

Spatial Analysis: Overlay operations

1. *Questions and Announcements*

- “Question 2” and window of tutorial resubmission today. Add comment!
- The **last Tutorial of the quarter** (11/30)!

* **Extra credit** for getting it done early:

- 2 points for final submission date 11/23 or earlier.
- 1 point for final submission date 11/27 or earlier.

Why? Because it will **improve your Final Project worksheets** (11/28)
and **set you up better for Quiz II** (12/02).

* Be sure you **know your options for getting to ArcMap!** Reread:

<https://canvas.uw.edu/courses/1066006/pages/gis-software-and-assistance-beyond-class-time>

<https://canvas.uw.edu/courses/1066006/pages/managing-your-gis-files-so-you-can-use-them-across-computers>

ArcMap is not only in the lab! **Some of these options require pre-planning.**

2. *Spatial Analysis (continued)*

- Overlay operations!

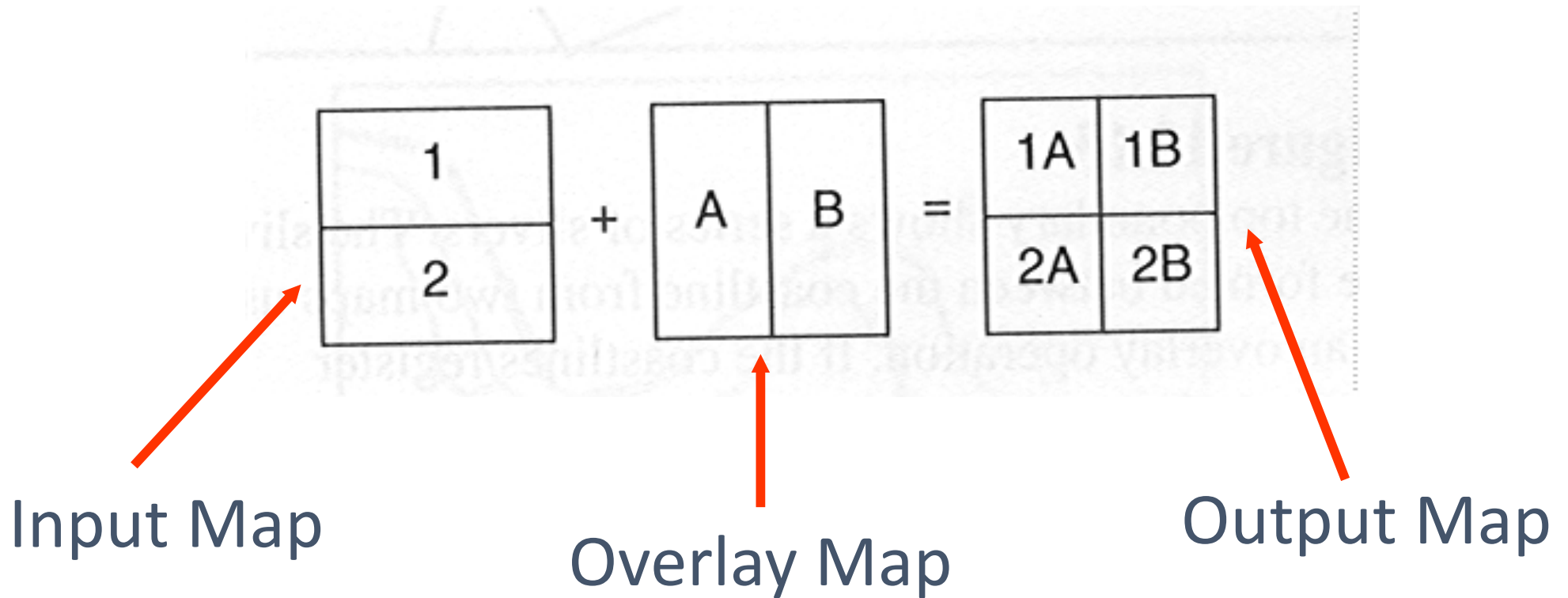
A few useful (vector data) spatial analysis techniques:

- Overlay
 - Union / Intersection
 - Clip / Merge / Append
- Buffering
 - Relies on the simpler spatial-analytical operation: 'calculate distance'
- Dissolve

Overlays

- An overlay operation takes two or more layers as inputs.
- It puts them together to produce an output layer.
- This is very general, so there are many possible variations on this theme.
- And there are many use cases.
 - As you look these over, think about possible ones.
 - Your tutorials demonstrate various uses, too.
 - Being good at GIS is not just knowing the operations, but being able to look into the world and ‘see’ when a certain kind of operation would be useful.

'Union': a simple overlay



(What appear to be labels inside polygons are attribute data values)

Three common types of vector overlay

- Point in polygon

Note: Here, this term describes a class of overlay approaches, not the specific problem/algorithm (Ways of solving, “Is this point in a polygon?”) we talked about last time.

- Line in polygon

- Polygon in polygon

Point in polygon

Line in polygon

Polygon in polygon

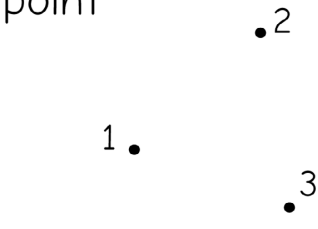
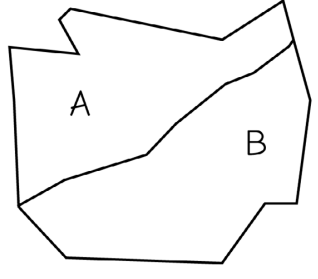
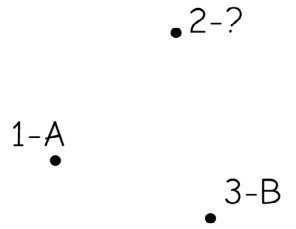
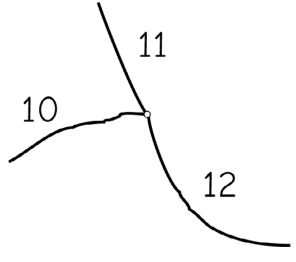
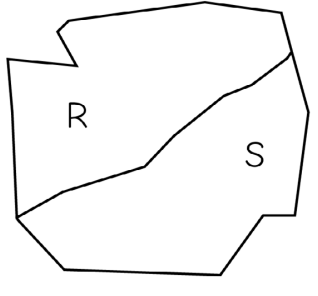
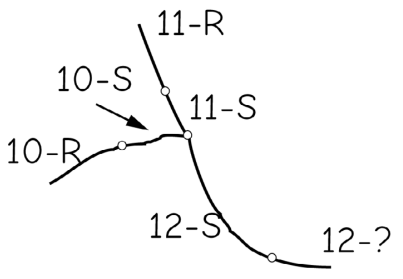
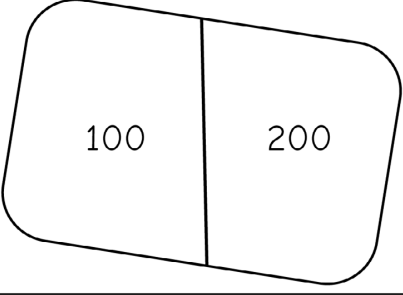
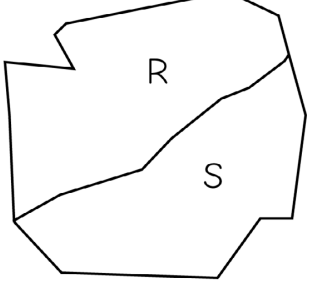
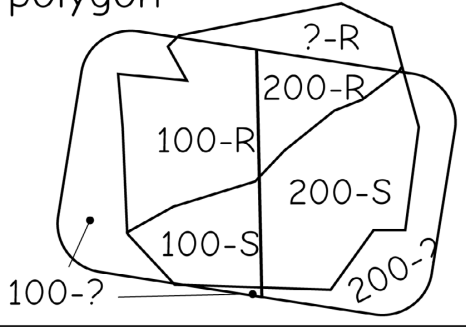
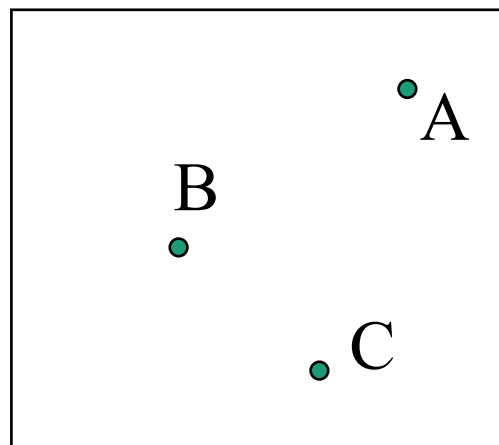
Input layer 1	Input layer 2	Output layer
point 	polygon 	point 
line 	polygon 	line 
polygon 	polygon 	polygon 

Figure 9-37: Examples of vector overlay. In this example, point, line, or polygon layers are combined in an inclusive overlay. The combination results in an output layer that contains the attribute and geographic data from input layers. The output data are typically the minimum order of the input, e.g., if point data are used as input, the output will be point. If line and line or line and polygon data are used, the output will be a line data layer.

Point in Polygon Overlay (abstract example)

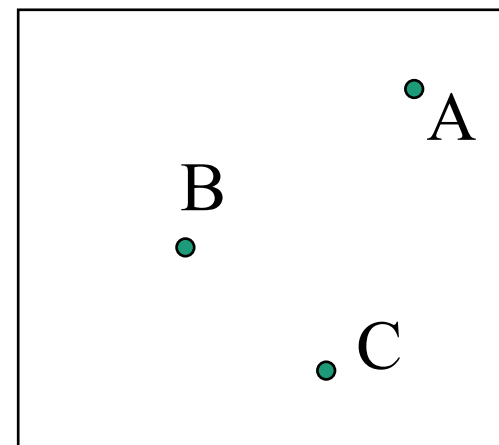
Input: Cities



Type of County

1	2
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Output Layer



Point Table

ID	City
A	Duluth
B	St. Paul
C	Rochester

Poly Table

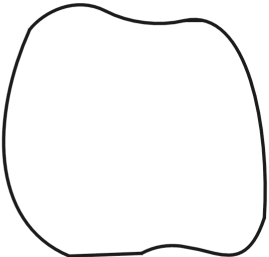
ID	County
1	Urban
2	Rural

Point Table

ID	City	County
A	Duluth	Rural
B	St. Paul	Urban
C	Rochester	Rural

If you have Point in Polygon.... Why not Polygon in Point?

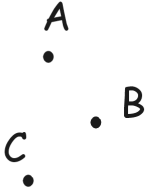
Input polygon layer



ID	type	name
1	county	Greene

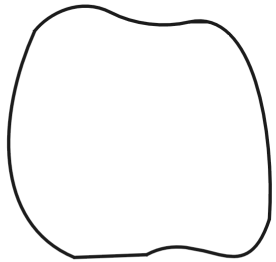
overlay

Input point layer



ID	class
A	HIC
B	Ur2
C	Y0

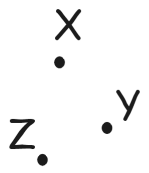
Output polygon layer



ID	type	name	class
X	county	Greene	?

A, B, or C?

Output point layer

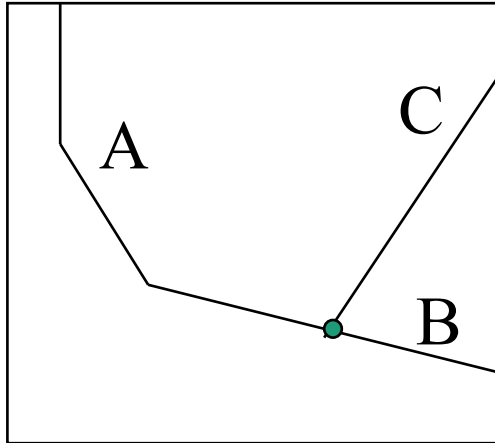


ID	type	name	class
X	county	Greene	HIC
Y	county	Greene	Ur2
Z	county	Greene	Y0

It's potentially ambiguous in a way that doesn't fit with relational database thinking. (Can you describe why?)

Line in Polygon Overlay (abstract example)

Input: Streets

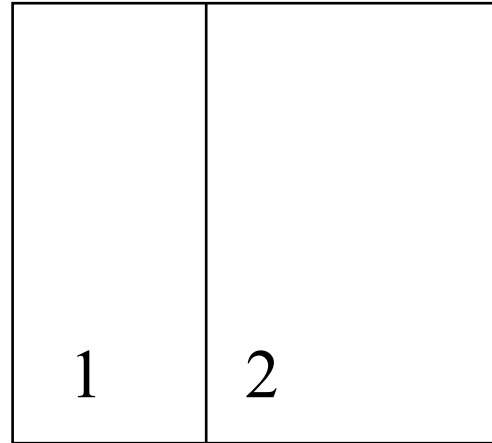


Line Table

ID	Street
----	--------

A	Wells
B	Wells
C	High

Overlay: City

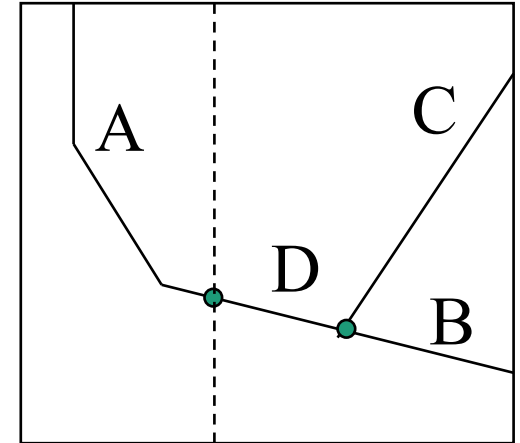


Poly Table

ID	Cover
----	-------

1	Mpls
2	St. Paul

Output: NewStreets



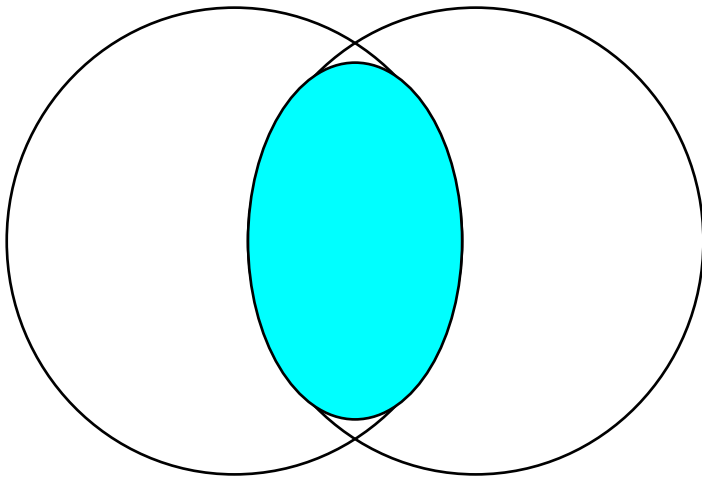
Line Table

ID	Street	Cover
----	--------	-------

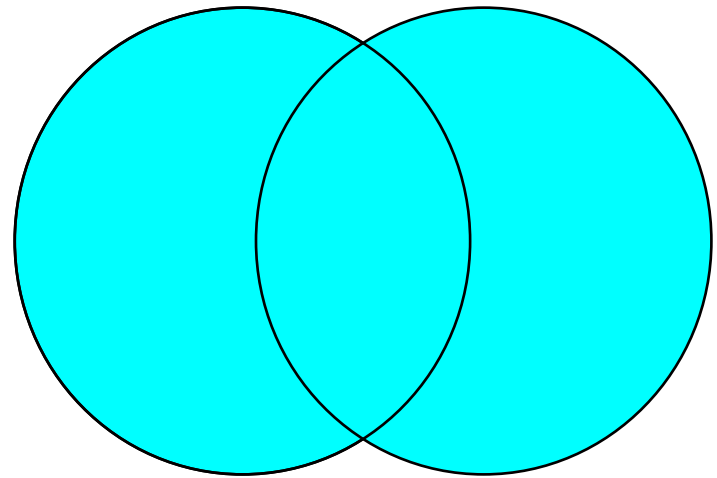
A	Wells	Mpls
B	Wells	St.Paul
C	High	St.Paul
D	Wells	St Paul

Polygon-on-Polygon Overlays

Intersection (and)



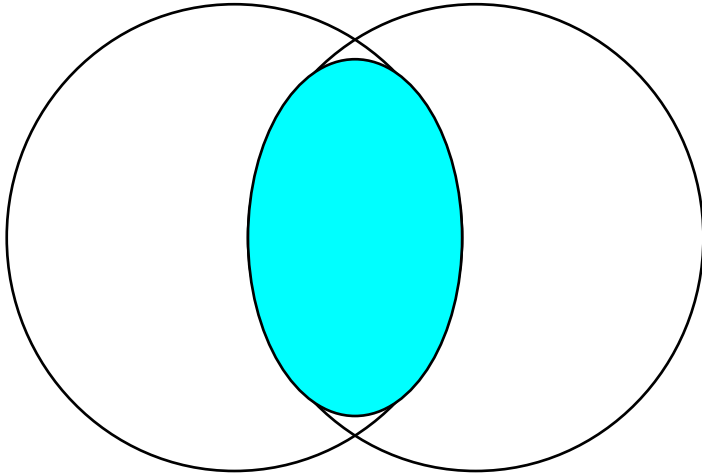
Union (or)



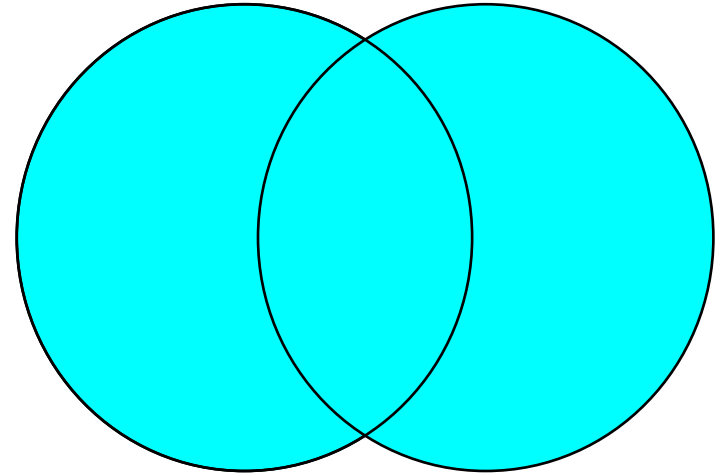
Not all polygon overlays are the same.

The geographic features and attributes in the output layer are different in different kinds of polygon overlays

Intersection (and)

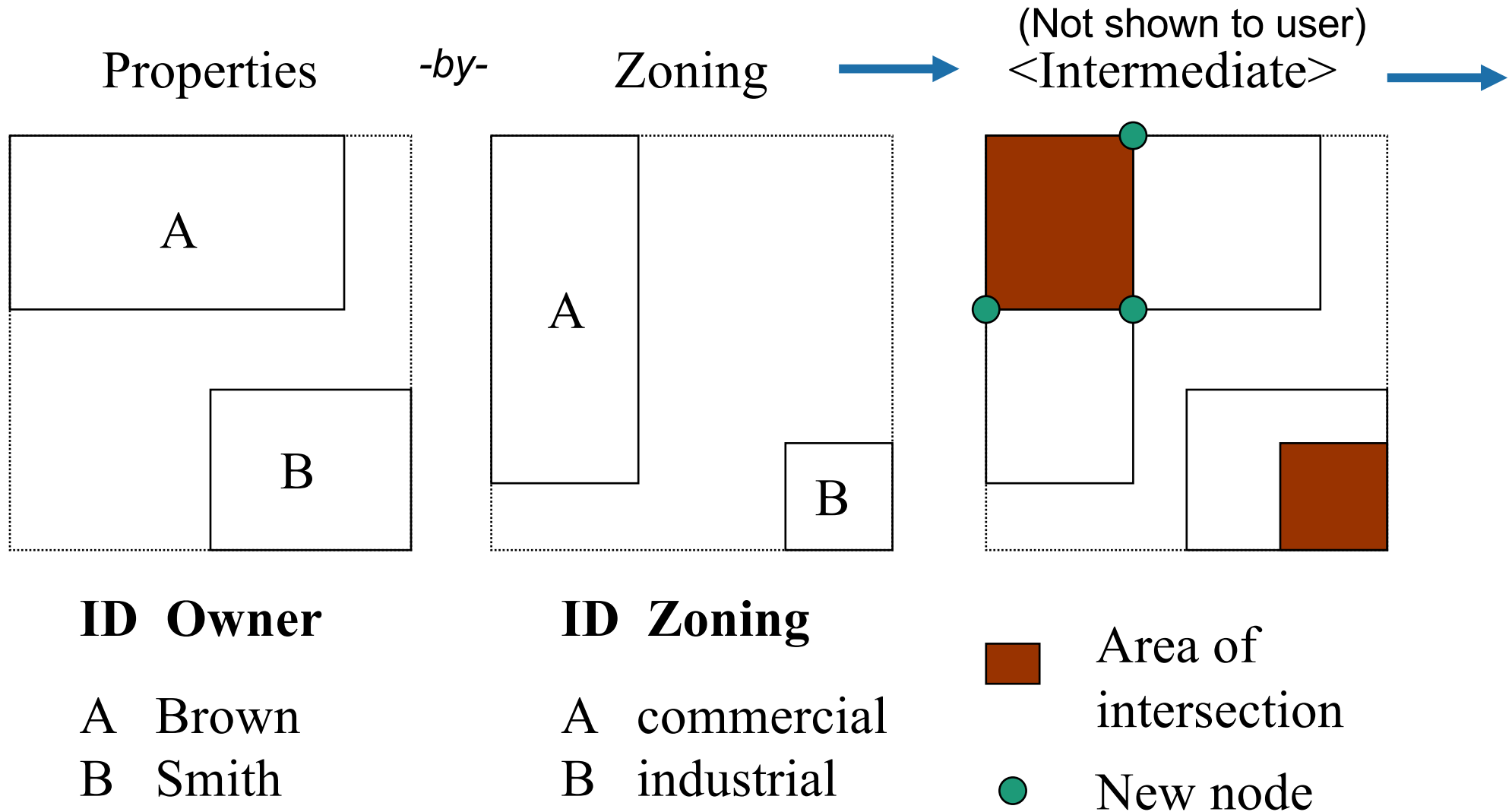


Union (or)



- **Intersection:** Selects out those areas that are common to BOTH layers, and attaches attributes from both layers to the output layer
- **Union:** Incorporates all areas from both layers, and attaches attributes from both layers to all features in the output layer

Polygon Overlay: Intersection (Part 1)

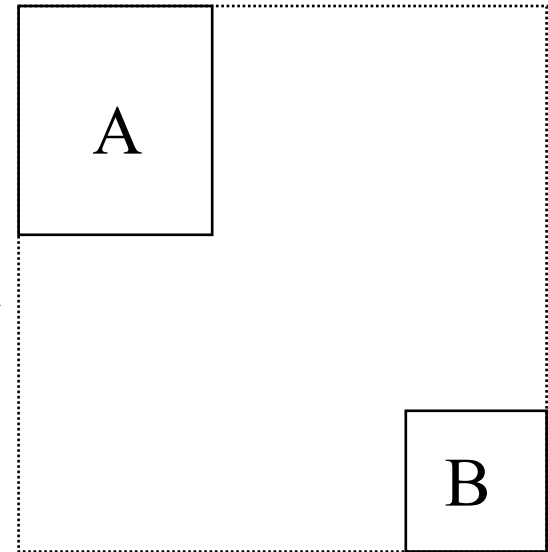
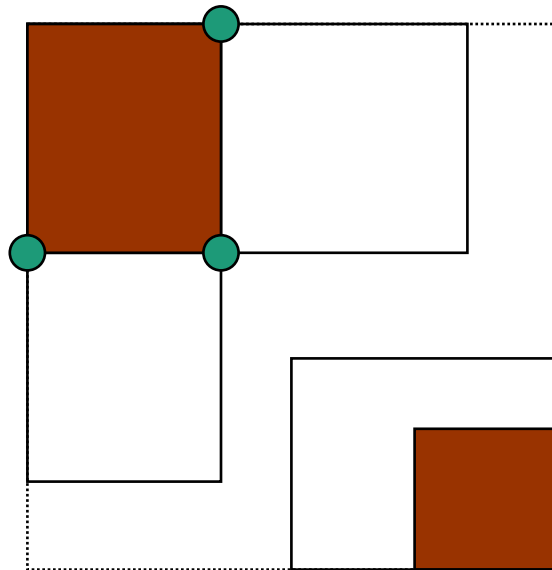




Polygon Overlay: Intersection (Part 2)

(Not shown to user)

<Intermediate>

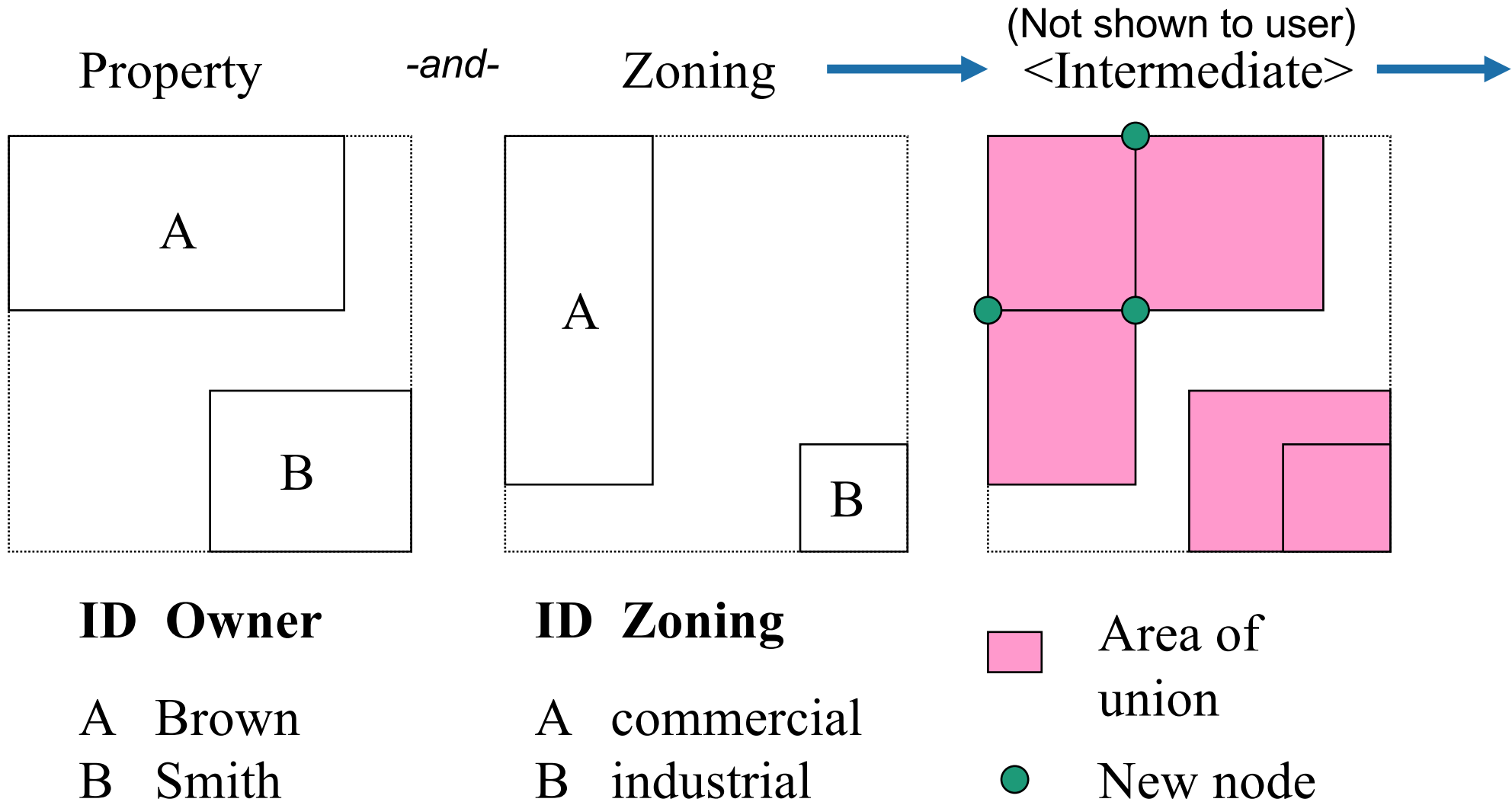
Output



-  Area of intersection
-  New node

ID	Owner	Zoning
A	Brown	commercial
B	Smith	industrial

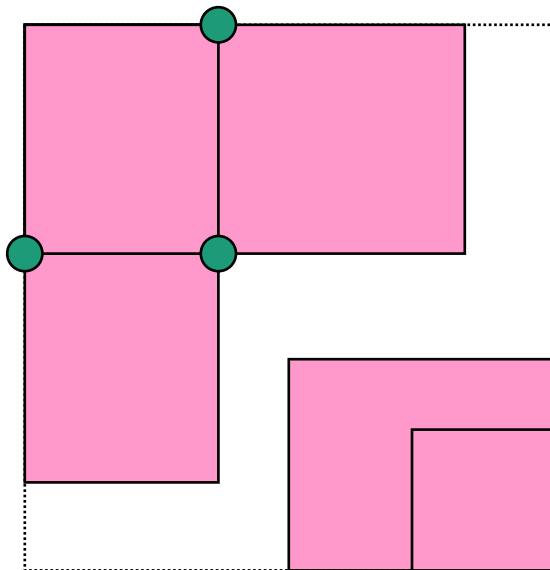
Polygon Overlay: Union (Part 1)





Polygon Overlay: Union (Part 2)

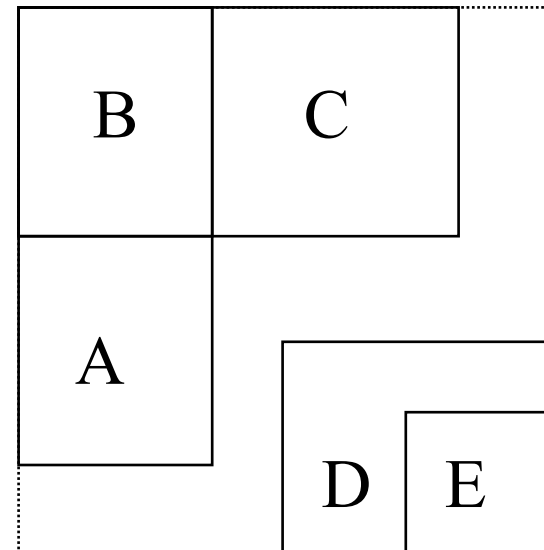
(Not shown to user)

<Intermediate>



-  Area of union
-  New node

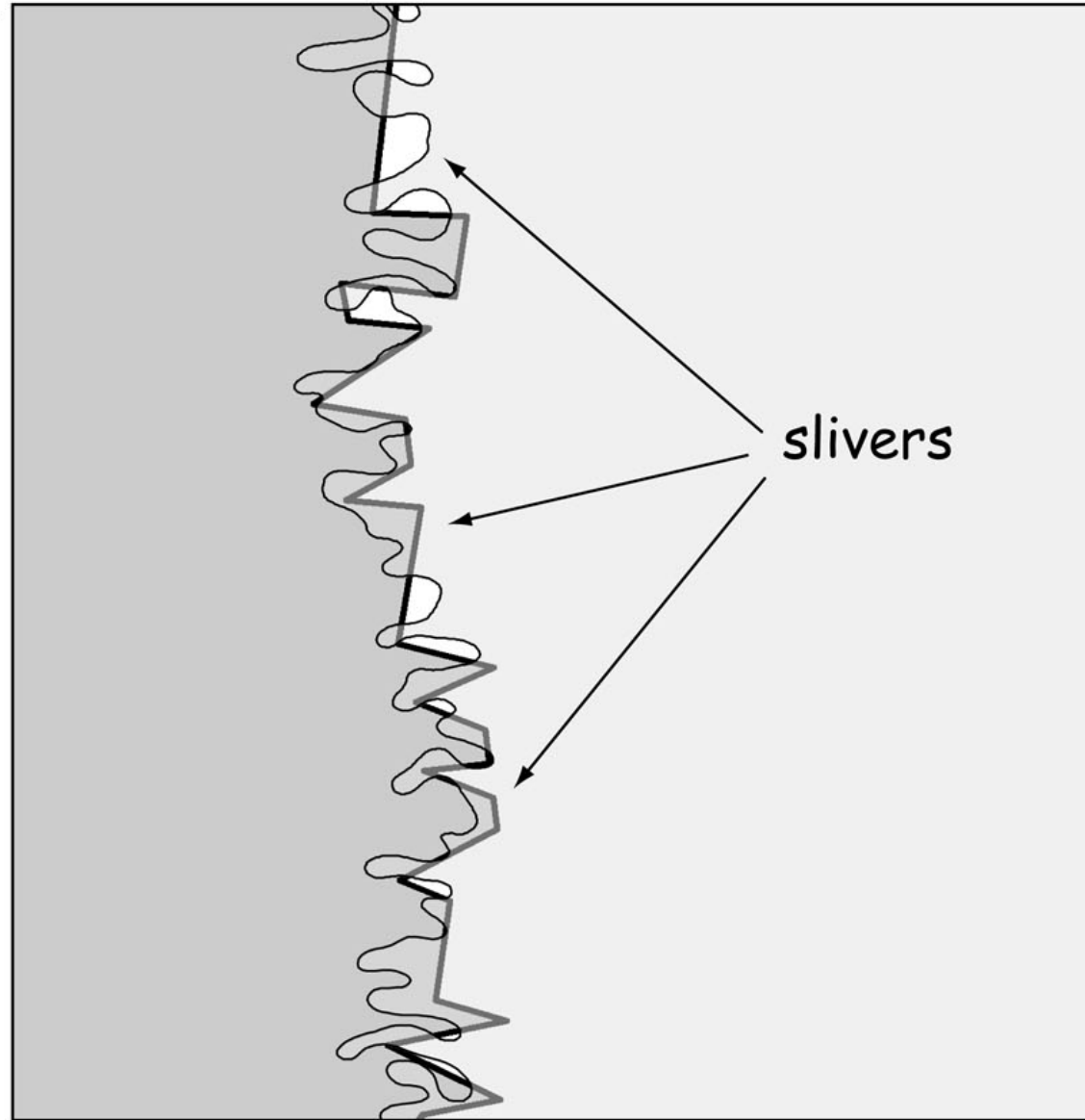
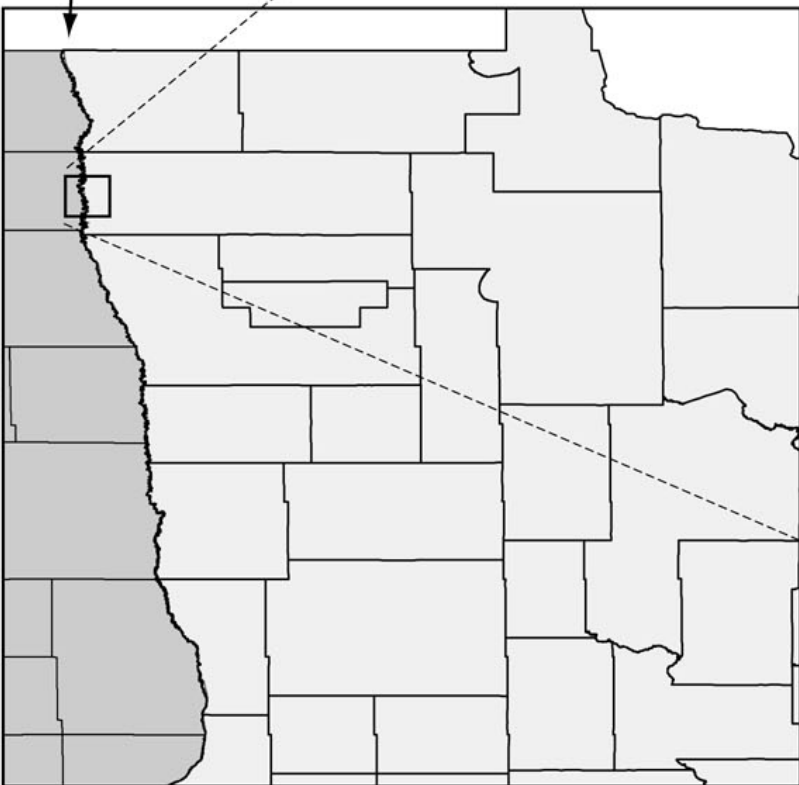
Output



ID	Owner	Zoning
A		commercial
B	Brown	commercial
C	Brown	
D	Smith	
E	Smith	industrial

A Pitfall of Overlay Operations: The possibility of **slivers**.

common
boundary



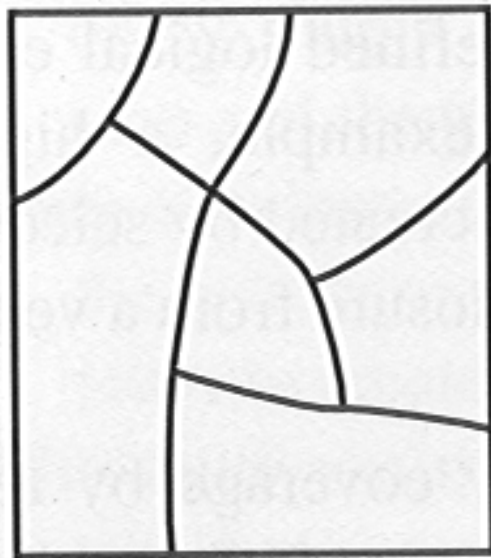
Overlays and attributes

- What happens to the attributes of the input layers?
 - *It depends* – different overlay operations handle attributes of the input layers differently.
 - Some overlay operations DO combine attributes from the two layers (intersect, union).
 - Some overlay operations DO NOT combine attributes from the two layers (clip, erase).

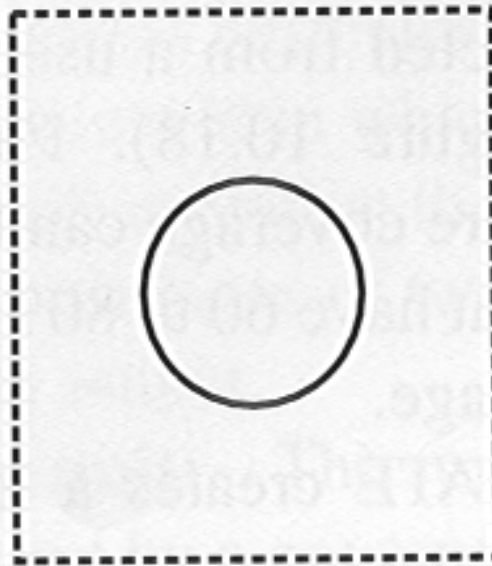
Clip

Uses a “clip theme” as a sort of filter for selecting only parts of the input theme.

That is, if you can’t “see it” through the clip theme, it doesn’t come along in the selection.



Input theme



Clip theme

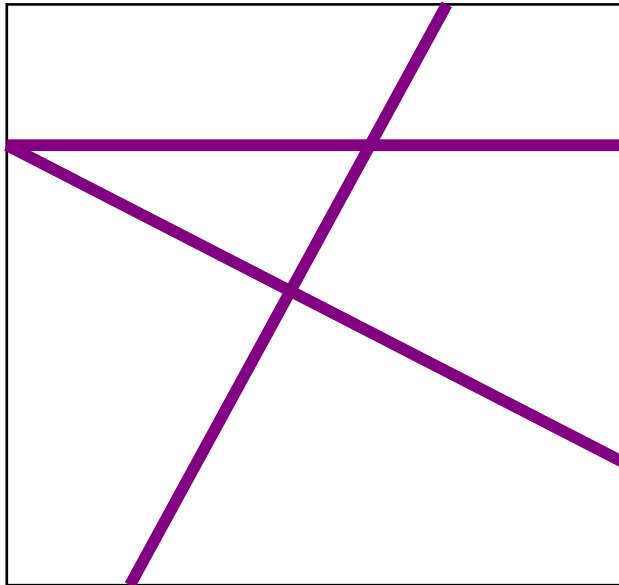


Output

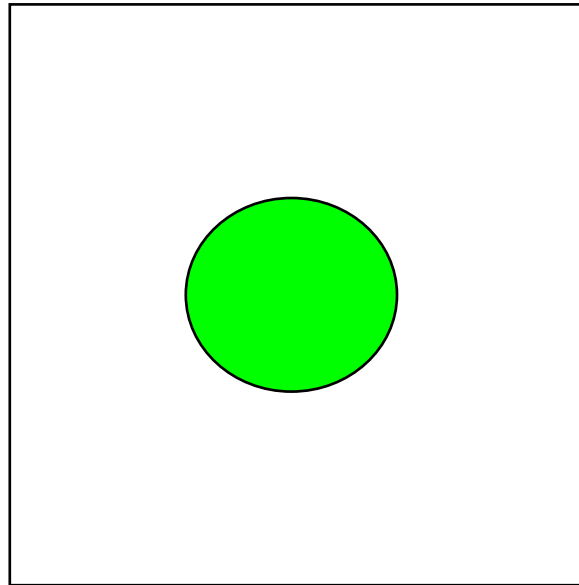
Erase

Opposite of clip: Uses one layer as a sort of filter for selecting certain parts of the input theme, but selects out only those parts of features that do NOT fall w/in the filtering layer

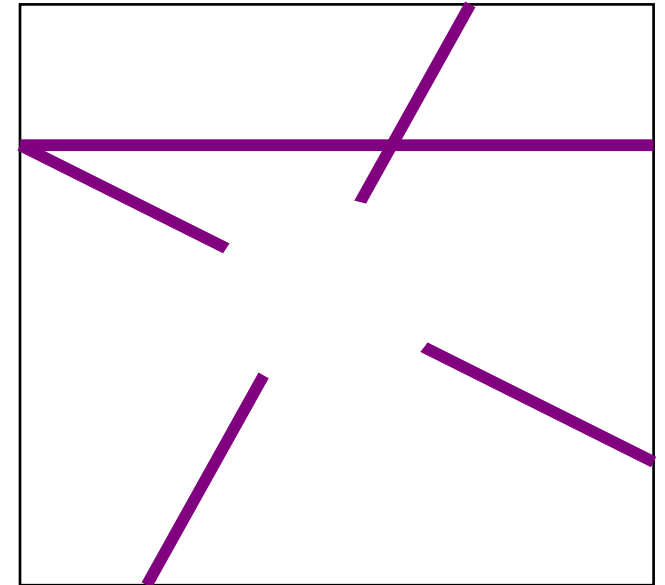
Input Layer



Erase Layer



Output Layer



Applications

You have 2 layers – areas w/ trees (in polygons) and areas over 5000 feet in elevation (also polygons). You want a layer that includes all areas of the map that are over 5000 feet and have trees. What do you do? What kind of overlay is this?

You have a mines layer and a landfills layer. You want to emphasize all features on the map that are mines or landfills. What kind of overlay is it?