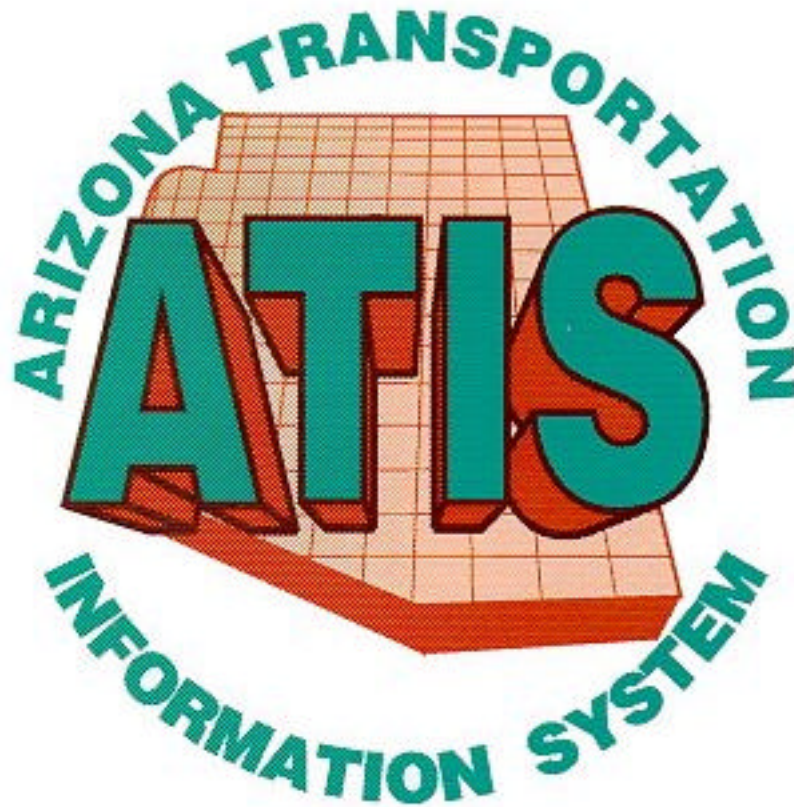


Introduction to GIS & ArcView 3.1

Developed by
The Arizona Department of Transportation
Transportation Planning Division



February 1999

Introduction to GIS & ArcView 3.1

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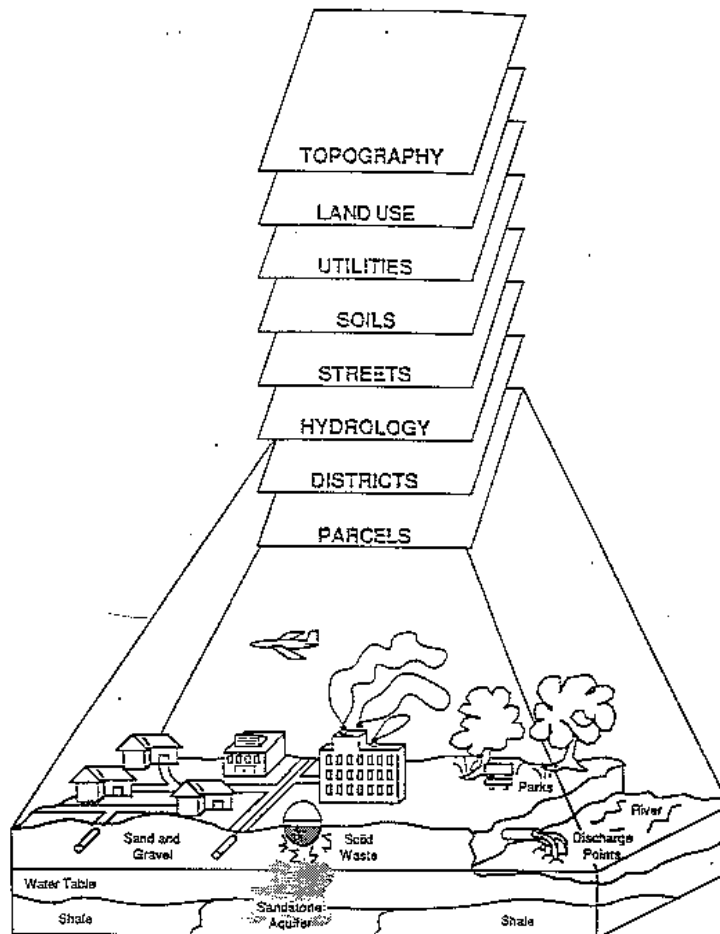
February 16, 1999

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What is Geographic Information System (GIS)?

- The study of people, places, things and their relationship to one another
- A computer based system to capture, store, edit, manipulate and display graphically referenced information
- GIS is about data:
 - Locating it
 - Maintaining it
 - Relating it to other data
 - Displaying it



The real world consists of many geographies

- **Leading GIS Companies:**

- MapInfo Corp.
- Intergraph Corp.
- PlanGraphics, Inc.
- Environmental Systems Research Institute (ESRI), Inc.

- **ESRI**

- ArcInfo®
- ArcView®
- PC ArcInfo
- ArcCad
- Et al

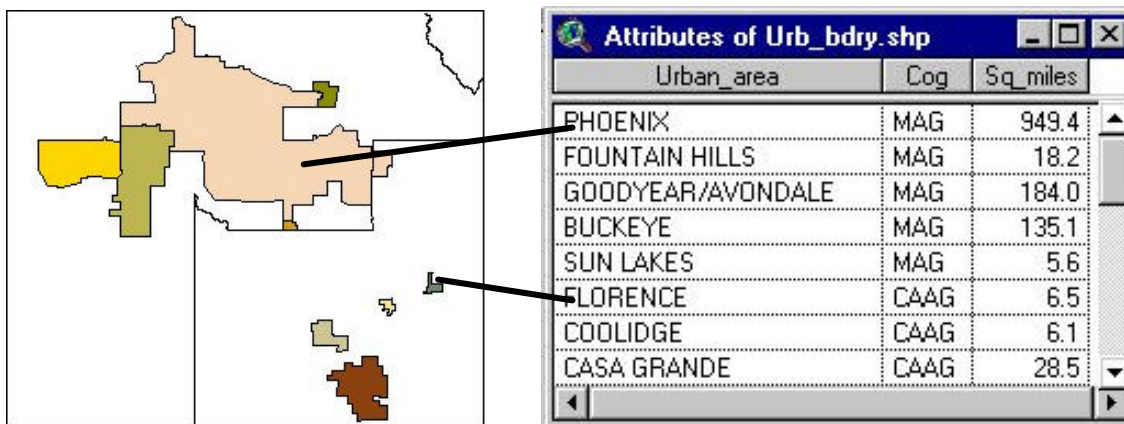
- **ArcView®:**

- Desktop GIS
- Easy to use graphical user interface (GUI)
- Tools for creating, editing, querying, analyzing, and viewing data
- Software comes with large amounts of data
- Operates on Windows, Macintosh, and Unix platforms
- Customizable with Avenue
- Extensions to digitize, project, use CAD images, et al

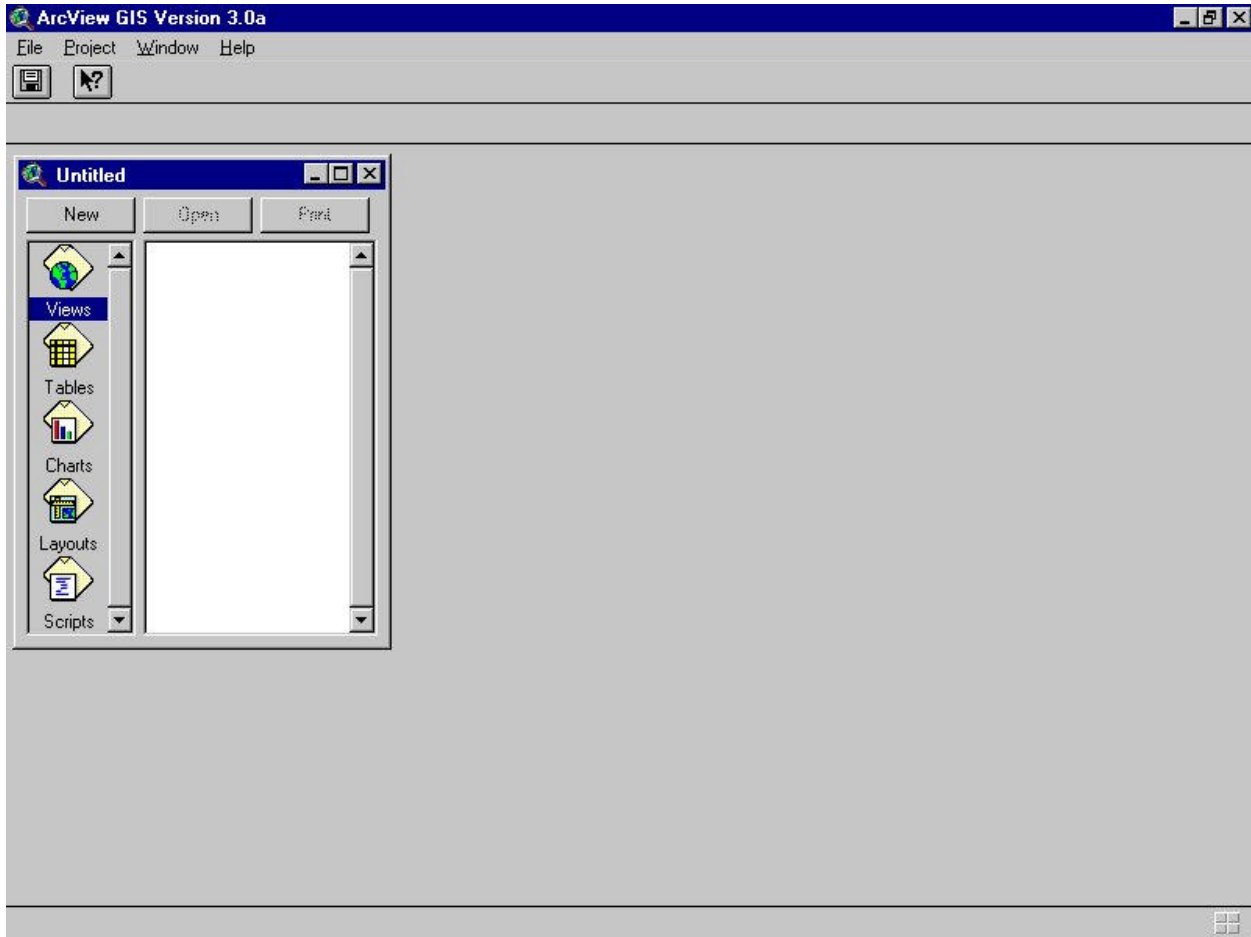
- **How ArcView® works:**

- Features on a map are linked to a table of attributes (database)
- Each feature has a unique record
- A set of features and attributes are called themes
- Themes can be queried, analyzed, mapped, and printed.

Urban Boundary Theme:



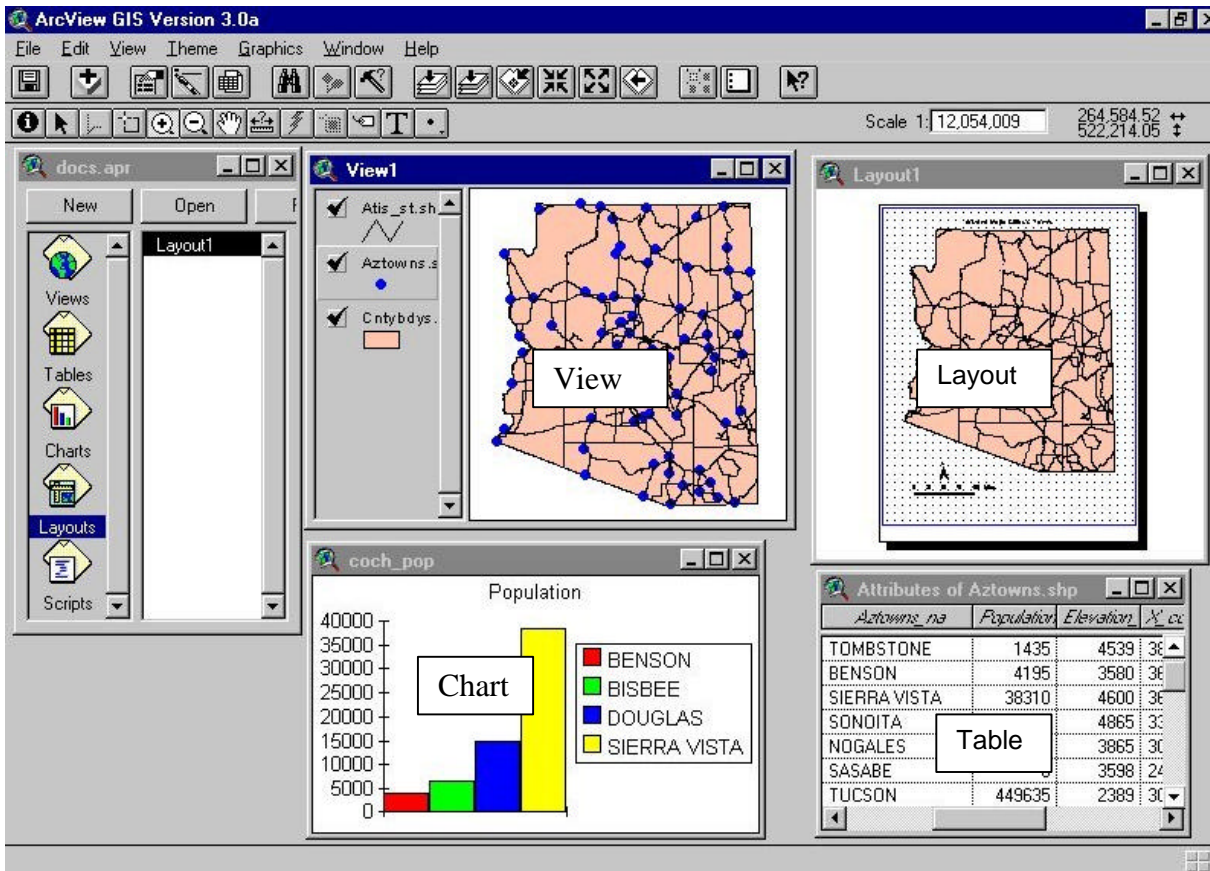
ArcView® Interface




- When you open ArcView®, you will see the ArcView® **Application** window.
- The **Application** window contains a basic Microsoft® Windows® type of menu and an ArcView® **Project** window.
- A **Project** window contains the names of various types of **Documents**.
- The image above, called a **Project**, has no documents listed because it is the default project, which is empty.
- As you add views, tables, charts, etc., you will give your project a unique file name so that you can be saved and called up again.
- A Project file is in ASCII format that can be view with any word processor.

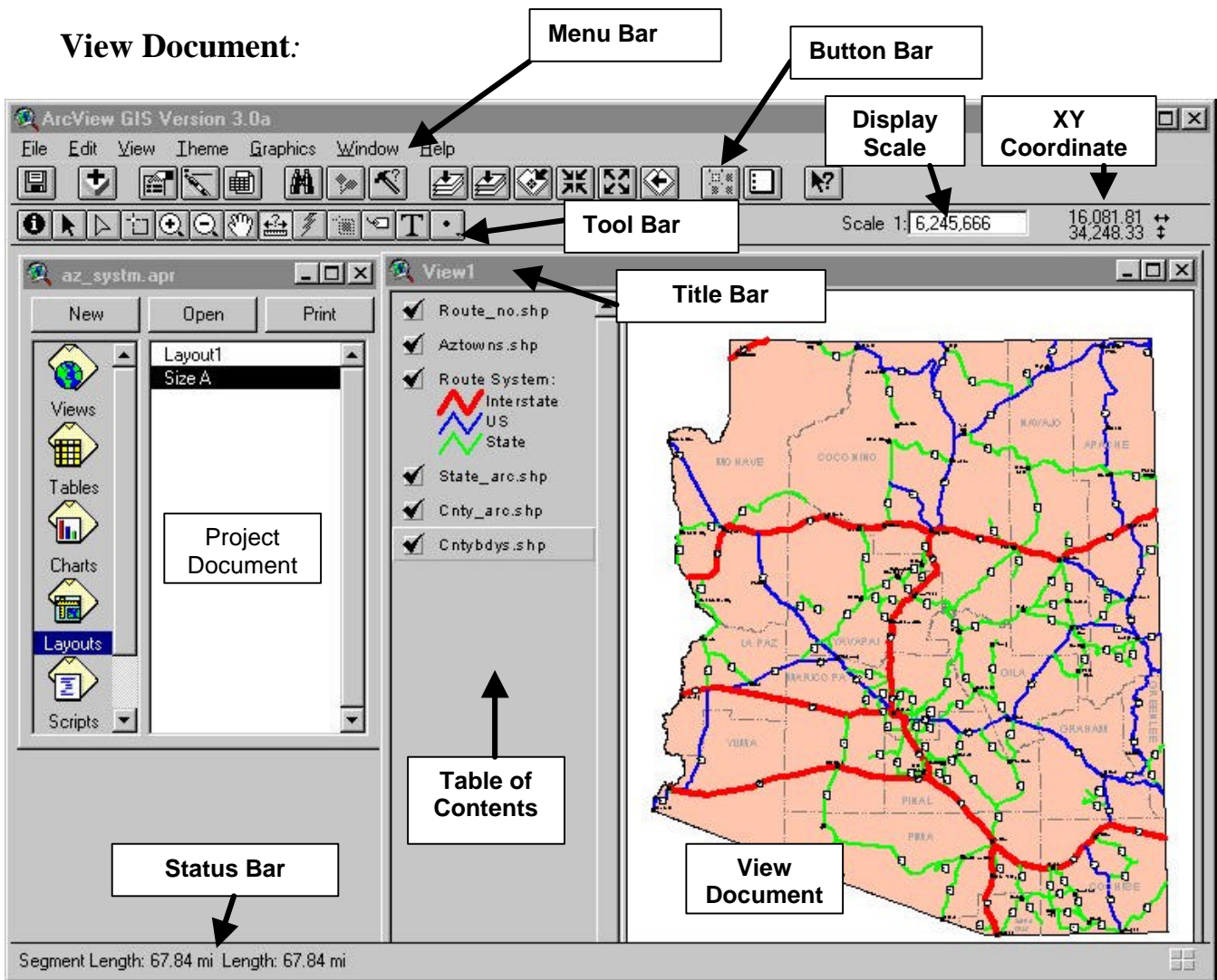
ArcView® Documents:

- There are five basic types of **Documents**:
 - Views:** Displays maps or images of spatial data
 - Tables:** Contains the attribute tables of views. May contain stand alone database tables.
 - Charts:** Lists charts created from any database table in the project.
 - Layouts:** Display images of views, charts, and tables that are to be printed.
 - Scripts:** Scripts are programs written in Avenue® to create custom applications or functions.



- Only one **Document** can be active at a time. The title bar of an active **Document** will appear raised and darkened.
- Each **Document** will have its own Graphical User Interface (**GUI**) with unique menu, button, and tool bars.
- Putting the cursor on an icon will provide a brief description of the icon's function.
- A detailed description of any icon can be displayed by selecting the Help icon  and selecting the desired icon.

View Document:



- Contains maps and other images.
- Has a unique GUI.
- Can be moved or resized.
- Can contain one or more themes.
- One, many, or no themes can be active at one time.
- Themes will draw in an order beginning with the bottom theme.
- Themes may be covered up by other themes if they are in the incorrect order.
- Themes may be turned off or on by clicking the checkmark box of the theme.
- In order to select or query features, the respective theme must be active (appears raised).
- Has a status bar at the bottom of the screen that provides information on measurements and on the status of long processes.

Exercise 1: Working with Views and Themes







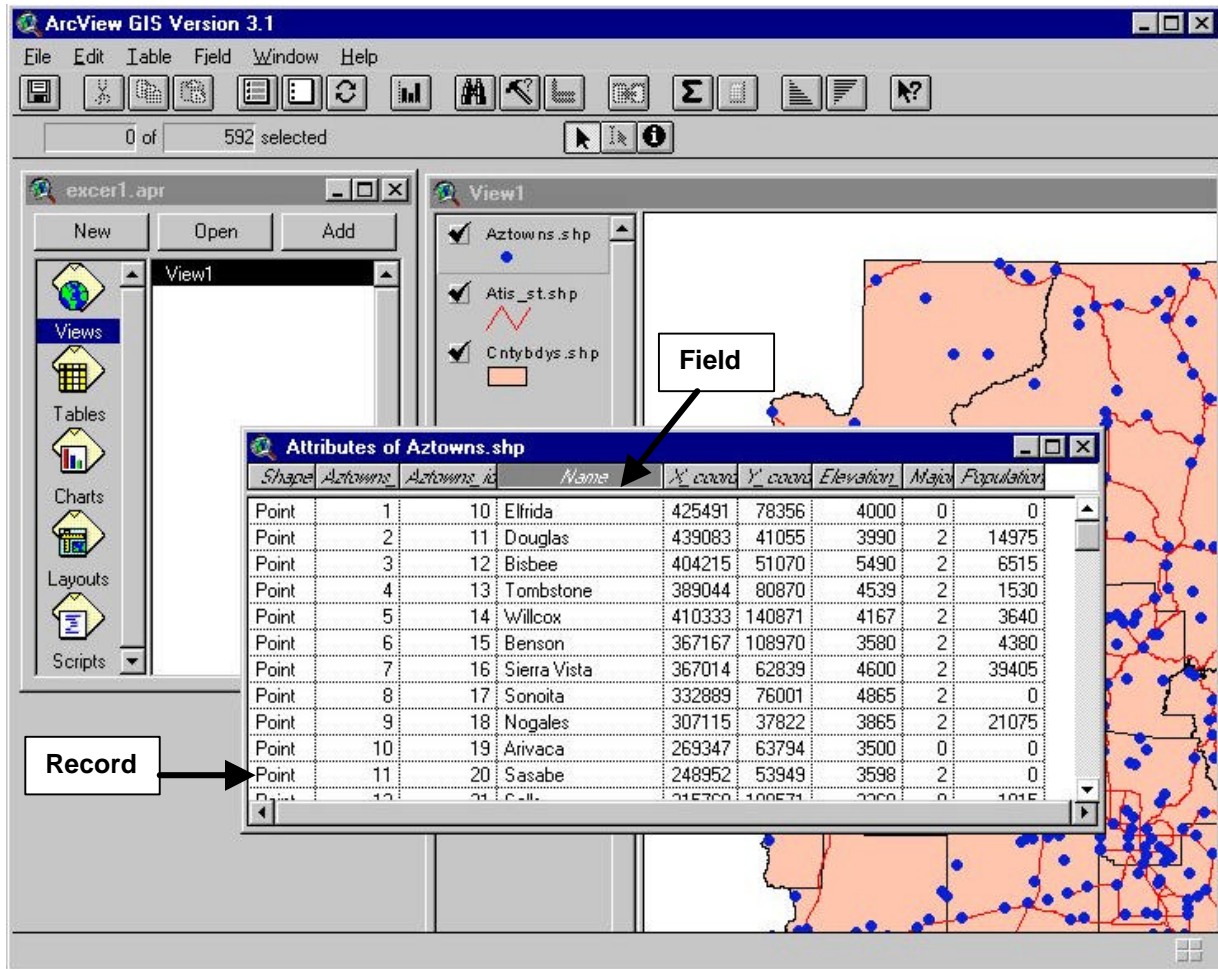





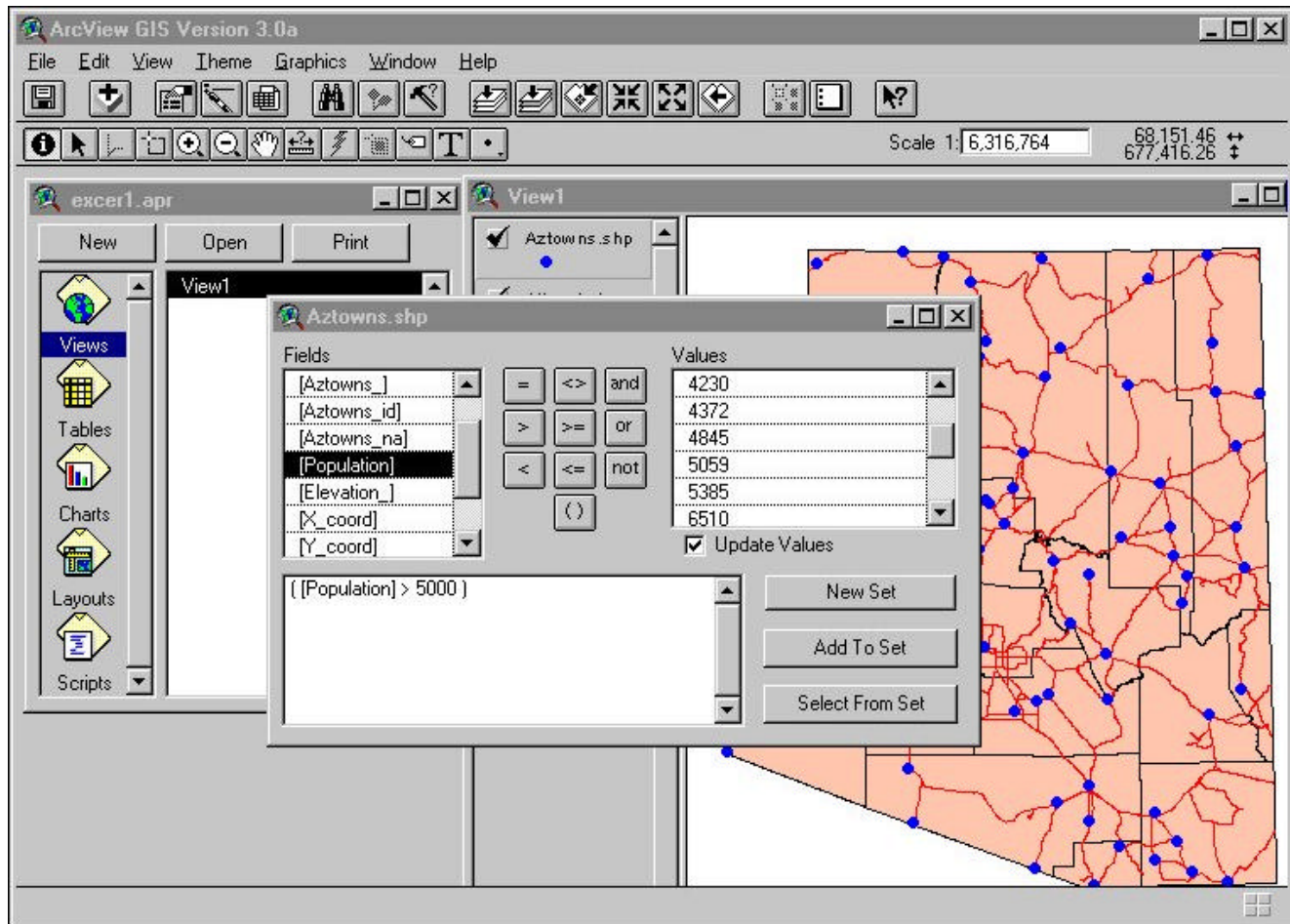
1. Open ArcView® by clicking the ArcView® icon or by clicking **Start**, point to **Programs**. Find the ESRI menu and click on **ArcView® GIS Version 3.1**.
2. From the file menu, select **Open Project**.
3. A dialog box will appear showing a sub-directory on the right and a list of project files, if any, on the left.
4. Move to the sub-directory called *c:\av_class\lessons*.
5. From the list of projects, select *excer1.apr*.
6. Resize and move the **Application** and **View** windows.
7. Make the **View** active; then make the **Project** window active. Compare **GUIs**.
8. Click on the **Help** button  and click several other buttons to see their function
9. Turn any theme off and back on again by clicking the **Check Box** .
10. Change the order of themes by dragging the themes up and down. Notice the effect.
11. Zoom in and out of the view using the **Button** bar icons . Use the **Help** button to see the zoom buttons' descriptions. Zoom in and out of the view using the **Tool** bar icons . What is the difference between using the **Button** bar and the **Tool** bar? Pan by using the Pan button .
12. While the cursor is in the **View** window, hold down the right mouse button. What's available?
13. Using the **Query** button  to query features of the various themes. Remember that the appropriate theme must be active.
14. Make the **Project** window active. Under the **File** menu, **Close** the file. Do not save the project.


Table Document:










- Contains the **Attributes** of a theme or other database table. A **Table** is not necessarily attached to a theme. It can be a stand-alone database such as a lookup table.
- Attribute tables are in a **dbf** format and can be edited with common software programs such as FoxPro, dBase and Excel.
- Opened by clicking the **Open Theme Table** icon  while in a **View** or by going to the **Theme Pull-down** menu and selecting **Table**.
- Each feature in a theme will have a **Record** and one or more **Fields**.
- You can select specific features by using the **Select Feature** tool  that allows you to select features graphically. The query builder  allows you to select features by building tabular expressions. Selected records or features will be yellow in color. Records can be added to the selected set by holding down the shift key.
- The **Promote** button  moves selected records to the top of the file to be easily viewed.
- ArcView® allows you to sort records by using the sort tools .
- Selected records can be used to create a new theme by going to the Theme pull down menu and clicking on **Convert to Shape File**.
- Attribute tables can be joined or linked to other tables based on a common Field.

Building Tabular Queries:

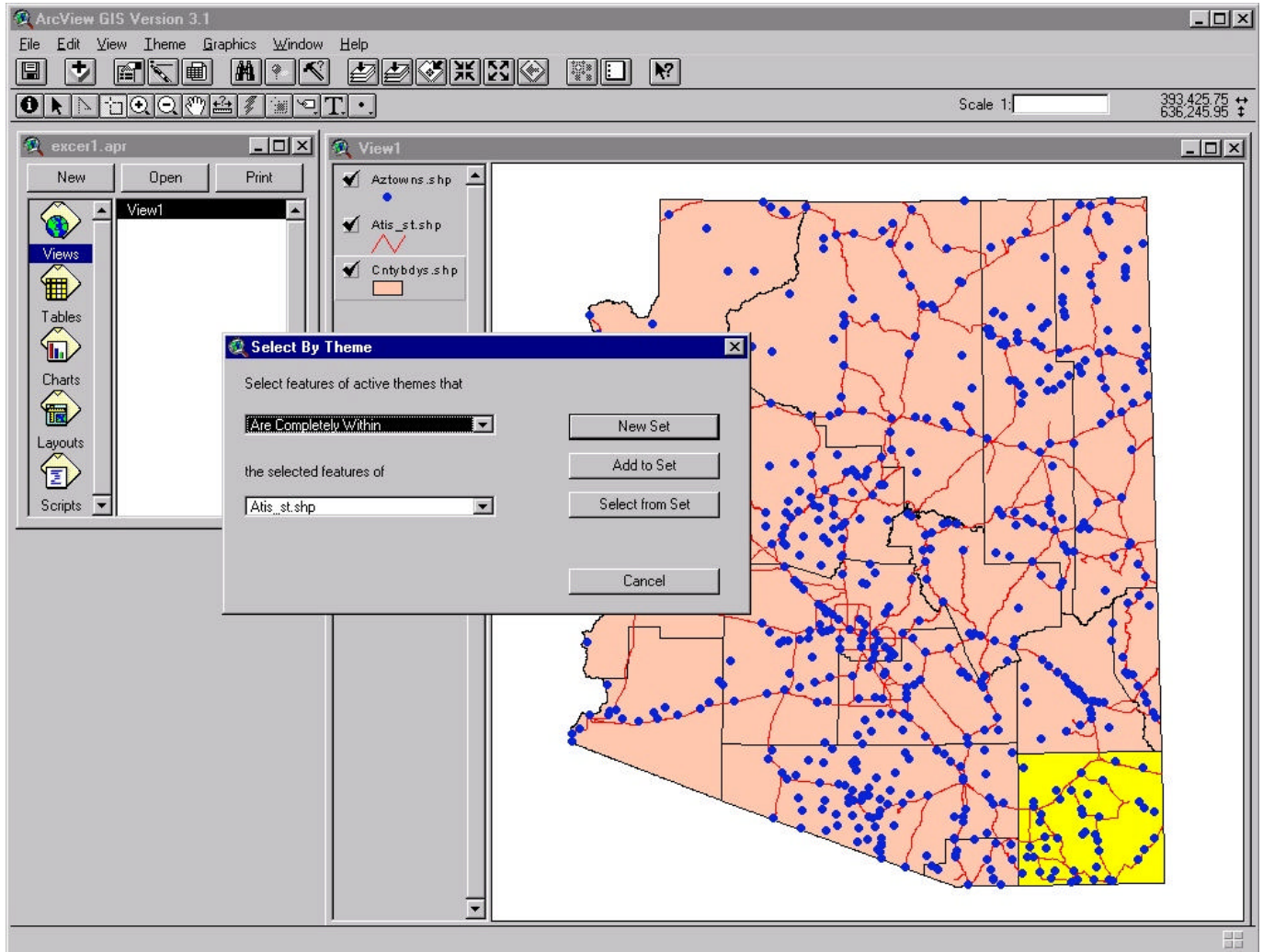


- **Tabular Queries** are created by selecting records from data in the **Attribute Table**.
- The **Query** window can be displayed by clicking the Query Builder button  or by going to the **Theme** pull-down menu and selecting **Query**.
- Expressions can be created by combining fields with mathematical operations and field values. Specific values may be typed in.
- Complex queries can be created by combining expressions. ArcView®'s query builder can be complicated when building complex expressions. Look under **Query Builder (Dialog Box)** in the **Help** menu for guidelines in building queries.
- Subsets of selected sets of data can be created by using the optional boxes in the Query window.
- Selected records can be saved to create a new Shape file or can be exported to a database or text file.

Exercise 2: ArcView® Tables




1. From the file pull-down menu, select **Open Project**.
2. If necessary, move to the sub-directory called **c:\av_class\lessons**.
3. From the list of projects, reselect exercise **excer1.apr**.
4. Make the View active and make the *aztowns.shp* theme active.
5. Click on the **Open Theme Table** icon .
6. Scroll through the list of field names and records.
7. Select the *name* field then sort it using the **Sort** buttons . Select the *population* field and sort the records in the two methods.
8. Select records from the attribute table by clicking any record. Hold down the shift key to select more than one record. Notice that as you highlight a record, the related feature in the View Window also turns yellow in color. Move or resize the attribute table if necessary to see the features in the View.
9. With records still selected, go to the button bar and experiment with the **Selection** icons . Use the **Help** button  to see their function.
10. Select all records using the appropriate icon. Make the *population* field active. Click on the **Field** pull-down menu and select the *Statistics* option. Notice the various statistical values. Note the total population.
11. Unselect all records and close the attribute table. Make the View and the Aztowns.shp shape file active.
12. Using the Select button , select several records from the Aztowns theme. Hold down and drag the left mouse button, creating a box, to select several records. Hold down the shift key to pick additional towns. Bring up the file attribute table and prompt the selected file to the top using the Prompt button . Unselect all records.
13. Click on the Query builder button . Select records that have a population greater than 5,000. Open the attribute table and prompt the selected records to the top.
14. Select the *population* field. Click on the **Field** pull-down menu and select the *Statistics* option. Compare the total population with the total population found in step 10.
15. Make the **View** active. Go to the **Theme** pull-down menu and select *Convert to Shape File*. Save the selected records to *c:\av_class\lessons\Major.shp*. If a “major.shp” shape file already exists, overwrite it or give it a different name. Click on *Yes* to add the *major.shp* theme to the view. Turn off the *aztowns* theme and turn on the *major* theme.

Building Spatial Queries:

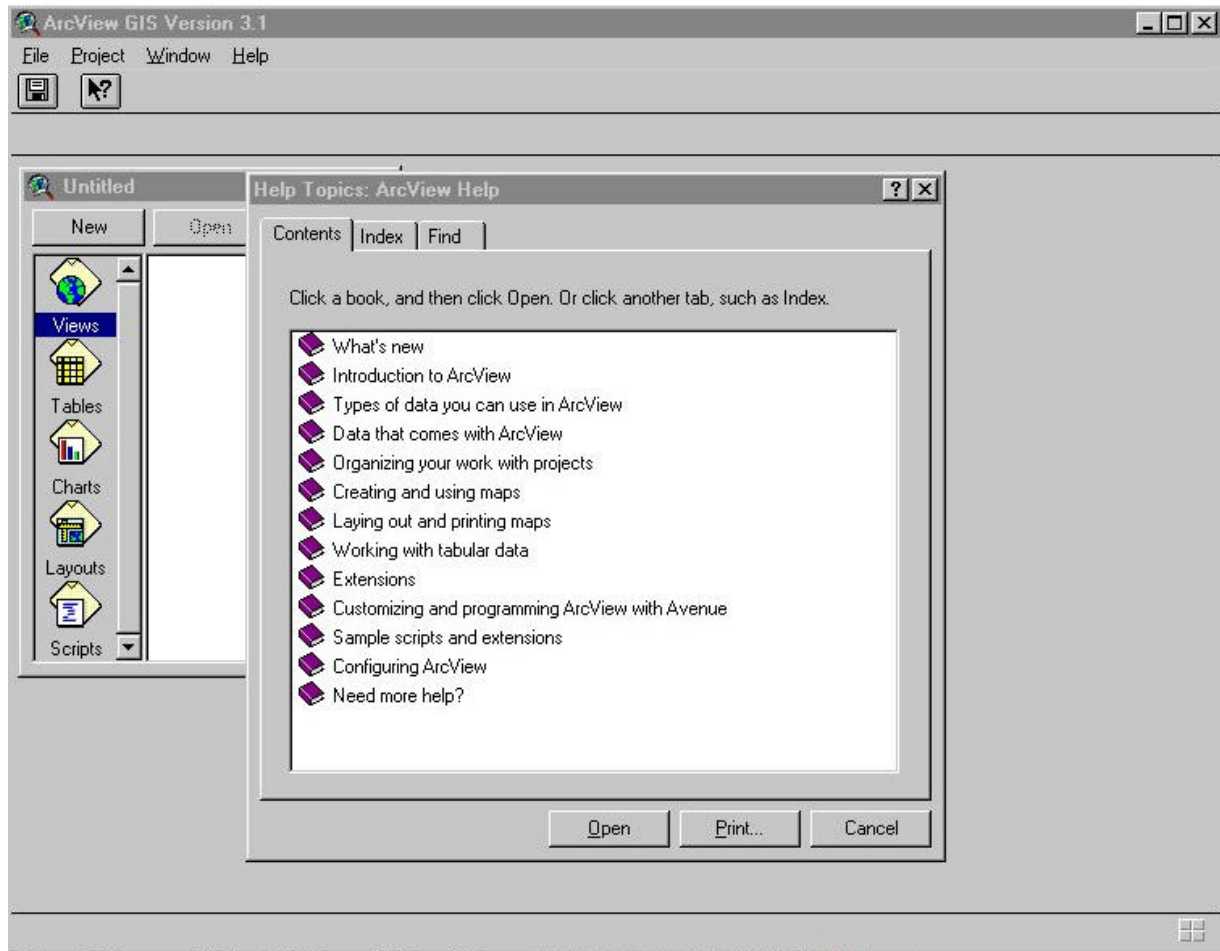



- **Spatial Queries** are created by selecting features based on their relationship to other themes or features.
- A selector theme must first be picked. This can be the same theme that you are selecting from or a separate theme.
- In the above example one county was selected from the active them. The theme containing the desired features must then be made active.
- The **Select By Theme** menu item is selected from the Theme pull down menu
- Various types of selection options exist:
 - Are Completely Within
 - Completely Contain
 - Have their Center In
 - Contain the Center Of
 - Intersect
 - Are Within Distance Of
- Selected records can be saved to create a new Shape file or can be exported to a database or text file.

Exercise 2a: Spatial Queries

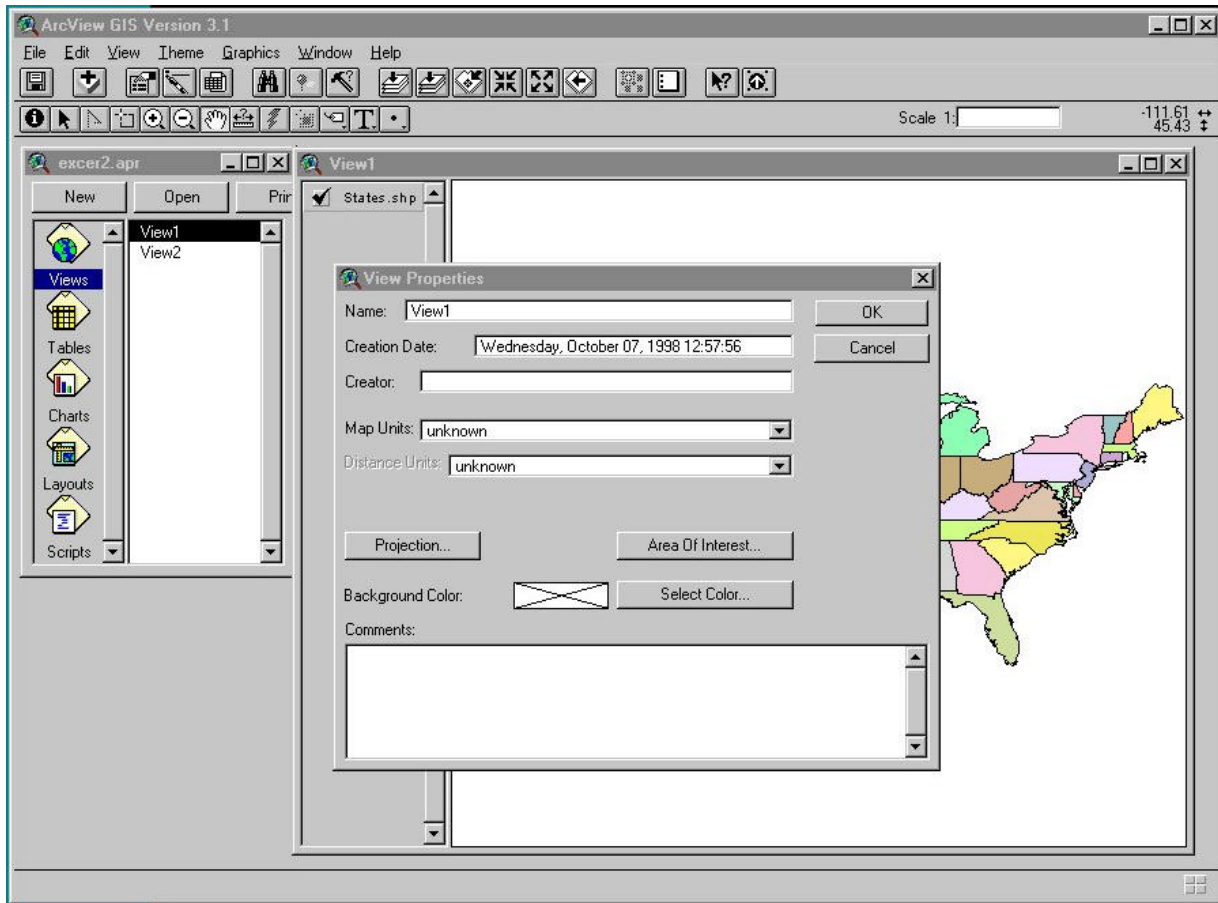
1. From the file pull-down menu, select **Open Project**.
2. If necessary, move to the sub-directory called **c:\av_class\lessons**.
3. From the list of projects, reselect exercise **excer1.apr**.
4. Make the View active and make the *Cntybdys.shp* theme active.
5. Select any county or a number of counties using the selection tool  or by using the tabular query tool .
6. Make the *aztowns.shp* theme active.
7. Go to the **Theme** pull down menu, and select the click the **Select By Theme** option.
8. Go to the lower drop down list of the dialog box (selected features of) and select the *Cntybdys.shp* theme.
9. Move up to the upper drop down list (Select features of active theme that) and select *That Are Completely Within*.
10. Click the New Set button.
11. Clear the selected set from the counties theme by making the *Cntybdys.shp* active again, and clicking on the Clear Selected Features button .
12. Make the *aztowns.shp* theme active. Go to the **Theme** pull down menu. Click **Convert to Shape File**. Convert the selected features to a new theme in the c:\av_class\data subdirectory using an appropriate name, i.e. *coch_twns.shp*.
13. Add the theme to your view if you wish.
14. Try selecting another set of towns using another method.

Getting help.



- ArcView® has a very robust **Help** system.
- Already mentioned, the Help button  that gives information about any of ArcView®'s buttons, tools, or menu choices.
- The **Help** pull-down menu provides three types of help.
- **Contents** gives introductions, overviews and descriptions of most ArcView® topics. **Contents** are organized as books that, when opened, expand the contents of the book.
- **Index** allows you to type in a key word or a topic. ArcView® then displays a list of entries for that word.
- The **Find** tab allows you to search for specific words in combination with other words and phrases.
- The Help system uses a hypertext system that allows you to jump to a highlighted word that contains additional information on a topic.

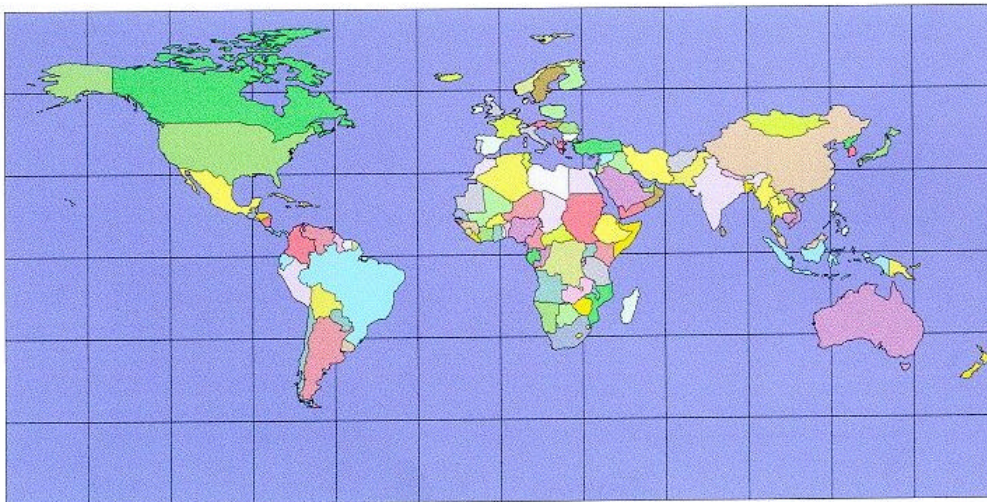
Document & Theme Properties



View Properties:

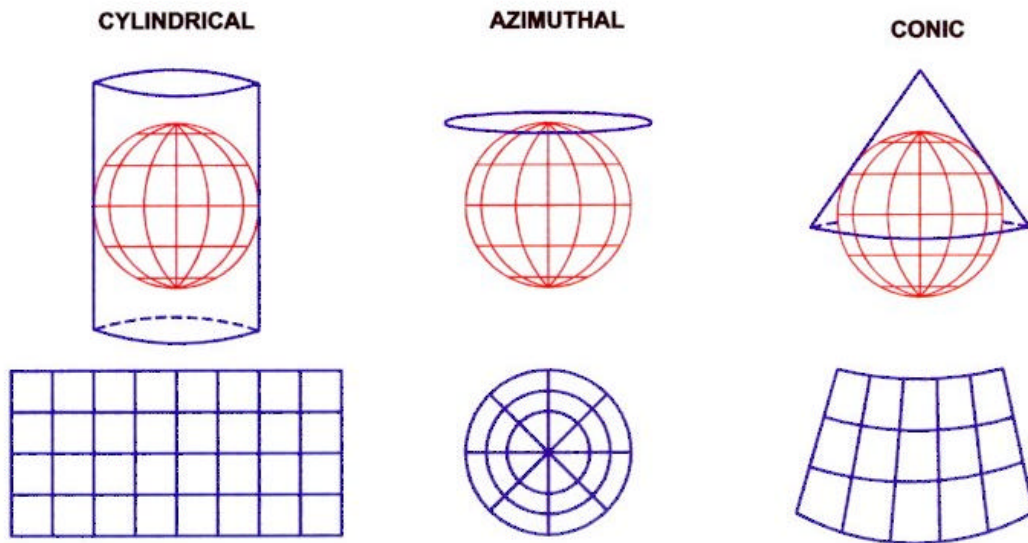
- The appearance and function of documents and themes are controlled by setting and controlling their **Properties**.
- Opening **View Properties** allows you to change basic information such as the View Name, Date, Creator, Background Color, etc.
- The most important function of View Properties is to define **Map Units** and **Distance Units**. These definitions are necessary if you need to make distance measurements or make a scale bar in a layout.
- In order to understand how **Map Units** and **Distance Units** change, you need to have a basic understanding of **Map Projections**.

Map Projections: The world flat! (When projected):



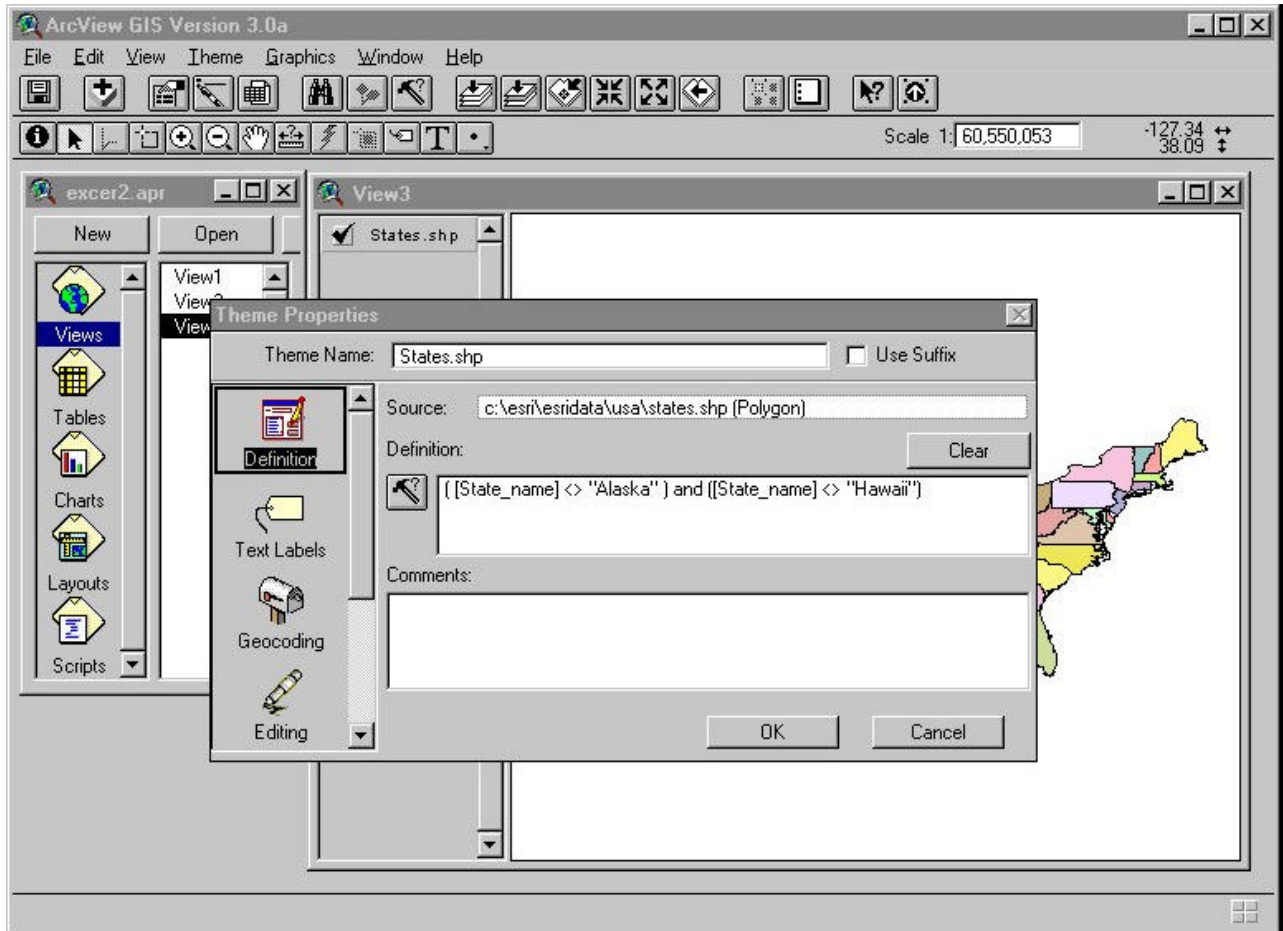
- The earth is a spheroid, a three dimensional object.
- All flat maps, two-dimensional objects, are projected in some way.
- Projecting a map always cause some type of distortion – angles, shape, area, or distance.
- There are many types of projections, but there are three basic types (dependent on locations of latitude):

MAP PROJECTIONS




- You need to know what projection your map is in when you exchange files with other organizations. If you do not know:
 - Ask whoever is providing you with the map.
 - If provided, Metadata may have a projection file information.
 - If you have ArcInfo, the *describe* command will give projection information on the cover
- ADOT uses a projection called **State Plane Central, NAD 83, in meters**. This projection is based on the **Transverse Mercator** projection.
- The State Land Department uses **Universal Transverse Mercator (UTM)** projection.
- You do not need to set the projection in the **View Properties** if the Themes in the View are already projected (not latitude & longitude).
- **North American Datum (NAD)** describes the size and shape of the earth. Datums are part of the parameters when setting projections. There are two types commonly referenced, **NAD 27** and **NAD 83**. Changes in datums cause changes in the planer coordinate system i.e., latitude and longitude). Therefore, locations of features change. **NAD 83** is used by most governmental agencies. You may need to know this when projecting maps.

Theme Properties:

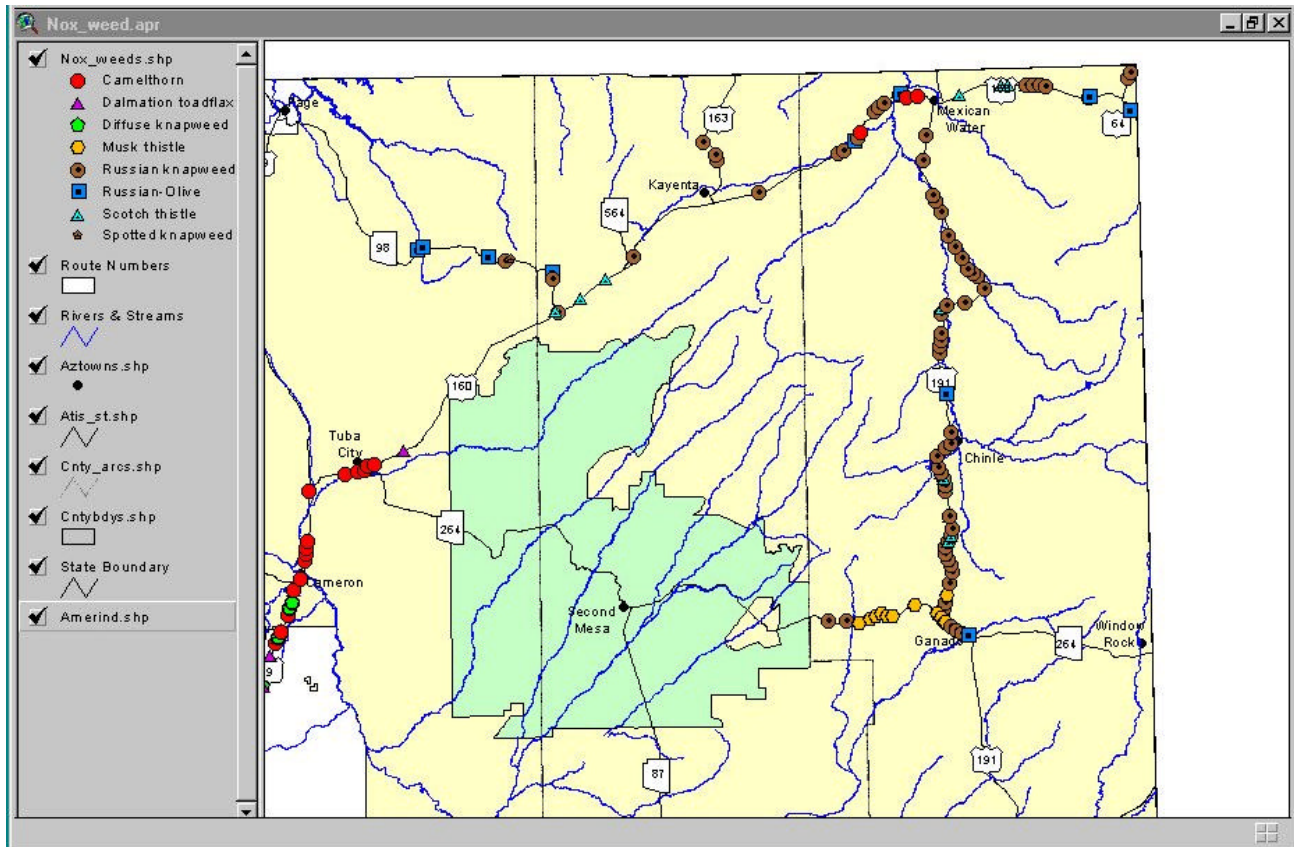


- Setting **Theme Properties** will set how the theme appears as well as how it will respond to various functions.
- The legend in the view can be made more understandable by changing the **Theme Name**. Changing the theme name does not actually change the shape file name.
- **Definitions** in the theme allow you to select specific records in the view.
- Setting **Text Labels** will define which field will be used as the labeling field.
- **Geocoding** sets up rules for geocoding addresses.
- Setting **Editing** properties will help in adding and editing records. If you do not see the Editing icon, you probably do not have write access to the shape file. Using the Windows file manager can change this.
- The **Display** setting allows views to be turned off and on depending on map scale.
- **Hot Links** are set up to connect features such as photographs, scripts, projects, or text documents.
- **Locking** write protects theme properties.

Exercise 3.

1. Open the project **Exer2.apr** in the c:\av_class\lessons directory.
2. Click on the **View** pull-down menu and select **Properties**.
3. Rename the View “USA” or something relating to the image.
4. Set the map units to **decimal degrees** and the distance units to **miles**.
5. Click on **OK**. Observe the shape of the states.
6. **Open View Properties again. Click on the** Projection box.
7. Set the **Category** to *UTM 1983* and the **Type** to *Zone 12*.
8. Click on **OK** and observe the shape of the states.
9. Click on the **Theme** pull-down menu and select **Properties**.
10. Change name of the theme to “States”.
11. Close the **Theme Properties** menu by clicking *OK*.
12. Click on the Identify button  and click on several states.
13. Close the project and do not save.

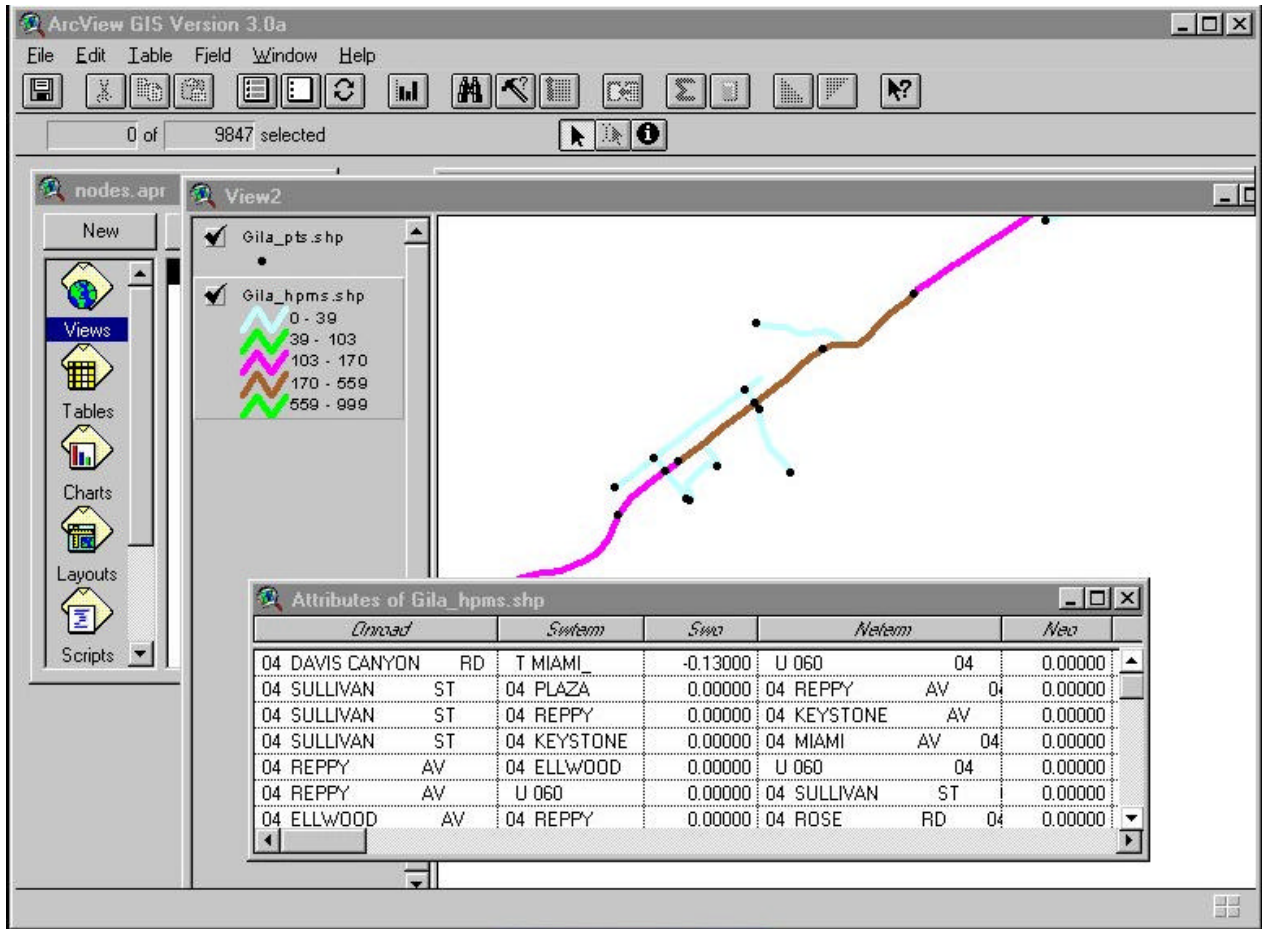
Feature Types:



Feature Types:

- Lines(arcs):
 - Roads
 - Rivers
 - Fault lines
- Points
 - Towns
 - Signs
 - Events (accidents, projects, etc.)
- Polygons (made from lines)
 - Political Boundaries
 - Land Use
 - Riparian Areas
 - Events (toxic, spills, noxious weeds, etc.)
- Routes
 - Groups of lines (arcs)
- Regions
 - Groups of polygons

Nodes- Ending points of lines



- **Nodes** are beginning and ending points of lines
- Every line segment (arc) will have a beginning and ending point
- Every arc in the HPMS database will have a street/road name called **Onroad**
- The beginning point of an HPMS line is called the **Swterm (south/west termini)**
- The ending point of an HPMS line is call end **Neterm (north/east termini)**
- The HPMS record will also have an offset value call **Swo** and **Neo**

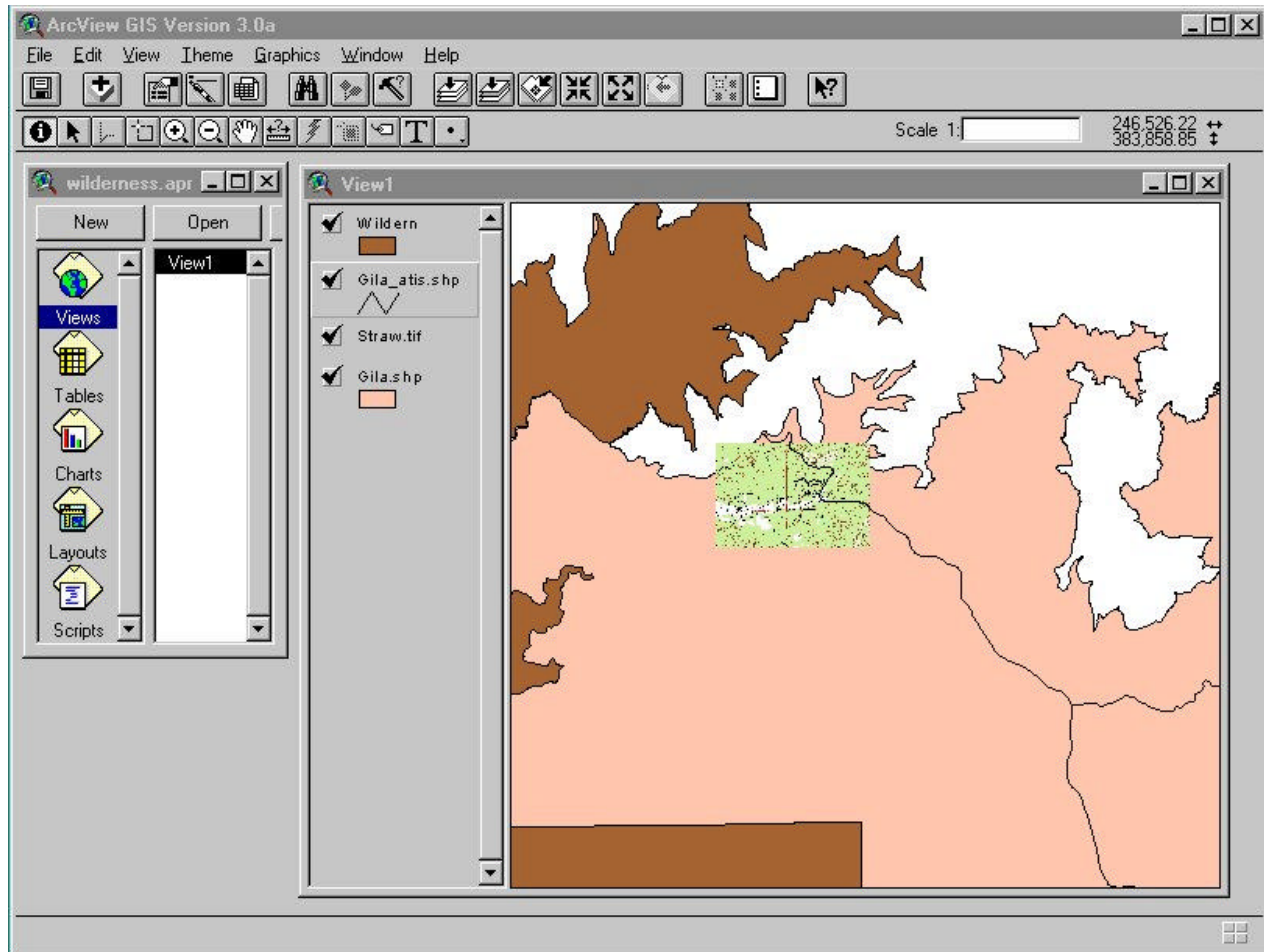
Data Sources:

- ArcInfo® files
 - Called coverages or covers which are made up of a sub-directory and an info file
 - Usually obtained in an ArcInfo® interchange (E00) format
 - ArcView® has an **Import** utility to bring ArcInfo® files into ArcView®
- CAD Drawings (AutoCAD & MicroStation)
- Text files having a spatial reference such as latitude and longitude.
- Global Positioning System (GPS) files
- MapInfo® (Ugh!) files in a MIF format
- Images (JIF, TIF, etc.) that have been rectified.
- Digitized drawings (from screen or digitizing board)
- ArcView® Shapefiles

ArcView® Shapefiles:

- ArcView®'s file format
- Shapefiles run faster and more efficiently than ArcInfo® coverages
- Shapefiles can be edited with ArcView®
- Shapefiles dbf files can be edited with other programs, i.e. FoxPro, Excel, dBase
- Shapefiles have three parts
 - .shp - contains the geometry
 - .shx – stores the index of the geometry
 - .dbf – stores the attributes of each feature in a dBASE format
- Shapefiles may have other files attached when you create and index or do a spatial join
 - .sbn & .sbx
 - these files are not necessary when copying them to another location

Working with Shape Files:



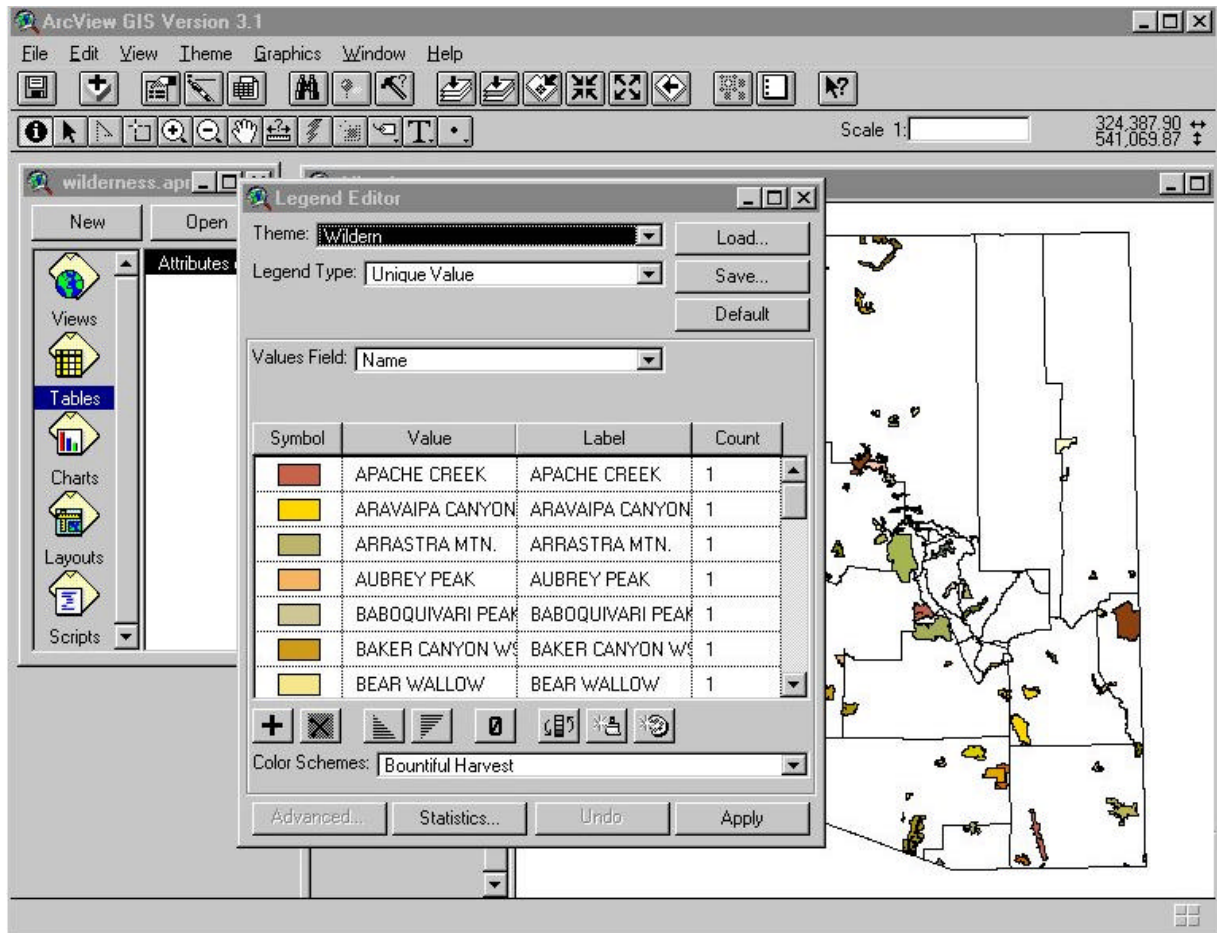
The above view has three types of themes

- ArcInfo cover (Wildren)
 - ArcInfo coverages consists of two sub-directories, the ArcInfo file and an Info file
 - ArcView® will run more efficiently if you convert the ArcInfo file to a shape file
- Shape files (Gila_atis.shp, Gila.shp)
- Image file (straw.tif)

Remember:

- Data must be in the same projection.
- Save often.
- Themes must be active in order to perform any function on it.

Classifying Themes:

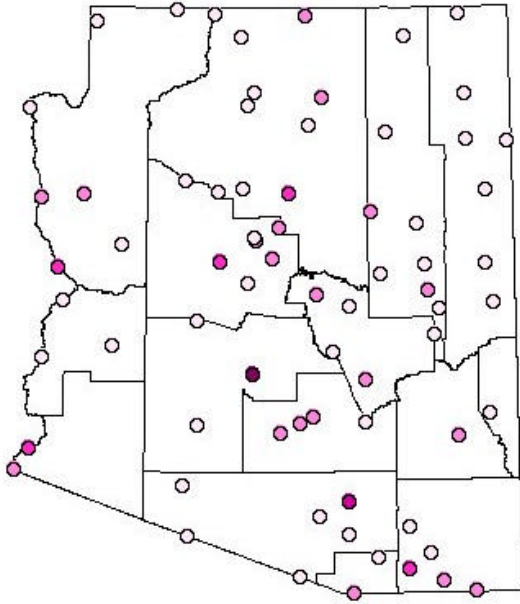


Themes can be mapped thematically or classified:

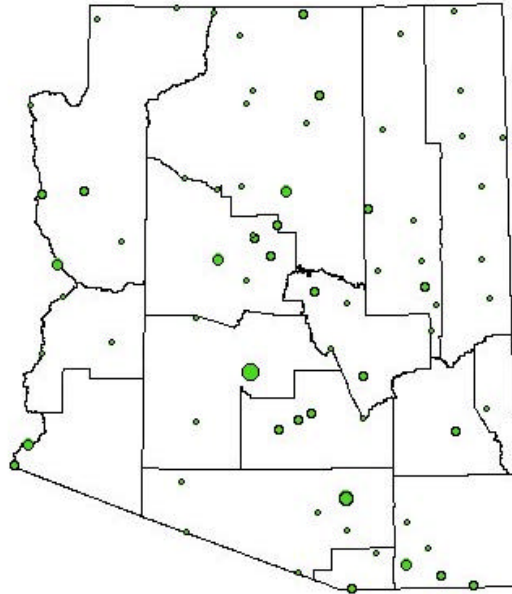
- Single symbol
- Unique value
- Graduated color
- Graduated symbol
- Dot density
- Chart

Legends can be saved for later use (.avl file).

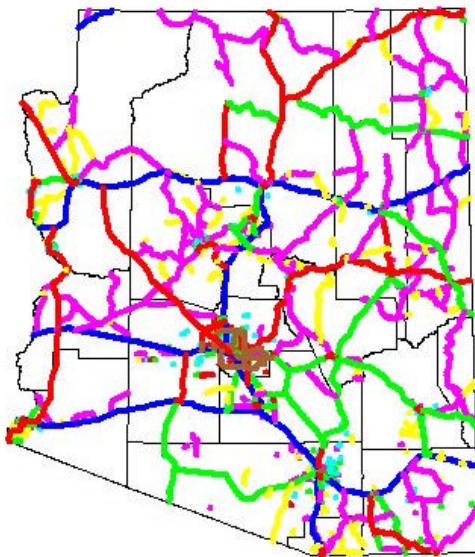
Classifying population of the Arizona towns theme:



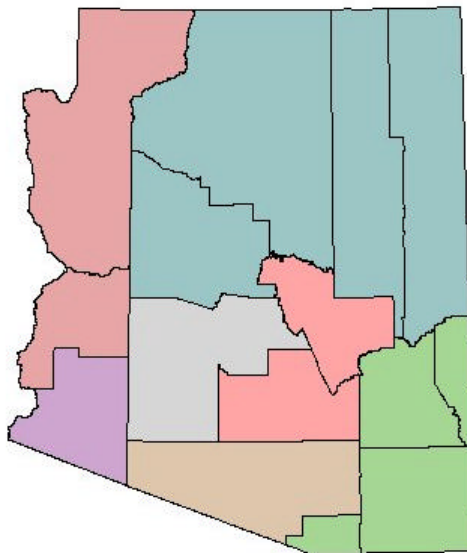
Towns classified using graduated color.



Towns classified using graduated symbol.



Functional classification classified using unique value.




Counties classified by COG unique value.

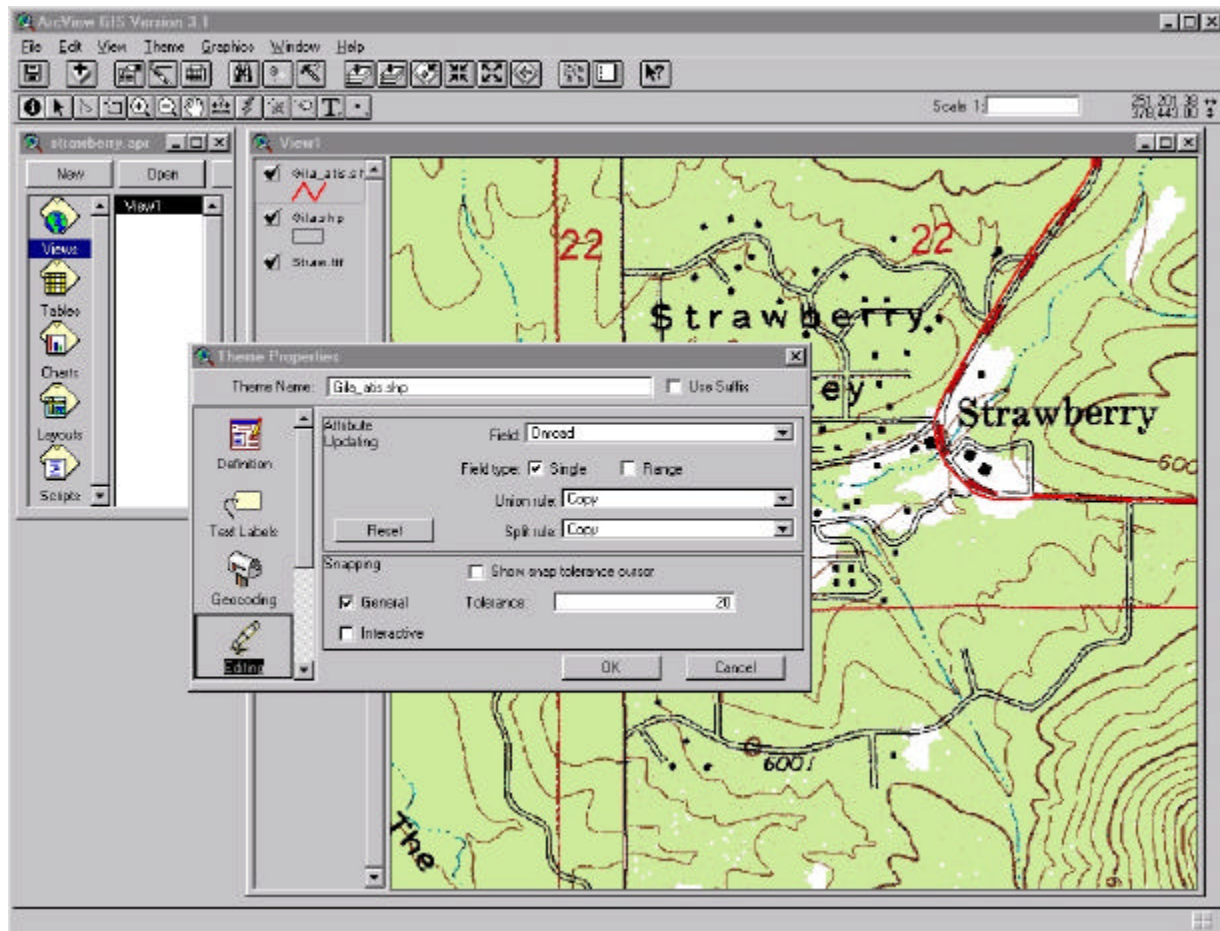
Exercise 4.

1. Open ArcView.

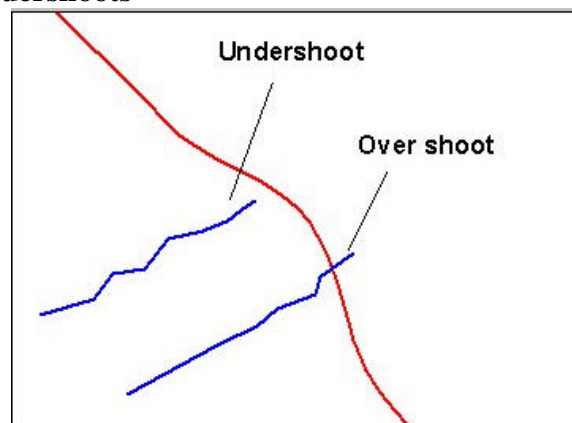


2. Open a new project. Create a new view by double clicking the **Views** icon in the Project window or by clicking **New** at the top of the Project window.
3. Drag and resize the new view so that it does not cover up the Project window.
4. From the button bar, click on the add theme button . (Make sure that the View project window is active.)
5. Go to the *c:\av_class\data* directory and add the county boundary shape file (*cntybdys.shp*).
6. Add the city boundary ArcInfo® coverage (*c:\av_class\data\cities\cities*). Convert the cover to an ArcView® shape file and name it *cities*. When asked to add the theme to the View, select *Yes*. Make the ArcInfo® cover active. Go to the Edit pull-down menu and select Delete Theme. Click on *Yes* to delete the theme.
7. With the View document active, double click the counties shape file.
8. Classify the theme using **Unique Value** on the *name Value Field*. Try different color schemes. Classify individual counties by double clicking its symbol. Classify the theme by *COG Value Field*. Finally, set the classification to single symbol with a blank fill (no color).
9. Add and make the *aztowns.shp* theme active. Classify the theme by graduated symbol using the *population* field.
10. Add the HPMS 98 shape file (*hpms98.shp*).
11. Make the *hpms98.shp* theme active. Double click the theme to open the **Legend Editor**. Click on **Load**. Move to the *c:\av_class\lessons* sub-directory and select *funcclass.avl*. Click on **All**, **Okay**, and **Apply**. Close the Legend Editor.
12. Make the Project window active. Save the project as *HPMS98* and close the project.







Creating new data



- Shapefile features and their attributes can be easily modified
- New themes and features can be added.
- Before editing can begin, the view and theme properties should be set.
- **Attribute Updating** determines how fields will be updated as changes are made to features
- Setting **Snapping** will help in creating new arcs and polygons that must connect to other arcs and polygons.
- **Overshoots and Undershoots**



Exercise 5.


1. Close any projects that may be open.
2. From the `c:\av_class\lessons` sub-directory open the `exerc4.apr` project file.
3. With the **View** active, open the **View Properties**.
4. Make the **Map Units** equal to meters and the distance units equal to feet.
5. Make the `gila_atis.shp` theme active.
6. Click on **Theme Properties**. On the left side of the window, click on **Editing**. Near the bottom of the box, click on General Snapping and set the Tolerance to 25 feet. Click on **Okay**.
7. Under the **Theme Menu**, click on **Start Editing**. Notice that a dashed line now appears around the check box for the theme that you are editing.
8. Zoom into the town of Strawberry so that the local streets on the quad map are visible.
9. Make sure the `gila_atis.shp` is active. Under the Tools button bar, select the Draw Line tool. Find a road that you want to add to the `gila_atis` shape file. Click on a beginning point (node) near SR 87. Digitize the road by clicking points along the road. Double click the last point to stop editing.
10. After you have finished adding road segments go to the **Theme** pull-down menu and click **Stop Editing** and save the additions. Use the Select tool  while in the **View Document** to select one of the new roads you added.
11. Open the **Attribute Table** . Go up to the **Table** pull-down menu and click **Start Editing**. Promote  the selected record to the top. Using the  Tools button, add a fictitious name data to the *Onroad* field of the newly added record. Add names to the *Neterm* and *Swterm* fields using actual termini or enter a fictitious road.
12. Go to the **Table** pull down menu and click **Stop Editing**. Save the changes.
13. Make the **View Document** active. Make the `Gila_atis.shp` them active. Go to the tool bar and select the Calculate Feature Geometrics button . This will recalculate the lengths or areas of theme features. Remember that map units (meters) must be set for correct calculations. Neither the table nor the view needs to be editable.
14. Open the Attribute table  and look at the new Length field.
15. Go the File pull down menu and save the project. Do not close the project.

Populating Fields With Field Calculator




The screenshot displays the ArcView GIS interface. The main window shows a map with a red boundary. Overlaid on the map is the 'Field Calculator' dialog box, which is used for calculating values for a specific field. The dialog box has three columns: 'Fields', 'Type', and 'Requests'. The 'Fields' column lists several fields: [Shape], [Onroad], [Swterm], [Swo], [Swq], [Neterm], and [Neo]. The 'Type' column has radio buttons for 'Number', 'String', and 'Date'. The 'Requests' column contains mathematical operators: *, +, -, /, <, and <=. Below these columns is a text box labeled '[miles] =' and buttons for 'OK' and 'Cancel'.

Below the Field Calculator dialog box is the 'Attributes of Gila_atis.shp' table. The table has the following columns: Surface, Pavement, Base, Lanewidth, Shoulder, Length, and miles. The data rows are as follows:

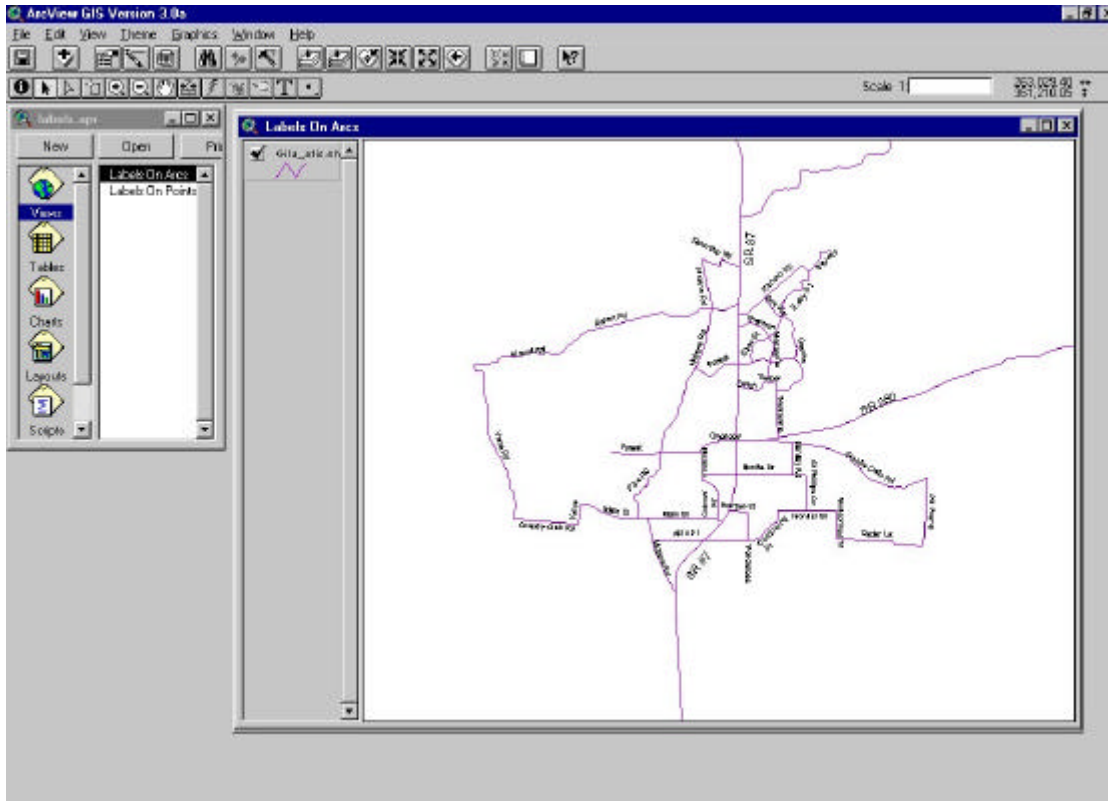
Surface	Pavement	Base	Lanewidth	Shoulder	Length	miles
52	4	0	12.00000	7	806.218	
40	0	0	12.00000	1	12630.761	
40	0	0	12.00000	1	322.007	
51	4	0	12.00000	1	3186.021	
00	0	0	0.00000	0	19040.260	
00	0	0	0.00000	0	8044.966	
00	0	0	0.00000	0	5117.116	

- Fields can be easily populated with the **Field Calculator** .
- The table must be editable.
- Numeric, string, and date fields can be populated.

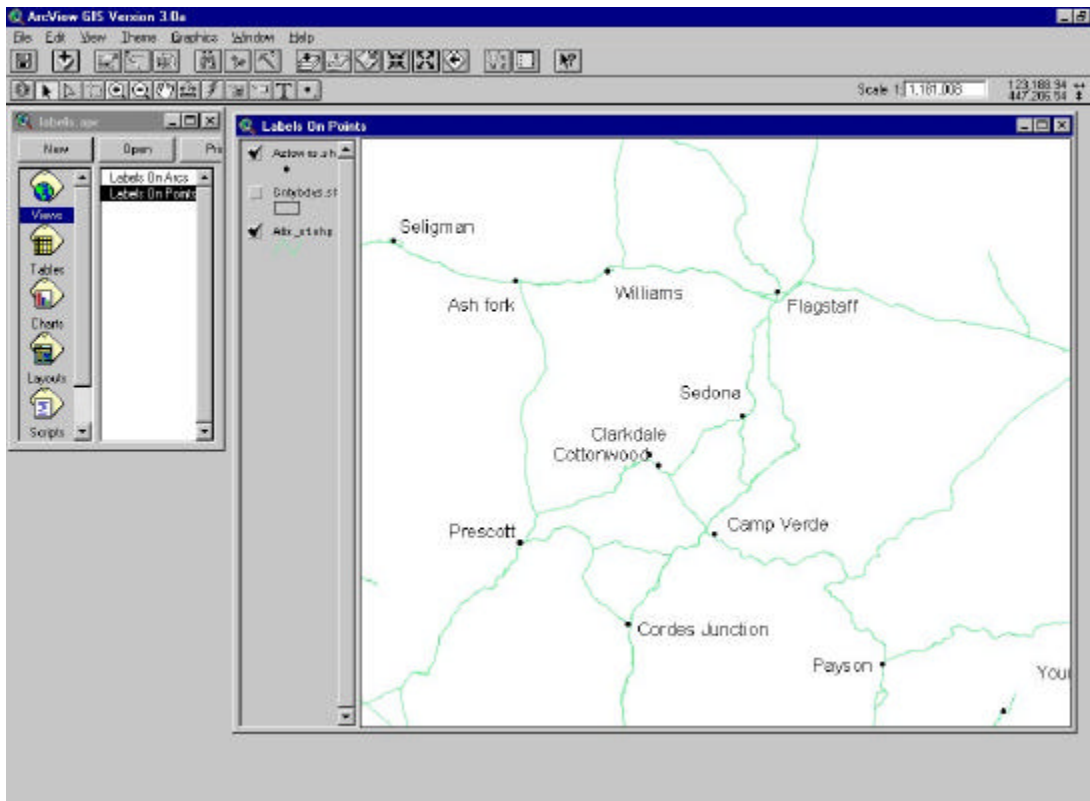
Exercise 5a.

1. Make sure that the *exerc4.apr* project file is still open and the **View** document is active.
2. In the **View** properties, change the distance units to miles.
3. Open the Attribute file  for the Gila_Atis theme. The Table Document should now be active.
4. Go to the **Table** pull down menu and click **Start Editing**.
5. Go to the **Edit** pull down menu and click **Add Field**. A **Field Definition** dialog box will open.
6. Enter “Miles” in the *Name:* field. Leave *Type* as a Number field. Change **Width** to *10* and **Decimal Places** to *2*. Click **OK**.
7. Make the new field, *Miles*, active.
8. Click on the Calculator icon .
9. While the cursor is in the lower blank dialog box, go up to the **Fields** dialog box and double click on the *[length]* field. Go to the **Requests** dialog box and double click on the * numeric operator. The cursor will move to the bottom **Fields** dialog box. Enter “(0.0006214)” (miles in a meter) after the * numeric operator. Do not enter quote marks. This should populate the *Miles* field. If an unrelated dialog box appears on the screen, close it.
10. Click **OK**. Stop editing and save.
11. Select a road segment in the **View**, open the attribute table, and check the *Miles* field.
12. Use the Distance measuring tool  to check the length against the length in the *Miles* field.
13. Close and save the project.

Adding labels to a theme:



- Labels on a line theme

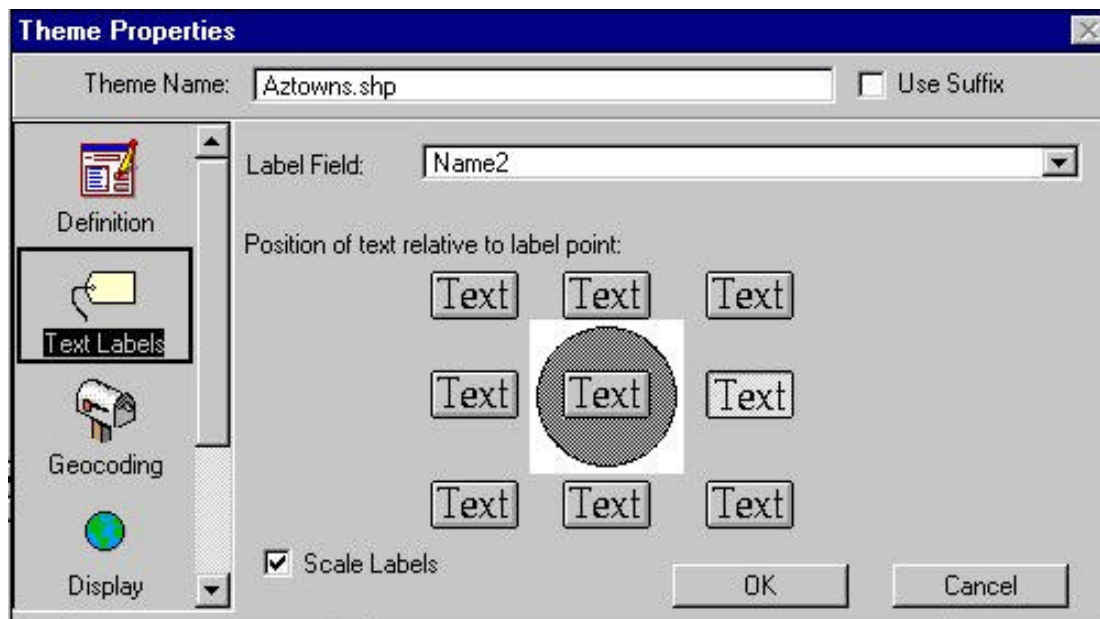


- Labels on point theme

Setting up ArcView® for labeling





- Setting properties for a line theme

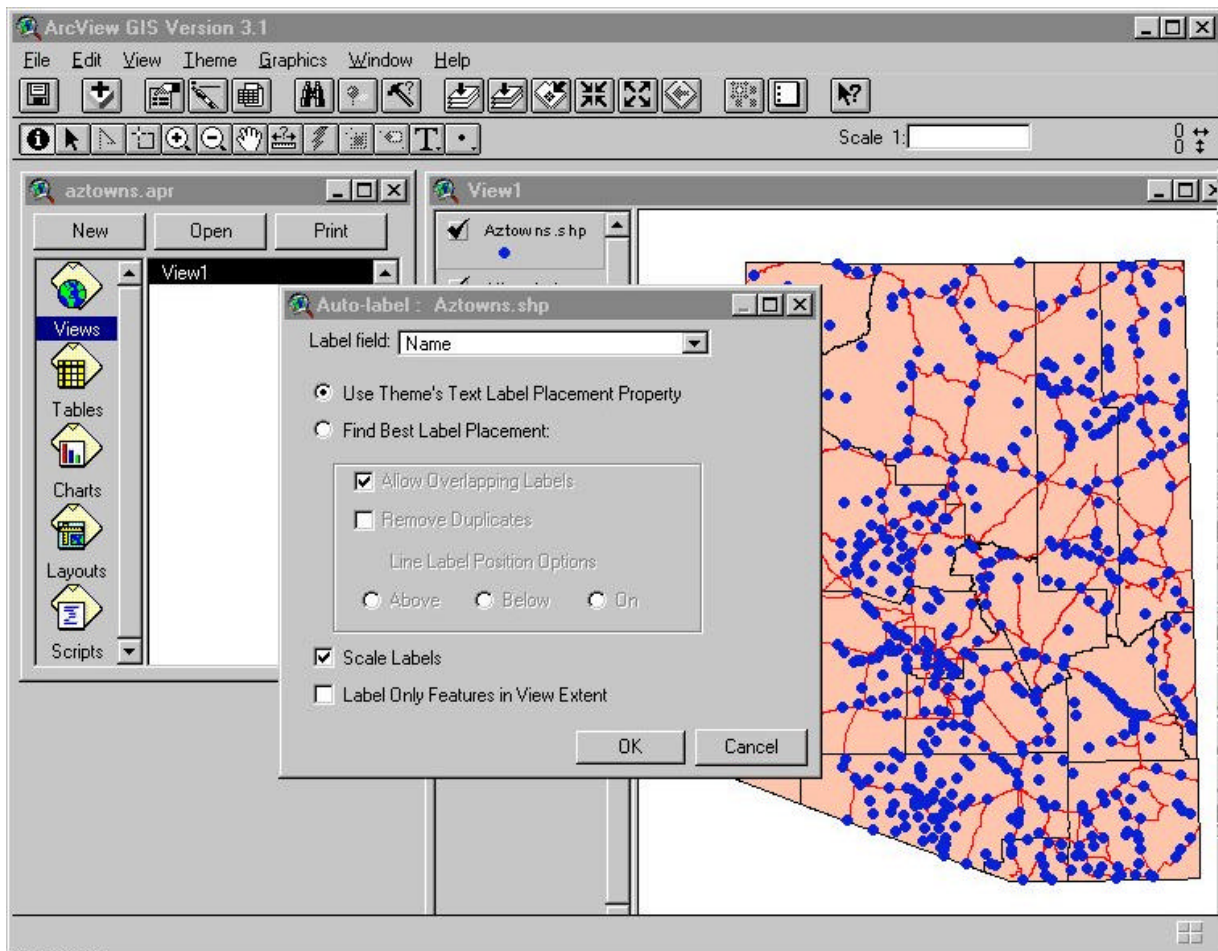


- Setting properties for point and polygon themes

Labeling features:





- Individual features may be labeled using the **Label** tool . Label one feature and then use the **Font Palette** to adjust the Font type and size. The Font Palette can be found by opening the **Window** pull-down menu and clicking Show Symbol Window and the Font Button .
- Double clicking the label will open an editing window that will allow you to change the text and the angle.

Using the Auto-label function:

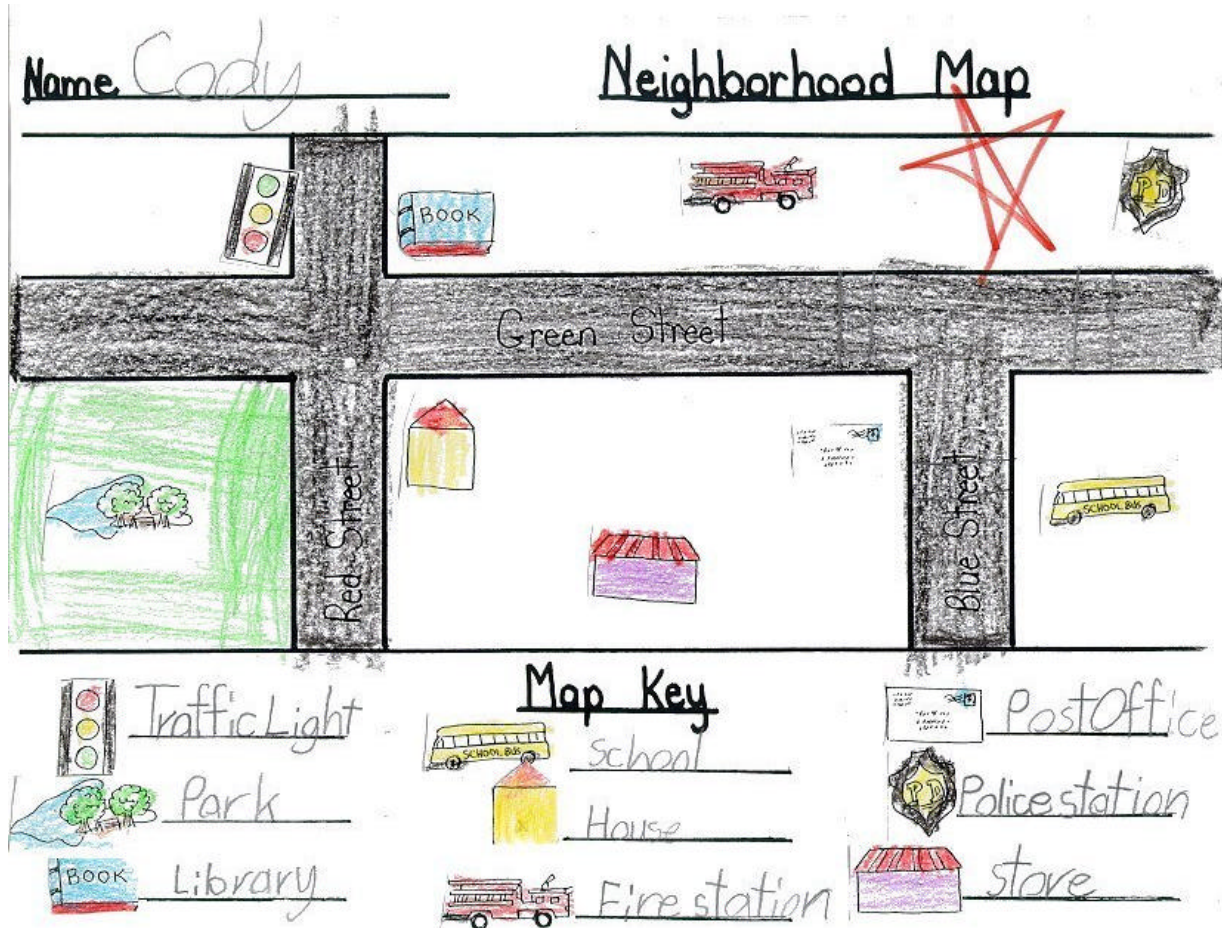


- The **Auto-label** function will label all of the features in an active theme.
- **Before** starting the **Auto-label**, set the font type and size. Otherwise, you find your screen covered by very large text.
- Options must also be set before starting the **Auto-label** function: Label Field, Placement Property, Allow Overlapping Labels, Scale Labels, and Label Only Features in View Extent.

Exercise 6.

1. Close any projects that may be open.
2. Open a **New** project and a **New** view.
3. Click on the Add Theme button . Go to the c:\av_class\data sub-directory. While holding the shift key select the cntybdys.shp and aztowns.shp shape files. Change their color and shape pattern by using the **Legend Editor**.
4. Select **Properties** from the **View** pull-down menu. Set the **Map Units** to meters and the **Distance** Units to *miles*.
5. Make the aztowns.shp shape file active. Open **Theme Properties**. Change the theme name to *Arizona Towns*. Set the **Definition** to towns with populations greater than 5,000. Set the **Text Labels** option to the town name (*name*). Set the Label Position to the upper right location.
6. Go to the button bar and select the **Label** icon . Move to the View Document and label a town. Open the **Window** pull-down menu and select **Show Symbol Window** to open the **Font Palette** . Select a font size that is more appropriate for the map scale.
7. Select any town labels with the **Select** tool , and delete them.
8. Go to the font palette and set the Font size with the appropriate font size. Try labeling some towns again.
9. Select all the town labels again and delete them. You may go to the **Edit** pull-down menu and click **Select All Graphics**. Hit the **Delete** key. Be careful because this will delete all labels from any active view.
10. Go to the **Theme** pull-down menu and select **Auto Label**. Click on **OK**.
11. If the font size is too large. Delete all the labels, and reset the font size from the **Show Symbol Window** menu (under the Window pull-down menu). Do the **Auto Label** function again.
12. Zoom in on a couple of towns. Move the label if it is not in a good place.
13. Zoom to the extents of the themes. Go to the **File** pull down menu, and click on **Save Project As**. Name the project **aztowns**.

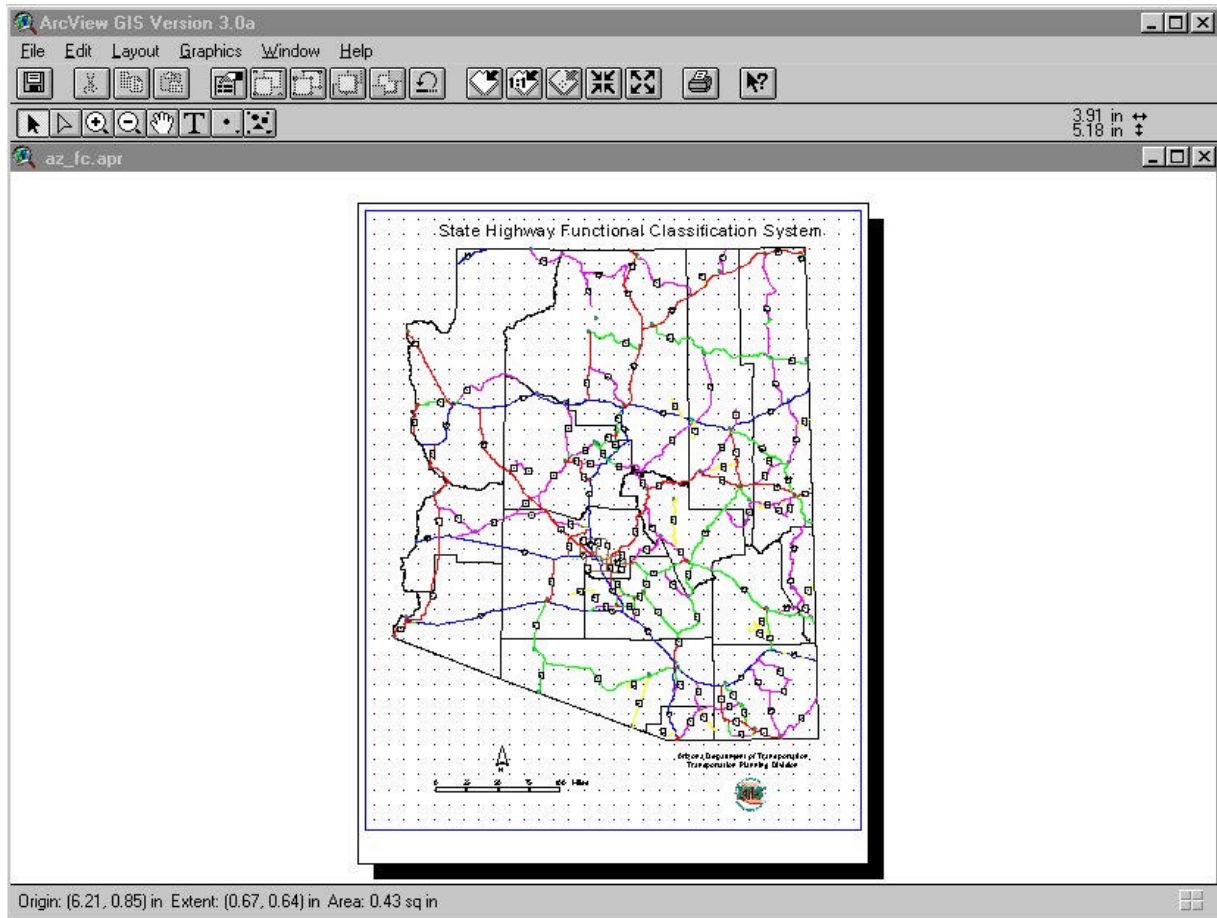
Creating layouts.



- With practice, you too can make a map like the one above.
- The map shows good balance in design.
- When designing a map, consider who your audience will be.




Note: Map courtesy of Cody Garrison, age 7.

Layout GUI:



- Layouts are maps containing views, charts, tables, and other graphic images. Layouts can be printed or plotted to a hard copy. Layouts may be exported to an electronic file so that the map can be used in other programs such as a word processor.
- ArcView® has several tools and extensions to assist you in making colorful, attractive maps.
- Layout GUI allows insertion of any **View Frame** (views, tables, charts, etc.)
- North arrows, map scale, text, and image files (.jpg, .gif, .bmp) can be inserted into a layout.
- Templates can be made from a layout to be used in other layouts.
- Save your project before creating a layout.
- Legend properties are dependent on the legend properties of a view.
- **Map Units** and **Distance Units** must be set before adding a scale bar.

Exercise 7.

1. If you have closed the `aztowns.apr` project, open it again.
2. Select Layouts under the **Project** document window
3. Maximize the Layout document.
4. Go the **Layout** pull-down menu, and select *Page Setup*. Set the page layout as necessary.
5. Go the tool bar and click the View Frame button. Click the cross hairs somewhere near the top left of the windows. Hold down the left mouse button, and drag to the right and bottom until the box fills the Layout. Leave room for the legend, scale bar and north arrow. Select **View1** from the popup window, then click OK Do not go beyond the blue lines. Move or change the size of the view if necessary.
6. Go to the button bar and select the **Legend** button  (hold down the mouse button and scroll down). Draw a box where you want the legend to appear. Select View1 from the pop-up menu. Place the legend in the lower left of the Layout. Zoom in on the Legend. Change the size if necessary. Notice the legend items. Close the Layout document and go back to the View document. Make the `cntybdys.shp` shape file active. Go to the Theme pull-down menu and click on **Hide/Show Legend**. Go back to the Layout document and look at the legend box again.
7. Go to the button bar and select the **Scale Bar** button . Select a scale bar style and other options. Click OK. While in the layout, adjust the scale bar as necessary.
8. Click on the **Text** icon . Add a title at the top of the Layout. Change the font style and size by opening the Show Symbol Window (under the Widow pull-down menu).
9. Close the layout and project.

What comes next?

- ESRI
 - www.esri.com
 - 1-800-447-9778
 - Listing training programs (local and in Redlands, CA)
 - List Serve
 - ArcExplorer® download
 - ArcUser Magazine
- Certified ESRI ArcView® 3.1 training class through ADOT
 - ADOT – TPD course four times a year
 - Sponsored by Local Technical Assistance Program (LTAP)
(602) 255-8461 Stefanie DeLeon
- Certified classes through private vendors
 - Check with ESRI for names and phone numbers
- Certified classes through Universities and community colleges
- Tutorials and other books
 - ESRI's GIS Store
 - SoftStore, Inc.
 - 1-888-763-8786
 - www.geobooks.com
- Geowarehouse
 - 1-800-704-6709
 - www.geowarehouse.com
- User groups
 - On internet
 - Through ADOT-TPD
 - Southwest User's Group (find through ESRI)

Appendix 1 – Definitions:

Term	Definition
Active theme	In ArcView, a theme that appears raised in a view's Table of Contents; many operations performed in a view work only on active themes.
Address geocoding	The process of assigning x,y coordinates to addresses so they can be displayed as points on a map.
Address matching	A process that compares a table of addresses to the address attributes of a theme to determine whether they are the same.
Alias	In ArcView, an additional name for a field in a table. ArcView displays the alias instead of the original name.
Application	A specific use of GIS; a GIS project.
Area	A closed shape (polygon) defined by the line or lines that comprise the boundary; also, an attribute of a polygon.
Area feature	A shape on a map representing a geographic object too large to be depicted as a point or line. Examples of area features include counties, census tracts, and lakes.
ATIS	Arizona Transportation Information System. The term used to describe the Arizona Department of Transportation's base road coverage.
Attribute	A characteristic of a map feature. Attributes of a river might include its name, length, average depth, and so on. A desktop GIS stores attributes in tables and links them to the map features that they describe.
Attribute table	Information about the features on a map, stored in rows and columns. Each row relates to a single feature; each column contains the values for a single characteristic.
Avenue®	The programming language that comes with ArcView. Avenue provides tools for customizing ArcView and developing applications.
Button bar	The middle row of controls in the Document GUI. A row of buttons.
Chart	A graphic representation of tabular data. A component of an ArcView project used for representing tabular data graphically.
Class	A group or category of attribute values.
Classifying	The process of sorting or arranging attribute values into groups or categories; all members of a group are represented on a map by the same symbol.
Color ramp	A range of colors used in a map to show ranking or order among classes.
Coverage	An Arc/Info term. A coverage is a set of thematically associated data considered as a unit. It usually represents a single theme or layer such as roads, streams or land use.
Data	A collection of related facts usually arranged in a particular format and gathered for a particular purpose.
Data dictionary	A catalog containing information about the data stored in a GIS database. A data dictionary includes such information as the full names of attributes, meanings of codes, scale of the source data, accuracy of locations, and the map projection used.
Database	A collection of related files organized for efficient retrieval of information.
Datum	A set of parameters used to define the 3D shape of the earth. The basis for a planar coordinate system. For example, the North American Datum of 1983 (NAD83) is the datum for map projections used within the United States and throughout North America.

Term	Definition
Decimal degrees	Degrees of latitude and longitude expressed as a decimal rather than in degrees, minutes, and seconds. Decimal degrees are computed using this formula: decimal degrees = degrees + minutes/60 + seconds/3,600.
Desktop GIS	A form of desktop mapping that has the ability to display, query, update, and analyze geographic locations and the information linked to those locations, and that runs on personal computers.
Desktop mapping	A system used for mapping information on personal computers. Desktop mapping systems range from display-only systems to full-featured geographic information systems.
Digital map data	The locations and shapes of map features stored in a computer-readable format.
Distance units	The units (e.g., feet, miles, meters, or kilometers) ArcView uses to report measurements, dimensions of shapes, and distance tolerances and offsets.
Document	A component of an ArcView project. Each document type (view, table, chart, layout, and script) has its own window and interface.
Dynamic segmentation	The process of computing the locations of events on linear features at run time based on event tables for which distance measures are available.
Electronic atlas	A display-only mapping system that provides pictures (maps) of geographic areas.
Event location	In ArcView, a location stored in a tabular data format rather than a spatial one; also known as an event. Examples of event locations are addresses, mileposts along a route, and latitude-longitude coordinates.
Event table	In ArcView, a tabular data source containing location information (event locations) and used for creating a spatial data theme.
Event theme	A spatial data theme created from a table of event locations.
Extension	An add-on program that provides specialized GIS functionality to the ArcView interface. Extensions are loaded and unloaded in the Extensions dialog box accessed from the File menu.
Feature	A shape and its associated location used to represent a real-world object on a map.
Field	A column in an ArcView table. Each field contains the values for a single attribute.
Filtering	A desktop GIS operation used to hide (but not delete) features in a map theme.
Geocoding	The process of assigning x, y coordinates to data that is not in a spatial data format, so that the data can be displayed on a map.
Geographic coordinates	A measurement of a location on the earth's surface expressed in degrees of latitude and longitude. (See also planar coordinate system).
Geographic Information System (GIS)	An organized collection of computer hardware, software, and geographic data designed for capturing, storing, updating, manipulating, analyzing, and displaying all forms of geographically referenced information.
GIS database	A collection of map themes (including features and related descriptive information) organized for efficient storage and retrieval by many users.
GUI	Graphical User Interface. This term is used to refer to the document or window interface on the computer.
Hot link	In ArcView, a way to display data (e.g., a file, image, ArcView document, or project) directly from a view, by clicking on a feature.
HPMS	Highway Performance Monitoring System.

Term	Definition
Image data	Graphic representations of objects. Examples include satellite pictures, aerial photographs, and scanned documents. One of the three basic kinds of geographic data (spatial and tabular data are the other two).
Image file	A file containing graphic representations of objects (image data). Examples of image file types are JPEG (*.jpg), GIF (*.gif), BitMap (*.bmp).
Join	In ArcView, an operation used to attach tabular data to a theme. The fields of one table are appended to another table (usually the theme table) using a common field. Join establishes a one-to-one or many-to-one relationship between records in the two tables.
Layout	The design or arrangement of elements in a digital map display or printed map. A component of an ArcView project used for creating presentation-quality maps.
Legend	A list of the symbols appearing on a map; includes a sample of each symbol and text describing what each symbol means. (The Map Key).
Legend file	In ArcView, a legend created in a View can be saved to a file for use with another view or project. Legend files have a .avl extension.
Line	A shape defined by at least two pairs of x, y coordinates.
Line feature	A shape on a map representing a real-world object too narrow to be depicted as an area. Examples of line features include roads, rivers, and elevation contours.
Link	In ArcView, an operation used to define a relationship between two tables, without appending any fields, and using a common field. Link establishes a one-to-many relationship between records in the two tables.
Map	A graphic representation of an area, using shapes to represent objects and symbols to describe their nature, organized according to location.
Map display	A graphic representation on a computer screen of a geographic area and the features on it.
Map feature	Same as feature
Map projection	A mathematical formula that converts latitude-longitude locations on the earth's spherical surface to x, y locations on a map's flat surface. Map projections cause distortion in one or more of these spatial properties: distance, area, shape, and direction.
Map scale	Same as scale.
Map units	The units (e.g., feet, miles, meters, or kilometers) in which the coordinates of spatial data are stored. ArcView uses the current map units to calculate a view's scale.
Map symbol	Same as symbol.
Neatline	A border commonly drawn around geographic features, often to separate them from other map graphics.
Node	The ending points of lines
North arrow	A map component that shows how a map is oriented.
Palette	A collection of symbols and colors stored in a file that you can load or create. In ArcView the palettes (e.g., symbol, line, color, etc) can be accessed from the Symbol Window, located through the Window menu item.
Planar coordinate system	A two-dimensional measurement system that locates features on a map based on their distance from an origin (0,0) along two axes, a horizontal x axis representing east-west and a vertical y axis representing north-south. See also geographic coordinates.
Point	A shape defined by a single x, y coordinate.

Term	Definition
Point feature	A shape on a map representing a geographic object too small to show as a line or area. Examples of point features include wells, hydrants, and benchmarks.
Polygon	A shape on a map representing a geographic object too large to be depicted as a point or line. Examples of area features include counties, census tracts, and lakes.
Project	In ArcView, a file for organizing your work. Projects use five types of documents to organize information: views, tables, charts, layouts, and scripts.
Projection	Same as map projection.
Query	A question or request used for selecting features or records. A query often appears in the form of a statement of logical expression. In ArcView, a query contains a field, an operator, and a value.
Record	A row in an ArcView table. If the table is a theme table, each record corresponds to a single map feature.
Scale	The relationship between the dimensions of features on a map and the geographic objects they represent on the earth, commonly expressed as a fraction or a ratio. A map scale of 1/100,000 or 1:100,000 (for example) means that one unit of measure on the map equals 100,000 of the same unit on the earth; that is, features on the map are 100,000 times smaller than what they represent in the real world.
Scale bar	A map component that graphically shows a map's scale. (used in a layout)
Script	A component of an ArcView project used for writing, loading, and modifying programs that contain Avenue code. ArcView scripts are used for automating tasks, adding new capabilities to ArcView, and building complete applications.
Select	To choose from a number or group of features or records; to create a separate set, or subset.
Selected set	A subset of the features or records in a theme. ArcView provides several ways to select features and records graphically or according to their attribute values.
Shape	The characteristic appearance or visible form of a geographic object. Most geographic objects can be represented on a map using three basic shapes: points, lines and areas (polygons). In ArcView, a map feature stored in a shapefile format.
Shapefile	ArcView's format for storing the location, shape, and attribute information of geographic features.
Spatial analysis	The study of the locations and shapes of geographic features and the relationships between them.
Spatial data	The locations and shapes of geographic features. One of the three basic kinds of geographic data (image and tabular data are the others).
Spatial join	A type of spatial analysis in which the attributes of features in two different themes are joined together based on the relative locations of the features.
Spatial overlay	The process of superimposing layers (themes) of geographic data that occupy the same space in order to study the relationships between them.
Spatial relationship	A relationship between geographic features based on their locations. Spatial relationships are shown on maps.
Street network	A system of interconnecting lines that represent thoroughfares.
Street-based mapping	A form of desktop mapping that links information to geographic locations and displays address locations as point features on a map.
Symbol	A graphic element used in a map to help identify and provide information about a feature.

Term	Definition
Symbol window	In ArcView, the window used to create/maintain/use various symbols, colors, lines, fonts, and polygons.
Table	Information formatted in rows and columns. A component of an ArcView project used for displaying tabular data. See attribute table.
Table of Contents (TOC)	In an ArcView view, this is the portion of the view GUI that lists the themes in the view. The Table of Contents is also used to control how the view is drawn.
Tabular data	Descriptive information, including locations, that is stored in rows and columns and can be linked to map features. One of the three basic kinds of geographic data (image and spatial data are the others).
Text label	Text added to a map to help identify a feature.
Thematic mapping	A form of desktop mapping that uses information stored in a spreadsheet or database to create map displays for graphic presentations.
Theme	A set of related geographic features, such as streets, parcels, or rivers, and the attributes (characteristics) of those features.
Theme table	In ArcView, a table of attributes linked to features in a theme. See attribute table.
Theme-on-theme selection	In ArcView, an operation that selects features in one theme using the features of another theme. Answers questions about spatial relationships between features, such as whether one feature lies within another, whether it completely contains another, whether it is within a specified distance of another, and so on.
Tool bar	The bottom row of icons (referred to as ‘tools’) in the Document GUI (docGUI). A Tool provides a means of interacting with the document display. A tool remains selected until you click on another tool.
Topographic maps	A graphic representation of natural and man-made features showing their relative positions and elevations.
View	A component of an ArcView project used for displaying, querying, and analyzing geographic themes.
Window application	Used in the documentation to refer to the ArcView program window running on a computer.
X axis	In a planar coordinate system, the horizontal axis representing east-west.
X, y coordinates	On a flat map, a location (its distance, horizontally and vertically, from an origin) that corresponds to the same location on the earth’s spherical surface.
Y axis	In a planar coordinate system, the vertical axis representing north-south.

Appendix 2 – Cool Web Sites:

Arizona Department of Transportation/Transportation Planning Division

- ArcView Internet Map Server
- GIS data, maps, misc.
- mapazfms.com

Arizona Department of Transportation/Traffic Operations Branch

- Highway Closure Reporting System (HCRS)
- GIS data, maps, misc.
- Freeway cameras
- www.azfms.com

Arizona Land Resource Information System (ALRIS)

- Training, data, news
- www.land.state.az.us/alris/alrishome.html

Dave's Software Library

- Avenue USGS scripts, macros
- rmmcweb.cr.usgs.gov/~dcatts/software/

Environmental Systems Research Instate (ESRI)

- Training, software, conferences, data, scripts, news, et al
- ArcExplorer® download
- www.esri.com

Gator.net

- Avenue Scripts
- www.gator.net/~garyg/aveSrcFrm.htm

Geoplace

- Training, data, news, jobs, services, conferences, books, et al
- www.geoplace.com

Geowarehouse

- Extension, Scripts, training, et al
- www.geowarehouse.com

Knowledge Base

- www.gfi-gis.de/en/services/avkb
- List Serve Summaries on keywords
- Southwest User's Group (find through ESRI)

Rowekamp Associates, Inc.

- Misc. sites
- www.rowekamp.com

University of Texas – Geography Department

- Map projections and datums
- www.utexas.edu/depts/grg/gcraft/notes/mapproj/mapproj.html

United State Geological Survey (USGS)

- Maps, DEMs, data, et al
- www.usgs.gov

