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GIS Laboratory Exercises: Introduction to GIS

2nd edition

by

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Preface

In 1990, the NCGIA published the 1000+ page set of lecture notes, the *NCGIA Core Curriculum in GIS* (Goodchild and Kemp 1990). To support the lecture materials contained in the original Curriculum, in 1991 we published a pair of Technical Reports (Dodson 1991, and Veregin 1991) containing the laboratory exercises developed and taught in the Introductory GIS course in the Department of Geography at the University of California, Santa Barbara (UCSB). Since that time, the hardware, software and theory have changed dramatically and it has become necessary to revise these laboratory materials to keep up with these changes. In 1995, the Office of Instructional Development at the University of California provided funds to undertake this major revision. During the summer of 1995, two Geography seniors (Jeremy Taylor and Jane Fletcher) worked in close association with Prof. Michael Goodchild, Dr. Karen Kemp and Steve Palladino of the NCGIA to bring these materials up-to-date. Working from the original exercises and revising and completely rewriting them where necessary, Taylor and Fletcher drafted a set of materials which were then used in the geography computer labs at UCSB during fall 1995 and fall 1996. These classroom evaluation periods led to revisions and the final version contained here.

This document, then, is the second edition of *GIS Laboratory Exercises: Volume 1*. Labs 2 to 4 in this new set of exercises draw heavily on the original materials and data, though the text and questions have been revised to be completed using Idrisi for Windows. Labs 5 to 7 are completely redesigned to take advantage of the more user friendly features and practice datasets of ArcView 2. An instructor's guide is available to accompany these materials.

As in the original laboratory exercises, these exercises have been developed with the following objectives in mind:

- provide students with the opportunity to gain experience in working with two widely available GIS (IDRISI for Windows and ARCView II, illustrating raster and vector approaches to spatial data respectively).
- illustrate the abstract issues presented in course lectures about how the real world is represented and manipulated in the computer.
- encourage students to think critically about how GIS can be used to solve problems, about the reliance of solutions on accurate data and appropriate methods of analysis, and about the presentation of results (maps, tables, and text) of GIS analysis.
- give students experience in working in teams in solving real problems of the type now commonly addressed with GIS.

References

Dodson, R F 1991 *GIS Laboratory Exercises: Volume 1*. NCGIA Technical Report 91-12, NCGIA, University of California Santa Barbara.

Goodchild, MF and KK Kemp 1990 *NCGIA Core Curriculum in GIS.* NCGIA, University of California Santa Barbara.

Veregin, H 1991 *GIS Laboratory Exercises: Volume 2, Technical Issues*. NCGIA Technical Report 91-14, NCGIA, University of California Santa Barbara.

Table of Contents

Lab 1: CREATING A GRIDDED DATABASE BY HAND

TASK:
To create, by hand, an analog gridded database from a base map.

LEARNING OBJECTIVES:
- understand how a gridded database is constructed
- explain how the features and qualities on the real earth are translated into a grid
- identify some issues related to this transformation process

MATERIALS NEEDED IN CLASSROOM:
- Copies of a base map of the campus
- Blank transparencies with a 2cm or 1/4" grid
- One transparency of the base map
- Overhead pens

INSTRUCTIONS:
Students pair off. Each pair receives one overhead grid, one base map and one or more pens and is assigned one theme and one resolution from the following lists: note, your instructor may add other themes which are appropriate for your location.

Themes
- water
- coastline
- paved areas
- buildings

Resolutions
- 1 cell
- 2x2 window
- 3x3 window

Steps

1. Determine a rule for deciding what value each cell contains and what codes will be used.
2. On the overhead grid, mark the appropriate value into each cell.
3. Once everyone has finished, each pair will show their finished map on the overhead and explain the rule they used and the problems they encountered.

DISCUSSION TOPICS

1. How do the rules vary? Are any correct or incorrect?
2. What was the effect of coding at different resolutions?
3. What happens to linear features when coded on the grid?
4. Can different grids be overlaid? (i.e. what about origin and orientation?)

NOTES

IDRISI FOR WINDOWS SUPPLEMENT

SECTION 1
What is IDRISI for Windows? & Raster GIS

IDRISI for Windows is a raster based GIS software package, with vector viewing capabilities. IDRISI for Windows is distributed by Clark University Graduate School of Geography in Worcester, Massachusetts. It is a desktop display and spatial analysis tool.

In GIS there are two common ways to model the world, **raster** and **vector**. Labs 2, 3, 4 and 8, will deal with the raster data model. Labs 5, 6, 7, and 8 as well, will deal with the vector model of GIS. Lab 8 will be a combination lab to compare and contrast the two data models.

IDRISI for Windows uses geographic data based on uniform cells (pixels) arranged in a grid. This gridded data is stored in an "image file". The image file (with a .IMG extension) contains rows and columns of cells, numbered down and to the right respectively, (0,0 is at the top left-hand corner of the image). Each cell contains values pertaining to the theme of the image.

As mentioned before, IDRISI for Windows also has vector viewing capabilities. These vector files (with a .VEC extension) represent features on the Earth's surface by a sequence of points located in space by X and Y coordinates. These points can be joined with straight lines to make lines or polygons. In IDRISI for Windows, features such as country boundaries, rivers, and the coast line, can be displayed in vector format.

With IDRISI for Windows a user can perform tasks in the following categories:

- Display spatial data, image data and other data formats using various modules
- Import, Export, and Display file contents
- Database query (reclassify, overlay, extract, area, etc...)
- Mathematical Operations (overlay)
- Distance Operations (Euclidean distance measurements, surface cost analysis, least cost routing, and Thiessen polygon creation)
- Context Operations (slope/aspect, viewshed, watershed)
- Image Processing
- Decision Support (ranking, weighting)
- Change / Time Series
- Reclassification of Images
- Raster / Vector Conversion
- Map Output

SECTION 2
Data that can be used in IDRISI for Windows

Data that describes the Earth's surface or the features found on it are called geographic data. This includes not only cartographic and scientific data, but also business data, land records, photographs, etc. IDRISI for Windows can display both raster and vector data but analysis is primarily oriented toward raster data. Realizing data may be of different types, IDRISI for Windows incorporates two basic forms of map layers: raster images layers and vector layers.

> **Raster Image Layers** describe a region of space by means of a matrix of cells. Image layers are good for describing spatially continuous data such as elevation, temperature, rainfall, and vegetation types.
>
> **Vector Layers** are useful for describing distinct features in the landscape. These include roads, district boundaries, point features, etc.

SECTION 3
Data Types & Documentation Files

Data Types

The values stored in an image file may be *integer* (whole numbers ranging from -32768 to 32768), *byte* (whole numbers ranging from 0 to 255), and *real* (numbers with a fractional part such as, 8.2794). *Integer* and *real* data types may be used to represent actual numbers (e.g. precipitation in inches) or categories (e.g. soil types). The *byte* data type is useful for data compression and other purposes.

Documentation Files

Both image and vector files "carry" with them files called documentation files. The image documentation file (with a .DOC extension) contains information on the number of rows and columns, projection, title, the ground dimensions of a cell and so on. The vector documentation file (with a .DVC extension) contains information such as title, data type, file type, resolution, and so on.

Documentation files are automatically updated when you modify the data using an IDRISI for Windows program module. A documentation file is also automatically created when you create a new file with a program module. However, documentation files are stored in ACSII format and can be edited.

SECTION 4
Program Modules

Program Modules

IDRISI for Windows has a series of over 100 program modules. Program modules are independent sub-programs that perform the functions of IDRISI for Windows. They are divided into three main classes: *Core Modules* are used for data entry, storage, management, and display; *Ring Modules* are used for image processing; and *Peripheral Modules* are used for data conversion.

There are three ways to access the program modules:

1. You can select a module from the pull-down menu selections.
2. You can select a module by clicking on it in the tool-bar menu.
3. You can select a module by activating the *SHORTCUT* option from the *ENVIRONMENT* menu and typing the name of the module or by selecting it from the list of module names

For a list and description of each module, use the on-line HELP.

Menu, Tool & Status Bars

The **menu** bar at the top of the application window provides command choices and contains pull-down menus (ENVIRONMENT, FILE, DISPLAY, ANALYSIS, REFORMAT, HELP, etc.). The pull down menus contain other selections based on the heading and some of these selections have options that are displayed with a fly-out menu. A fly-out menu is displayed when you click on a selection which contains a triangle in it.

The **tool** bar is composed of buttons and is directly beneath the menu bar. The tool bar icons (buttons) let you quickly select program modules or interactive operations. Many of the items in the menu bar can be found here.

The **status** bar is the bottom of the application window. If you pass (without clicking) the mouse over a tool button you will see a description of the tool operation here. The status bar also provides x,y coordinates if the cursor is over an image, and if the cursor inquiry tool is in use, the attributes (z values) will appear in the status bar.

Lab 2: EXPLORING AFRICA WITH A RASTER GIS: IDRISI for WINDOWS

SECTION 1
Introduction

INTRODUCTION TO LAB

THE GEOGRAPHIC THEME

Exploring geographic data as an aid in decision-making.

THE DATA

The data you will be exploring covers the continent of Africa. The data, from the Global Change Africa Database is compiled by the National Geophysical Data Center in Boulder Colorado. The dataset includes many layers of data including the following files which will be used for this lab:

- ***veg*** - a file containing general vegetation land cover classified into sixteen categories.
- *tmpjan* - a file containing the average January temperature.
- ***soiltex*** - a file containing soil texture classified into eight categories.
- ***elev*** - a file containing elevation in feet.

Also included in this dataset are five vector (or line) files which will be available for each lab. They are:

- ***coasts*** - a file containing lines that represent the outline of the coast of Africa.
- ***country*** - a file containing lines that represent the boundaries for all the countries in Africa.
- ***rivers*** - a file containing lines that represent major rivers on the continent of Africa.
- ***lakes*** - a file containing lines representing the outline of major lakes in Africa.
- ***islands*** - a file containing lines representing the outline of islands off Africa’s coast.

LEARNING OBJECTIVES
After completing this lab you should be able to:

- Manipulate the IDRISI for Windows environment.
- Understand the terminology used by IDRISI for Windows.
- List and describe image and vector files.
- Display data with different functions.
- Understand and use the different color palettes in IDRISI for Windows.

- Perform basic statistical analysis.
- Understand how a grid represents reality.
- Calculate image resolution.
- Explore the geography on an area using IDRISI for Windows.
- Use the on-line Help.

SECTION 2
Getting Started

YOUR MISSION:

You have just started work as a regional planner at the UN headquarters in Geneva, Switzerland. Your region of responsibility is the continent of Africa. One of the tools you have available for your work is IDRISI for Windows and a digital database of Africa. You have decided that now is a good time to familiarize yourself with both the geography of Africa and how it can be represented in a raster GIS. The bold questions in the following exercise represent questions you ask yourself.

HINT: Throughout this and any Idrisi lab, using the on-line **HELP** can solve many problems you may encounter!

Open IDRISI for Windows by clicking on the IDRISI for Windows box in the program manager. Then click on the IDRISI for Windows icon to open an application window.

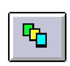
One of the functions in IDRISI is *ENVIRON* . This function tells the software where to look for files and where to put files you create. The *ENVIRON* must be correctly set in order for you to continue with the lab.

Your data is located at:

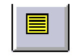
Set the ENVIRON to: ____

SECTION 3
Viewing the Data

What data do I have available?

Use the *LIST* function  to view a list of the data files available. Notice that you can select what type of file you want listed. If you select one of the files in the list, a brief description is displayed at the bottom of the dialog box.

What are the characteristics of these data? What metadata is available?

As explained in the introduction to IDRISI for Windows supplement, each image and vector file carries with it a documentation (.DOC or .DVC) file. These files give you information about the associated display files. To read the documentation files use the *DESCRIBE* function  and select the .DOC file you wish to read.

Use DESCRIBE to examine the metadata about the file ***veg****.*

Q! **1**

Now using DESCRIBE again, switch to file type vector *and examine the metadata about* ***rivers****.*

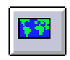
Q! **2**

How can I "see" this data? Can I make these files look like maps?

TIP: In the "name of file" box you can click with the **right-mouse-button** and get a list of files available. **Double-click** on the file you want and it will appear in the box.

There are different ways to display data in IDRISI. The choice depends on what type of data it is and how you want it displayed.

DISPLAY FUNCTION

- DISPLAY  creates colored "maps" in which the colors are determined by the value in the cell.
- ORTHO  creates an orthographic view in which the value in each cell is displayed as an elevation.
- HISTO  is used to display data as a histogram or in numeric summaries.

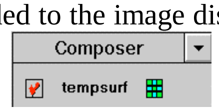
For now we will concentrate on DISPLAY. Begin by taking a look at the "map" of soil textures.

Display ***soiltex****, use the "Idrisi 16" color palette and ask for a legend.*

I need more information to help me understand where things are. Can I see the country boundaries?

TIP: An "active window" is one whose title bar is highlighted as a different color than the others.

HINT: The composer will affect which ever image is active, so make sure the correct image is active.

The database also contains vector files (points, lines, or polygons) which can be added to the image displayed on the screen. Use the *Composer* 

dialog box to *Add Layer*. Select the vector file **country** and accept defaults.

Q! **3**

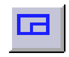
Experiment with the *Composer* to see what it can do.

I want to see what's going on in northwest Africa more closely?

HINT: Be careful in how many images you display. If you display more than 5 or 6 images the software exceeds it's memory and boots you out of the program.

*Display **veg** with the "Qualitative 256" color palette and ask for a legend.*

Unlike paper maps you can zoom into portions of this image. Use either the *zoom* tool or the *window* tool:

- zoom tool  - *select the tool, then click on a location at the center of your area of interest.*
- window tool  - *select the tool then draw a box around the area of interest.*

To zoom out, select the *window tool* and click in the image with the right mouse button.

Try these tools, zooming in on the NW coast where there are some small islands.

Q! 4,5

How do these images represent what has really been measured in Africa?

Using the *cursor inquiry tool* , you can see the data value in any cell.

Choose the cursor inquiry tool. Place cross-hairs over any cell and click. The value of that cell will appear as the z-value in the status bar.

Q! 6

*Now DISPLAY **tmpjan** using the Idrisi 16 palette and include a legend. Check out some values on this image.*

Q! 7 & 8

Now experiment with the DISPLAY Launcher. Choose different images and palettes and play with the various map components to see if you can figure out...

What is a palette? Which palette do I use?

The palette you choose depends on the type of data you are displaying. The data can be either *continuous* or *classified*. Continuous data can potentially have any value in a given range of values measured on ratio or interval scales. Classified data has only a few values representing a limited number of categories. Classes can be derived from continuous data (e.g. wind speed classes), ordinal data (e.g. order of states entrance into the Union), or qualitative classifications of nominal data (e.g. ethnicity, species, landuse, or soil type).

Q! 9

Continue to experiment with DISPLAY using different images and palettes until you understand what a palette does.

Q! 10

IDRISI for Windows comes with a variety of palettes.

- Idrisi palettes - have a smooth color progression from blue to red to yellow to green.
- Gray palettes - have smooth progression from black to white.
- Bipolar palettes - have smooth progression for blue through red to yellow.
- Qualitative palettes - have random color schemes.

Use the DISPLAY launcher to display **elev** with <u>each</u> of these palettes, using the 256 option. Make sure the autoscaling box is checked for all these labs.

Q! 11

*Now DISPLAY **veg**, with Idrisi 256 and Qualitative 256 color palettes.*

Q! 12 & 13

Getting back to the data, how does this gridded data relate to the real world?

*DISPLAY **elev** using the appropriate palette and other parameters.*

Q! 14

How much ground is represented by a single cell?

Resolution is determined by the area on the ground that is covered by a cell. An image with a large number of cells covering a small area is said to have relatively *high resolution*. An image with a small number of cells covering a large area is said to have relatively *low* or *coarse resolution*. The resolution determines the minimum size of the features which are discernible on an image.

Cells or pixels, in satellite images are often a consistent size (e.g. a Landsat Thematic Mapper image has a resolution of 30 X 30 meters). The African database, however, uses cells which are 20 arc-minutes of latitude by 20 arc-minutes of longitude (1/3 of a degree by 1/3 of a degree). Therefore, the cells do not cover the same ground area everywhere on the image.

Q! 15

So, can I calculate how much land is covered by a specific cell?

A rough area calculation can be made using the following information. Assuming the Earth is a sphere:

1 degree latitude = 111.15 km

1 degree longitude = 111.15 km * COS (latitude)

EXAMPLE:

1° longitude @ 45° latitude = 111.15 km* COS (45)
= 111.15 km * (.7071)
= 78.59 km

HINT: *Don't forget, these cells are 20 by 20 minutes.* For these area calculations multiply length of latitude by length of longitude.

Q! 16 - 20

SECTION 4
Different views of the data.

Are there other ways to view this data? Can I see a land surface in a perspective view?

GIS allows the user the freedom to view data in multiple forms and to manipulate data in an interactive manner. *Use the DISPLAY launcher to view the **elev** image*, an elevation and bathymetry image. This is similar to how a paper map would display elevation.

ORTHO FUNCTION

Now you will display elevation in a more interesting manner. Use the ORTHO function to display **elev**, do not drape another image, switch the resolution to 800 X 600, accept all other defaults.

HINT: Read HELP to understand the effects of the different options.

Q! 21

Try experimenting with the options in ORTHO to see if you can get a better view of the landscape.

Can I put another colored image over the elevation surface? Would this allow me to compare two different themes?

To visually compare vegetation and elevation you can display the orthographic view of the elevation file and *drape* the vegetation file over it.

Now use *ORTHO* to display **elev** and drape **veg** over it.

Q! 22

SECTION 5
Basic Statistics

Can I use Idrisi to calculate summary statistics of an image? Can I determine the areas covered by different vegetation classes?

A common use of GIS is to measure the areas covered by different classes in a single theme.

*Display **veg** with "Qualitative 256".*

Q! 23

Now you let IDRISI tell you the area of the vegetation types. Use the *AREA* function on **veg** to calculate the number of cells for each vegetation type. Set the *output format* to tabular.

Q! 24 & 25

You can calculate the area in different area units. Experiment with the *AREA* function until you are comfortable with it, maybe try it on other images.

How can I display a histogram of an image?

HISTO FUNCTION

Use *HISTO* to display a histogram of **soiltex.** Change the *minimum value* to 1 (which screens out the background areas that are coded 0) and leave the *maximum value* at 8. Leave *class width* at 1. Select *graphic output*.

Each bar on the resulting graph represents one soil texture category. The vertical axis (labeled f) represents the relative frequency, or number of cells, for each category.

Q! 26

SECTION 6
What is the geography of...

Your Latest Assignment

It seems that the UN Agricultural Development Department is considering sending advisors to Madagascar. The director of your division just called and told you that they need a preliminary report on the physical geography of Madagascar. Fortunately, you have just learned a useful tool!

Q! 27

Name: ____________________________________ Date Due: ________________

TA: ______________________________________ Time to complete: ___________

QUESTION & ANSWER SHEET

---

1. For each of the following headings, what value is displayed and what does it mean?

   Columns:

   Rows:

   Ref. system:

2. For each of the following headings, what value is displayed and what does it mean?

   Object type:

   Ref. Units:

3. Using the map of soil texture, what seems to be the *dominant* soil texture class in the Sahara Desert?

4. Why is this data displayed as rectangles?

5. What are the dimensions of each cell in degrees? HINT: Use *DESCRIBE* and look at "ref. Units" and "unit distance"

6. What are the values you get on ***veg*** and what do they represent?

7. What are the values you get on ***tmpjan*** and what do they represent?

8. How is a *number* in a cell on the ***veg*** image different from a *value* in a cell on the ***tmpjan*** image?

9. Give the file name of an example of each of the following types of data in the Africa dataset.

   Continuous data:

   Classified data:

   Nominal data:

10. What is the function of a palette?

11. Which palette is least useful in displaying elevation? Why? For what type of data might this palette be useful?

12. Which palette was more appropriate? Why?

13. Name a palette / image combination that does not make sense and explain why.

14. What elevation value is given for the location 13.5 deg N lat, 24.5 deg E long. Be sure to include the units. Is this the actual elevation at this point? Explain.

15. Why do the cells NOT cover the same ground area everywhere on the Africa images?

16. What is the area of a 20 min. X 20 min. cell at 3° latitude? Show your work.

17. What is the area of a 20 min. X 20 min. cell at 50° latitude? Show your work.

18. Are your answers to 16 & 17 really the true area of these cells? Why?

19. Considering that the state of Delaware has an area of approximately 5000 km^2, how accurately do you think a cell in this Africa database describes reality?

20. Given the size of the cells, would it be appropriate to include in the database an image of roads and highways? Why?

21. What direction (N, S, E, W) are you facing? What physical features can you identify?

22. Is there an obvious correlation between elevation and vegetation classes? Is there another factor that seems to influence vegetation types more?

23. Visually determine the most common and least common vegetation type.

    Most Common:

    Least Common:

24. What is the calculated result?

    Most Common Type (most cells):

    Least Common Type (least cells):

25. What is the measured unit in question 24? What does this suggest about the need for care when using such statistics?

26. Which category is most frequent? Which type of soil texture does this category represent?

27. Describe the geography of Madagascar <u>with the data you have available.</u>

Lab 3: SUITABILITY ANALYSIS FOR FOREST MANAGEMENT

SECTION 1

INTRODUCTION TO LAB

This lab uses raster GIS to identify areas suitable for lease to timber companies, based upon certain criteria.

THE DATA

The area in question is centered on Maple Mountain, located in the Timiskaming District of Ontario, Canada, north of Lake Huron. The image files are derived from the Canada Geographic Information System, one of the first large-scale GIS's ever developed.

You have been provided with 3 images:

- *forspec* - forest species showing Jack Pine and White Pine
- ***shorline* -** shorelines showing areas of water or land
- ***roads* -** roads

From these images, you will create a further 12 images.

LEARNING OBJECTIVES

After completing this lab you should be able to:

- Prepare an output image
- Construct a flow chart of operations in IDRISI
- Perform mathematical overlay operations
- Explain how to perform site suitability analysis using raster data

SECTION 2
PROBLEM 1

TIP: bring up Help and make it "Always on Top". Use it to help you answer the questions in this lab.

YOUR MISSION

Your task is to conduct a spatial search to identify suitable forested areas that will be leased to timber companies for harvesting. The spatial search is based on meeting **all 3** criteria below:

1. Only White Pine is to be harvested
2. Leases cannot be granted for areas less than 1000 m from a water body
3. Leases cannot be granted for areas less than 1000 hectares (ha) in size

Each area fitting all 3 criteria will be assigned a unique identification code used for leasing purposes.

YOUR DATA IS LOCATED:

Set the ENVIRON to:
____

Examine your data

HINT: since the images have less than 16 categories, use the palettes with only 16 colors.

DISPLAY all 3 images experimenting with different color palettes to choose the best one for each. DESCRIBE the three images to see the metadata, including the data resolution. In particular, you will need to determine what data value is assigned to each category in each of the 3 datasets.

Q! 1 - 4

LAB PROCEDURE

TIP: look at *RECLASS* in Help to learn how it can be used in this exercise.

In order to complete this lab, you will make a series of *binary images* which you will eventually combine to create a final image in which suitable locations are uniquely identified. Binary images have only 2 data values: **1** indicates those areas which have the criterion being considered and **0** indicates areas which have not. In IDRISI, you will use the *RECLASS* module to assign **1**'s and **0**'s to the appropriate categories of your source images.

Q! 5 & 6

TIP: later in the lab, you will create a flow chart. Take notes on the operations performed and images created from now on, to make life easier.

1. **Solving for White Pine Only criterion**

To isolate areas of White Pine, use RECLASS on **forspec** to create an output image called **whitep**. Choose the user-defined classification system and assign a value of **1** to the White Pine category and a value of **0** to all other categories.

TIP: after each reclassification, display the new image as a visual error-check. It is easier to correct mistakes now than later.

2. **Solving for areas more than 1000 m from water**

First, you are going to isolate the areas of water. Then you will calculate how far away the other cells in the image are from the water bodies so that you can create a buffer threshold of 1000 m. Then all the cells falling outside the 1000 m distance from the water will be reclassed as satisfying the criteria.

STEP 1

To isolate areas of water, use RECLASS on **shorline** to create an output image called **water**. Assign a value of **1** to water and **0** to all other categories.

STEP 2

To calculate the distance between each cell and the nearest water body, *use the DISTANCE module. The "feature image" is **water** and the output image should be called **waterdis**.* This module takes a while to run. Check on its progress in the lower right corner of the application window.

BUFFER

HINT: use *DESCRIBE* on ***waterdis*** to find out the minimum and maximum values. Be careful and make sure the upper limit for the new value of 1 is at least equal to the maximum value.

STEP 3

Create a buffer around the water bodies by applying a 1000 m threshold to the distances in the image **waterdis.** Use RECLASS on **waterdis** to create an output image called **waterbuf**. Choose the user-defined classification system and assign a value of 1 to the old values greater than or equal to 1000 and a value of 0 to the old values less than 1000.

OVERLAY

3. **Finding areas that are both White Pine Only AND 1000 m from water**

*Use the OVERLAY module on the images for "White Pine Only" and "1000 m from water". Choose a mathematical operator that will give you a binary image with 1's for only areas satisfying both criteria. Call the output image **drypine**.*

Q! 7 & 8

4. **Solving for suitable areas that are more than or equal to 1000 ha**

Now you are going to identify contiguous stands of timber in the **drypine** image. Then you will find the areas of these stands of timber and remove from consideration all the stands that are less than 1000 ha in size. Then you will join any 1000 ha or larger areas that are touching each other to make plots for lease.

Q! 9

TIP: use *DISPLAY,* with legend, to check the image and answer the questions.

STEP 1

*Using the GROUP module **without** "diagonal links" between groups, identify all the stands (or groups) of suitable timber (i.e. away from water AND White Pine only). Call the output image **groups**.*

Q! 10 & 11

STEP 2

Using the AREA module, calculate the areas, in hectares, of the groups of timber. Call the output image ***area1.*** *In the following sections, the areas without timber are referred to as the "background" area.*

Q! 12 - 14

Remove the background values using the OVERLAY module with "multiply". The input images are ***drypine*** *and* ***area1****. Call the output* ***area2****.*

Q! 15 & 16

HINT: before you *RECLASS*, use *DESCRIBE* on ***area2*** to find the minimum and maximum values of the image.

STEP 3

To extract all areas that are greater than or equal to 1000 ha in size, use RECLASS on **area2**. Call the output **lgstands**. Be sure to assign 1 to suitable areas and 0 to all others.

STEP 4

TIP: use *DISPLAY* on ***leases*** to answer question 17

You will now assign a unique identification code to each stand satisfying the three criteria. This code will be used in the administration of the leases. *Use the GROUP module with "diagonal links" on the large stands image to create an output image called* ***leases****.*

Q! 17 - 20

5. **<u>What is the total harvestable area</u>**?

Use the *HISTO* module with "numeric" output and what you know about the resolution of the raster images to calculate the total area of harvestable White Pine.

Q! 21

<u>Creating a presentable final output image</u>

To create a printout of the final results, use OVERLAY with the "cover option" to combine the ***roads*** *image to the* ***leases*** *image. Call the output image* ***leasroad****.*

Q! 22 & 23

*Complete the steps you have discussed in the above question. Call the output image **roads2.***

Now use the OVERLAY module and choose the "cover" option to combine **roads2** and **leases**. Call the output image final.

HINT: use *DISPLAY*, with legend, on ***leases*** to help in up-dating the legend categories of ***final*.**

You need to update the legend categories for **final**. Go to FILE/DOCUMENT in the menu bar. Fill in the boxes in the first dialog window, then click OK. In the second dialog window, click on "legend categories". For each of the areas in **final**, type in an identification code number or name. These codes can be anything you want, but must be different from each other. Be sure to include the item "Roads" for the last category.

Display **final** to make sure the up-dated legend categories are satisfactory.

Q! 24

PROBLEM 2

CHANGING THE CRITERIA

Now your task is to change some of the criteria in the previous suitability analysis to examine how sensitive the results are to minor changes. What happens if you change the threshold distance from water to something like 750 m?

Indicate with an asterisk (*) the parts of the flowchart (question 24) you had to redo.

Q! 25 - 27

Name: _____________________________________ Date Due: _________________

TA: _______________________________________ Completion Time: ___________

QUESTION & ANSWER SHEET

---

1. List the legend categories for the 3 images:

forspec	**shorline**	**roads**
category 1:	category 1:	category 1:
category 2:	category 2:	
category 3:	category 3:	

2. What is the resolution, with units, of this data?

3. How large is the area covered by the data?

4. What type of file are all 3 datasets?

5. How are binary images used to combine several layers?

6. Explain briefly in plain English (not IDRISI terms) how you will manipulate each of the datasets to perform this site suitability exercise.

7. Which mathematical operator did you choose? Why?

8. What does **drypine** show?

9. How can you identify a “contiguous stand” in a raster image like **drypine**? (Hint: look at GROUP in Help)

10. What do the cell values in **groups** represent?

11. How many groups have been identified? How did you determine this?

12. What do the cell values in **area1** represent?

13. Why does the background area have a high cell value?

14. Why must you remove the background value?

15. Explain why you “multiply” the **area1** and **drypine** images. What is the result?

16. Describe another way you could have removed the background values.

17. Why is it advantageous to group the stands again?

18. How many areas have been identified as suitable for leasing?

19. When you identified contiguous stands, you used *GROUP* **without** diagonal links. How would your answer to question 18 change if you had used *GROUPS* **with** diagonal links at that stage in the process? (Hint: think about what would be implied when 2 different groups meet diagonally across a single corner point.)

20. Considering the two links options, why might it be advantageous to use diagonal links when identifying the leasable stands?

21. How much area (in square meters) is harvestable? What percentage of the total area of White Pine is this? Show all work.

22. Which image should be on top of, or cover, the other image? Why?

23. Why can't you see the roads clearly? What should you do to the **roads** image categories before overlay to make it visible on the image? (Hint: think about the *RECLASS* module)

24. On a separate sheet, draw a flow chart which shows the sequence of steps you took in going from the original 3 images (**forspec, shorline,** and **roads)** to the end product (**final)**. Label all intermediate images and identify the IDRISI for Windows function used for each step of the analysis. The flow chart should contain approximately 16 labeled boxes

25. What did you change the distance threshold to? Now how much area (in square meters) of white pine is harvestable?

26. Does the change in the threshold have minor or major impacts on the final results?

27. What does this tell you about the sensitivity of the results to changes in threshold area or distance or about the sensitivity to inaccuracies in the data?

Lab 4 CHANGE DETECTION

SECTION 1

INTRODUCTION TO LAB

THE GEOGRAPHIC THEME

Change detection is the process of identifying and assessing differences in geographic phenomena over time. It is often used to identify changes in land cover or land use on the earth's surface. GIS technology can be useful in investigating factors which change the landscape such as urban sprawl, deforestation, and desertification. Other applications of change detection include crop stress monitoring and the study of seasonal changes in vegetation.

Change on the earth's surface can be discerned by observing the same area at different times. When such *multitemporal* data are available, many GIS functions are useful in detecting areas of change and also in exploring the factors which may have caused the land to change.

THE DATA

The Africa Database contains monthly Vegetation Index (VI) data which were collected by the Advanced Very High Resolution Radiometer (AVHRR) aboard the NOAA-11 (National Oceanic & Atmospheric Administration) polar-orbiting satellite. The monthly images cover the time period from August, 1985 to November, 1988. The data is in a medium-scale, 20-minute spatial grid.

The Vegetation Index (VI) data were compiled from observed reflectance values of energy in the visible and near-infrared wavelengths of the electromagnetic spectrum. The VI is the ratio of reflected near-infrared to reflected visible energy (also known as the "normalized difference vegetation index" (NDVI)). Healthy green vegetation tends to reflect far more near-infrared energy than areas covered by dead vegetation, rocks, soil, clouds, etc. Therefore, areas with abundant healthy vegetation tend to have the highest VI values.

As values in the VI data represent the relative level of biomass at any given location, data values are quantitative. The legend shows the range of values associated with each color.

DATA FILES

The data files used are:

- **nov88**, **aug88**, **aug85 -** showing VI data
- **spring**, **summer**, **fall**, **winter -** showing average VI data over each of the four seasons
- **veg2 -** showing the Matthews' vegetation classification system using 32 classes
- **vifiles -** a text file containing the names of 14 VI images which are used when running the time series module

LEARNING OBJECTIVES

After completing this lab you should be able to:

- Carry out image differencing and image ratioing
- Establish threshold values for change
- Mask out areas of disinterest
- Display and analyze profiles over time

YOUR DATA IS LOCATED:

Set ENVIRON path to:

____

SECTION 2 - Problems
Problem 1

YOUR MISSION:

In recent years the UN has become more concerned about deforestation on the African continent. The planners in your division at the United Nations would like to know if your available data shows any significant change between August 1985 and November 1988.

EXPLORING VI DATA CHANGES

<u>Examining the Data</u>

*Use DESCRIBE on some of the VI files to see the available metadata. DISPLAY the VI image of **nov88** (the most recent VI image in the database) choosing an appropriate palette and other options for continuous data. Add some vector files to make the image easier to interpret.*

Q! 1

Use the inquiry tool  *to get data about the small area which is noticeably different from its surroundings on the northern coast of Africa (approx. column 153, row 20)*

Q! 2 & 3

Seasonal Changes in VI

TIP: use expansion factor = 1 so that the images all fit within the application window at one time

In your dataset are 4 images in which VI data has been averaged over each of the four seasons. Use *DISPLAY* to view the following four images on screen at the same time: **spring** (March-May)**, summer (**June-August)**, fall** (September-November)**, winter** (December-February). Consider how vegetation changes seasonally in Africa.

Q! 4

Detecting Change using Pairwise Comparison Techniques

Multitemporal data can be manipulated in various ways in order to discern areas which have changed and also to evaluate how much change has occurred. With quantitative data, change can be determined between two dates using the following methods:

1. IMAGE DIFFERENCING

TIP: you will have to draw a **flowchart** at the end of the lab, so you may want to take note of the steps you perform starting with the differencing of **aug85** with **aug88**.

One way to identify areas of change is to subtract one image from another. The resulting image (a "difference image") shows the differences in the values of corresponding grid cells in the two images.

You will subtract two images which are far apart in time (with respect to the available data) in order to investigate whether the VI might be generally increasing or decreasing in certain areas between 1985 and 1988.

*Use OVERLAY with the SUBTRACT option to subtract **aug88** from **aug85** (i.e. **aug85 - aug88**). Name the new image **augdiff** and use DISPLAY with the **bipolar 256** palette.*

Q! 5 - 8

TIP: if there are any values of zero in the input images, IDRISI solves the problem of dividing by zero in 3 ways:

(a) 0/0 = 1.0, i.e. no change;
(b) +ve/0 = positive infinity;
(c) -ve/0 = negative infinity.

2. IMAGE RATIOING

Instead of image differencing you can use image ratioing (one image divided by another). Use the RATIO option of OVERLAY to divide **aug85** by **aug88** (i.e. **aug85/aug88)**. Call the new image **augdiv** and DISPLAY it.

Q! 9 - 12

Detecting Change Using Other Methods

Other methods in which changes between images can be discerned include image regression (which looks at the relationship between the data of two images), and principal components analysis.

Problem 2

ESTABLISHING THRESHOLDS OF CHANGE

Areas in which VI values are decreasing over time are potential sites of deforestation and desertification. However, we have not determined what constitutes a significant amount of change. In this section, we will establish a threshold value above which change is assumed to be significant. The threshold will be used for identifying significant change in forest areas in Problem 3.

Q! 13

Numeric Histograms

A simple method of determining a threshold value is to consider a certain percentage of cells which contain the highest difference values. In the following steps, we will assign a threshold value based on the highest 1% of cell values in **augdiff**.

Use HISTO to create a histogram of ***augdiff****. Don't change the min and max values. Choose a class interval of* ***1*** *and* ***numeric*** *output mode.*

The output is a table of VI values in **augdiff** from lowest to highest. The last column in the table, **cum prop**, shows the cumulative proportion for the cell value associated with each row in the table. The cumulative proportion of a cell value refers to the percentage of cells in the image up to and including that cell value.

Scroll through the numeric histogram until you find a cumulative proportion of approximately ***0.99****.* The VI value associated with this proportion will be the threshold value, since 99% of the cells in **augdiff** have values less than or equal to this value (and therefore only 1% of the image cells have a greater value).

Q! 14

Using the threshold value calculated above, your task is to identify areas of forest that have changed significantly between August 1985 and August 1988. To do this, you will reclassify the **augdiff** image into a binary image and overlay this on a vegetation image (**veg2**) to mask out areas that have not changed significantly. Finally, you will reclassify the overlaid vegetation image so that it shows only the forest areas of significant change.

Examining the data

You will be using the vegetation image veg2. This image file shows the Matthews' vegetation classification system and is grouped into 32 categories of vegetation. *DESCRIBE* **veg2***. Scroll down the legend categories to see the range of vegetation types.*

Masking out areas of disinterest

Reclassify **augdiff** as a binary image where 1 indicates those cells above the threshold value. Call the result **aughigh**.

TIP: you might want to look at a numeric histogram to explain **vegchg**

Q! 15

In order to associate the change areas with their vegetation cover, combine **aughigh** with **veg2**. *Call the output image* ***vegchg****.*

Q! 16 & 17

TIP: to see the classes keep DESCRIBE open.

Masking out non-forested areas

The next step is to reclassify **vegchg** so that it shows only forest areas. These are areas which could be experiencing deforestation (i.e., they are forest areas whose VI values are dropping over time).

Assume that in **vegchg**, classes from **1** to **16** belong to the forest class and that all others (including **0**) belong to other classes. *Call the output image* ***deforest****.*

Q! 18 & 19

Problem 4 **PROFILES OF CHANGE OVER TIME**

The image differencing, which you did earlier, ignored the intervening dates. In order to visualize the VI data continuously over a 3-year study period, you will create time profiles. These are graphs which plot statistics of the data on the vertical axis versus time on the horizontal axis.

TIP: read Help on TSA (time series analysis). The time series file (**vifiles**) has already been created for you.

Creating a time profile

IDRISI needs 2 files to create a time profile:

- an image which defines the areas which are to be plotted (**deforest**)
- a file which contains the names of the time series images (the VI images, **vifiles**).

The **vifiles** is a text file which contains the names of 14 VI images which make up the time series data. To view the time series file, **vifiles**, *run the EDIT module,* ***but do not change the values****. Click "exit".*

Q! 20

Run PROFILE and choose the "over time" option. The image defining the "sample spots" is ***deforest*** *and the "time series file" is* ***vifiles****. Choose "mean" for this plot in order to get a general view of the trends in the data over time.*

Q! 21 & 22

Time Series Plots

Run PROFILE 3 more times to make time series plots for the "min", "max" and "range" statistics.

Q! 23 & 24

Problem 5 **TIME PROFILES OF SEVERAL VEGETATION CLASSES**

In addition to forest, you are concerned about grassland areas (grassland with decreasing VI values might also be experiencing desertification). The IDRISI *PROFILE* module can simultaneously plot up to 16 different classes of data. You are interested in the 2 classes of forest and grassland.

HINT: the reclassification will no longer be binary since you now have more than one class.

You will need to determine which legend categories are grassland in **veg2**, then reclassify the **vegchg** image to include both forest and grassland. Call the new image **change2**.

*Now run PROFILE again using **change2** and specify "mean" for the plot.*

This time you will see 2 lines on the plot labeled 1 and 2. Each line on the plot represents the VI value over time for a single vegetation class.

Q! 25 & 26

Name: ____ Date Due: ___________________

TA: ____ Completion Time: ____________

QUESTION & ANSWER SHEET

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1. Which areas appear to have lots of vegetation? (high VI values). Which areas seem to have sparse or unhealthy vegetation? (low VI values)

2. What is this place? What is its z-value? What is the linear feature extending southwards from there?

3. Why do these features stand out so sharply against their surroundings in terms of their vegetation index?

4. Which vegetation types have VI values that don't vary greatly throughout the year? Which types show considerable seasonal fluctuations in vegetation index?

5. Why is the bipolar palette good for displaying this image?

6. What do high positive values indicate on **augdiff**? What do low negative values indicate?

7. Why do you think the ocean shows variability in VI values? Wouldn't you expect it to appear the same year after year and thus show a difference of zero?

8. Given that this data has been collected by satellite sensors, aside from an actual change in the vegetation cover, what else might cause a cell's value to fluctuate over time?

9. What do high values mean on **augdiv**? What do low values mean?

10. How is this image different from **augdiff**? Does it convey the same information? Is it easier to interpret?

11. What happens to the magnitude of the ratio the smaller both VI values get? In what circumstances might this be useful?

12. Which method - differencing or ratioing - seems to be better for revealing areas of change?

13. What criteria could be used to help determine a threshold value for significant vegetation decrease?

14. What is the threshold value you found? (Use the “lower limit” and “upper limit” columns to determine the threshold, not the “class” column created for this histogram.)

15. Do you see any pattern associated with the areas now categorized as significantly changed? Are they evenly scattered about the image? Do they occur at similar latitudes? Do they occur at a certain distance from the coast?

16. What are some of the vegetation types that are present in **vegchg**?

17. Why do you see almost no desert areas in **vegchg**?

18. Describe any spatial pattern in the areas of potential deforestation.

19. On a separate sheet, diagram a flowchart which shows every step of the analysis from the initial data layers (**aug85** & **aug88**) to the final image **deforest**. Be sure to label each image and each IDRISI function used to create the images.

20. What do the first 2 numbers in the file signify?

21. What does the vertical axis of the plot show?

22. What general trend is apparent in the data? Is there a seasonal component to the temporal changes in VI values?

23. How does August 1988 seem to fit in with the typical seasonal cycle of VI values?

24. After viewing the time series profiles, are you confident that you captured accurate change over that time? Which year skewed the data? What does this tell you about temporal resolution?

25. How do the 2 vegetation classes vary with respect to each other?

ARCVIEW SUPPLEMENT

SECTION 1
What is ArcView?

ArcView is a vector based GIS software package, with raster viewing capabilities, distributed by ESRI (Environmental Systems Research Institute) in Redlands, California. It is a desktop display and query tool that has some spatial analysis capabilities. Data cannot be created in ArcView, but rather in ESRI's original software, Arc/Info.

Lecture has taught you that in GIS there are two common ways to model the world, **raster** and **vector**. The previous labs have dealt with the raster model and the following labs will deal with the vector (or object) based model. Vector GIS stores the geometric description of an object (point, line, or polygon) and its location separately from a table of its attributes. The table of attributes contains fields (-#, -id, etc...) which are pointers to other tables that contain the description and location of an object (or feature). The rest of the columns in the table contain tabular data (demographics, soil type, flow rates, date, etc...) pertaining to each feature.

With ArcView a user can perform the following tasks:

- Display spatial data, Arc/Info data and other data formats
- Display tabular data on a view
- Use SQL (Standard Query Language) to retrieve records from a database
- Geocode tables containing addresses and display them
- Find attributes of any feature on a view
- Classify features with different symbols
- Select features according to their attributes
- Create charts showing the attributes of features
- Summarize the attributes of features
- Select features based on their proximity to other features
- Find places where certain features coincide
- Layout a map and print it.

SECTION 2
Data that can be used in ArcView

Data that describes the Earth's surface or the features found on it are called geographic data. This includes not only cartographic and scientific data, but also business data, land records, photographs, customer databases, travel guides, legal documents etc. Geographic data from a variety of sources can be used in ArcView.

Spatial Data stores the geometric characteristics and location of geographic features. Attribute information related to the geographic features describe what these features represent. Spatial data are called **themes** in ArcView and coverages in Arc/INFO. Some examples are lakes, cities, vegetation zones, roads, rivers, fire hydrants etc.

Image Data includes satellite images, (aerial) photographs and other remotely sensed or scanned data stored in raster format. In ArcView you can access image data by selecting **Image Data Source** in the **Add Theme** dialog box.

Tabular Data can include almost any data set whether or not it includes geographic data. Some tables can be viewed from a theme directly and others may contain additional attributes that can be **joined** to your existing data through common fields.

SECTION 3
ArcView: Terminology & User Interface

In ArcView you work with **view, tables, charts, and layouts**. They are all stored in one file called a **project**, you work with one project at a time and there are different windows within a project.

******To make anything *active* (view, tables, chart, layout, theme, etc..) just click on the window in which it is displayed. NOTE: The available menu items and tools change according to what type of window is active, only one window can be active at a time.

<u>Terminology and Basic Descriptions</u>

Project

A project can be thought of as a collection of documents, where a document is a view, table, chart, layout or script that you create. In reality it is a file that ArcView creates so that the users can organize their work about a single topic. Projects always have **.APR** extensions. The **project window** allows the user to manage and list the documents in the current project. To access the project menu and tools, the project window must be active. To open an existing project, make sure the project window is active and select **File/Open Project.** To start a new project select **File/New Project.** Projects contain any number of the following:

View

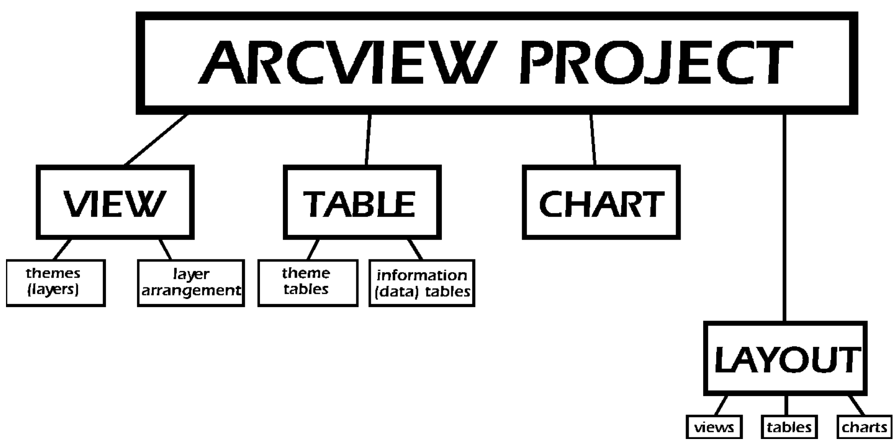
A view appears in a view window as an interactive digital map for display, query and analysis. The window must be active if you wish to use the view menu and tools. A view is a collection of **themes.** The view legend defines how the themes will be displayed and organized. The user can **zoom** in to a certain area by selecting the zoom tool and drawing a box around the desired extent of the zoom. Individual objects of a theme can be selected and identified on the view by using appropriate tools. A view has **view properties** (title, projection, map/distance units) which can be altered by selecting the **View/Properties** box.

T**heme**

Themes are thematically related sets of a single type of spatial element (e.g. points representing wells, lines representing roads, polygons representing census tracts). Themes are added to an active view by selecting **add theme** in the button bar. The display of themes can be turned off/on by clicking on the ✓check mark box in the theme box. The user can add, delete, copy, paste or create new themes in the view window. The display sequence of themes can be changed by clicking and dragging themes up and down in the view legend. The theme at the top of the legend will be drawn last so that it is on top of the others. Graphic display attributes for a theme can be customized by *double-clicking on the theme* and using the **legend editor** and **color palette** to create the desired look. Themes have **tables** which can be displayed in a **table window** by clicking on the **show table** button when the desired theme is active (shown by a highlighted box in the theme legend).

Tables

Tables of data pertaining to themes are displayed in tables windows and can be accessed once a theme is added to a view. In order to access the table menu and tools, the window of the desired table must be active. Tables store tabular data which can be displayed, queried and analyzed. Each record (row) corresponds to a single feature in the theme. The **fields** (columns) along the top of a table are the **attributes** (e.g. population growth, birth rate, etc.). There are two types of tables used in ArcView. The first type is a *theme table* which is directly related to the geographic features displayed in the view. The second type is a *data table*. This table contains additional data from any tabular data source and has no direct geographic expression. The functions of **link** and **join** are performed on tables. A *data table* can be **joined** to a *theme table* to increase the number of attributes for a theme. Selected features can be highlighted in both tables and views.



Charts

Charts display tabular information graphically in chart format (pie charts, scatterplots, bar graphs, etc.). Charts reflect the current status of the data in the table, if the source data changes it is automatically reflected in the chart. In order for a user to access the chart menu and tools, the desired chart window must be active.

Scripts (not used in these labs)

A script is a program written in Avenue, the ArcView programming language. Avenue allows a user to customize the GUI (graphical user interface) and otherwise alter and enhance the functionality of ArcView.

Layouts

Layouts allow you to organize, display, and print any combination of the above documents in one window so as to produce a final product within your project. The user can add a title, scale bar, legend and north arrow to a layout. The layout window is where you will organize a layout for **printing.** To access the layout menu and tools, the desired layout window must be active.

Menu, Button, Tool & Status Bars

The **menu** bar at the top of the application window provides command choices and contains pull-down menus (**File, Edit, View, Layout** etc.).

The **button** bar is directly underneath the menu bar and provides shortcuts for commands contained in the menu bar.

The **tool** bar is underneath the button bar. The tool bar icons let you modify the action of the cursor.

The **status** bar is the bottom of the application window. If you pass (without clicking) the mouse over a button or tool you will see a description of the button or tool operation here.

Lab 5: EXPLORING VECTOR GIS WITH ARCVIEW

SECTION 1
Introduction

THE GEOGRAPHIC THEME

Exploring geographic data as an aid in decision-making.

THE DATA

The data you will be exploring covers the lower 48 United States. Themes include city and state demographics, interstate routes and state boundaries. The demographic themes include information from the 1990 census such as population, percent male and female, median rent and so on. The project contains one view, the Conterminous United States and four themes: Cities (over 100,000 population), Interstates, Lakes, and States.

LEARNING OBJECTIVES

After completing this lab you should be able to:

- Display data (maps and tables) and do some simple querying
- Manipulate the ArcView windows environment
- Understand the terminology used by ArcView
- Use the online Help
- Select information about a record

APPLICATION AREA

Real-time political campaign planning, routing

SECTION 2
Vector GIS

INTRODUCTION TO WINDOWS & VECTOR GIS

Open ***ArcView*** *by clicking on the ArcView box in the* ***program manager****. Then click on the* ***ArcView 2*** *icon to open an* ***application window****.*

In the ***menu bar*** *go to* ***FILE/OPEN PROJECT*** *and locate your data*

YOUR DATA IS LOCATED: Path: ____

TIP: to save re-drawing time, you may want to turn off themes you are not using

When the project opens, all the themes in the **view** will be turned off. Find out what is available by turning on each theme as described below.
*To make a **theme** in the **view** visible or invisible, click on the box or* ✓ *check mark in the theme you want to turn on / off.*

The view clearly needs to be manipulated in order to make the map look more presentable. Follow the instructions below.

---

1. Display

TIP: from the menu bar, choose **HELP/CONTENTS/HELP/ ALWAYS ON TOP** and use Search for Help on ... for full explanations. Click on the down arrow button on the title bar of Help to reduce the help window to an icon. To recall Help, click on the icon.

Theme Order

To move the polygon themes (lakes and state) so they appear underneath the point and arc themes, hold down left mouse button while pointing with the cursor at *the theme **state**. Drag the box to the bottom of the list of themes. Do the same to **lakes.***

*Turn off the display of **cities** and **interstates** using the check box.*

Active Theme

Themes must be made **active** in order that they are responsive to analysis using the tool, menu and button bar commands.

To make one of the themes **active** *place the cursor over the name of the theme and click mouse once.*

*Make the **state** theme active. A gray box should appear around the **state** theme.*

View Properties

The view's appearance, or properties, can be changed. For example, the projection of the US can be changed.

NOTE: changing the meridian and parallel information will change the centerpoint of the projection. Notice that the latitude and longitude selected are within the United States.

*Go to **VIEW/PROPERTIES/PROJECTION**. Click on **standard**. From the **category** box scroll down to and choose "Projections of the United States". Since this view is of the conterminous US, in the **type** box click on the down arrow and choose **Lambert Conformal Conic (conterminous US)**. Hit **OK**.*

You will notice that **map units** have already been set as **projected meters**. The map units are determined during data creation.

Now you need to set the **distance units** so that measurements on the view can be made. *Click on the down arrow of distance units and choose **miles**. Hit **OK**.*

Color of Themes

To change the colors, *with the cursor on the **state** theme double click the mouse. This brings up the **legend editor dialog box**. Double click on the colored rectangle under the symbol heading, which brings up the **fill palette**. Click on the **paintbrush** to get the **color palette**. Click on a color, then hit **apply** in the legend editor dialog box.*

*To close the dialog boxes (or any window), double click on the top left hand corner of the **title bar**. To make a window fill the screen click once with cursor on the up arrow on the right hand side of the title bar.* (The down arrow creates an icon in the lower left corner of the application window. The window can be re-opened by clicking once on the icon.)

HINT: as you pass the cursor over the buttons, their function appears on the status bar at the bottom of the application window.

Object Identification

To identify an object of the active theme in a view, *click on the **information about a feature** tool*  *from the toolbar.*

*Place the cursor on the map and click once on California. The **identify results** dialog box shows the details stored about the state.*

Q! 1 & 2

HINT: the button and tool functions apply to the active theme only.

Now identify the lake in Florida.

Q! 3

You can obtain information about any active theme. More than one theme can be made active by holding down the **shift key** and clicking with the cursor over a second, third etc., theme.

Experiment a little with variations on this function.

Close the identify results window.

TIP: read the Help on **scale**

Scale

A view's scale is shown on the right hand side of the tool bar. A view's scale is displayed as a representative fraction, and is thus true for whatever units in which the fraction is expressed. There are a few different ways to zoom in and out of a view, here is one way.

Click on the zoom out center tool.

Q! 4

Now use the button to zoom to the extent of all themes.

Q! 5

In ArcView you can't generalize the spatial data itself, but you can set the range of map scales at which a theme is drawn on the view by defining a **scale-dependent display property**.

*Turn on the **cities** theme using the check box.*

Q! 6 - 8

To set the scale-dependent display property of the cities theme, *make **cities** the **active** theme. Go to **THEME/PROPERTIES/DISPLAY**. In the **maximum scale** box type in **10000000**. Hit **OK**.*

Now cities do not appear on the view at the current scale. To see the cities now, *change the scale in the tool bar by clicking with the cursor inside the box and typing in a number less than **10000000**. Hit **Enter** on the keyboard.*

The view will now be zoomed into the center of the map. To move the map around the view at this scale, c*lick on the **drags the display** ... tool and place this cursor in the view. Hold down the mouse button and drag the cursor to move the map.*

When you have finished, *with **state** theme active zoom back to the extent of the **state** theme*

Q! 9

From your answer to question 9, *use the **zooms in on a rectangle you drag** tool to select a box from the view that will be of a scale large enough to show the cities.*

Q! 10

2. Attributes

Vector GISs represent features in the real world as spatial objects (e.g. cities as points, roads as lines and urban areas as polygons). Features have characteristics called attributes (e.g. the area of a city). ArcView accesses the data source it displays, but does not contain the data itself. That is, the tables you see in ArcView are a dynamic reflection of data stored in external databases (such as Arc/Info coverages or dBASE files). Every table you see in ArcView has basic fields (ID and # fields) that are necessary for ArcView to reference the data in the database. Hidden tables store information used to define the shape, type (point, line and polygon) and placement (geographic location) of the object.

The ID field references both rows in the themes attribute table and the file containing the geometry and location of features.

Q! 11

---

3. Selecting Features

Relating tables to the spatial themes enables spatial searches to be performed using the attributes of features, which, in ArcView, are represented as spatial objects in the view.

To bring up a theme's table, make the ***view*** *the active window by clicking with the cursor on the* ***title bar****, which will become highlighted. Make* ***state*** *the* ***active*** *theme. To bring up the* ***attribute table*** *for* ***state*** *theme, click with the cursor on the* ***opens table*** *button in the button bar* .

You can also open table windows by clicking with the cursor on the word **tables** in the **project window.**

Then double-click with the cursor on the required table name.

In addition to ***Attributes of State****, open the tables for* ***Attributes of Cities*** *and* ***Attributes of Interstates****.* Familiarize yourself with the fields of the tables you have brought up on the screen.

Q! 12

Selecting Features from a View

TIP: hold down the shift key and click with the cursor on other features in order to select more than one feature.

Make sure the ***state*** *theme is active. Choose the* ***selects features in the visible, active themes*** *tool* *. Click on a few states in the view.* You should see the states highlighted and the corresponding records in the attribute table also highlighted.

*To see several highlighted states together in the table, make the table **active**. Use the **promotes selected rows to the top** button in the button bar . To **unselect** features, click on the **unselect** button in the button bar .*

Selecting Features from a Table

HINT: in order to highlight objects in a theme by selecting features from a table, that table's theme must be active in the view

The same process can be done in reverse. *Click on a record in the **Attributes of State** table. The object linked to that record will become highlighted in the view window.*

Box Selecting

*Using the **selects features** ... tool again, draw a box on the view by clicking the mouse and dragging the cursor diagonally.* All the states within and intersecting the box will be highlighted.

Modifying the Appearance of a Table

TIP: To make the table easier to read, unwanted fields can be turned off. *Go to **TABLE/ PROPERTIES** and in the **visible** column, click off the check marks to the first 5 fields. Hit **OK**.*

You may wish to see the state name field in the table next to another field (rather than scrolling through the table). You can move the fields by clicking on and dragging the field name horizontally to the desired position.

To change the width of columns, place the cursor between two field headings until you see double arrowheads, click and hold the mouse button while dragging horizontally to enlarge/shrink.

Finding a Feature

*Another type of query is finding the location of a feature. Click on the **finds features** ... button . In the dialog box, search for a state of interest to you using the State's name.*

Q! 13

SECTION 3 - Problem
Exploring & Querying

Exploring & Querying the Data

You are working for a potential presidential candidate who lives in California and it is nearing election time. The campaign manager has asked you to prepare a plan for a visit to the first few states the candidate will visit by road before the election. The candidate's campaign is based on family values, so the manager wants to begin by rallying support in states which have a large proportion of two parent families. The candidate is sitting beside you and starts by asking:

"Which states have at least 30% of all households with both parents?"

TIP: ArcView specifically requires certain parentheses in the query box, but by clicking with the cursor on the fields and icons, these are inserted automatically. Search Help on **query builder**.

*To perform a query on a table, bring up the **Attributes of State** table. Choose the **query builder** button. To build a query on states which have >= 30% married households with children (**P_Marhhchd**), double-click on **P_Marhhchd**. (You will need to scroll to see the field.)*

*Now click once on **>=** and then type **30**. Click on **new set**. Close the query builder dialog box, use the **promote** button to list the selected set at the top of the table. Look at the far left of the tool bar to see how many records have been selected.*

"There seems to be some pattern there!"

Q! 14 & 15

"What additional states have at least 30% of all households with childless married couples?"

*Perform a second query on the table asking for **P_Marhhnoc >= 30**. Click on **add to set**.*

Q! 16 - 18

TIP: browse through Q 19-23 to be aware of what is required from the following dialog.

"Hmm, let's be sure to remember which were the first states that we selected, since they are the most important ones that I should visit."

"Now, let's find a route which goes through all these states. I want to start in Portland, Oregon and end in San Antonio, Texas".

TIP: you may want to turn off the state theme momentarily to locate the start and end cities (which will also be highlighted in the same color)

"I think 8 stops total will be enough. Let's see which major cities I should go to so I can stop in each state at least once."

TIP: you may want to change the scale dependent display property of cities so they are shown when the display is at a smaller scale

Use zoom tools and information tool to find suitable cities.

"Hmm, there's a gap. What additional states should I visit? Let's choose the best ones."

You could use the label tool to label the Interstates as you plan the route. First you will need to make sure the label will be an Interstate number: go to THEME/PROPERTIES/TEXT LABELS then in the box next to label field scroll down and click on Route. Click OK. Now you can click on the label tool  *and then on the Interstates in the view to see a label appear.*

"OK, let's plan the route. Where shall I go and how long is the route?"

Q! 19 - 23

Name: ______________________________________ Date Due: _________________

TA: ____ Completion Time: ___________

QUESTION & ANSWER SHEET

---

1. What is the population of California in 1990?
2. What was the population of North Dakota in 1990?
3. What is the name of the lake?
4. What happens to the scale as you zoom out? (Remember to think of the scale as a ratio or representative fraction, such as 1:24,000 or 1/100,000)
5. What does the scale ratio represent?
6. Describe the spatial pattern of cities across the US. Where does there appear to be grouping?
7. What problem does this display present?
8. Why might you use the scale-dependent display property with the cities theme?
9. There are several other ways to zoom besides zooming to the extent of the active theme. What are these ways? (Hint: see Help)

10. What is the smallest scale ratio at which the cities theme will appear?

11. What are advantages or disadvantages to using a related table with ID numbers?

12. What are the necessary fields for a point, line and polygon table. The necessary fields are usually within the first few fields of the table.

    Point Table: (hint, there are 4)

    Line Table: (hint, there are 7)

    Polygon Table: (hint, there are 4)

13. List the state you have chosen, 5 demographic fields and their values.

14. How many records are selected?

15. What is the spatial pattern in the selected set?

16. How many states are selected?

17. What is the difference between **add to set** and **new set**? (Hint: check Help and search for help on ... add to/new set.)

18. What does **select from set** mean?

FOR QUESTIONS 19 - 21 THERE ARE NO SPECIFIC <u>CORRECT</u> ANSWERS.

19. List the 8 cities and their states. (The first city is Portland, Oregon and the last is San Antonio, Texas.)

20. Which Interstates should the candidate take via the cities to minimize travel time?

21. Approximately how many miles is the tour of the states from question 19? (Hint: use **distance** tool in toolbar .)

22. Explain how you used ArcView to make your decision (i.e. which tools etc.).

23. Think of some other questions you might ask about this data? Write some more dialog for this politician using your questions.

Lab 6: SITE-SUITABILITY ANALYSIS

SECTION 1
Background

INTRODUCTION TO LAB

THE GEOGRAPHIC THEME

An often used capability of GIS is **site-suitability analysis**. By performing spatial searches, an analyst can locate places that are best suited for either an activity (logging, campaigning, bike touring) or a facility (dump site, resort hotel, dam, protected area).

THE DATA

The Atlanta regional dataset provides a wide selection of geographic data. The data set also provides a hierarchy of census areas and accompanying tables. These tables include various demographic information which will be of use.

LEARNING OBJECTIVES

After completing this lab you should be able to:

- perform an interactive query (tabular and spatial)
- manipulate tables (joining tables)
- perform point-in-polygon and buffer queries
- prepare hardcopy results

APPLICATION AREA

Geodemographics and market analysis

SECTION 2
Lab Procedure

INTRODUCTION TO THE EXERCISES

This lab includes two site-suitability analysis problems.

1. The first is to locate a shopping center from a total of about 200 shopping centers that meets the requirements given to you.
2. The second is a more flexible search for between 5 & 10 areas (census tracts) in which a resort hotel may be located. This search requires you to determine your own logical requirements.

YOUR DATA IS LOCATED: Path:____

SECTION 3 - Problems
Siting a shopping center

YOUR MISSION

You are a GIS analyst for a major **discount** supermarket chain. With expansion in mind, your bosses have given you the task of **siting a new supermarket** within a suitable shopping center in the greater Atlanta, GA region. Fortunately for you, two major steps toward this goal have already been completed by the previous analyst. First, they painstakingly created a tight database that has every piece of data you could need to perform this analysis. Second, market research has outlined the spatial search conditions for the problem.

Market research has identified the following logical conditions as being economically viable:

The shopping center:

- must be greater than 200,000 sq. ft
- must be located in a tract that has an average income of less than $30,000
- must be less than 0.5 miles (i.e. very close) to a major highway (not just a street)

Q! Answer questions 1 & 2

LAB PROCEDURE

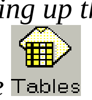
Go to FILE/NEW PROJECT to create a new project, add the appropriate themes (from question 2) and bring up their tables. *To add themes, click on **new** in the project window to obtain a new view. You will now add themes to this view. Click on the **add theme** button*  *for a list of the data. Navigate to your data location path and click on the file icon next to the name of the file you want to add. You will see the feature type listed, e.g. arc, polygon, route etc. You can select several themes to add by using the shift key and clicking on the files.*

***** Before you start the lab, you need to complete the following procedures:

NOTE: the map projection and distance units need to be defined in order to carry out spatial queries.

1. *Under VIEW/PROPERTIES set the **map projection** category to **State Plane 83** and **type** to **Georgia West**. Then set **distance units** to "miles"*

2. To **query** the Tracts table for average income *you need to* ***JOIN*** *the "demographics by tract"* ***(trdemog)*** *table to the "****Attributes of Tracts****" table.* This will append the demographic data to the tracts coverage through the fields **Tract**.

- *Bring up the table* ***trdemog*** *by clicking with the cursor on the*  *icon then click on* ***ADD*** *in the* ***project window****. Import the table as you would a theme.*

TIP: use HELP and search for help on JOIN.

- To join the **trdemog** table to **Attributes of Tract** table *you need to identify a common field, i.e., ones where the contents of the fields are the same (e.g. Tract).*
- The **destination** table should be **Attributes of Tract**
- *(OPTIONAL) Rename your joined table by clicking on the menu bar* ***TABLE/PROPERTIES.*** *(e.g. Title=Tract & trdemog)*

Q! 3 - 5

Buffer

Now you are ready to find the ideal location. Start by finding all the shopping centers within 0.5 miles of a route:

Make ***shopping centers*** *the active theme. Go to* ***THEME/SELECT BY THEME****...set the dialog box to proper search parameters and click on* ***new set***

.

(Result: There should be 161 selected, which is shown on the top bar of the application window when the table is active.)

Q! 6

Now for the above selected subset, extract the records for all shopping centers that are greater than 200,000 sq. ft in size:

With the shopping center theme active, use the ***query builder*** *button*  *to build the appropriate query and* ***select from*** *the* ***set*** *of 161.*

(Result: There should be 47 selected out of the 161.)

Point in Polygon

Use **select by theme** to find the tracts (active theme) that **completely contain** the selected shopping centers using **new set**.

(Result: There should be 37.)

Q! 7

*Use the **query builder** again to find which of the already selected tracts has an average income of less than $30,000.*

(Result: There should be 1 tract with a value of 006700 in the field "tract".)

*Use **select by theme** to find the shopping centers (active theme) that **have their center in** the selected features of tract.*

(Result: There should be one shopping center, Crossroads Mall)

Q! 8 & 9

Problem 2
Siting a resort

YOUR MISSION

Now you are working as a freelance GIS analyst/consultant. As part of the contract that awarded Atlanta the 1996 Summer Olympics, the International Olympic Committee specified that more resort lodging was required to house spectators. Izzy Hotels has hired you to help them locate possible areas in which to site a luxurious resort hotel. Based on the scale and detail of your data, you are to find a range of possible locations for the hotel.

This time you will identify between 5 & 10 (out of 482) census tracts that would be suitable for the hotel and merit further investigation.

YOUR DATA IS LOCATED: Path:____

You must now determine the logical conditions for your search. Some considerations are: proximity to the coast or other water bodies, proximity to other hotels, accessibility, standard of living in the area.

Q! 10 & 11

*Begin by starting a **new project**. Add appropriate themes from the Atlanta regional dataset. Use any of the ArcView functions to complete your search. These may include **LINK, JOIN, SELECT BY THEME**, overlay functions, buffering, point-in-polygon and so on…*

Q! 12-18

SECTION 3
Creating layouts

TIP: use HELP and start the TUTORIAL on LAYOUT

PRESENTATION

Presentation is an important aspect of your analysis. *Create a **layout** of your project including the **view, table** showing the final selection of fields and tracts, scale bar, north arrow and title.*

Print a copy of your layout and attach it to your question and answer sheet.

Name: ____________________________________ Date Due: ________________

TA: ______________________________________ Completion Time: ___________

QUESTION & ANSWER SHEET

1. What are the possible reasons for each of the theme requirements?
   - Square footage > 200,000:
   - Average Income < $30,000:
   - < 0.5 miles from a route:

2. What data themes will you need to complete this query? Include path.

3. Why is setting the distance units important? What would happen if the distance units were not set?

4. Why must the tables to be joined have a common field?

5. Investigate **JOIN** and **LINK** in Help. What is the difference between these two table functions?

6. How was this buffer operation different from ones you did in the raster labs?

7. Could you perform a point-in-polygon operation in the raster model? If YES how? If NO why not?

8. What would happen if you did the spatial search in a different order?

9. On a separate sheet, draw a flow chart of the operations you used.

PROBLEM 2

10. Without specific reference to your available data, list at least 4 characteristics which might be important for locating a resort hotel.

11. Given the available data, what themes and logical conditions can you use for this exercise? How would you organize your steps in a flowchart form? *(Note - if you did not find all of your 4 themes in your data, repeat question 10 until you have 4 to use here.)*

- Themes:

- Logical conditions:

- Steps (in flow chart form):

12. How many tracts did you locate? What are the **tract** reference numbers?

13. Did you end up with a helpful conclusion? If so, explain why. If not, what were some problems?

14. Considering the spatial location and demographic data, which out of those tracts located would you choose and why?

15. How could you change the parameters used in this search in order to make them more effective?

16. What are some different (not provided) data that might have made this a better search?

17. What limitations & capabilities can you see for using GIS in site location?

18. Could these types of queries be done in a raster data model? Why?

Lab 7: GEODEMOGRAPHICS & SPATIAL PATTERNS

SECTION 1
Introduction

INTRODUCTION TO LAB

THE GEOGRAPHIC THEME

GIS is useful for dynamically analyzing spatial and temporal patterns. Data can be manipulated easily to yield information about geographic phenomena, such as the distribution of demographic data over time.

THE DATA

Problem 1 uses Atlanta regional data including: a table of sights of interest in downtown Atlanta and a downtown streets theme. Problems 2 and 3 use the Atlanta region's tracts, demographics and banks.

LEARNING OBJECTIVES

After completing this lab you should be able to:

- Geocode streets by address
- Add event themes by geocoding addresses and latitude / longitude
- Classify themes by different fields
- Define themes as new themes
- Create shapefiles
- Edit tables by adding fields and records
- Calculate new fields in a table

APPLICATION AREA

Determining spatial and temporal distribution patterns.

SECTION 2
Geocoding and Address Matching

TIP: open HELP and use it ALWAYS ON TOP for this lab

PROBLEM 1 - PLANNING A TOUR

You are a GIS analyst and you own a map dealership in Atlanta, GA - The Mappe Shoppe, 160 Luckie Street N.W. A tour company has contracted you to plan a bus tour of the downtown area. They have given you a list of 27 sights that are possible candidates for visitation. Being an opportunist you realize the power that you have in directing a steady flow of money spending tourists almost anywhere you choose. The tour company has agreed that one of your benefits in working for them can be adding your map dealership to the tour. The only specification they have is that you must plan the tour to include a least 10 sights on the list given to you.

YOUR DATA IS LOCATED: Path: ____

LAB PROCEDURE

Address matching is a type of geocoding that allows you to use addresses to identify locations along a network (e.g. streets). In essence, all data spatially referenced to the Earth is geocoded, that is, "tied" to the Earth by a coordinate system. However, in order to use a network theme as a basis for geocoding other data, the theme must contain certain attributes and be set up to handle operations, such as address matching. Then, any table which contains address data may be geocoded to the network. This creates a new theme.

TIP: read HELP on "What is Geocoding"

Q! 1 - 3

<u>Add themes to new project</u>

*Add theme to view: **streets***
*Add table from project window: **sights.dbf***

<u>Prepare streets theme</u>

You will need to prepare the streets theme so that tables can be geocoded to it. *Under **Theme/Properties** is the **Geocoding** dialog box.* As you will be doing address matching, *change address-style to **US Streets**. Click OK.*

<u>Shapefiles explained</u>

HINT: For more information on **Shapefiles**, use HELP

Later in the lab you will need to view and edit the **sights** theme. In order to do this you need to create a **shapefile** that you "own".

ArcView **shapefiles** are a simple, non-topological format for storing the geometric location and attribute information of geographic features. Shape files are used to:

- display features more rapidly
- edit the geometry and attributes of features
- create new themes based on a shapefile format (*important for next step)

You can work on a shapefile as you would any other theme.

<u>Geocoding (by address) the table to the streets</u>

To plan the route for the tour you will need to geocode the **sights.dbf** table so that it can be displayed on a view. This is done by address matching **sights.dbf** to the streets theme. This automatically creates a **shapefile** which appears as a new theme in the legend.

*While **streets** is active go to the menu bar and use **View/Add Event Theme.** Choose the correct Event Theme (i.e. **sights.dbf**) and the **address option**, which is an icon*  *in the top left of the dialog box. Click OK. Name the new shapefile in the resulting file dialog box.*

****The Geocoding Dialog Box will take a few moments to display****

Click START, wait until finished, then click DONE

<u>Editing the table</u>

You now need to add your shop to the new shape file theme table. Edit the ***Attributes of (the shapefile you created) table***. To edit the table of the shapefile you must be in edit mode. This is done by making the table active and going to **Table/Start Editing**. When you are finished editing you must remember to Stop Editing.

HINT: Don't forget to open the final shape file's table so you can select features simultaneously in the view and table

*Start editing and **add** a **record** to the shape file theme table (it will be added to the bottom of the table) then fill in the fields. *Use edit tool* *. Enter your shop's name and address.* ArcView will fill in the rest of the records when geocoding is completed.

You must *STOP EDITING* the table! (go to Table/Stop Editing)

Q! 4

<u>Geocoding (by address) the edited shapefile table to the streets</u>

Make sure nothing is selected in the attribute table, then Add Event Theme to streets theme and use the correct Event Theme (i.e. the edited shapefile table). Remember to **wait for**

the Geocoding Dialog Box, then do as before.
Bring up the table for the new shapefile, it will contain your shop which is now visible on the view.

<u>Choosing your route</u>

*Now choose a route along the streets that will pass 5 sights then your shop then 5 more sights. You can use any of these tools (identify), (select), or (label) to get information about the **streets** or any other theme.*

Q! 5 - 7

<u>Geocoding using other georeferencing systems</u>

There are other ways to geocode features. As an experiment, one of your colleagues used a GPS to determine the true locations of some sights which you have just address matched. These locations are stored in the file ***sightxy.dbf.*** The file contains all your 27 Atlanta sights plus other sights around the region.

*Now add the table **sightxy.dbf** and **geocode** it using **lat / long** instead of address.*

Compare the placement of the sights these two files share in common.

Q! 8

SECTION 3
Change Over Time

PROBLEM 2 - DIFFUSION OF BANKS

Decisions to establish new bank branches are made following detailed financial and demographic analyses of potential locations. With the data we have available, we can uncover one of these decision factors by examining the diffusion of banks in the Atlanta region in relation to population growth. The issues you will need to consider are:

- What data do I have which can be used to illustrate the diffusion of banks?
- What data do I have to determine the rate of population growth in census tracts?
- What are the growth rates in census tract population during the recent period of rapid bank diffusion?
- Is there a geographic pattern in the growth rates?
- Is there a similarity in the geographic patterns exhibited

by population growth rates and bank diffusion?

LAB PROCEDURE

Following are some hints to help you complete this problem:

- Create a new view
- Add themes to view: ***banks, tracts***
- Join the tract demographics table to the tracts theme table
- Convert tracts into a shapefile so you can edit the table
- Add field: population growth 80 - 93
- Calculate population growth into new field
- Classify tracts by population growth
- Classify banks by year established

Hint: formula for % growth:
[Pop_93]-[Pop_80]/[Pop_80]* 100

TIP: follow the Tutorial on charts (it is easier to understand than HELP) then create your own chart from your data.

Q! 9 - 13

SECTION 4
Redefining Themes & Classification

PROBLEM 3 - DEMOGRAPHICS OF BANK LOCATION

To continue our examination of the demographic aspects related to decisions to establish new banks, we will now focus on a single bank, Bank South NA (a former National Association bank), and its many branches. The issues we will consider here are:

- Is there a spatial pattern to the distribution of the Bank South NA branches?
- Of the many Bank South NA locations, which one is the main branch?
- What are the special demographic characteristics of this location?
- Is there a spatial pattern exhibited by the bank branches when they are classified according to the total amount of bank deposits at each branch?
- When considering the year of acquisition, some years show large numbers of new branches.
- What else can I learn about the geography of Atlanta by examining all of the data I have available?

LAB PROCEDURE

These are some suggested steps you *may* want to take while working on this problem. By now you should be familiar enough with ArcView to do any steps you think necessary to answer the last few questions.

- Create a new view
- Copy and paste the tracts shapefile and the banks theme (this way you can visually compare 2 views of the same theme, the changes you have made to the original theme will not have to be repeated in the next view)
- Change the definition of the banks theme so that it includes only the Bank South NA banks
- Classify banks by deposits 94'
- Classify banks by branch number

Q! 14 - 23

Name: ______________________________________ Date Due: _________________

TA: ____ Completion Time: ___________

QUESTION & ANSWER SHEET

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1. What do you gain by associating addresses to geographical features?

2. What geographic feature is usually used to determine the location of an address? Suggest some others which might be used.

3. How does geocoding by address matching work?

4. Why do you now need to geocode the shapefile table again?

5. Which sights does the tour pass by and what are their addresses?

6. Which streets should the tour take?

7. What other information about the streets might have been useful for this tour?

8. Why are the address matched locations less accurate than the actual locations?

PROBLEM 2

9. What data do you have which can be used to illustrate the diffusion of banks?

10. What data do you have to determine the rate of population growth in census tracts?

11. What are the effects of *quantile, equal interval* and *unique value* as a method for classifying attributes?

Quantile:

Equal Interval:

Unique Value:

12. Which method of classification is best for the range of the data values for population growth? Why?

13. What does your analysis show about the diffusion of banks in relation to the growth of population around Atlanta?

PROBLEM 3

14. Describe the spatial distribution of Bank South NA.

15. Which do you think is the main branch of Bank South NA? (Hint: it is not necessarily the oldest bank.) How did you determine this?

16. Where is the main branch located in relation to the other branches?

17. Describe the demographic characteristics of the tract containing the main branch.

18. Are these the demographics you would expect to encounter? Why?

19. Considering a classification of the branches by "deposits '94", where are the banks that have the highest amount of deposits? What does this tell you?

20. To which field does branch number have the closest correlation, *year established* or *year acquired*?

21. When considering the year of acquisition, some years show large numbers of new branches. Why might this be?

22. Does the spatial distribution of branch acquisitions suggest anything about the way this bank expanded?

23. Is the main branch located downtown? How do you know?