyst extensions but not the Business Analyst extension.)

***Introduction to ArcInfo using ArcMap, ArcCatalog and ArcToolbox**
Introduction to ArcInfo using ArcTools
Introduction to ArcView 3D Analyst
Introduction to ArcView Business Analyst
Introduction to ArcView GIS
Introduction to ArcView Network Analyst
Introduction to ArcView Spatial Analyst
Introduction to Visual Basic for ESRI Software
***Learning ArcGIS I (for ArcView 8, ArcEditor 8 and ArcToolbox 8)**
***Learning ArcGIS II: Presenting Information (ArcView 8, ArcEditor 8 and ArcInfo 8)**
Learning ArcIMS
Programming with Avenue
What's New in ArcInfo (7.x to 8.0.1 or 8.0.2)
What's New in ArcInfo (7.x to 8.1)

Other classes (not listed here) are freely available to the general public which you can attend as well. An example of one of these classes is "Migrating from ArcView GIS 3.x to ArcView 8." To see a list of such classes go to

<http://campus.esri.com>

and click on GIScience, GIS Technology or GIS Applications on the left side of the screen. Some Virtual Campus classes are not free to UCI because these are written by individuals outside ESRI. If you want to attend those classes you will have to pay the designated fee.

Books For Learning To Use ArcGIS

I've found that a good book for learning to use ArcGIS is "**Getting to Know ArcGIS Desktop 8.1.**" Professors who will use this book in teaching classes can get a free copy at:

<http://www.esri.com/industries/university/>

Click on "Request a desk copy of an ESRI Press Book" on the left side of the screen. Other good user guides are "**Using ArcMap**", "**Using ArcCatalog**" and "**Editing in ArcMap**" from the ESRI bookstore:

http://www.esri.com/library/esripress/arcgis_doc.html

With the ArcGIS Site License we also have a CD (included with the ArcGIS software package that NACS distributes) called "**ArcGIS Digital Books and Sample Maps.**" The CD contains a slew of maps and associated data, and ArcGIS manuals, some of the titles include:

Building a Geodatabase
Editing in ArcMap
Getting Started with ArcGIS
Understanding Map Projections
Using ArcCatalog
Using ArcGIS 3D Analyst
Using ArcGIS Geostatistical Analyst
Using ArcGIS Spatial Analyst
Using ArcMap
Using ArcToolbox
What is ArcGIS

Free ArcGIS Basemap Data

When planning a GIS project you might consider utilizing the free GIS basemap data that are available to you at UCI. Included with the campus ArcGIS site license is a set of seven CDs containing GIS data that cover individual States, the United States collectively, Mexico, Canada, Europe, and the World. Also included in the CDs are elevation data and street map data. An ESRI online document describes the data that are available:

<http://www.esri.com/library/whitepapers/pdfs/datamaps2002.pdf>

Following is a topical list of data contained on each of the CDs. You can check out the seven CDs with the ArcGIS 8.2 package (no charge) at the NACS Response Center in Engineering Gateway (nacs@uci.edu, x4-6116).

ESRI Data & Maps 2000

World - CD ROM 1

- Countries (Generalized)
- Countries 2002
- Countries 1992
- Administrative Units 2002
- Continents
- Regions
- CountryWatch Demographics (Table)
- Country Memberships of Political Organizations (Table)
- Cities
- Gazetteer
- Drainage Systems
- Lakes

- Rivers
- World Wildlife Fund Ecoregions
- UTM Zones
- Time Zones
- Latitude and Longitude Grids
- Named Latitudes and Longitudes
- World Map Background
- WorldSat Color Shaded Relief Image

Europe - CD 1

- Germany ZIP Code Areas
 - One-Digit
 - Two-Digit
 - Five-Digit

- Europe Basemap
 - Countries
 - Provinces
 - Cities
 - Places
 - Urbanized Areas
 - Major Roads
 - Roads
 - Railroads
 - Major Water
 - Water Bodies
 - Canals

- Europe Demographic
 - Province/State Demographics
 - Country Demographics
 - Regional Demographics
 - Province/State Purchasing Power

Canada - CD 2

- Provinces
- Major Cities
- Middle Cities
- Municipalities
- Regional Municipalities
- Indian Reserves
- Highways
- Railways
- FSA Postal Centroids
- Telephone Area Code Boundaries
- National Parks

Provincial Parks
Water Bodies

Mexico - CD 2

States
Cities
Roads
Road Routes
Drainage Systems
Lakes
Rivers

United States - CD 2

States (generalized)
Counties (generalized)
County Population Estimates (table)
Census Feature Class Codes (table)
107th Congressional Districts
Cities
Populated Place Points
Populated Place Areas
Metropolitan Statistical Areas
Urbanized Areas
Roads (generalized)
Road Routes (generalized)
Major Roads
 National Transportation Atlas
 Interstate Highways
 Major Road Net
 Railroads
Parks
Drainage Systems (generalized)
Lakes (generalized)
Rivers (generalized)
Designated Market Areas
Telephone Area Code Boundaries
ZIP Code Points
ZIP Code Areas (three-digit)
ZIP Code Areas (five-digit)
National Atlas of the United States
 Airports
 Cities
 Urbanized Areas
 Federal and Indian Land Areas
 Federal Land Lines
 Water Feature Areas

- Water Feature Lines
- Public Land Survey
- Historic Earthquakes
- Volcanoes

- State Plane Zones for NAD 1927
- State Plane Zones for NAD 1983
- USGS Topographic Quadrangle Series Indexes
 - 1:24,000
 - 1:100,000
 - 1:250,000

United States (Continued) - CD 3

- States
- Counties
- Census Tracts
 - National Transportation Atlas
 - Highways
 - U.S. Highway Routes
- Major Water

United States (Continued) - CD 4

- GDT Landmarks
 - Airports
 - Institutions
 - Large Area Landmarks
 - Park Landmarks
 - Recreation Areas
 - Retail Centers
 - Transportation Terminals
- Geographic Names Information System Cultural Points
 - Buildings
 - Cemeteries
 - Churches
 - Golf Locales
 - Hospitals
 - Locales
 - Populated Places
 - Schools
 - Summits

Western United States (by State) - CD 4

- Census Tracts
- Census Block Groups
- Census Block Centroid Populations
- Rivers

Major Roads
ZIP Code Areas

States Included on CD 4

Alaska
Arizona
California
Hawaii
Idaho
Montana
Nevada
New Mexico
Oregon
Utah
Washington
Wyoming

Central United States (by State) - CD 5

Census Tracts
Census Block Groups
Census Block Centroid Populations
Rivers
Major Roads
ZIP Code Areas

States Included on CD 5

Arkansas
Colorado
Illinois
Iowa
Kansas
Louisiana
Minnesota
Missouri
Nebraska
North Dakota
Oklahoma
South Dakota
Texas
Wisconsin

Eastern United States (by State) - CD 6

Census Tracts
Census Block Groups
Census Block Centroid Populations
Rivers

Major Roads
ZIP Code Areas

States Included on CD 6

Connecticut
Delaware
District of Columbia
Indiana
Kentucky
Maine
Maryland
Massachusetts
Michigan
New Hampshire
New Jersey
New York
Ohio
Pennsylvania
Rhode Island
Vermont
Virginia
West Virginia

Southern United States (by State) - CD 7

Census Tracts
Census Block Groups
Census Block Centroid Populations
Rivers
Major Roads
ZIP Code Areas

States Included on CD 7

Alabama
Florida
Georgia
Mississippi
North Carolina
South Carolina
Tennessee

Elevation Data - CD 6

North America Digital Elevation Model (grid)
North America Shaded Relief (grid)
World Digital Elevation Model (MrSID Image)
World Shaded Relief (MrSID Image)
World Topography and Bathymetry (MrSID Image)

ArcGIS StreetMap USA - CD 8

Background

World Countries

World Map Background

Canada and Mexico

Cities

Cities

Cities (National Atlas)

Populated Places

Highways

Roads (generalized)

Interstate Highways

Major Roads

Landmarks

Airports (U.S. Bureau of Transportation statistics)

Airports (National Atlas)

Hospitals

Major Water

Lakes (generalized)

Major Water

Parks

Parks

Park Landmarks (GDT)

States

States

States (generalized)

Streets

Detailed Streets

Exercise 3: Working with ArcCatalog: Data Management and Metadata


In this exercise you will...

- Explore the components of ArcCatalog: Viewing spatial and attribute data and metadata
- Relate and join an external table to a feature layer's attribute table

1. Open ArcCatalog

Go to **Start/Programs/ESRI/ArcGIS** and click on **ArcCatalog**. (Note: on your office computer you might go to **Start/Programs/ArcGIS** then **ArcCatalog**.)


2. View Spatial Data

Click on the **Connect to Folder** icon . The **Connect to Folder** dialog box appears.

Navigate to **c:\apps\esri\esridata** and click on **esridata** so that "**c:\apps\esri\esridata**" appears in the top (small) window of the dialog box. Click the **OK** button.

Notice a new listing for **c:\apps\esri\esridata** appears in the folder window on the left side of ArcCatalog.

Click the **+** button to the left of **c:\apps\esri\esridata** then click the **+** button to the left of **ca**. Notice the list of GIS data files available within the **ca** (California) folder.

Click once on "**ca**" to cause "**ca**" to be highlighted. On the right window of ArcCatalog make sure (by clicking) the **Contents** tab is active, then click the **Large Icons**  button.

In turn, click the **List** , then **Details** , then **Thumbnails**  buttons to view the various ways ArcCatalog will present information about GIS data files for you.

The **Thumbnails** button is particularly interesting because, at once, you can view simple graphical displays of all the GIS data that reside within one directory. A very handy tool!

In the folder listing (left side of ArcCatalog), under the **ca** folder click once on **Census Tracts** to display a thumbnail view and other summary information about that layer.

Click the **Preview** tab to display a full view of the GIS data for the **Census Tracts**.

Using **Preview**, you have access to the **Zoom In**, **Zoom Out**, **Pan**, **Full Extent**, and **Identify** tools and buttons like you used in ArcMap.

3. View Attribute Data

Click the **Preview** tab. In the **Preview:** scroll box, at the bottom of the **Preview** window, scroll to and select **Table** (you won't have to scroll far).

The attribute table for the **Census Tracts** layer is displayed. The table looks the same as the table you viewed within ArcMap. However all of the *selections* functionality that you worked with in ArcMap are not available in ArcCatalog's version of the table view. As a result, you can only display all the records, not a selected set of records.

4. View Metadata

Click on the **catrct** layer in the folders listing window, then click the **Metadata** tab in the data viewing window. Here you will see information that someone has stored in reference to the **catrct** layer.


Click on the **Spatial** and then the **Attributes** tabs to view specific information about the geographic and the database sides of the GIS data.

In the **Stylesheet** scrolling window, located sort of in the middle and left side of ArcCatalog, scroll to and select **FGDC** and then **Geography Network** to see different display formats of the metadata.

Each stylesheet displays the same basic information though in different formats, and some stylesheets display more information than others. Sometimes finding specific metadata about a layer requires some digging. Occasionally switching to a different stylesheet can help bring forward the desired information.

Minimize ArcCatalog without closing it completely.

5. Creating a table relate

Open **ArcMap** with an empty document and add GIS data  from the following layer:

c:\apps\esri\esridata\ca
cazip.shp

Right-click on the **cazip** name in the TOC then, in the layer menu that appears, click **Joins and Relates / Relate...** The **Relate** dialog box appears.

In the **Relate** dialog box, under item **1**, scroll to, then click on **ZIP**.

ZIP is the name of the **cazip** attribute table field that contains Zip Code numbers.

Under item **2**, click the folder browse button  at which point the **Add** dialog box appears.

Click the **Connect to Folder** button, then click on **c:\SaveHere** then click the **OK** button.

Double-click on **c:\SaveHere** to open the folder then click **ZIP_DATA.dbf** then click the **Add** button. The text **ZIP_DATA** is added to the window box under item 2.

Under item **3** scroll to, then click on **ZIP**.

Under item 4 change the relate name to **Zip1**.

(For a fine discourse on what we are doing here, click on the **About relating data...** button.)

Click the **OK** button.

To verify that the relate has been established, right-click again on the **cazip** name in the TOC, click **Joins and Relates** then just move the mouse pointer over the name **Remove Relate(s)**. You will notice the name **Zip1** appears as an active relate name.

During project work you could have multiple relates active and those relates' names will be listed here.

Click elsewhere on the map to close the menu.

At the base of the TOC click, to activate, the **Source** tab. Notice the only listing within the active Data Frame is the **cazip** layer. Back to this in a moment.

Right-click on the **cazip** name in the TOC, then click **Open Attribute Table**.

In the **Attributes of cazip** table click the **Options** button then click **Related Tables / Zip1: ZIP_DATA**. The **Attributes of ZIP_DATA** table opens (initially it might be obscured by the **Attributes of cazip** table) and a new entry is made within the active Data Frame for the **ZIP_DATA** table. Notice how different the **ZIP_DATA** icon appears from other GIS data layers you have viewed.

Click the **Display** tab at the base of the TOC and you will see that the **ZIP_DATA** entry is not listed there. The **ZIP_DATA** file is a table, not spatial data, hence it does not appear as a layer within the **Display** tab.

Manually select several records in the **Attributes of ZIP_DATA** table (they should turn cyan).

Click the **Options** button within the **Attributes of ZIP_DATA** table then click **Related Tables / Zip1: cazip**.

The records you selected in the **Attributes of ZIP_DATA** table have an associated (*related*) set of records in the **Attributes of cazip** table. Those records are now selected (click the **Selected** button in the **Attributes of cazip** table to view them) as are the associated Zip Code features in the map.

In the preceding scenario, records within the **Attributes of ZIP_CODE** table are *related* to, but not *attached* (or joined) to, records within the **Attributes of cazip** table. In the next step we will join attributes from one table to the next so that the attributes all appear only within the **Attributes of cazip** table.

Click **Selection / Clear Selected Features** in the menubar then close both attribute tables.

6. Creating a table join

Right-click on the **cazip** name in the TOC then click **Joins and Relates / Join...** The **Join Data** dialog box appears.

Leave the top scroll box set at **Join attributes from a table**.

Under item **1**, scroll to, then click on **ZIP**.

Under item **2**, browse to, and add **ZIP_DATA.dbf**.

Under item **3** scroll to, then click on **ZIP**.

If you wish to read specific information about table joins, click on the **About joining data...** button.

Click the **OK** button.

To verify that the join was successful, right-click on the **cazip** name in the TOC, click **Joins and Relates** then move the mouse pointer over the name **Remove Join(s)**. You will notice the name **ZIP_DATA** appears as the join name. Click elsewhere on the map to close the menu.

Right-click on the **cazip** name in the TOC, then click **Open Attribute Table**.

In the table, use the horizontal scroll bar to move across the table, viewing the attribute names as you do so.

Notice the attribute names from the original table (**cazip**) include the layer name as the prefix to each of the attribute titles. Attributes that have been added from the joined table (**ZIP_DATA**) include that table's name as a prefix to each of the attribute titles.

Scroll vertically to view data brought in from the **ZIP_DATA.dbf** file. Many of the cells are empty because the **ZIP_DATA.dbf** file contains only a subset of zip codes for California.

Once joining (or relating) tables is successful, you can perform the selections and queries on joined or related items just as you had done with the attributes that came with the original GIS data files. ***This procedure, then, is a way to bring in outside tabular data (possibly representing research data that you have collected) and add those data to the layer attribute table for query purposes.***

End of Exercise 3

Exercise 4: Symbolizing GIS Data and Generating Map Output

In this exercise you will...

- Define custom symbology to display information spatially
- Save custom symbology to a *layer* file
- Define symbology to *mask* distracting information
- Generate a map of Orange County showing year 1990 housing values
- Download and incorporate GIS data from the Internet
- Export your map to a portable and viewable PDF file

1. ArcMap: Bring in some GIS data

Open **ArcMap** and start a new empty map.

Save the empty map document as **Orange County.mxd** within the **SaveHere** directory on your computer.

Change the **data frame** name to **Orange County** (View/Data Frame Properties/General).

Add GIS data from the following layers:

c:\apps\esri\esridata\county

dtl_cnty

c:\apps\esri\esridata\ca

Major Roads

Census Tracts

Zoom in to Orange County so that the county outline fills the map display.

Deactivate (i.e., un-check) all layers except for the **Census Tracts** layer.

Reposition the layers within the TOC into the following order:

dtl_cnty

Major Roads

Census Tracts

2. Develop the Census Tracts layer symbology

Open the Census Tracts **Symbology** tab (right-click on **Census Tracts** in the TOC to bring up the **Properties...** window then click on the **Symbology** tab).

Under **Show** (on the left side) click on **Quantities** then **Graduated Colors**.

Under **Fields/Value:** scroll to, then click on **MEDIAN_VAL** (it's about the 9th attribute from the bottom of the list). Leave **Normalization:** set at **<NONE>**.

Under **Classification** click the **Classify...** button.

Notice the histogram window (this is an *extremely* useful utility) which shows you where the classification breaks occur for the current classification *method* and number of *classes* (as defined under **Classification**). Within this window you can make manual modifications to the breaks by moving the mouse pointer over one of the vertical bars and dragging the bar left or right to define the desired break point. Notice that when you do this the Classification Method changes to **Manual** (which means the classification mechanism is now up to you and, at least for the current classification, is not necessarily according to some standard). To insert an additional break point, move the mouse pointer into the histogram window at the approximate location where you want the new break point then right-click the mouse and click the **Insert Break** button. You can then reposition the new break point bar as before.

Under **Classification / Method** scroll to, then click on **Defined Interval**. Once you do this, notice the **Classification / Interval Size**, the histogram window breaks points, and the **Break Values** (on the right side) are redefined to divisions of about 100,000.

In the **Break Values** window set each of the break values to be whole hundred-thousand units (except for 500001). The values in the window should look like this:

100000
200000
300000
400000
500001

Notice, again, when you make these changes that the **Classification / Method** changes to **Manual**.

Click the **OK** button. You are returned to the **Layer Properties** window.

Back in the **(Layer Properties) Symbology** tab, click **Symbol** (it's the menu button directly above the color boxes) then click **Flip Symbols** if necessary in order to get the most saturated color to appear at the top of the list of color boxes.

Click **Range** then click **Reverse Sorting** if necessary in order to get the largest numbers appearing at the top of the list.

Double-click on the color box next to the **0-100000** classification. The **Symbol Selector** window appears.

Under **Options** click the color box next to **Fill Color**. The color palette appears. Click on the lightest gray color. (If you hover the mouse pointer over the lightest gray box the text

“**Gray 10%**” appears.) Click the **OK** button. You are returned to the **Layer Properties** window.

You now have a valid set of symbols for the Median Value of homes and you could stop modifying the colors at this point. However, for this application, let’s define each of the color boxes.

Double-click on the color box next to **400,001 - 500,001**. In the **Symbol Selector** window, scroll down the list of colors and choose **Lt Orange**. Do the same for the other three colors:

300,001 - 400,000 Lake
200,001 - 300,000 Yellow
100,001 - 200,000 Med Green

Click **Label** then click **Format Labels**. The **Number Format** window appears.

Under **Category** click **Numeric**.

Under **Rounding** make sure the **Number of decimal places** radio button is selected then, in the scroll window, scroll to **0**.

Under **Alignment** leave the radio button selected on **Left**.

Check the **Show thousands separators** box, then click **OK**.


Back again in the **Layer Properties** window, click the **Apply** button. The changes you made to the Census Tracts symbology are applied to the TOC and to the Map Display.

Click the **OK** button.

Save your work as a new map document in the SaveHere directory.

3. Save the symbology for your Census Tracts layer

Right-click on **Census Tracts** layer within the TOC. In the layer menu, click on **Save As**

Layer File... In the **Save Layer** dialog box click the **Connect to Folder** button  then, in the **Connect to Folder** window, click on **SaveHere** then click the **OK** button. In the **Save Layer** window click the **Save** button. A copy of the **Census Tracts** layer file gets saved to the **SaveHere** directory.

Remember that this file (**Census Tracts.lyr**) is the skeleton layer file that contains symbology information and a pointer to the actual spatial data. So the specific GIS data that this layer file accesses is still on the hard drive of the computer.

We will do further work with this copy of the layer file in the next step when we look at ArcCatalog.


4. Optional: In ArcCatalog, view the saved Census Tract layer custom symbology

Reopen ArcCatalog and click the **Connect to Folder** button to connect to the **SaveHere** folder the same way you did with **ArcMap** in Step 3.

Open the **C:\SaveHere** folder then click on **Census Tracts.lyr** to open the layer file.

Click the **Preview** tab and you should see your new symbology for the Census Tracts displayed in the right window.

If ArcCatalog indicates it cannot access the data then do the following: Click to highlight the **Census Tracts** layer name under the **C:\SaveHere** folder. Then click **File / Properties**, then click the **Source** tab, then the **Set Data Source...** button. Navigate to, and click on **c:\apps\esri\esri\data\ca** then click on **catrct.shp**. Click on the **Add** button then the **OK** button. Following this procedure should reconnect the layer file within the **SaveHere** folder with the census tracts data file on the disk. Though this operation is not likely to be necessary in this exercise, the procedure defined in this paragraph could be useful to you in the future should such a disconnect occur.

Use the **Zoom In**, **Zoom Out** and **Pan** tools as necessary to center Orange County within the display. Then click the **Create Thumbnail** button  to create a thumbnail image of your layer.

Click the **Contents** tab to view the new thumbnail image for your **Census Tracts** layer.

5. Change the symbology for the Major Roads layer

In **ArcMap**, activate the **Major Roads** layer.

In the TOC, double-click on the light gray line next to **Ramps**. The **Symbol Selector** window appears.

Click the color box next to **Options / Color** then click **No Color**, then click the **OK** button.

This is done to make the freeway ramps, which are non-essential at the scale we are using, invisible.

Do the same for the gray line next to the **Local Roads** (i.e., set it to **No Color**).

Double-click on the orange line next to **Highway** to bring up the **Symbol Selector** for highways. Under **Options / Width** click the down-arrow once so that "2" appears in the window next to **Width**. Click the **OK** button.

This will reduce the size of the highway symbols so that they do not obscure the essential underlying map information (from the Census Tracts layer).

Do the same for the line next to **Limited Access Highway** (i.e., set the width to **2**). Close the **Symbol Selector** window by clicking the **OK** button.

In the TOC, right-click on **Major Roads** then click **Label Features** to deactivate the highway symbols.

For some maps, particularly where roads are a focus of the map, the highway symbols should be included. For this map the highway symbols would be a distraction to the map's theme, hence we turn them off.

6. Change the counties surrounding Orange County to gray

Activate the **dtl_cnty** layer. In the Map Display this layer now obscures the other two lower layers, but we'll fix that in a moment.

Using the **Symbol Selector** as you've done before, change the **dtl_cnty** layer **Fill Color** to **Gray 10%**. Also, while in that window, set the **Outline Width** to **"2"**, and the **Outline Color** to **Gray 60%**.

In this next step we are going to apply a filter (via attribute selection) that will expose the underlying data layers. To do this we will select, and display, all the counties that are not "Orange County". As a result, the **dtl_cnty** layer will be colored gray for all counties except for Orange County which will be, essentially, transparent.

In the TOC, right-click on the **dtl_cnty** layer name. Then click on **Properties...** In the **Layer Properties** window click the **Definition Query** tab then click the **Query Builder...** button. The **Query Builder** window appears.

Each county in California (and the U.S. for that matter) has a **FIPS** (Federal Information Processing Standards) **code** that is a unique identifier for the county. Orange County's FIPS code is 059.

In the **Fields** window double click on **"CNTY_FIPS"**. The text "CNTY_FIPS" will appear in the window if your double-clicking was successful. Make sure that the text appears in that window. Then click the '< >' button.

Click the **Complete List** button under **Unique sample values**. Within the **Unique sample values** window scroll to **'059'** and double-click on that number. In the window, the resulting expression should look like this:

```
"CNTY_FIPS" <> '059'
```

Click the **OK** button to close the **Query Builder** window. You are returned to the **Layer Properties** window. Click the **OK** button to close the **Layer Properties** window.

You should now see map information for Orange County with the surrounding counties (Los Angeles, San Bernardino, Riverside and San Diego Counties) obscured with a gray mask yet delineated with a bold gray line.

7. Add the Pacific Ocean color background

Click **View/Data Frame Properties...** then click the **Frame** tab.

Click on the white space under **Background** then click the **Lt Blue** color box. A light blue box should fill the **Background** box. Click the **OK** button.

The area offshore from Orange County is now colored with a light blue pattern. At this stage of the map building process you are finished with symbolizing your data layers.

Save your work.

8. Begin map construction using the Layout View

Click **View / Layout View** (or the tiny “page” icon at the lower left corner of the Map Display). ArcMap’s **Layout View** is displayed.

The **Layout View** is where you proceed with the construction of your map by customizing the map’s design (or layout). Within the Layout View, you can choose to work with a “**portrait**” or “**landscape**” formatted map and a map that is of any standard (as well as custom) map size. For this exercise we will construct a “landscape-formatted” map, in order to explore some text rotating features. The map will also be 11” x 8.5”.

Click **File / Page Setup** then click **Landscape** under **Printer Setup**. Click the **OK** button. The map converts to a landscape format.

When you do this, the map might not occupy most of the page. If so, click on the map once to cause the eight cyan-colored boxes to appear around the map. Then reposition the map within the page as necessary by dragging on individual cyan boxes with the mouse pointer.

Use the **Pan**, **Zoom In** and **Zoom Out** tools, from the **Tools** toolbar, as necessary to center and maximize Orange County within the map page.

Remember, all of the tools available in the **Data View** are available to you in the **Layout View**.

9. Add the Census Tracts legend to the map and modify its display

Click **Insert / Legend**. The **Legend Wizard** appears.

Under **Legend Items** click **dtl_cnty** then click the ‘<’ button. Doing this will cause the legend for **dtl_cnty** not to appear on the map page.

Do the same for the **Major Roads** layer while the **Legend Wizard** is open.

Click the **Next** button.

Change the **Legend Title** to read **Median Value**.

Change **Size** to **18**.

Change **Font** to **Arial**.

Depress the “**B**” (bold) button.


Under **Title Justification** click the “center” button.

Click the **Preview** button then click the **Finish** button.

You now have a legend for the Census Tracts layer that resides in the middle of the map. We will perform some edits on the legend.

Drag the legend to the upper right corner of the map so that it fits within the gray area of the map (over Riverside County).

10. Optional: Edit the Census Tracts legend

Using the **Layout** toolbar custom **Zoom In** tool  (not the standard **Zoom In** tool), zoom in to the new legend.

Change the mouse pointer to the arrowhead then click on the Census Tracts (specifically Median Values) legend once or twice until it is selected. A cyan dashed-line box envelopes the legend and cyan markers appear at the four corners around the legend.

Right-click inside the legend. A menu appears. Notice the **Ungroup** menu item is grayed-out.

Click **Convert To Graphics**.

Right-click inside the legend again to bring up the menu and click **Ungroup**. When you do this you will see the cyan box disappears and green dashed-line boxes appear around each of the graphics that comprise the legend.

Click anywhere outside the boxes to de-select them all.

Click on **MEDIAN_VAL**. While **MEDIAN_VAL** is highlighted with the cyan box press the **Delete** key on the keyboard. (Alternatively, you could right-click on **MEDIAN_VAL** and, in the menu that appears, click **Delete**.)

Click on the lowermost legend box that contains the text **“0 - 100,000.00”** then press the **Delete** button on the keyboard to remove that line from the legend.

Click on one of the legend items to select it then hold down the **Shift** key and click-select the other three items.


Right-click on one of the selected items then click **Group** in the menu. All of the legend items are now contained within a single group.

Select the text **“Median Value”** and reposition it over the legend items.

Shift-click the legend items so that both the **Median Value** text and the legend items are highlighted.

Right-click inside one of the highlighted boxes then click **Align / Align Center**. The **“Median Value”** text is now centered over the legend items.

With the legend items and title still selected, right-click inside a highlighted box then click **Group** in order to group the title with the legend items.

Now that the legend edits are completed, press the **Zoom Whole Page** button  (in the **Layout** toolbar) to view of the entire map.

11. Optional: Add “Pacific Ocean” text

Within the **Draw** toolbar (most likely residing at the base of ArcMap) click on the dropdown arrow to the right of the **“A” (New Text)** character. Click the **New Splined Text** button.

In the **Font** window (in the middle of the **Draw** toolbar) scroll to and click on **Times New Roman**. In the **Font Size** window select **26**.

Move the cursor into the map and, within the area of the ocean, create a curving line from the northwest to the southeast. To do this, click once to the northwest, move the mouse down then click in the middle of the ocean, then move the pointer down again – forming a curving line – then double-click. A text box opens.

Type the words **“Pacific”** and **“Ocean”** with single spaces between each character and three or four spaces between **“P a c i f i c”** and **“O c e a n”**. Press the **Enter** key to close the text window. Select and drag the text into an appealing location within the ocean part of the map.

12. Add a north arrow

Click **Insert / North Arrow...** then choose a north arrow, click on it, then click the **OK** button. The chosen north arrow will appear in the middle of the map page.

With the mouse pointer, drag the north arrow to the lower left portion of the map page.

You can grab and pull one of the corners of the north arrow graphic if you want to change its size.

13. Optional: Add a scale bar

A good thing to do cartographically is to include a scale bar on the map. But for this size map (8.5" x 11") the scale bar might be overwhelming. If you choose you can add a scale bar via **Insert / Scale Bar...** On larger maps a scale bar is quite appropriate and, in some cases where relative distances will be made, the scale bar is a necessary addition.

14. Add a title to the map

Click **Insert / Title**. A text box appears, probably with the name of your map document.

Within the text box, type **Orange County Housing Values in 1990** then press the **Enter** key.

If the title box becomes de-selected, left-click on the title box to select it, then right-click on the title box and choose **Properties...** from the window that appears. Within the **Properties** window you can edit the text that appears in the title box. Assuming no changes are necessary, close the **Properties** window.

With the title text box highlighted, change the **Font** in the **Draw** toolbar to **Arial** and the **Font Size** to **26**.

Click the dropdown arrow to the right of the **Font Color** (it appears as an "A") and choose a dark green color from the color palette.

Right-click the **Orange County Housing Values in 1990** text then, in the menu, choose **Rotate or Flip / Rotate Right**.

Drag the text to the right side of the map page. While the text is still selected, shift-click the map so that both the map and title are selected. Right-click inside the map page then click on **Align / Align Vertical Center**. The text should then be centered over the right side of the map.

Save Your Work.

15. Optional: Group the graphics and add a neatline around the map

Select the title then, in turn, shift-click (to select) the map page, the legend, the Pacific Ocean text, and the north arrow.

Right-click inside the map page then click **Group** in the menu.

All of the graphic features are now contained within one group that can be moved as a unit.

Click on the map with the mouse to select it then drag it left a little so that the map and title are centered on the page left-to-right.

Click **Insert / Neatline...** The **Neatline** window appears.

Under **Placement** click the button **Place around all elements**.

Click inside the **Border** window. A graphical list of border options appears.

Click on the border type **Triple, Graded** then click the **OK** button. A neatline border is drawn around the map and title. This concludes the map construction for this exercise. **Save Your Work.**

16. Download GIS Data from the Geography Network

Open **ArcMap** with your **Orange County** data frame active.

Click on **File / Add Data from Geography Network...** An Internet connection is made to ESRI's **Geography Network** where you can access free and for-fee GIS data.

In the text box under **DEFINE SEARCH AREA** type **California** then click the **GO** button.


In the list that appears, click on **California, State, United States**. Within the map on the left a frame will be created around California.

Under **DEFINE SEARCH CRITERIA / Data Theme** scroll to, then select, **Topographic Data**, then click the **Search** button. A list of sources of topographic data for California appears with thumbnail sample images of the data.

Scroll to the bottom of the list to the U.S. Geological Survey's National Elevation Dataset then click the **Add to ArcMap** button. A group of shaded relief data files will be downloaded from the data provider's web site and loaded into ArcMap (as a data group) including a new listing in the TOC for the data files.

Move the entire shaded relief data group above the other GIS data layers that you brought in during the previous exercise. When the shaded relief file finishes drawing the underlying layers will be obscured.

Open the **Effects** toolbar. In the **Layer** window scroll to, then select the name of the shaded relief layer.

Click the **Adjust Transparency**  button. Drag the scroll bar handle up to the middle of the scroll bar, then release it and (this is where it gets fun) watch the map display. Experiment with various settings of the scroll bar handle to determine what position (and transparency percentage) provides a good view of your data with the overlapping display of shaded relief.

17. Export (or Print) to an Adobe PDF file

Click **File / Export Map...** The **Export** dialog box appears.

Under **Save in** scroll to, then pick, **SaveHere**.

Under **Save as type** scroll to, then pick, **PDF (*.pdf)**.

Under **File name**, type a file name then click **Export**. A PDF file of your map will be created in the **SaveHere** directory.

18. View the PDF file using Adobe Acrobat

Open the Microsoft **Windows Explorer**, navigate to the **SaveHere** directory, then double-click on the **Adobe** icon next to the name of your PDF file. **Acrobat Reader** will open and display your map.

Before the end of class copy your PDF file to your floppy disk. Back at your office you can print the map directly to a printer by opening the PDF file within **Acrobat Reader** then, at the top of **Acrobat Reader**, choosing **File / Print**.

End of Exercise 4

Exercise 4: Working with ArcCatalog: Data Management and Metadata


In this exercise you will...

- Explore the components of ArcCatalog: Viewing spatial and attribute data and metadata
- Download and incorporate GIS data from the Internet
- Relate and join an external table to a feature layer's attribute table

1. Open ArcCatalog

Go to **Start/Programs/ESRI/ArcGIS** and click on **ArcCatalog**. (Note: on your office computer you might go to **Start/Programs/ArcGIS** then **ArcCatalog**.)


2. View Spatial Data

Click on the **Connect to Folder** icon . The **Connect to Folder** dialog box appears.

Navigate to **c:\apps\esri\esridata** and click on **esridata** so that "**c:\apps\esri\esridata**" appears in the window at the top of the small window in the dialog box. Click the **OK** button.

Notice a new listing for **c:\apps\esri\esridata** appears in the folder window on the left side of ArcCatalog.

Click the **+** button to the left of **c:\apps\esri\esridata** then click the **+** button to the left of **ca**. Notice the list of GIS data files available within the **ca** (California) folder.

Click once on "**ca**" to cause "**ca**" to be highlighted. On the right window of ArcCatalog make sure (by clicking) the **Contents** tab is active, then click the **Large Icons**  button.

In turn, click the **List** , then **Details** , then **Thumbnails**  buttons to view the various ways ArcCatalog will present information about GIS data files for you.

The **Thumbnails** button is particularly interesting because, at once, you can view simple graphical displays of all the GIS data that reside within one directory. A very handy tool!

In the folder listing, under the **ca** folder click once on **Census Tracts.lyr** to display a thumbnail view and other summary information about that layer.

Click the **Preview** tab to display a full view of the GIS data for the **Census Tracts**.

Using **Preview**, you have access to the **Zoom In**, **Zoom Out**, **Pan**, **Full Extent**, and **Identify** tools and buttons like you used in ArcMap.


3. View the saved Census Tract layer with your new custom symbology

Click the **Connect to Folder** button to connect to the **SaveHere** folder the same way you did with **ArcMap** in Exercise 3, Step 3.

Open the **C:\SaveHere** folder then click on **Census Tracts.lyr** to open the layer file.

Click the **Preview** tab and you should see your new symbology for the Census Tracts displayed in the right window.

If ArcCatalog indicates it cannot access the data then do the following: Click to highlight the **Census Tracts** layer name under the **C:\SaveHere** folder. Then click **File / Properties**, then click the **Source** tab, then the **Set Data Source...** button. Navigate to, and click on **c:\apps\esri\esri\data\ca** then click on **catrct.shp**. Click on the **Add** button then the **OK** button. Following this procedure should reconnect the layer file within the **SaveHere** folder with the census tracts data file on the disk. Though this operation is not likely to be necessary in this exercise, the procedure defined in this paragraph could be useful to you in the future should such a disconnect occur.

Use the **Zoom In**, **Zoom Out** and **Pan** tools as necessary to center Orange County within the display. Then click the **Create Thumbnail** button  to create a thumbnail image of your layer.

Click the **Contents** tab to view the new thumbnail image for your **Census Tracts** layer.

4. View Tabular Data

Click the **Preview** tab. In the **Preview:** scroll box, at the bottom of the **Preview** window, scroll to and select **Table** (you won't have to scroll far).

The attribute table for the **Census Tracts** layer is displayed. The table looks the same as the table you viewed within ArcMap. However all of the *selections* functionality that you worked with in ArcMap is not available in ArcCatalog's version of the table view. As a result, you can only display all the records, not a selected set of records.

5. View Metadata

Click on the **catrct** layer in the folders listing window, then click the **Metadata** tab in the data viewing window. Here you will see information that someone has stored in reference to the **catrct** layer.

Click on the ***Spatial*** and then the ***Attributes*** tabs to view specific information about the geographic and the database sides of the GIS data.

In the ***Stylesheet*** scrolling window, located sort of in the middle of ArcCatalog, scroll to and select ***FGDC*** and then ***Geography Network***.

Each stylesheet displays the same basic information though in different formats, and some stylesheets display more information than others. Sometimes finding specific metadata about a layer requires some digging. Occasionally switching to a different stylesheet can help bring forward the desired information.

6. Download GIS Data from the Geography Network

Open ***ArcMap*** with your ***Orange County*** data frame active.

Click on ***File / Add Data from Geography Network...*** An Internet connection is made to ESRI's ***Geography Network*** where you can access free and for-fee GIS data.

In the text box under ***DEFINE SEARCH AREA*** type ***California*** then click the ***GO*** button.


In the list that appears, click on ***California, State, United States***. Within the map on the left a frame will be created around California.

Under ***DEFINE SEARCH CRITERIA / Data Theme*** scroll to, then select, ***Topographic Data***, then click the ***Search*** button. A list of sources of topographic data for California appears with thumbnail sample images of the data.

Scroll to the bottom of the list to the U.S. Geological Survey's National Elevation Dataset then click the ***Add to ArcMap*** button. A group of shaded relief data files will be downloaded from the data provider's web site and loaded into ArcMap (as a data group) including a new listing in the TOC for the data files.

Move the entire shaded relief data group above the other GIS data layers that you brought in during the previous exercise. When the shaded relief file finishes drawing the underlying layers will be obscured.

Open the ***Effects*** toolbar. In the ***Layer*** window scroll to, then select the name of the shaded relief layer.

Click the ***Adjust Transparency***  button. Drag the scroll bar handle up to the middle of the scroll bar, then release it and (this is where it gets fun) watch the map display. Experiment with various settings of the scroll bar handle to determine what position (and transparency percentage) provides a good view of your data with the overlapping display of shaded relief.

7. Creating a table relate

Continuing in **ArcMap**, switch to **Data View (View/DataView)** then insert a new data frame (**Insert / Data Frame**).

Add the **cazip.shp** data file to the new data frame.

Right-click on the **cazip** name in the TOC then, in the layer menu that appears, click **Joins and Relates / Relate...** The **Relate** dialog box appears.

In the **Relate** dialog box, under item **1**, scroll to, then click on **ZIP**.

ZIP is the name of the **cazip** attribute table field that contains Zip Code numbers.

Under item **2**, click the folder browse button  at which point the **Add** dialog box appears.

Click the **Connect to Folder** button, then click on **c:\SaveHere** then click the **OK** button.

Double-click on **c:\SaveHere** to open the folder then click **ZIP_DATA.dbf** then click the **Add** button. The text **ZIP_DATA** is added to the window box under item 2.

Under item **3** scroll to, then click on **ZIP**.

Under item 4 change the relate name to **Zip1**.

For a fine discourse on what we are doing here, click on the **About relating data...** button.

Click the **OK** button.

To verify that the relate has been established, right-click again on the **cazip** name in the TOC, click **Joins and Relates** then just move the mouse pointer over the name **Remove Relate(s)**. You will notice the name **Zip1** appears as an active relate name.

During project work you could have multiple relates active and those relates' names will be listed here.

Click elsewhere on the map to close the menu.

At the base of the TOC click, to activate, the **Source** tab. Notice the only listing within the active Data Frame is the **cazip** layer. Back to this in a moment.

Right-click on the **cazip** name in the TOC, then click **Open Attribute Table**.

In the **Attributes of cazip** table click the **Options** button then click **Related Tables / Zip1: ZIP_DATA**. The **Attributes of ZIP_DATA** table opens (initially it might be

obscured by the **Attributes of cazip** table) and a new entry is made within the active Data Frame for the **ZIP_DATA** table. Notice how different the **ZIP_DATA** icon appears from other GIS data layers you have viewed.

Click the **Display** tab at the base of the TOC and you will see that the **ZIP_DATA** entry is not listed there. The **ZIP_DATA** file is a table, not spatial data, hence it does not appear as a layer within the **Display** tab.

Manually select several records in the **ZIP_DATA** attribute table (they should turn cyan).

Click the **Options** button within the **Attributes of ZIP_DATA** table then click **Related Tables / Zip1: cazip**.

The records you selected in the **Attributes of ZIP_DATA** table have an associated (*related*) set of records in the **Attributes of cazip** table. Those records are now selected (click the **Selected** button in the **Attributes of cazip** table to view them) as are the associated Zip Code features in the map.

In the preceding scenario, records within the **Attributes of ZIP_CODE** table are *related* to, but not *attached* (or joined) to, records within the **Attributes of cazip** table. In the next step we will join attributes from one table to the next so that the attributes all appear only within the **Attributes of cazip** table.

Click **Selection / Clear Selected Features** in the menubar then close both attribute tables.

8. Creating a table join

Right-click on the **cazip** name in the TOC then click **Joins and Relates / Join...** The **Join Data** dialog box appears.

Leave the top scroll box set at **Join attributes from a table**.

Under item **1**, scroll to, then click on **ZIP**.

Under item **2**, browse to, and add **ZIP_DATA.dbf**.

Under item **3** scroll to, then click on **ZIP**.

If you wish to read specific information about table joins, click on the **About joining data...** button.

Click the **OK** button.

To verify that the join was successful, right-click on the **cazip** name in the TOC, click **Joins and Relates** then move the mouse pointer over the name **Remove Join(s)**. You

will notice the name **ZIP_DATA** appears as the join name. Click elsewhere on the map to close the menu.

Right-click on the **cazip** name in the TOC, then click **Open Attribute Table**.

In the table, use the horizontal scroll bar to move across the table, viewing the attribute names as you do so.

Notice the attribute names from the original table (**cazip**) include the layer name as the prefix to each of the attribute titles. Attributes that have been added from the joined table (**ZIP_DATA**) include that table's name as a prefix to each of the attribute titles.

Scroll vertically to view data brought in from the **ZIP_DATA.dbf** file. Many of the cells are empty because the **ZIP_DATA.dbf** file contains only a subset of zip codes for California.

Once joining (or relating) tables is successful, you can perform the selections and queries on joined or related items just as you had done with the attributes that came with the original GIS data files. ***This procedure, then, is a way to bring in outside tabular data (possibly representing research data that you have collected) and add those data to the layer attribute table for query purposes.***

End of Exercise 4