

# LESSON 5

## Geospatial Analysis



# Geospatial Analysis

Analysis of the spatial relationships between entities that represent real world places or processes



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LA039	WOODLAND	2.06	3.36	2	0	
LA289	WINNSBORO RD	2.37	3.82	2	0	
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LA048	WILLOW	1.17	1.89	2	0	
LA026	WILLOW	1.17	1.89	2	0	
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## Geospatial analysis

Geospatial analysis is the analysis of the spatial relationships between entities that represent real world places or processes.

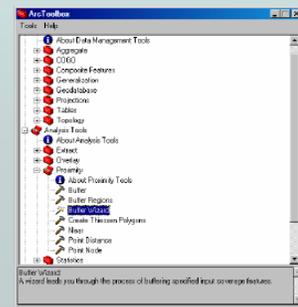
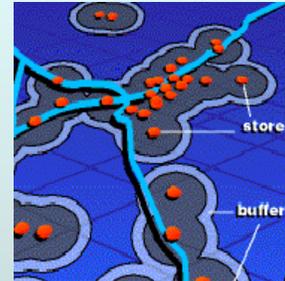
What types of questions can we answer with Geospatial analysis?

Perhaps we want to know what soil types underlie a certain section of roadbed, or which types of vegetative cover certain wildlife species prefer or how far is a mining operation from schools, churches, etc.

These are all questions that can be answered using ArcGis' spatial analysis tools

# Overview

- Geospatial analysis categories
  - Proximity
  - Overlay
  - Extraction
- Analysis with ArcToolbox
  - Wizards
  - Tools
  - ArcToolbox tips and tricks



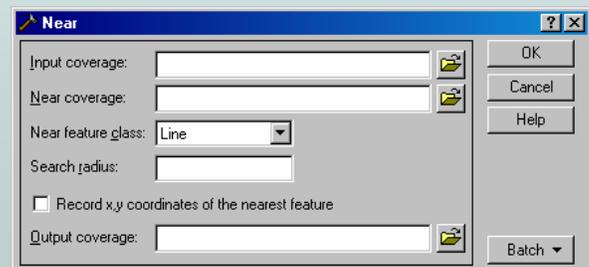
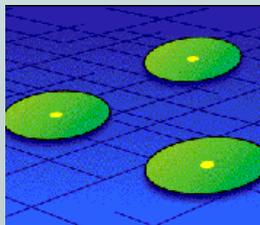
## Overview

The three categories of vector spatial analysis I will discuss today are, proximity, overlay and extraction.

I'll also describe some of ArcToolbox's features and describe how to use them for solving spatial problems.

# Proximity analysis

- Buffering
- Finding nearest neighbors



## Proximity Analysis

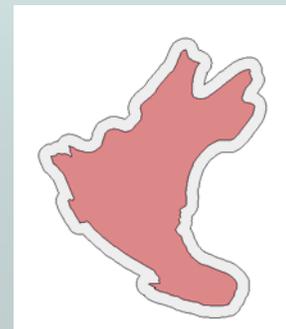
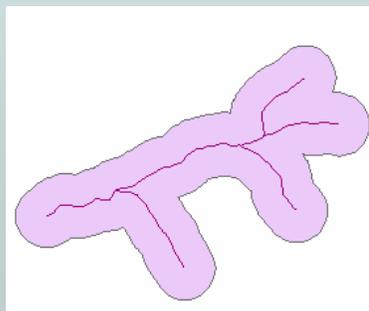
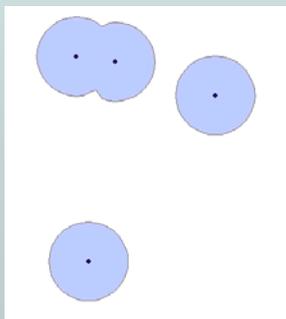
Proximity analysis lets us analyze the space between vector objects in ArcGIS, and to create new data layers based on this analysis.

Proximity analysis includes buffering, and finding the nearest neighbor.

- Buffering - Lets us create a polygon zone around a certain object, and then using this zone for display and other spatial queries or analysis
- Finding the nearest neighbors – Lets you find the closest feature to another feature or set of features.

# Buffering

- Provides distance analysis for points, lines and areas
- Creates a new polygon which represents the specified distance
  - New features can have inside field with special values
- Used to answer questions about proximity



## Buffering

A buffer is a polygon zone around some geographic feature or set of features. You can use buffers to find out if certain features are inside or outside of a specified distance from another feature.

### •Create new polygon features

You create buffer zones by specifying a distance. You can use the same distance for every feature in the layer, or use a numeric field in the attribute table to specify different distances for each feature.

The output of a buffer operation is either a new polygon feature class, buffer polygons as simple graphics, or features added to an existing feature class.

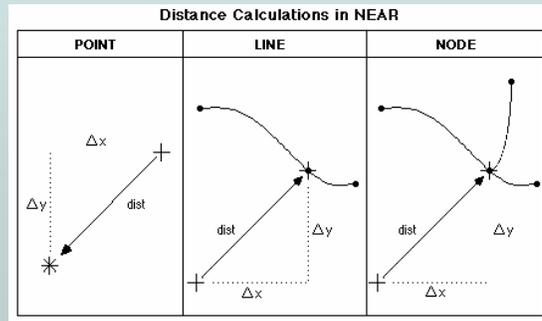
If you create the buffer in ArcToolbox the output feature class will have a new field named “inside” by default, or the field’s name can be supplied by the user.

### •Answer proximity questions

You can use buffers to select features from other feature classes in your database

# Finding Nearest Neighbors

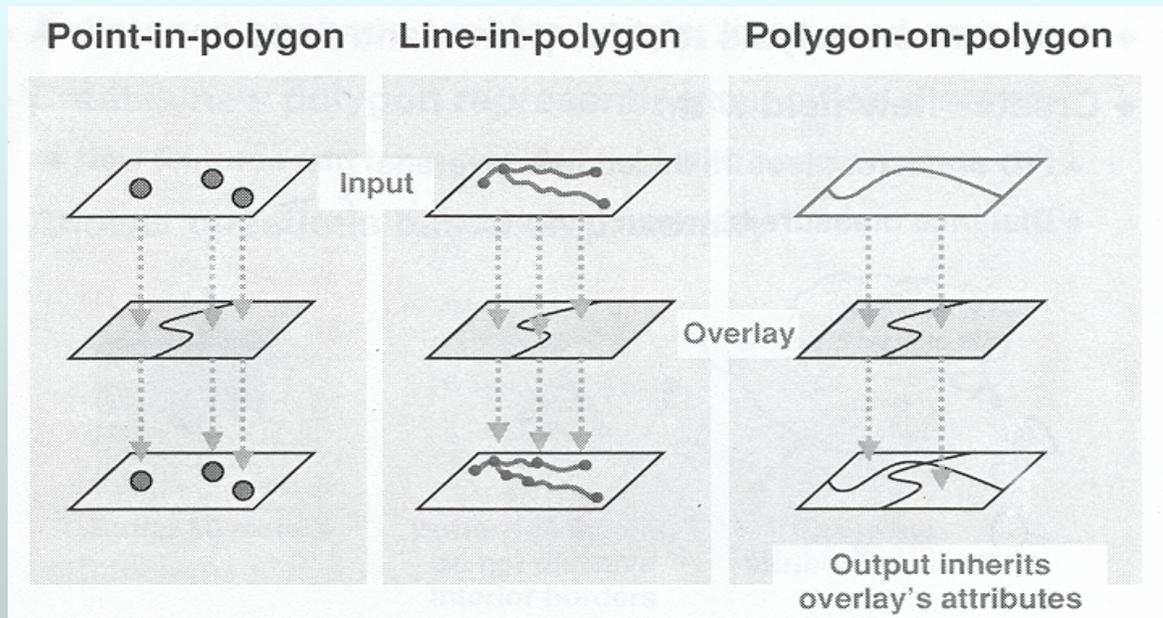
- Distance analysis for points and lines
- Creates a new field with:
  - FID of nearest feature in second coverage
  - Distance measure between features



## Finding nearest neighbors

Can help you find the closest feature to another feature. For example, a nearest neighbor analysis allows you to calculate distances from schools to the nearest hospital. The new attribute field contains distances in map units, which can be then be further queried or analyzed.

# Overlay analysis basics



Arcinfo operations – Union, intersect, identity



## Overlay analysis basics

At the heart of spatial analysis is the ability to integrate separate feature classes together into a new feature class that represents the combination of the two inputs. The number of output features and attribute fields depends on which overlay operation you use. The output coverage is always of the same type as the input coverage.

### •Point-in-polygon overlay

To find out which point falls inside which polygon, use point-in-polygon overlay. In a point-in-polygon overlay, attributes from the overlay (polygon) coverage are added to the point attribute table of the output coverage.

### •Line-in-polygon overlay

To find the common geographic space between a line feature class and a polygon feature class, use line-in-polygon analysis. When using line-in-polygon overlay analysis, the arcs of the input coverage are split at the overlay coverage's polygon boundaries, and new lengths are calculated for these arcs. Attributes from the overlay (polygon) coverage are then added to the arc attribute table of the new arcs.

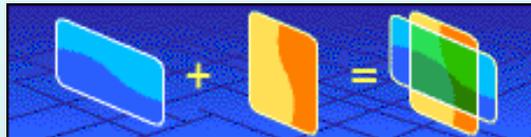
### •Polygon-on-polygon overlay

To find the common areas between two polygon feature classes, use polygon-on-polygon overlay analysis. In a polygon-on-polygon analysis, the polygons of the input coverage are split at the overlay coverage's polygon boundaries, and new areas are calculated for the polygons of the input coverage. Attributes from the overlay (polygon) coverage are then added to the polygon attribute table of the new polygons.

# Overlay operations

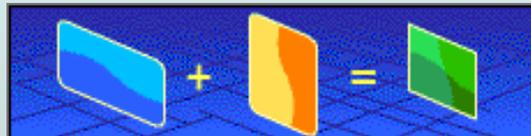
## Union

- More features
- More fields
- Polygons only



## Intersect

- More features
- More fields
- Limited extent



## Identity

- More features
- More fields
- Limited extent
- Order matters



## Arc overlay operations

### Union

Union combines features from two polygon coverages at a time to create a new polygon coverage. The output feature class will have more polygons than the sum of the polygons from the two original coverages because the objects are usually being split by multiple features. By default, the new feature class will contain all attribute columns from both input coverages.

### Intersect

Intersect combines features and attributes from two coverages that share the same geographic extent into a third coverage. You can intersect point, lines or polygons with another polygon layer. The output coverage will be of the same type as the input coverage as well as both input sets of attributes. If two polygon coverages are intersected, the output will show the combination attributes and features.

### Identity

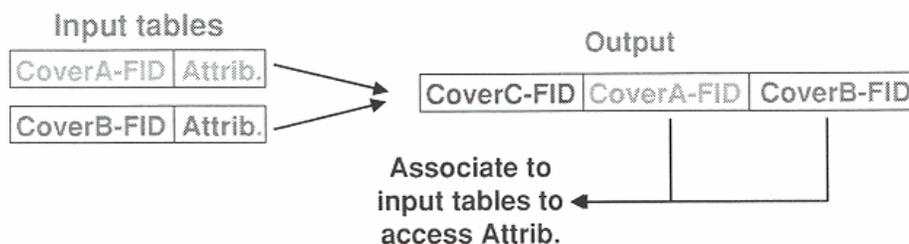
An identity operation is similar to an intersect operation, but the output will not be clipped by the extent of the second input coverage.

# Combining overlay attributes

## ◆ Default: Combine all attributes into the new table



## ◆ Combine identifiers only



## Combining overlay attributes

ArcInfo gives the user some options for combining attributes during overlay operation.

### •Combine all attributes into a new table

This is the default for all ArcInfo overlay operations and usually works well but causes problems when working with count attributes such as populations.

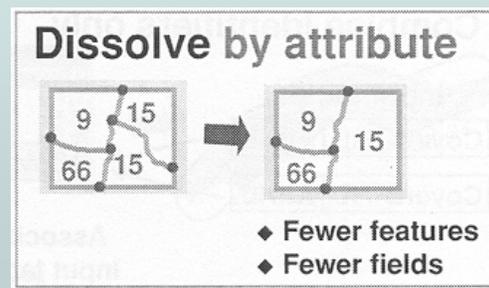
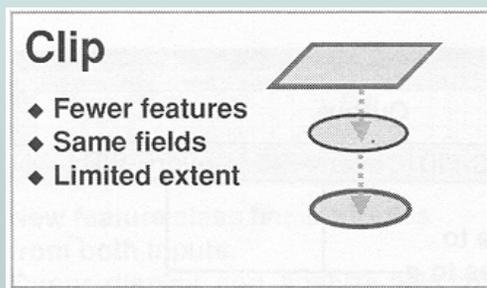
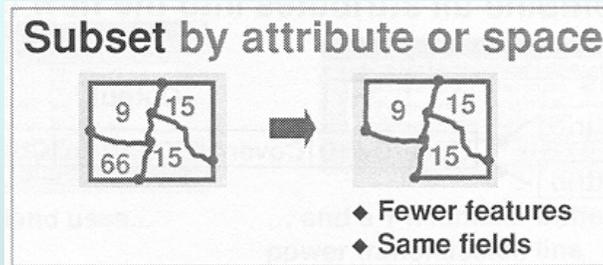
For example, the US Census Bureau reports population as total population per area, (census tract, census block, county, etc). When these blocks are subdivided by an overlay operation, the total population will still refer to the entire block and not the new subdivided blocks. To extract population estimates in this situation, you must first convert the raw population totals to population density (population per square mile for example), then using the area of the new polygons a population estimate can be calculated from the population density.

### •Combine identifiers only

If you prefer not to combine all attribute fields into the output coverage. Only the input coverage feature identifiers will be carried into the output. You must then use a tabular association to access the attribute values. This can be done by joining the tables or by creating a relationship class (see **Lesson 2.**)

This second method is preferred if you are going to be working with data that changes or is updated often. The most recent attributes can be accessed through your tabular associations. You must still take care when working with count attributes.

# Spatial extraction functions



## Spatial extraction functions

### Subset

•You can select a subset of features from a coverage by selecting only features with certain attribute values or by selecting features interactively using a mouse. The output can be saved to a new coverage (ArcToolbox) or a new shapefile (ArcMap). This is useful if you are only interested in a small area of a large data set, or if you are trying to isolate areas with certain attribute values.

### Clip

•Clipping trims the area of the input coverage down to the extent of a second (clipping) coverage. Input coverages can be point, line or polygon coverages, but the clipping coverage must be a polygon. The output coverage will be of the same feature class as the input coverage, but will encompass a smaller area. Also, in clipping, the output coverage will not inherit any of the attributes of the clipping coverage.

### Dissolve

•Dissolve combines adjacent features within a feature class based on an attribute value. You can dissolve either line or polygon feature classes, and the output coverage will be of the same feature class as the original coverage, but will have a smaller number of features. Other than some ArcMap internal attributes, only the attribute used to dissolve is carried forward into the new coverage.

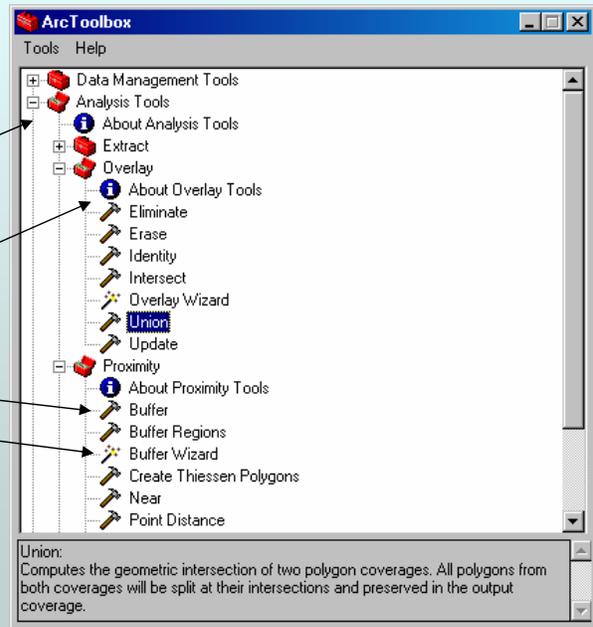
# ArcToolbox

Tools organized by function

- Data management
- Analysis
- Conversion
- My Tools

Tree Objects

- Tool sets
- Information screens
- Tools
- Wizards

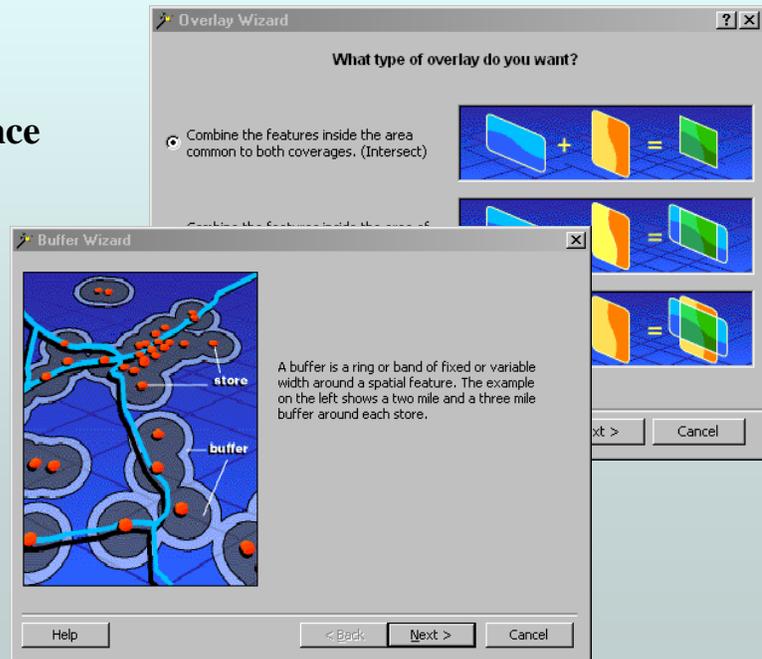


## Analysis with ArcToolbox

ArcToolbox features many spatial analysis tools in a three level structure. Tools sets are groupings of similar tools. An information tool in each set describes the tools contained within. The individual tools can be used for single or batch jobs. The Tool wizards are better for a single complex task or for an operation that you are not familiar with.

# Working with wizards

- **Multiple panels**
- **Explanation and guidance**
- **Helpful graphics**
- **One job at a time**

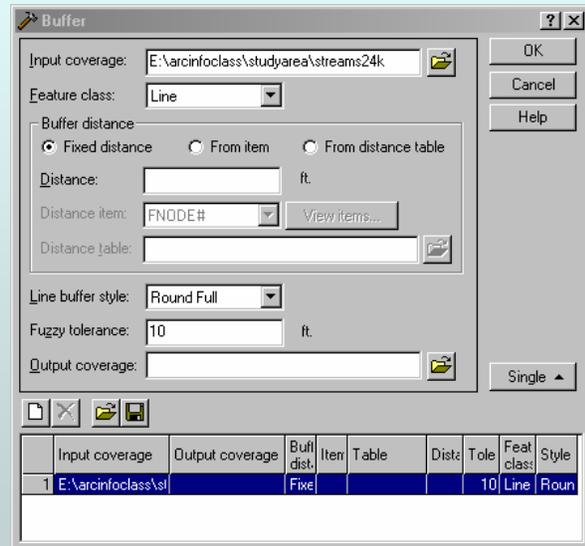


## Working with wizards

- Tool wizards step you through the operation with supporting graphics and often provide more options than the equivalent tool.

# Working with tools

- **One panel**
- **Less explanation**
  - **What's this?**
  - **Help button**
- **Multiple jobs**

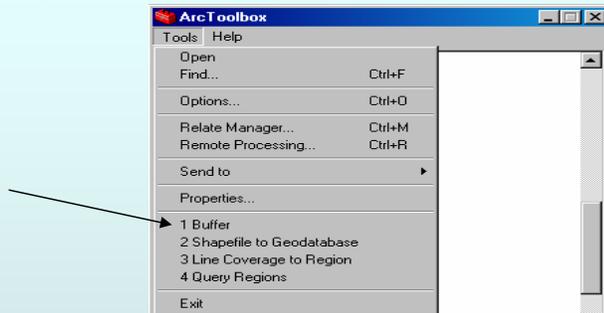


## Working with tools

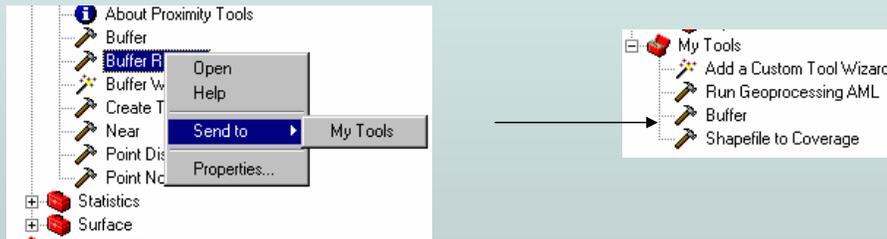
Tools do not provide the same level of detail and graphics as the wizards, but they can be used for multiple jobs. The wizards are useful for learning a typical procedure, but the tools are more helpful for subsequent operations, or to perform multiple or batch operations

## ArcToolbox tricks and tips

- Recently used tools appears in Tools menu



- May send to My Tools for simple customization



- Use My Tools to run user-created AML programs
- Access workstation functionality



### ArcToolbox tools and tricks

- Recently used tools and customization
- Recently used tools appear in the Tools pulldown menu. You may add any of the tools or wizards to the My Tools folder.
- Run user-created AML programs or other applications
- Custom tools can be constructed using ARC Macro Language (AML©) programs and can be added to ArcToolbox to access other workstation functions not included in ArcToolbox by default.

# Summary of analysis operations

Analysis type	Data type		
	Shapefile	Coverage	Geodatabase
<i>Select by location</i>	yes	yes	yes
<i>Extraction</i>	yes	yes	yes
<i>Proximity</i>	yes	yes	yes
<i>Network</i>		yes*	yes
<i>Overlay</i>		yes	

\* Available with ARC NETWORK extension



## Summary of analysis operations

Each data type supports different analysis operations. This summary can help you decide if you need to convert a dataset from one type to another to perform a certain analysis operation.

# Exercise 5

## Geospatial Analysis

