

## **Introduction to Spatial Data Resources and Analysis for research in Urban Design and Planning**

2-day workshop notes  
27-28 September 2004

Introductions – please put on a name tag to help me know who you are

Background and Objectives:

1. What is your experience with computers?
2. What is your experience with GIS?
3. What are your expectations for this workshop?
4. What do you hope to be able to do by tomorrow afternoon?

Workshop Outline

### **Monday (8-4 with 1 hr break for lunch)**

- 8-9: Lecture introduction to GIS
- 9-11: Introduction to ArcGIS 9.0 GIS software and “Exploring ArcCatalog and ArcMap” example
- 11-12: Representing the geometry of spatial phenomena (lecture)
- 12-1: Lunch break, questions
- 1-3: ArcTutorial example: basics of geoprocessing
- 3-4: Questions and ideas for day 2

### **Tuesday: (9-3:30 with 1 hr break for lunch)**

- 9-10: Web resources, Downloading and understanding data
- 10-11: Vector Analysis – types of analyses
- 11-12: Hands-on example 1.
- 12-1: Lunch Break
- 1-3: Hands-on example 2 or 3 or “user suggestion”

# **I. Introduction to Geographic Information Systems and spatial analysis (8-9 am)**

## **A. What is spatial analysis? Definitions**

- Process for looking at spatial patterns in your data and relationships between features.
- The actual methods used can be simple (making a map) or complex, involving multiple processing steps and combining many data layers to mimic the real world.

What is GIS?

Three parts:

1. Database – attribute data
2. Map or spatial information
3. A way to link 1 and 2

A GIS is a toolbox – a set of tools for analyzing spatial data

GIS is “a powerful set of tools for storing and retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes (Burrough 1986, p. 6) – “toolbox definition”

GIS are “automated systems for the capture, storage, retrieval, analysis, and display of spatial data” (Clarke 1995, p. 13) – “process definition”

GIS is “a special case of information systems where the database consists of observations on spatially distributed features, activities or events, which are definable in space as points, lines, or areas. A geographic information system manipulates data about these points, lines, and areas to retrieve data for ad hoc queries and analyses” (Dueker 1979, p 106) – “information system definition”

Examples of spatial analysis relevant to Urban Ecology and Planning

1. Determining the frequency of patches of remnant forest at various distances from downtown Seattle
2. Determining the change in human density at different distances from major town centers
3. Calculating the amount of water that flows through a drainage basin
4. Identifying parcels that are within a specified distance from parks
5. Calculating the total length of streams in a watershed
6. Others ?

Several examples of analyses that are not necessarily spatial

1. Calculating the number of parcels with more than 200 people in them
2. Calculating the density of people in census blocks (provided you know the area of each census block)
3. Others ?

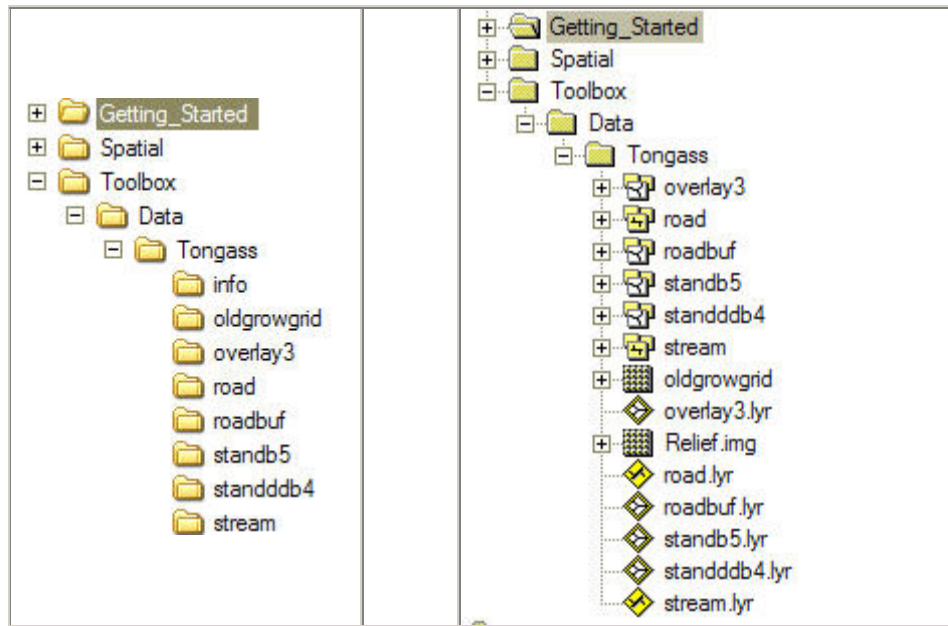
What is "Image Processing" or "Remote Sensing" and how is it different from GIS?

## **B. Introduction to ArcGIS 9.0 software to do GIS**

ArcGIS 9: ([Getting Started with ArcGIS workbook](#): Chapter 1)

1. ArcMap - mapping, basic spatial analysis commands, similar to ArcView
2. ArcCatalog - similar to Windows Explorer, but the difference is IMPORTANT
3. ArcToolBox - access to vector commands, topology tools, database tools
4. ArcInfo / command line - access to ALL the commands for analysis

Example differences in viewing directories and files with Windows Explorer and with ArcCatalog



## DEMO: Exploring ArcCatalog and ArcMap

Note: For the following demo, you will need to first do the following steps:

1. Copy the tutorial data to your local drive for use today – copy the entire **udp-gis-intro** directory to your local (c: or d: ) drive under the **workspace** directory
2. Demo: Running through parts of Chapter 2 in [Getting Started with ArcGIS workbook](#): pages 17-34 in workbook (pg 23 in the pdf file) – open the pdf file and substitute the root directory that you just copied when told to access data in the workbook.
3. After doing the demo, Compare for yourself the difference in views that Windows Explorer and ArcCatalog give of the Tongass Directory (under **D:\udp-gis-intro\ArcTutor\Toolbox\Data\Tongass\**)

## II. Representing the geometry of spatial phenomena (10-11 lecture)

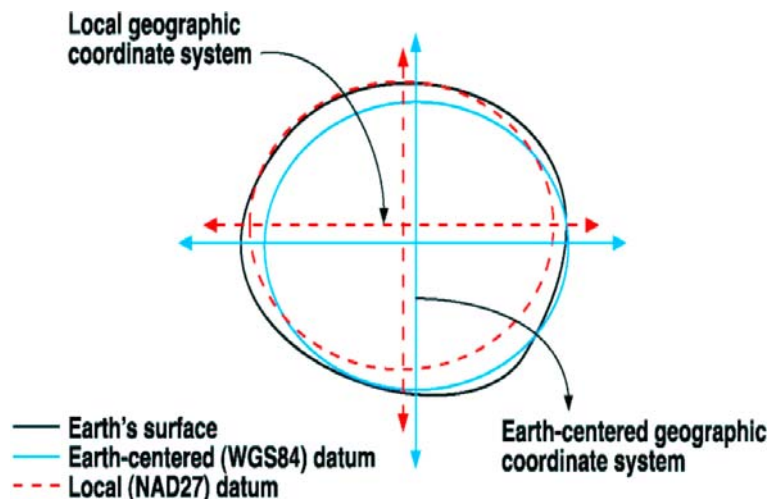
### A. Abstracting real-world entities: representing the geometry of spatial phenomena

## Coordinate systems and Projections (Notes and Images taken from "Understanding Map Projections" by ESRI)

**Geographic coordinate system** - uses a 3-D spherical surface to define locations on the earth. Each point on the earth has a longitude and latitude which are angles measured from the earth's center to the point on the earth's surface.

**Sphere and Spheroids** - the shape and size of a geographic coordinate system's surface is defined by the sphere or spheroid used to represent it. In general, the data we will be using will use spheroids (ellipoids) to represent the shape of the earth.

**Datums** - the datum defines the position of the spheroid relative to the center of the earth, providing a frame of reference for measuring locations on the surface of the earth.



Data present you will download will likely be in WGS 1984, NAD 1927, or NAD 1983 Datums. The NAD (North American Datum) datums are usually preferred for spatial data of North America. While the generally preferred datum is NAD 1983 (with the GRS 1980 spheroid) because of its accuracy, many datasets will be in NAD 1927 and require reprojection into NAD 1983.

- Some data may be in State Plane Coordinate System (SPCS) which divides each state in a series of numbered sections.

- Raw GPS data is reported in the WGS 1984 coordinate system, but because of the similarity of WGS 1984 and NAD 1983, the data are directly comparable.

**Projected Coordinate Systems** - are defined on a flat, 2-D surface, and therefore has constant lengths, angles, and areas across the two dimensions. A projected coordinate system is always based on a geographic coordinate system that is based on a sphere or spheroid. Locations are identified by x,y coordinate pairs on a grid.

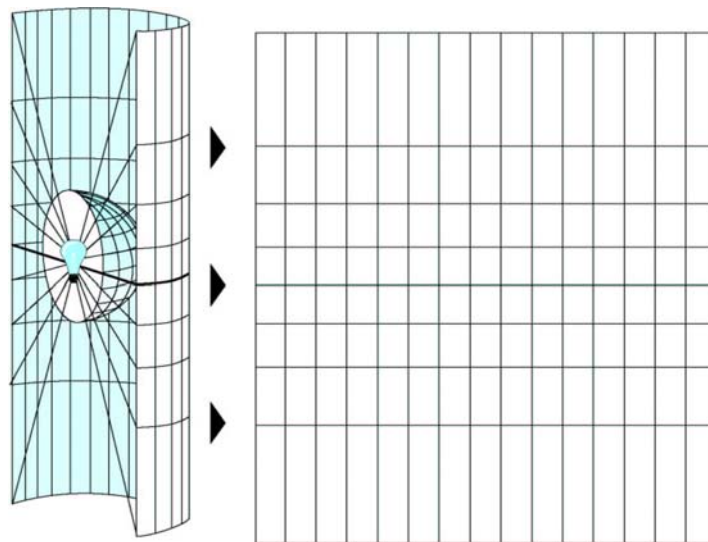
To translate a 3-D surface to a 2-D plane, you must transform the 3-D surface (= map projection). Representing the earth's surface in 2-D causes distortions of shape, area, distance, or direction of the data. Different projections cause different types of distortions.

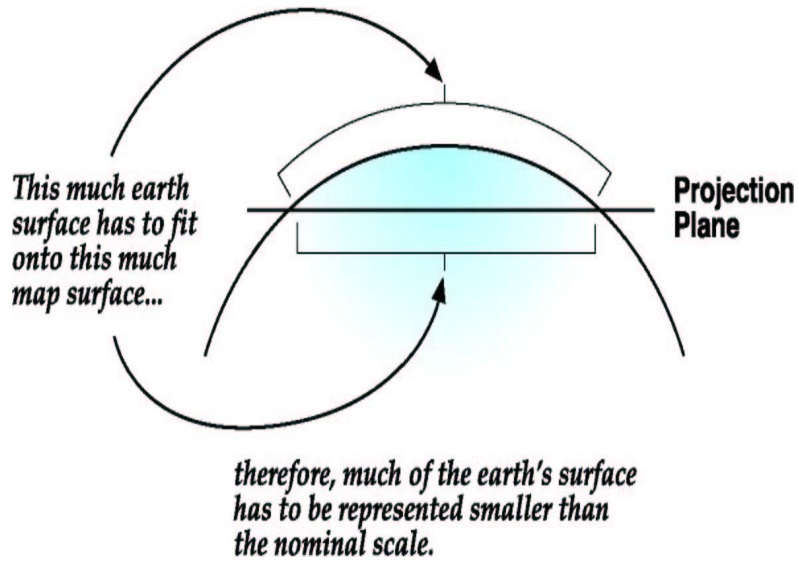
Conformal Projections - maintain local shape

Equal area projections - maintain area of local features

Equidistant projections - preserve distances between certain points

True-direction projections (azimuthal) - direction/asmuths are correct





Creating a projection starts by creating a point of contact with the 3-D object called a point or line of tangency. Projections can be Conic, Cylindrical, or Planar

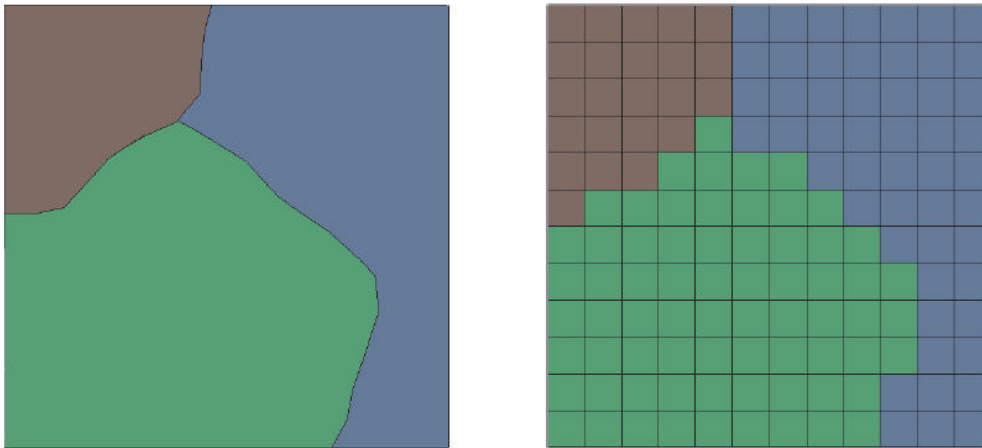
The most commonly used map projection for our purposes is the Universal Transverse Mercator (UTM). It is a conformal projection (shapes accurate) that does not maintain true directions, based on a cylinder tangent to a meridian where the globe has been divided into 60 zones, each spanning 6 degrees of longitude. Specific properties - accurate representation of small shapes, minimal distortion of large shapes at edges of zones, minimal distortion of area within zone, local angles are true, minor distortion of lateral distance.

Things to remember:

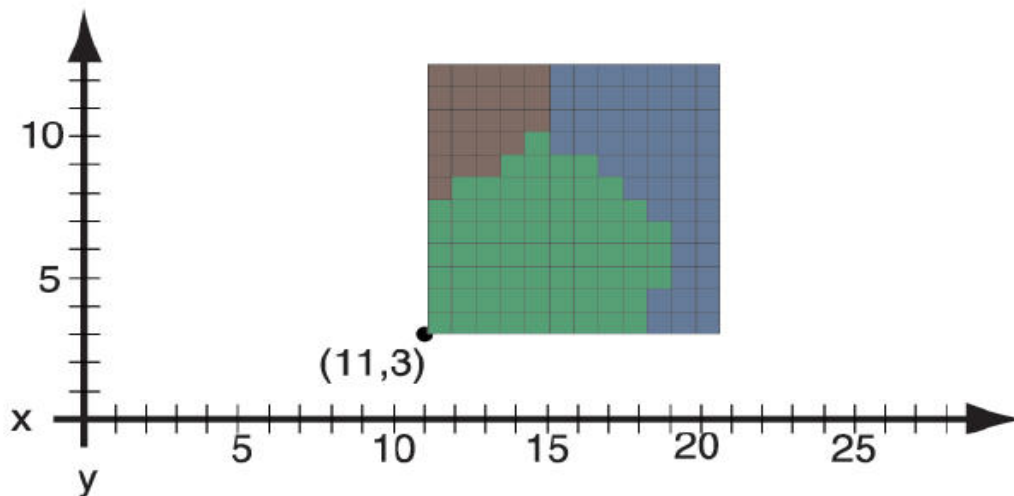
- a. All data layers used **MUST BE** in the same map projection and coordinate system so that features in each layer will be comparable spatially to do any spatial analysis that involves more than one layer.
- b. **Programs we will be using may allow DISPLAY of data in different projections/coordinate systems, but on-the-fly reprojection for analysis is NOT recommended.**
- c. Data from several sources need to be checked to be sure they are all in a common projection and coordinate system and reprojected to a common system before analysis proceeds.

**Examples: opening files, determining metadata, projection, etc.**

**B. Ways of representing spatial data: Raster and Vector**  
(Also refer to Chapter 3 in [Getting Started with ArcGIS](#)) – (11:00 – noon)



**Raster or Grid**

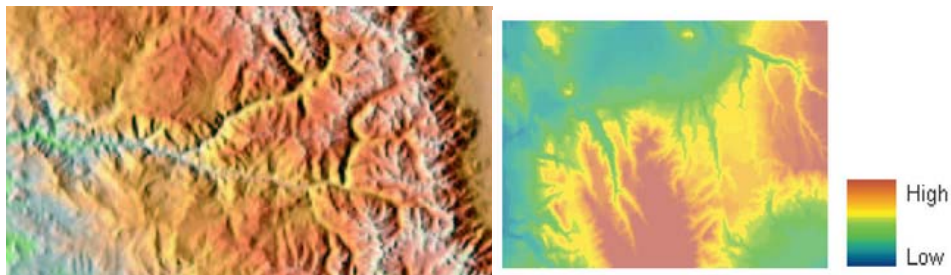


The raster model represents features as a matrix of **cells** in continuous space. Each cell (or pixel) is a square that represents a specific portion of an area.

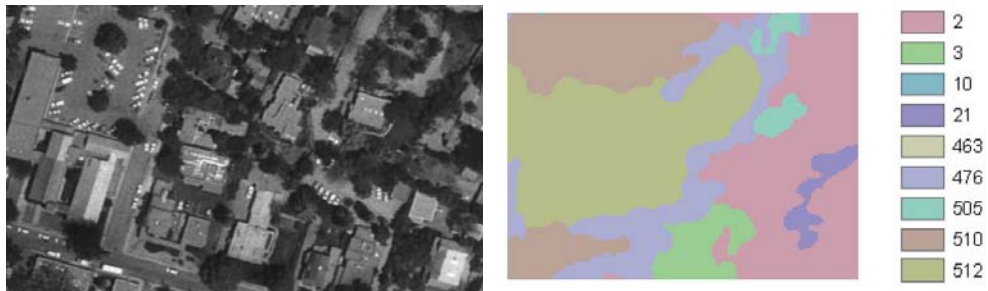
- All cells in a raster must be the same size
- Cells are arranged in rows and columns, producing an x,y Cartesian plane, with each cell having a unique x,y value
- All locations are covered by the matrix

- Each layer represents one attribute - attributes are tied to each cell rather than to an area
- Cells with the same value belong to the same **zone** which do not have to be spatially contiguous (as with most vector features)
- Both integer and floating-point values are supported - continuous data can be represented as either types; categorical data as integer only

Rasters can represent continuous values such as Elevation



Rasters can also represent discrete values such as buildings, parking lots, and roads, or soil types.



Categorical rasters can also store additional attribute data

Value	Count	Name	Suitability
2	30672	Cropland and pastureland	4
3	3339	Urban and industrial	5
10	212	Clearings and brushfields	5
21	1383	Cottonwood	4
463	142	Ash-Cottonwood	3
476	7205	Oak	3
505	1112	Douglas fir	2
510	6557	Mixed evergreen-broadleaf	3
512	7943	Douglas fir-Hemlock-Cedar	1

Most analysis occurs by combining the layers to create new layers with new cell values

The cell size used for analysis will affect the results of the analysis

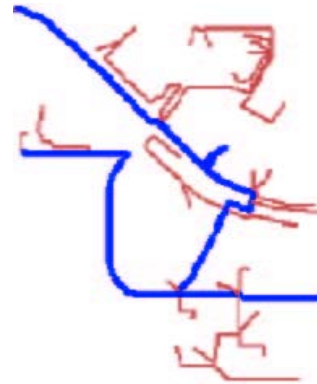
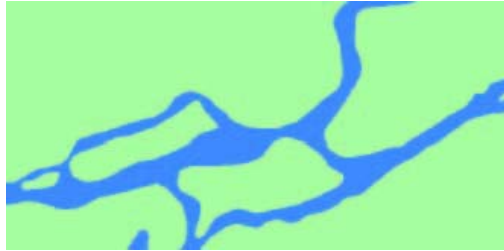
Potential Uses:

Inherent Limitations:

Types of raster data

1. satellite imagery
2. scanned aerial photographs
3. digital orthophotos
4. grids - ArcGIS raster files

**Vector** (Vector data are stored in Coverages, Geodatabases, and Shapefiles in ArcGIS)



Types of Vector data (data models):

The vector model represents features as x,y locations – points  
These locations are connected together to make arcs (lines) and polygons (areas)

**Points** represent single locations and are

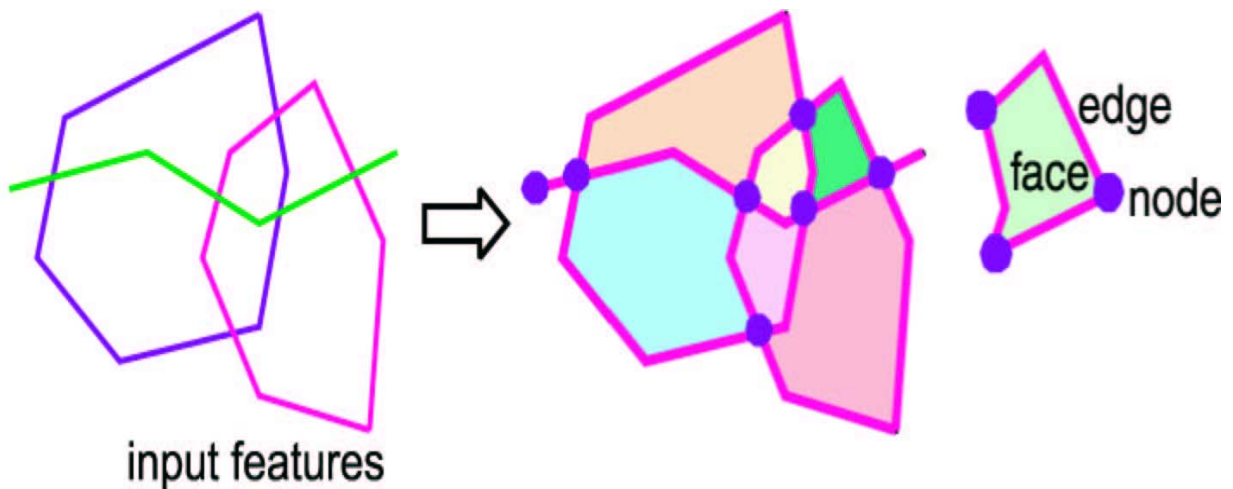
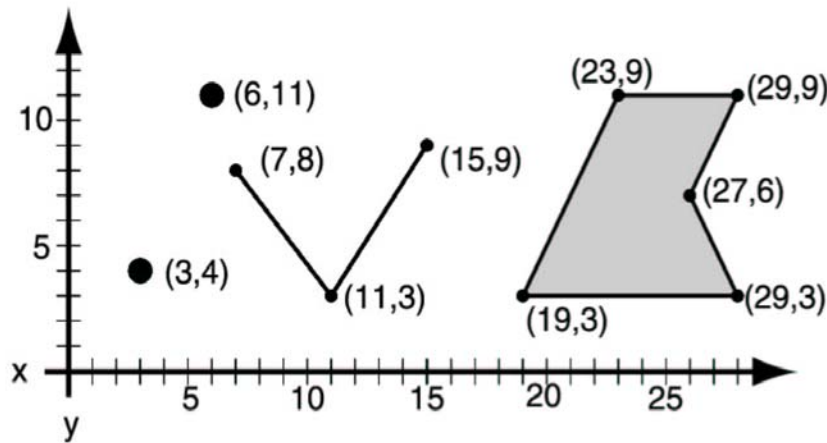
**Lines** (arcs) represent a series of coordinate pairs

**Areas** are represented as closed polygons

**Coverage** – the traditional (ArcInfo, ArcGIS) format for complex geoprocessing, building high-quality geographic datasets, and sophisticated spatial analysis. Primary features are label points, arcs, and polygons. Composite features (**Routes** - complex lines and **Regions** - overlapping polygons) are built from primary feature types.

**Shapefile** (ArcView) – a vector data storage format for storing the location, shape, and attributes of geographic features, stored in a set of related files and contains one feature class, topology is not inherently stored.

**Geodatabases** – a geographic data model that represents real-world geographic features as objects in an object-relational database, features are stored as rows in a table, geometry is stored in a shape field. Objects may have custom behavior.



#### Potential Uses of Vector Data

1. Representing linear objects - roads, streams, fault lines
2. Representing area - lakes, cities, census blocks
3. Representing overlapping areas - the overlapping habitat within the home range of multiple crows ("Regions")
4. Networks - transportation networks ("Routes")

## Advantages

1. can more accurately represent some spatial objects (e.g., stream lines, roads)

## Inherent Limitations

1. slower processing than raster database
2. difficult to represent "soft" or gradual edges

## Topology

- The branch of geometry that deals with the properties of a figure that remain unchanged even when the figure is bent, stretched, or otherwise distorted.
- Defines the spatial relationship between geographic features
- Topological relationships:

**Adjacency** - implies whether two polygon features are adjacent to one another

**Containment** - indicates whether a single feature is contained within the boundaries of a polygon

**Connectivity** - indicates whether two line segments are connected

GISs are used for spatial analysis because they can integrate all three elements of spatial information in a logically consistent manner

**Tabular**: Tabular manipulation of attribute data

Working with data tables is an important part of GIS analysis.

**RDBMS**: relational database management system – a type of database in which the data is organized across several tables. Tables are associated with each other through common fields. Data items can be recombined from different files.

1. These tables can contain the attribute data of the features, or derived summary statistics.

2. Tabular data can be generated within a GIS and then exported and opened in a spreadsheet (Excel) or statistics software package (SPSS) for further non-spatial analyses

## **Data types**

### **Types of features**

1. Discrete
  - a. For discrete locations and lines, the actual location can be pinpointed
  - b. At any given spot the feature is present or it is not present
  - c. Streams, tree locations, bear dens
2. Continuous
  - a. Continuous phenomena can be found or measured anywhere, there are no gaps
  - b. A value can be determined at any given location
  - c. Precipitation, temperature, elevation, slope, water depth
3. Features summarized by area
  - a. Summarized data represents counts or density of individual features within area boundaries
  - b. Density of trees in a stand, population size within a region, number of businesses within a Zip Code
  - a. The density measure applies to the entire summarized area, even if the individual (trees, people) are clustered in certain subsections of the area
  - c. GIS allows you find the spatial coincidence of areas with features to perform summaries
  - b. Unless these are standardized to a density per unit area, features summarized by area cannot be directly compared to other features summarized by a different area (e.g., it does not make sense to compare the density of people in Seattle with the average income of people in all of King County to make a statement about the relationship between density and income for all of King county)

### **Representation of geographic features**

1. Discrete features (e.g., points and lines) and data summarized by area are usually represented by

vectors, but can be converted to raster when combined with other raster layers.

2. Continuous categories (categorical) are represented by either vectors (e.g., Isopleth maps) or rasters.
3. Continuous numeric values (e.g., elevation) are represented by rasters.

Hands-on Example: [Chapters 5 and 6 \(Assembling the database and Preparing data for analysis\) from “Getting Started with ArcGIS” \(1-3\).](#)

Review of Objectives and ideas for Tuesday’s session

# Tuesday, September 28th

## 9 am – 4 pm

### I. Planning a project and Data Available on the Web (9:00-10:00)

#### Planning a Spatial Analysis

When performing an analysis you go through 5 major steps:

- ii. 1. Framing the question
  1. How will the results be used
  2. Who will use the results
  3. Understanding your data
  4. What type of data, features, and attributes are available
- iii. 2. What will need to be generated
- iv. 3. Choosing a method(s)
  1. Many different methods exist
  2. Some methods are more approximate than others
- v. 4. Processing the data
  1. Many steps required for most analyses
  2. A flow chart of the steps required and the expected results from each step is helpful in organizing an analysis
- vi. 5. Examining the results
  1. Results can be displayed as a map, a table, or a chart.
  2. Looking at the results is important to determine if the information is valid or useful
  3. Often the analysis will need to be rerun with slightly different methods to achieve the desired results

Web sites Sites containing spatial data

<http://ads.ahds.ac.uk/project/goodguides/gis/> -

The GIS Guide to Good Practice - advice on conducting GIS analysis

<http://wagda.lib.washington.edu/>

WAGDA - Washington State Geospatial Data Archive

<http://wa-node.gis.washington.edu/>

Washington State Geospatial Clearinghouse

<http://www.metrokc.gov/gis/index.htm>

King County GIS Center

<http://dnr.metrokc.gov/topics/map/carto.htm>">King County Natural Resource Maps</a></p>

<p><a href="http://www.metrokc.gov/assessor/">King County Assessors Office</a></p>

<p><a href="http://www.ecy.wa.gov/services/gis/index.html">Washington Department of Ecology GIS data</a></p>

<p><a href="http://www.seattleurbannature.org/">Seattle Urban Nature Project</a></p>

<p><a href="http://www.fish.washington.edu/naturemapping/">Seattle NatureMapping</a></p>

<p><a href="http://www.dnr.wa.gov/">Washington Department of Natural Resources</a></p>

How to connect to the data

## **Examples: Understanding data when it comes to you**

**Metadata: information about the content, quality, condition, and other characteristics of data. Metadata consists of properties and documentation – properties are derived from the data while documentation is entered by a person (keywords, description of attributes).**

Subject matter: how, when, where, and by whom the data was collected

Type

Projection

Scale

Accuracy

Appropriateness

Availability

Reliability

What it looks like with Microsoft Explorer and why NOT to use Explorer to move GIS data around

How the data are organized

## **II. Methods and Examples of spatial analysis - Part 1 (10:00-11:00)**

### **Vector Analysis**

Three major types of analysis:

1. Drawing - visual analysis, mapping where things are
2. Selecting - selects features and attributes, but generally does not create a new spatial dataset
3. Overlaying - generates new spatial datasets by combining two or more input datasets

[Notes from "The ESRI Guide to GIS Analysis, Volume 1"](#)

Two major objectives:

1. Finding what's inside
2. Finding what's nearby

### **Finding what's inside – selecting, summarizing, calculating**

Do you need a list, count, or summary?

- Find out whether an individual feature is inside an area
- Get a list of all the features inside an area
- Find out the number of features inside an area
- Get a summary of what's inside an area, or each of several areas, based on a feature attribute

Do you need to see the features that are completely or partially inside the area?

- Choose to include only features that fall completely inside
- Features that fall inside but extend beyond the boundary
- Include only the portion of the features that falls inside the area boundary

### Three ways of finding what's inside

1. **Drawing** the areas and features – create a map showing the boundary of the area and the features for viewing

**What it's good for:** **seeing** whether one of a few features are inside or outside an area and for checking the output of analysis

**What you need:** two datasets: boundary and features

2. **Selecting** features inside the area – specify the area and the layer containing the features, and the GIS selects a subset of the features inside the area

**What it's good for:** getting a **list or summary of features** inside a single area, or a group of areas you're treating as one, finding what's within a give distance of a feature

**What you need:** dataset containing the areas and a dataset with the features, including any attributes you want to summarize

3. **Overlaying** the areas and features – GIS combines the area and the features to create a new layer with the attributes of both, or compares the two layers to calculate summary statistics for each on the fly

**What it's good for:** finding which features are in each of **several areas**, or finding out **how much** of something is in one or more areas

**What you need:** data containing the areas and a dataset with the features, including any attributes you want to summarize

### Choosing a method

1. Use a map if you have a single area and only need to see which features are inside
2. Select features inside the areas if you have a single area and need a list or summary of discrete features fully or partially inside

3. Overlay the areas and features if:
  - a. Multiple areas and need a summary of what's inside each
  - b. Single area and need a list or summary of discrete features, including only the portion of the features inside the area
  - c. Single area and need a summary of continuous values

## Drawing areas and features

### 1. Making the map – drawing only, no “analysis”

#### Locations and lines

- Draw individual locations or linear features with a single symbol, or symbolize them by category or quantity
- Draw the boundary of the area on top in a thicker line
- With several areas, label them so that map readers can identify each one

#### Discrete areas

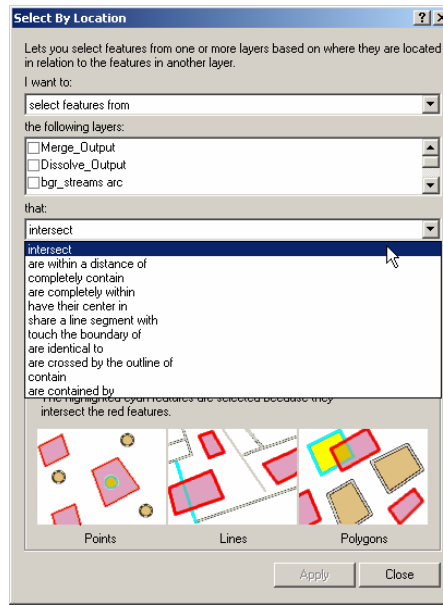
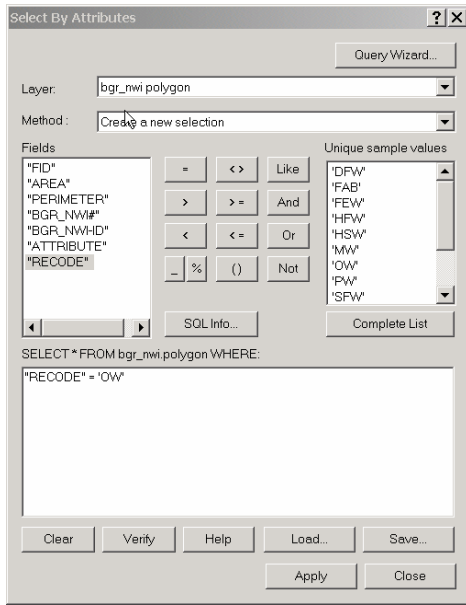
- Shade the outer area with a light color and draw the boundaries of the area features on top – emphasizes which features are inside
- Fill the outer area with a translucent color or pattern on top of the discrete area boundaries – this emphasizes the outer area
- Draw the outer area boundary with a thick line, and the discrete area boundaries with a thin line in a lighter shade or different color – use if you're shading the discrete areas by category or class range

#### Continuous features

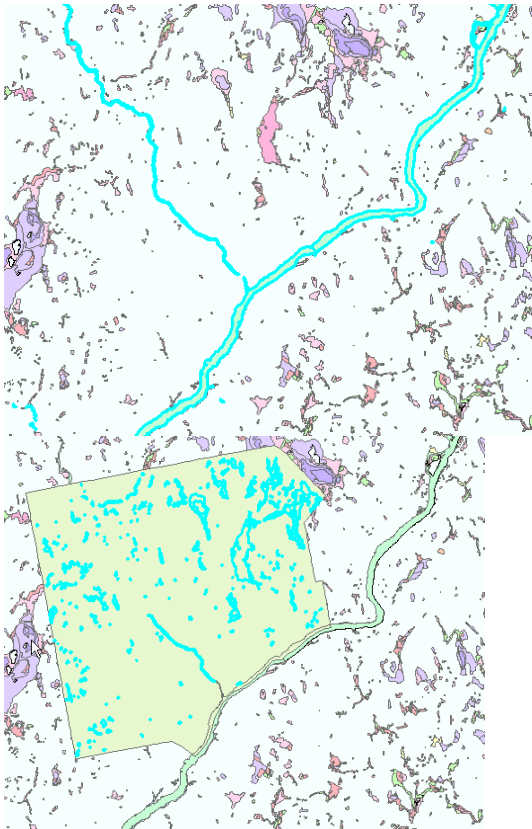
- Mapping continuous areas (soils, elevation), draw the areas symbolized by category or quantity (class range), then draw the boundary of the area(s) on top
- Mapping a single area, you can draw the boundary with a thick line, or shade the area with a translucent color or pattern to highlight it
  - drawing only the boundary emphasizes what's inside
  - shading emphasizes the area itself

### 2. Selecting features inside an area – selecting only, no creation of new coverages or grids

1. you specify the features and the area



2. GIS checks the location of each feature to see if it's inside the area, and flags the ones that are
  
3. GIS then highlights the selected features on the map and selects the corresponding rows in the feature set's data table



4. You can then use the data table to get information about the features, such as a list, a count, or a summary of an associated attribute

Selected Attributes of bgr_nwi polygon								
FID	Shape*	AREA	PERIMETER	BGR NWI#	BGR NWI-ID	ATTRIBUTE	RECODE	
6	Polygon	447514.460752	19825.948012	6	252712	R3UBH	OW	
32	Polygon	2951733.666672	30779.906387	32	246700	R3UBH	OW	
433	Polygon	2810.884800	266.257191	433	261472	R3UBH	OW	
689	Polygon	141686.530999	7136.062168	689	266379	R3UBH	OW	
802	Polygon	1471.171200	142.465476	802	268146	R2UBH	OW	
811	Polygon	2285730.333374	21195.779827	811	268366	R1UBV	OW	
897	Polygon	10423.941550	711.937665	897	269832	R3UBHx	OW	
1290	Polygon	5178.234400	349.765790	1290	275599	R3UBH	OW	
1317	Polygon	3690.521850	306.965317	1317	275821	R3UBH	OW	
1320	Polygon	21912.503600	1414.902869	1320	275904	R3UBH	OW	
1372	Polygon	9384.509700	599.459051	1372	276732	R3UBH	OW	
1426	Polygon	87.182944	46.235767	1426	277519	R3UBH	OW	

- This method does not differentiate which area each feature is in, only that it's in one of them
- Geographic selection is a quick way to find out which features are within a given distance of another feature – specify to location of your source (e.g., an eagle nest), the layer containing your features, and the distance and the GIS selects the features within that distance

- Data that is already summarized by area can only be summarized using boundaries that fully enclose the area – number of eagles by protected area could not then be summarized by township, since many protected areas span town lines

#### Using the results

- Create a report
- Count – the total number of features inside the area
- Frequency – number of features with a given value (or range of values), inside the area, displayed as a table, bar chart, or pie chart (percentages)
- A summary of a numeric attribute – sum, average, median, standard deviation
- A map is potentially useful as well

ATTRIBUTE	RECORD
U	U
R3UBH	OW
PF04Ba	SFW
PSS4Ba	PW
PF01E	HFW
PEM1Eb	FEW
PF01/4E	HFW
PF01E	HFW
PF04E	SFW
PF01/4E	HFW
PF04E	SFW
PF01E	HFW
PF04/1E	SFW
PF01E	HFW

**Summarize** [X]

Summarize creates a new table containing one record for each unique value of the selected field, along with statistics summarizing any of the other fields.

1. Select a field to summarize:  
 RECODE

2. Choose one or more summary statistics to be included in the output table:

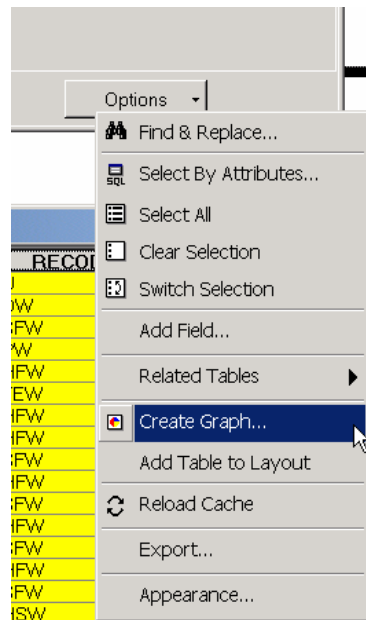
- AREA
  - Minimum
  - Maximum
  - Average
  - Sum
  - Standard Deviation
  - Variance
- ATTRIBUTE
- BGR\_NW#
- BGR\_NW-HD
- FID
- PERMETER

3. Specify output table:  
 C:\gis-class\lab1\Lab1\Sum\_Output\_6.dbf

Summarize on the selected records only

More about Summarize...    OK    Cancel

Attributes of Sum_Output_5						
	OID	RECODE	Count RECODE	Minimum AREA	Maximum AREA	Average AREA
	0	DFW	3	1903.505000	9945.847250	6784.9602
	1	FEW	32	666.555300	80352.962800	6905.8675
	2	GS	4	1539.429900	7167.229000	4147.0291
	3	HPW	84	1166.078750	274686.525799	23673.7906
	4	HSW	98	618.064100	80544.892400	7345.1475
	5	MW	15	675.218900	864972.11205	64034.0902
	6	OW	4	10423.94155	2285730.33337	721338.8167
	7	PW	1	158170.4807	158170.4807	158170.4807
	8	SFW	32	1553.06125	479790.018224	41958.5383
	9	SSW	1	2395.311700	2395.311700	2395.3117
	10	SW	93	304.956150	67251.884300	3428.0753
	11	U	3	529.546000	144575511.466	48193251.7884



## 2. Finding what's near

### Selecting features within a distance

- is similar to creating a buffer
- you specify the distance from the source and the GIS selects the surrounding features within the distance
- only a selected set is generated, no new feature dataset is created
- the selected set can be used to extract those selected features to a new feature dataset (coverage)
- when selecting line or area features, the GIS selects all features that have any portion within the specified distance

**Selecting features near several sources** – requires multiple selections and assignment of unique values to the feature dataset's attribute table to keep track of

Ex: selecting features in a conservation database that are within 100 km of Olympic National Park and also within Kitsap county

**Selecting features within several distance ranges** – requires separate selections and attribute assignments

## Feature to feature

- if you are calculating the distance between each surrounding location and the nearest source, the distance for each location is automatically added to the data table for the surrounding locations, along with an identifier for the nearest source
- if you are calculating the distance between each location and several sources, you get a new table listing, for each location, an identifier for the source, and the distance to each
- optionally can specify a maximum distance to reduce potential processing time
- several options exist for mapping the output
  1. map surrounding locations color-coded (color ramp) by distance
  2. map surrounding locations color-coded (unique color) by source
  3. map by creating a spider diagram which draws a line between each location and its nearest source
  4. map source features using graduated point symbols



Methods that create derived data (feature datasets/coverages, tabular output)

### 3. Overlaying areas and features – creating new vector or raster datasets

- Find which discrete features are inside which areas and summarize them

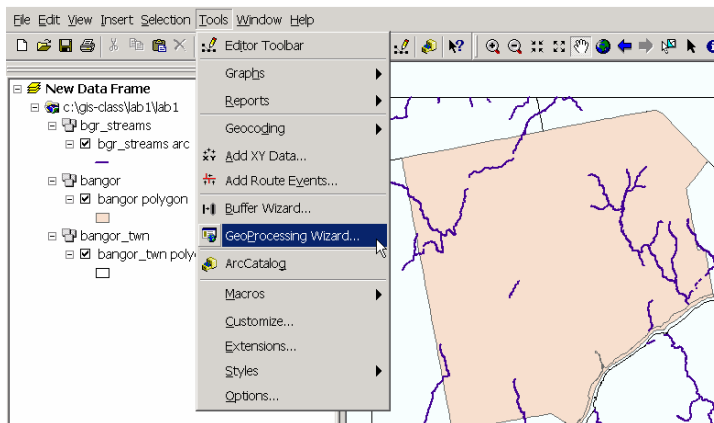
- Calculate the amount of each continuous category or class inside one or more areas
- Summarize continuous values inside one or more areas

#### a. Overlaying areas with discrete features

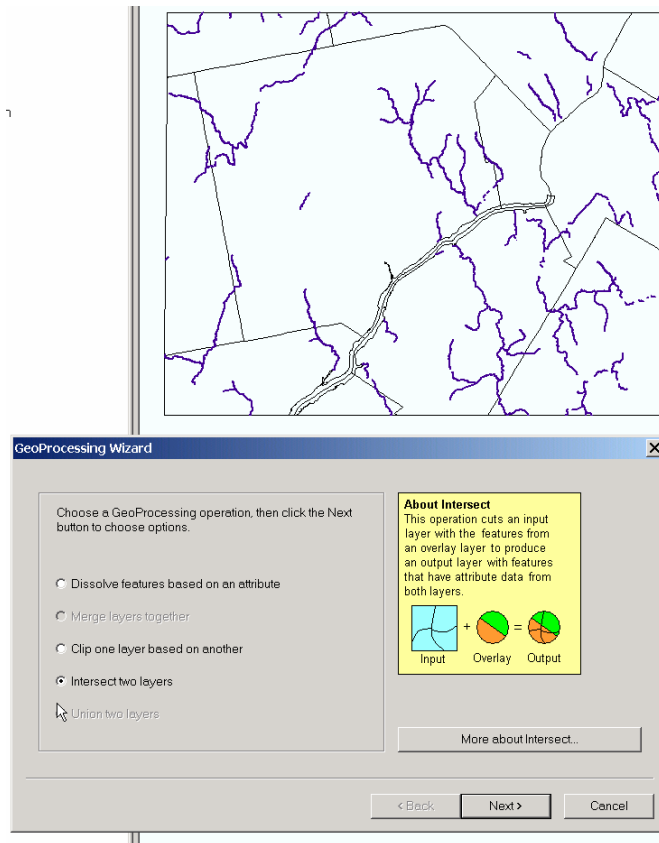
- GIS tags each feature with a code for the area it falls within, and assigns the area's attribute to each feature = permanently modifies attribute table, creating a new dataset or a new attribute in an existing dataset
- Output can be a list of features or summary of an attribute value by area
- Because the attributes are permanently stored in the attribute table, the data is available for further analyses

What the GIS does:

- GIS checks to see which area each feature is in and assigns the area's ID and attributes to the feature's record in the data table



- If a line or area feature falls within two or more areas, the GIS splits the feature where it crosses the area boundary and builds new areas in a new dataset



- Each new feature has the attributes of the area it falls within, in addition to its original attributes



Attributes of Intersection_Output														
FID	Shape*	FNODE	TNODE	LPOLY	RPOLY	LENGTH	BGR_STREAM	BGR_STRE_1	TYPE	AREA	PERIMETER	TOWN	GEOCODE	L
0	Polyline	22	28	2	2	1451.694614	18	62370	2	10536860.3943	15455.535486	Glenburn	19240	y
1	Polyline	11	22	2	2	1725.700000	14	47364	2	10536860.3943	15455.535486	Glenburn	19240	y
2	Polyline	17	19	2	2	1079.555588	12	47294	1	10536860.3943	15455.535486	Glenburn	19240	y
3	Polyline	15	12	2	2	234.129507	7	47357	1	10536860.3943	15455.535486	Glenburn	19240	y
4	Polyline	13	10	2	2	197.863772	5	47354	1	10536860.3943	15455.535486	Glenburn	19240	y
5	Polyline	8	14	2	2	238.248536	6	47345	1	10536860.3943	15455.535486	Glenburn	19240	y
6	Polyline	16	11	2	2	1069.449105	10	47386	2	10536860.3943	15455.535486	Glenburn	19240	y

## Using the results

- For a single area, the analysis is the same as with geographic selection
- For lines or areas you're now dealing with just the portion of each feature inside the area
- If you are overlaying several areas on a set of features, you can summarize the features by area
- Can summarize results by category or value

## Making a map

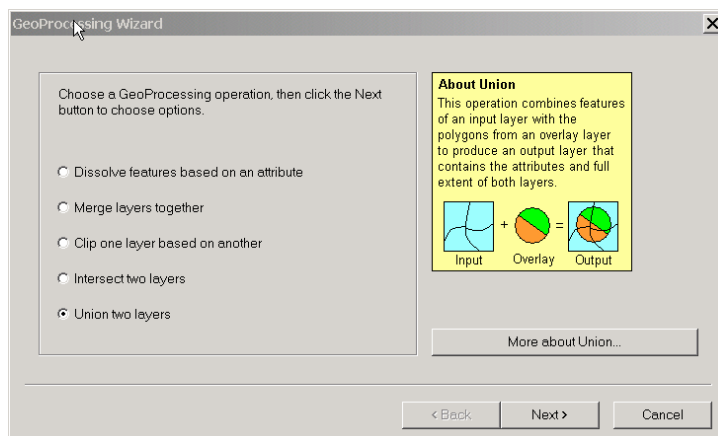
### b. Overlaying areas with continuous categories or classes

- GIS summarizes the amount of each category or class features falling inside one or more areas
- Output can be a map, table, or a chart of the results

## What the GIS does:

### 1. The vector method

- GIS splits category or class boundaries where they cross areas and creates a new dataset with the areas that result
- Each new area has the attributes of both input layers (already described above)





Layer Properties

General | Source | Selection | Display | Symbology | Fields | Definition Query | Labels | Joins & Relates

Show:

**Draw categories using unique values combining up to 3 fields.** Import...

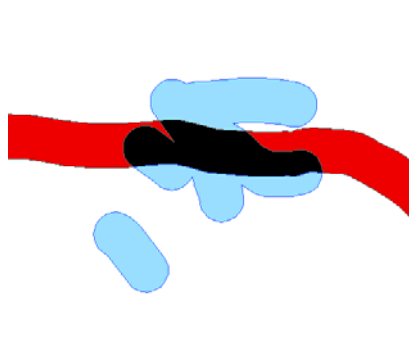
Value Fields: IN-FISH, IN-ROAD, <NONE>

Color Scheme: [Color palette]

Sym...	Value	Label	Count
[Pink]	<all other values>	<all other values>	0
[Heading]	<Heading>	IN-FISH, IN-ROAD	129
[Purple]	0, 0	0, 0	1
[Blue]	0, 1	0, 1	11
[Yellow]	1, 0	1, 0	100
[Red]	1, 1	1, 1	17

Add All Values | Add Values... | Remove | Remove All | Advanced

OK | Cancel | Apply

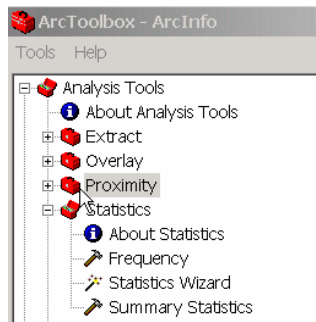


Attributes of overlay1 polygon

FID	Shape	AREA	PERIMETER	OVERLAY1#	OVERLAY1-ID	FISHBUF#	FISHBUF-ID	IN-FISH	ROADBUF#	ROADBUF-ID	IN-ROAD
2	Polygon	301118.221615	2672.199890	2	1	2	1	1	1	1	0
3	Polygon	174207.001074	2031.814056	3	2	3	2	1	1	1	0
4	Polygon	84710.181661	1161.378745	4	3	4	3	1	1	1	0
5	Polygon	96485.508271	1279.586316	5	4	5	4	1	1	1	0
6	Polygon	85973.167334	1174.652049	6	5	6	5	1	1	1	0
7	Polygon	231711.140211	2629.692519	7	6	7	6	1	1	1	0

- Then use the data table for the new layer to summarize the amount of each category in each area

- If you've done a vector overlay, you will need to summarize the category values for each area
  - Calculate a frequency which will give you a list of each combination and the amount of land represented by that combination



Rowid	CASE#	FREQUENCY	IN-FISH	IN-ROAD
1	1	2	0	0
2	2	11	0	1
3	3	100	1	0
4	4	17	1	1

- Then convert this output to a file that has one row for each area and a column for each category value
  - Using a spreadsheet program
  - Selecting all the rows having a specific category value, create a new table, and join it to the data table for the areas (for each category value)
- Once you have a summary table, you may also want to calculate the percentage of each category for each area, so you can map and compare the areas based on relative amounts (to account for differences in area)
  - Add a new field to the table for each category value, and then calculate the value for the field by dividing the area of each category by the total areal extent of the containing area
  - Pie charts and stacked bar charts calculate and display the percentage for you, but having the calculated percentages will let you map each area by its percentage for a particular category

- The information in the table can be displayed using charts or joined to the data table containing the areas to create maps

## Tabular Analysis

Three common operations performed on features and values within tables are **selecting**, **calculating**, and **summarizing**.

### 1. Selecting

- a. Selected to work on a subset or assign a new attribute value to a subset
- b. For example, assigning a specific rank to several different categories
- c. Done by value or by spatial location
- d. Rows in the data layer's attribute table that pertain to your selected features are selected
- e. Value-based selection is usually done in the form of a logical expression:  
Select attribute = value
- f. Logical operators used: equals (=), greater than (>), less than (<), contains (cn), ...
- g. Several expressions can be strung together using AND (exclusive) or OR (inclusive):  
Select attribute = 2 or attribute = 3

### 2. Calculating

- a. Used to calculate attribute values to assign new values to features in the data table
- b. If the new values will be assigned to a new attribute, this new attribute must first be added to the table
- c. Values can be assigned directly or derived from other attributes (such as ratios)
- d. For example, a land cover classification with 25 forest type classes might need to be simplified into 4 classes

### 3. Summarizing

- a. Used to summarize values for specific attributes into summary statistics (e.g., mean, max)

b. Often we want a unique listing of an attribute and the number of times it occurs (plus additional statistics) – this is a frequency

Hands-on Example: [Chapter 7 \(Performing the Analysis\)](#) from [“Getting Started with ArcGIS”](#) (1-3).

Hands-on Example 2: [Chapter 8 \(Presenting the Results\)](#) from [“Getting Started with ArcGIS”](#) (1-3).

Advanced Hands-on Example 3: [Chapter 2 \(Quick-start tutorial\)](#) from [“Geoprocessing in ArcGIS”](#) (1-3).