FE 257. GIS and Forest Engineering Applications

Week 5

Week 5

- Last week (Chapter 3):
  - Acquiring, creating, and editing GIS databases
  - Examining Error
- Chapter 7
  - Buffering and other proximity operations
- Questions?
- Next week- read:
  - Chapter 2: pp. 27-37

Mid-term exam

- Wednesday of next week
- All lecture and lab material through this week
  - Bring calculator
- Book: Chapters 1, 2, 3, 4, 5, 6, 7, 8, 11
  - Book questions
- Labs:
  - Processes (import, clip)
  - Software (licensing and modules)
  - Data (shapefiles, DOQ, DRG)
- Matching, True / False, Multiple choice

This week's topics

- Chapter 11
  - Overlay processes
- Chapter 8
  - Combining and splitting landscape features and merging GIS databases

Geographic Information Systems

Applications in Natural Resource Management

Chapter 11

Overlay Processes

Michael G. Wing & Pete Bettinger

Objectives: Overlay Processes

- _____
- The outcomes from using an overlay process to accomplish one or more analytical tasks within GIS;
- The circumstances that help you decide when each of the three overlay processes might be used to support an analysis or research objective; and
- The differences among the three overlay processes, and between them and other similar GIS processes.

Overlay strength

- One of the most powerful capabilities of GIS is its ability to integrate landscape and attribute information from multiple databases into a single layer
- Design with Nature (Ian McHarg 1969) demonstrated a manual overlay process that caught the attention of many and started some critical thinking among people who would later create the first GIS software programs

Overlay process mechanics (1)

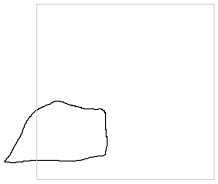
- Typically, we are working with two databases
  - A point, line, or polygon database contains features of interest
  - A polygon database is used to define the union, intersect, or identity area to be considered in processing
    - Can also intersect two line databases
- A third database is created that contains the results

Overlay process mechanics (2)

- Unlike a merge process, which also integrates two databases to produce a third, a overlay process
  - _____
  - Creates new features when intersections occur
- Depending on the type of overlay and input databases, the results of some overlay processes will be identical or very similar to the results of other GIS database processes
  - Example: A clip process and an identity or intersect process may lead to the same resulting database, depending on the inputs

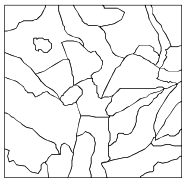
Overlay databases

Fire database



attributes:
day, month, year

Stands database



attributes:
basal area, volume
per acre, vegetation
type, age

Union overlay process

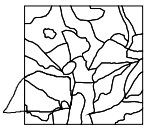
Fire database

attributes:
day, month, year

Stands database

attributes:
basal area, volume
per acre, vegetation
type, age

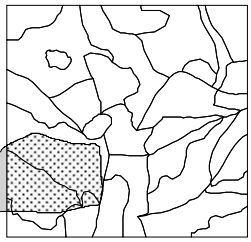
Resulting database



attributes:
basal area, volume
per acre, vegetation
type, age, day, month,
year

All polygons from both databases will be split at their intersections and preserved in the output database

Union output



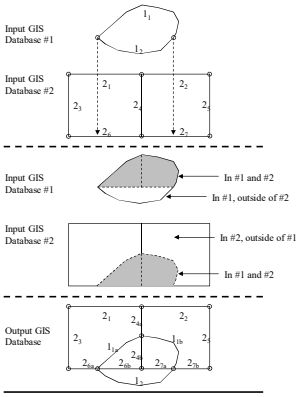
Stand attributes present, fire attributes absent

Stand attributes present, fire attributes present

Stand attributes absent, fire attributes present

Resulting database:
fire and stands, defined along original fire boundaries and along the boundaries of the stands

Attributes:
basal area,
volume
per acre,
vegetation
type, age, day,
month,
year



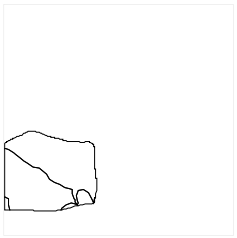
An example of the processing of database features during an union operation.

Intersect overlay process

Fire database	Stands database	Resulting database
attributes: day, month, year	attributes: basal area, volume per acre, vegetation type, age	attributes: basal area, volume per acre, vegetation type, age, day, month, year

Only those features in the area common to both databases will be preserved in the output database.

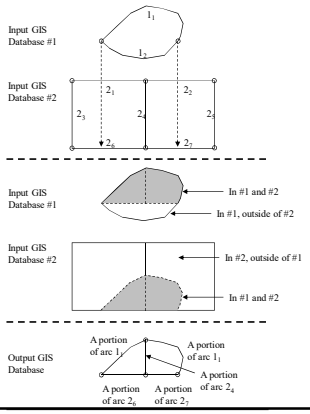
Intersect output



Should have a full set of attributes in the output database.

Resulting database: stands, defined along original stand boundaries yet only within the boundary of the fire

Attributes: basal area, volume per acre, vegetation type, age, day, month, year



An example of the processing of database features during an intersect operation

Identity overlay process

Fire database	Stands database	Resulting database
		
attributes: day, month, year	attributes: basal area, volume per acre, vegetation type, age	attributes: basal area, volume per acre, vegetation type, age, day, month, year

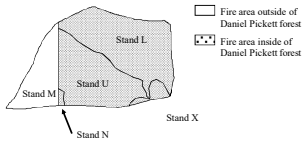
All features of the input database, as well as those features of the identity database that overlap the input database, are preserved in the output.

Identity output

Resulting database: fire, defined along original fire boundaries and along the boundaries of the stands

Attributes: basal area, volume per acre, vegetation type, age, day, month, year

A closer look at the results of the identity operation of fire and stands…



Stand	VegType	Basal Area	Age	MBF	Month	Day	Year
L	C	120	30	5.6	7	2	2002
M		0	0	0	7	2	2002
N	C	190	45	17.3	7	2	2002
U	A	260	70	37.7	7	2	2002
X	B	20	10	1.8	7	2	2002

Identity overlay process II

Stands database

attributes:
basal area, volume per acre, vegetation type, age

Fire database

attributes:
day, month, year

Resulting database

attributes:
basal area, volume per acre, vegetation type, age, day, month, year

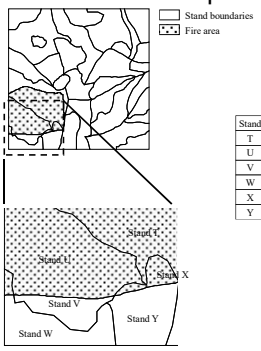
All features of the input database, as well as those features of the identity database that overlap the input database, are preserved in the output.

Identity output II

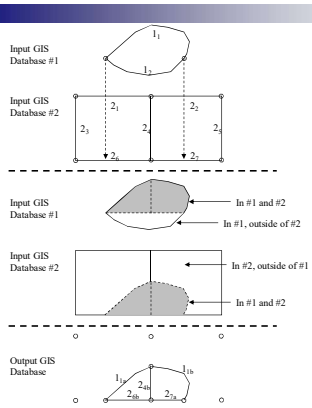
Resulting database:
stands, defined along original stand boundaries and along the boundaries of the fire

Attributes:
basal area,
volume
per acre,
vegetation
type, age, day,
month,
year

A closer look at the results of the identity II operation of stands and fire



Stand	VegType	Basal Area	Age	MBF	Month	Day	Year
T	C	120	55	19.5	7	2	2002
U	A	260	70	37.7	7	2	2002
V	A	260	70	37.7	0	0	0
W	C	190	45	17.3	0	0	0
X	B	20	10	1.8	7	2	2002
Y	B	20	10	1.8	0	0	0



An example of the processing of database features during an identity operation.

Overlay Considerations

- _____
  _____
- Usually requires a polygon layer as the overlay
  - Two line layers can be intersected
- ArcGIS allows more than two layers
- Potential users should clearly understand the differences among the overlay processes before selecting one
- May require significant processing time depending on size of inputs

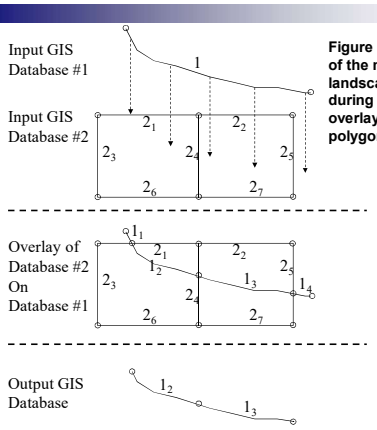
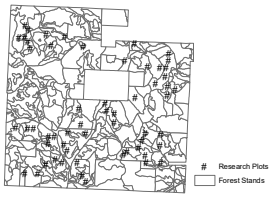


Figure 11.15 An example of the manipulation of landscape features during an intersect overlay of line and polygon databases.

Point overlay application

- Research plots (57) on the Brown Tract
- What is the land allocation?
- An intersect overlay process could help you answer

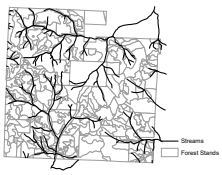


Research plot land allocations

Land allocation	**Research plot ID**
Even-aged	48
Research	6
Uneven-aged	3

Line overlay application

- Stream records: 398
- What is the land allocation for streams?
- An intersect overlay process could help you answer

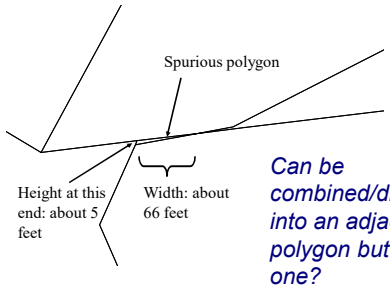


Stream record land allocations

Land allocation	Stream record count
Even-aged	281
Meadow	2
Oak Woodland	3
Research	7
Uneven-aged	65
<No Value>	40

Spurious or sliver polygons

- _____
  _____
  _____
- Can be detected by looking at area measurements in tabular database
  - Very small areas will help identify their presence
- Deciding whether these very small areas are meaningful will depend
  - On your organization's policies about minimum mapping units
  - The goals of your analysis project



Can be combined/dissolved into an adjacent polygon but which one?

Figure 11.4. A spurious polygon that was created during the intersect process.

Overlay summary

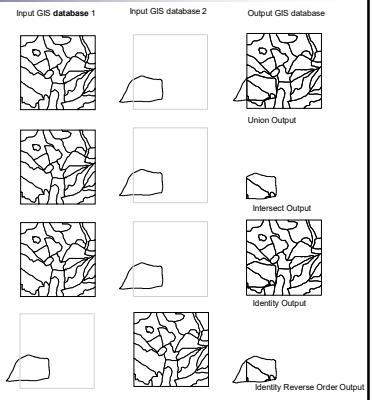


Figure 11.18. Summary of results for union, intersect, identity, and identity reverse order for the stands and 070202_fire GIS databases.

Geographic Information Systems

Applications in Natural Resource Management

Chapter 8

Combining and Splitting Landscape Features, and Merging GIS Databases

Michael G. Wing & Pete Bettinger

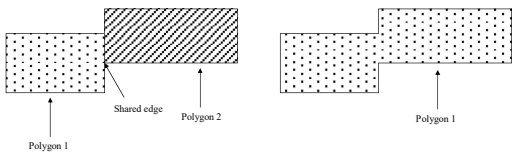
Chapter 8 Objectives

- Objectives:
- Why, when, and how you might want to combine landscape features;
- The reasons for splitting landscape features, and the situations where this process might be appropriate; and
- Why two or more GIS databases might be merged, and what you would expect to find within a merged database.

The combine process

- _____
  _____
  _____
- These changes are saved in a new database
- The combine process is also known as a dissolve

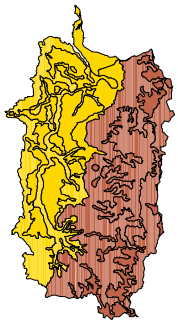
Figure 8.1. Combining two polygons, by eliminating a shared edge, to produce a single polygon.



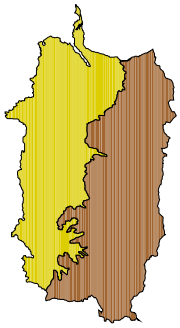
Prior to combining the polygons

After combining the polygons

Combine/Dissolve Input



Combine/Dissolve Output



Why combine features?

- May help remove some of the smaller features that are the products of digitizing or other GIS process
  - Spurious or erroneous polygons
- _____
- Landscape delineations in data acquired from elsewhere does not match existing data
- Remove redundant features in a database
  - No need for boundaries between features that have the same attribute values
- Changes in a landscape
- Supporting a spatial analysis
  - Using ROS classes to aggregate landscape features

A combine example

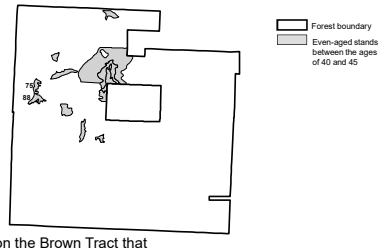


Figure 8.2. Stands on the Brown Tract that are even-aged, and between the ages of 40 and 45.

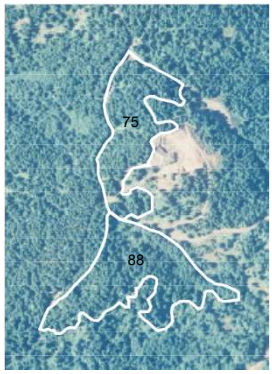


Figure 8.3. Two similar-aged stands on the Brown Tract that share a common border. Both are even-aged, and between the ages of 40 and 45.

Attributes may need attention following a combine…

Table 8.1. Results of combining two stands.

Stand	Acres	Hectares	Age	Site index	Trees per hectare	Height (m)	Board feet per hectare
Both stands before using a "combine features" process							
First stand selected							
75	7.5	3.0	44	100	250	23	15,325
Second stand selected							
88	9.9	4.0	44	117	492	28	39,388
Combined stand after using a "combine features" process if age is used as the combine field			44				
Combined stand after using a "union features" process							
75	7.5	3.0	44	100	250	23	15,325

Multiple spatial features, one database record

- Options:
  - Leave as is
  - Spit into two
  - Combine with help of land separating the two stands

Figure 8.4. Two polygons (regions) represented by a single database record in the Brown Tract stands GIS database (stand 283).

Overlapping polygons

- Why?
  - Editing spatial locations
  - Merging (discussed later)
- Possible fix
  - Combine

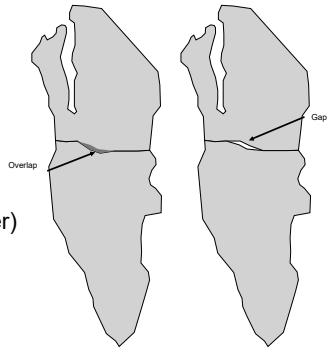
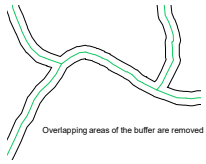


Figure 8.5. Overlap and gap remaining after editing polygon boundaries.

Another combine application

- Combine can be used to remove overlapping buffer results



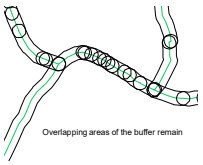
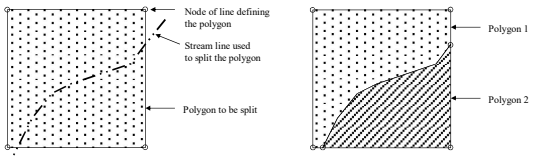


Figure 8.6. The results of two buffering operations, one where the overlapping areas of the buffer around each stream are removed, and the other where the overlapping areas remain.

Splitting landscape features

- Used to redefine a portion of a landscape and is typically in reference to polygons or lines
- _____
  _____
  _____
- We use an existing GIS database or can create a graphic with the shape we want to use as a "splitter"
  - Example: splitting a stand into two parts to reflect an intersecting stream

Figure 8.7. A 160-acre (64.8 ha) polygon split along a stream, forming two smaller forest management units.



a. 160-acre (64.8 ha) polygon and a stream that will be used to split it into two smaller polygons

b. Resulting two smaller forest management units after splitting the 160-acre (64.8 ha) polygon

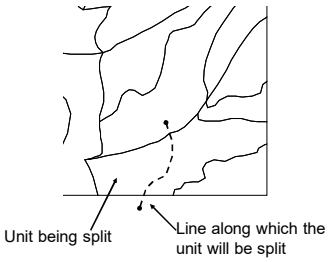
Reasons for splitting a landscape feature

- A road that has had part of its length resurfaced with a different material or obliterated through a restoration process
- A stream that has been surveyed and now has attribute data available for part of its length
- _____
  _____

The split process

- Varies among GIS programs
- Within ArcGIS, we can draw a graphic shape (line or polygon) through the feature we want to split
  - Splitting lines is typically straight-forward
  - In the case of polygons the graphic shape must cross the border of the polygon twice
- Make sure you have a back-up copy of the feature that you split

Splitting a large management unit along a line created by a user of desktop GIS software.



Merge

- A merge process creates a new GIS database from a set or subset of one or more previously developed GIS databases
- Point, line, and polygon databases can be merged but different database feature types are generally not mixed
  - While several polygon databases might be merged, a line or point database would not typically be included in this process
- A merge process is also called an append process in some software
- When merged features overlap, no new features are created

Why merge databases?

- _____
  _____
- Example: identify forest areas that have no management restrictions (all silvicultural practices appropriate for the resources affected are allowed)
  - Identify restricted areas:
    - Within a certain distance of streams (buffer)
    - Within a certain distance of roads (buffer)
    - Near sensitive habitat areas (buffer)
  - Merge the restricted areas into a single database
  - Use the single database as an "erase" database and to remove these layers any databases that will be used to guide management activities
- This should make the delineation of restricted areas more efficient

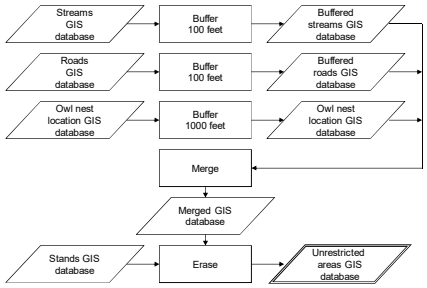


Figure 8.9. A process that can be used to delineate unrestricted areas in a forested landscape.

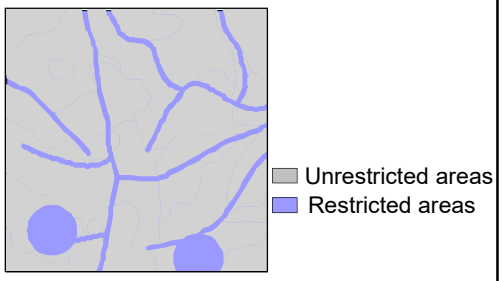
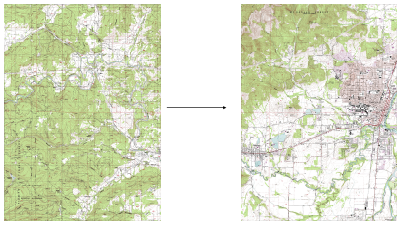


Figure 8.10. A description of the restricted and unrestricted areas on the Daniel Pickett forest.

Another use for a merge…

- The merge process can also be used to "stitch" together spatial databases that share common borders
- Examples:
  - Merging adjacent USGS topographic maps together
  - Connecting data from two adjoining counties
    - Roads, streams, and other features

Merge example



Merge example