

Session 7: Spatial Analysis

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Outline: Spatial Analysis

- Introduction
- Buffers
- Single Layer Geoprocessing
- Vector Overlay Analysis
- Demonstration

Class Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
<p>08/05/19</p> <p>Introduction to Geographical Information Systems</p> <p>10:45 am–12:15 am</p>	<p>08/06/19</p> <p>Cartography and Spatial Data Display</p> <p>8:30am – 11:00pm</p>	<p>08/07/19</p> <p>Querying Data for Spatial & Attribute Selections</p> <p>8:30am – 11:00pm</p>	<p>08/08/19</p> <p>Data Formats for GIS</p> <p>8:30am – 11:00pm</p>	<p>08/09/19</p> <p>Map Projections and Coordinate Systems</p> <p>8:30am – 11:00pm</p>
<p>08/12/19</p> <p>Editing and Storing Spatial and Attribute Data</p> <p>8:30am – 11:00pm</p>	<p>08/13/19</p> <p>Spatial Data Analysis Tools</p> <p>8:30am – 9:30 am</p> <p>Scripps Institute of Oceanography</p> <p>10:30am – 1:30pm</p>	<p>08/14/19</p> <p>Analysis Tools/Online Map Creation</p> <p>8:30am – 11:00pm</p>	<p>08/15/19</p> <p>Map Creation/ Geocoding</p> <p>8:30am – 11:00pm</p>	<p>08/16/19</p> <p>Geocoding/ Wrap up</p> <p>8:30am – 11:30am</p> <p>Closing Ceremony and Certificates</p> <p>12:00pm – 2:00pm</p>

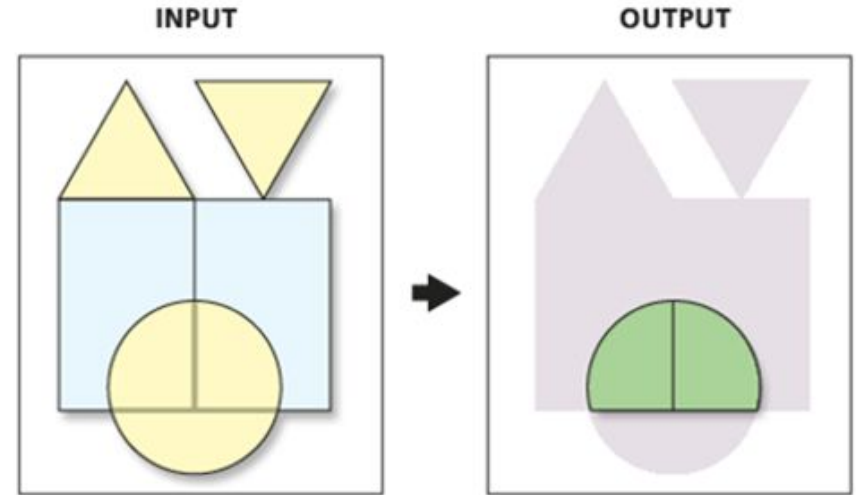
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08/12/19 Spatial Analysis Tools 8:30am – 11:00pm	08/13/19 Raster and Terrain Analysis 8:30 am – 10:00 am Scripps Institution of Oceanography 1:00pm – 4:00pm	08/14/19 Image Analysis 8:30am – 11:00pm	08/15/19 Editing Spatial Data and Geocoding 8:30am – 11:00pm	08/16/19 Web Mapping/ Wrap up 8:30am – 11:30am

Outline: Spatial Analysis

- Introduction

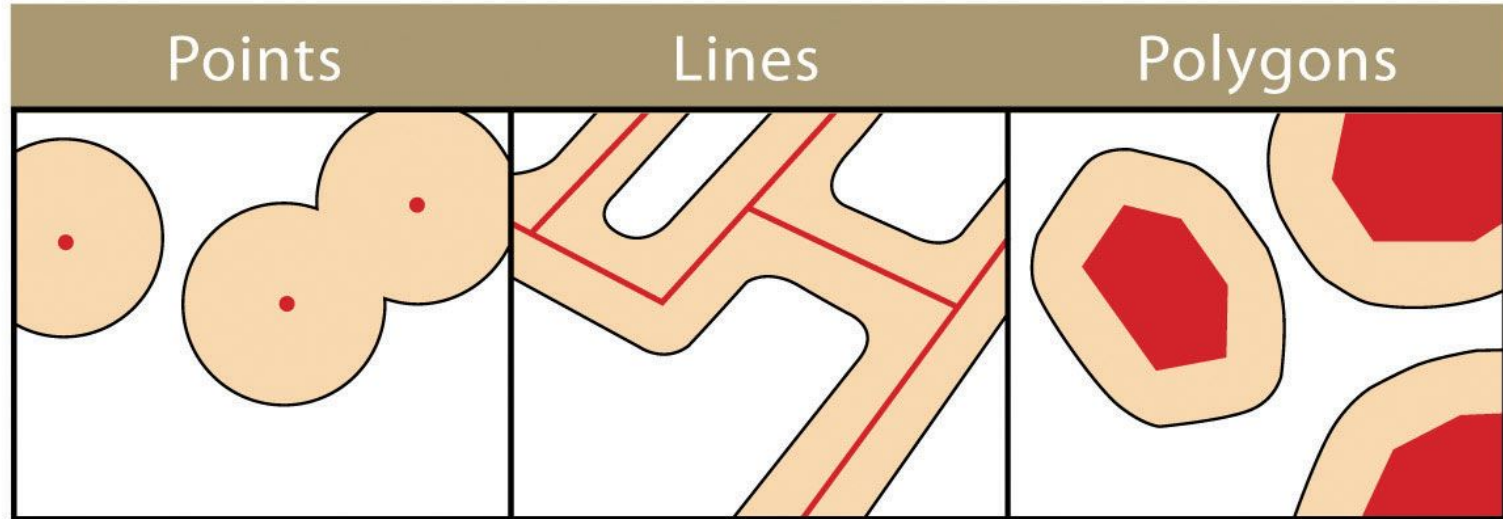
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- Vector Overlay Analysis
- Demonstration



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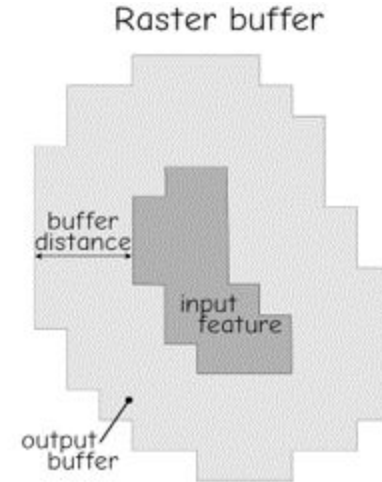
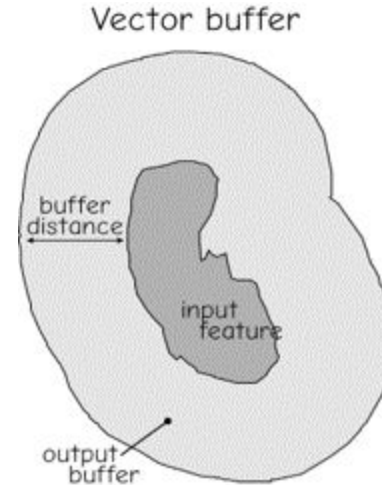
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Buffers



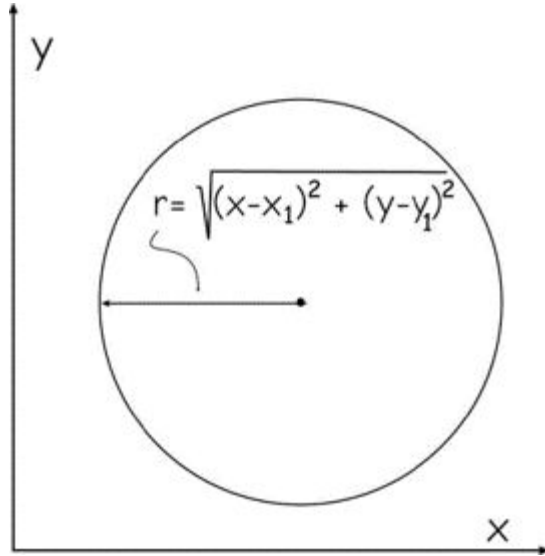
Buffer Analysis

- **Buffer** is a region less than or equal to some distance from another feature.
- Vector or Raster Buffers
- Typically identify areas that are “outside” or “inside” some threshold distance

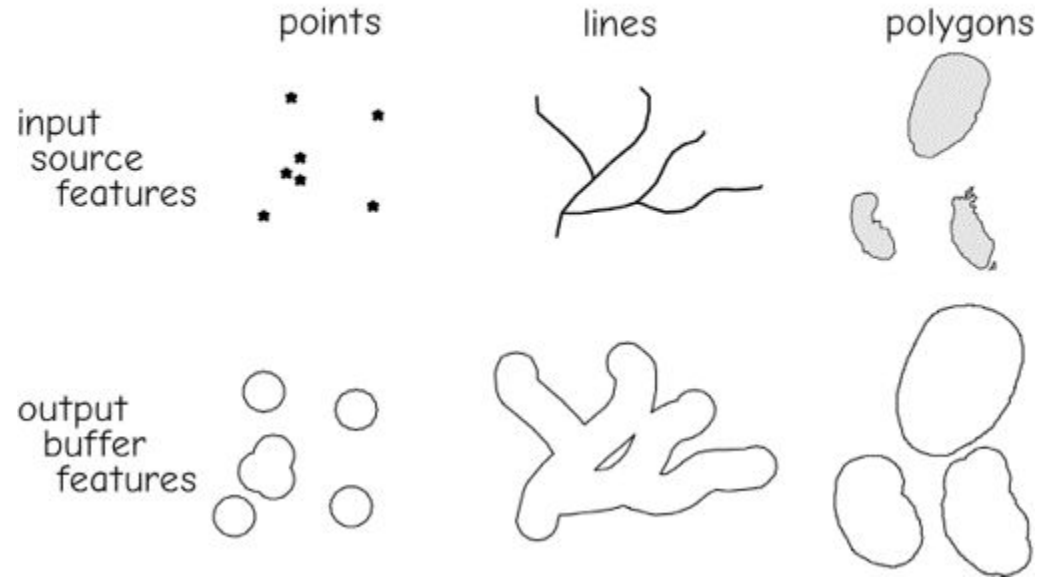


Vector Buffers

Distance Formula:



Vector buffers

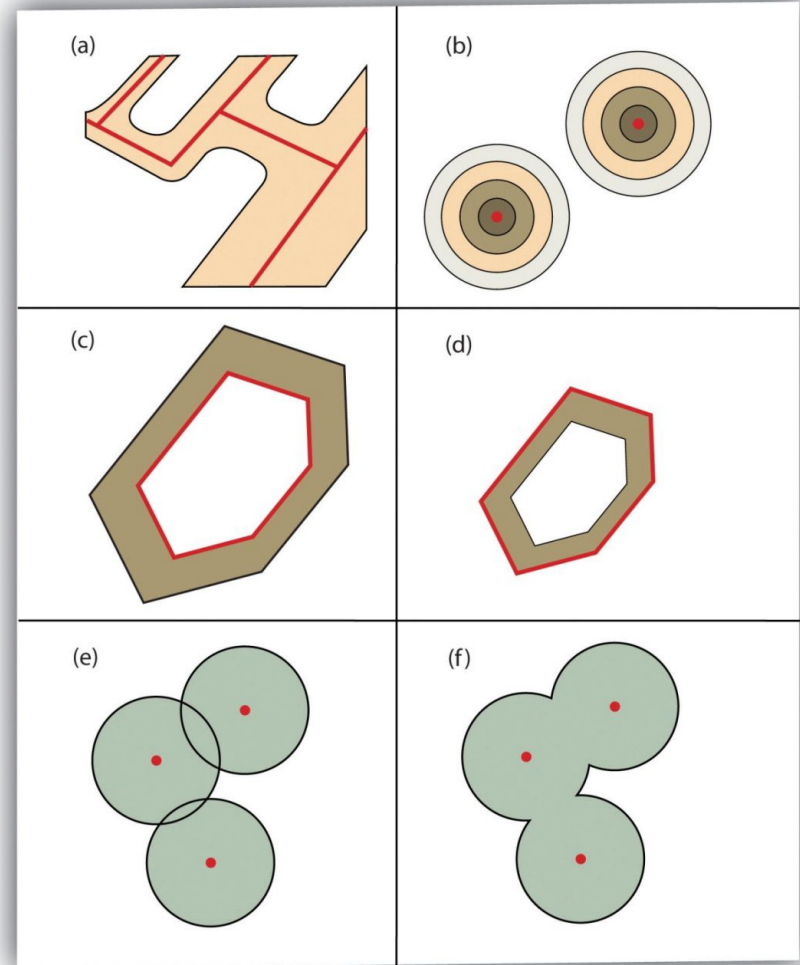


Source: GIS Fundamentals by Bolstad, 2015.

Buffers

Additional Buffer Options
around Red Features:

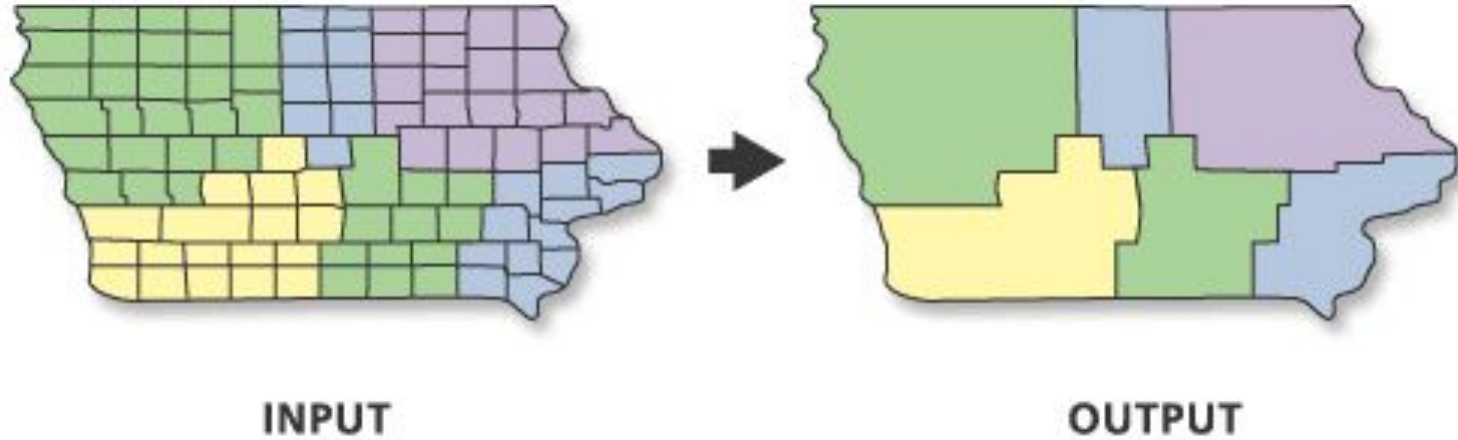
- (a) Variable Width Buffers,
- (b) Multiple Ring Buffers,
- (c) Doughnut Buffer,
- (d) Setback Buffer,
- (e) Nondissolved Buffer,
- (f) Dissolved Buffer



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Dissolve



- Spatially combine similar features
- Reduces dataset

Dissolve Example

Example: Select states west of Mississippi River and dissolve their boundaries.

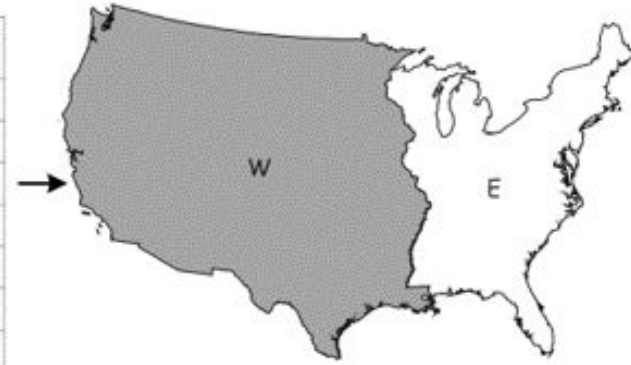
****** Reduces the set from 48 polygons to two polygons.



Dissolve operation

Dissolve table

state name	is_west	dissolve value
Alabama	0	E
Arizona	1	W
Arkansas	1	W
Colorado	1	W
Connecticut	0	E
....
Wyoming	1	W



The Dissolve Tool in Action



Input - Parcels attributed with Zoning Classification

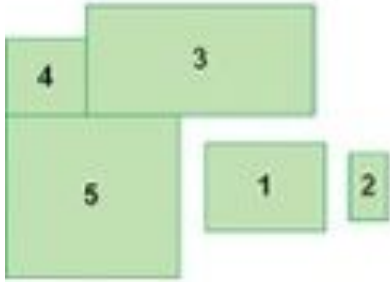
Dissolve Field - Zoning



Results - New layer with individual polygons for each zoning class

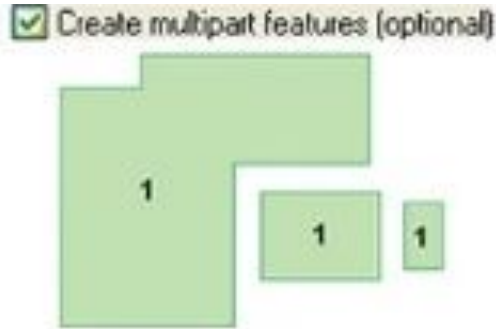
Dissolve: Multipart Features

DISSOLVE INPUT



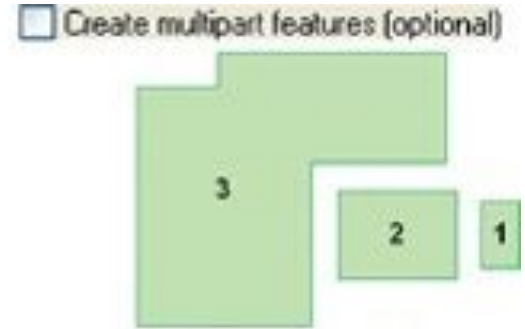
Five input features will be dissolved by geometry

OUTPUT: Multipart Checked



The output is one multipart feature

OUTPUT: Multipart Not Checked

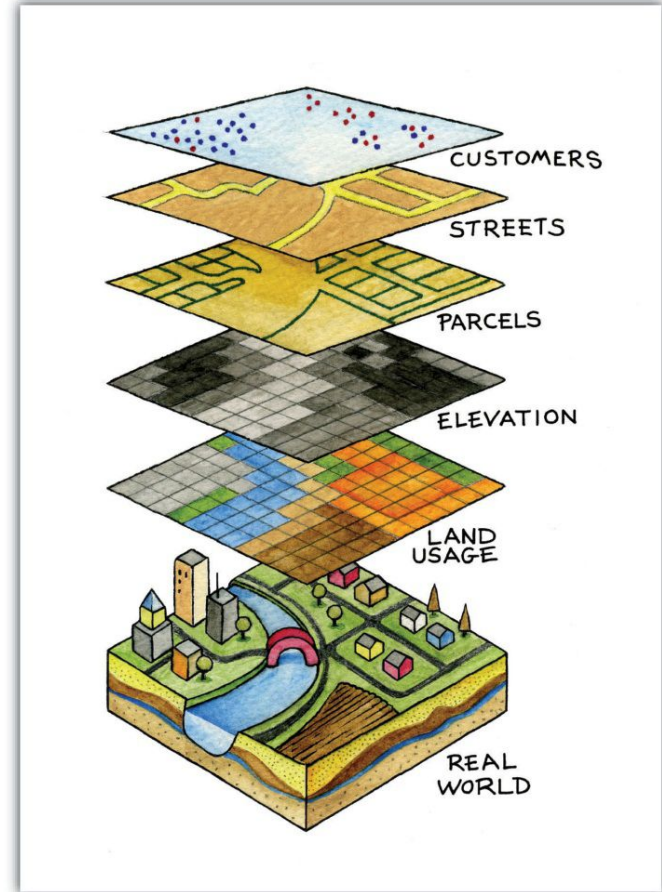


The output is three single-part features

Source: Understanding GIS

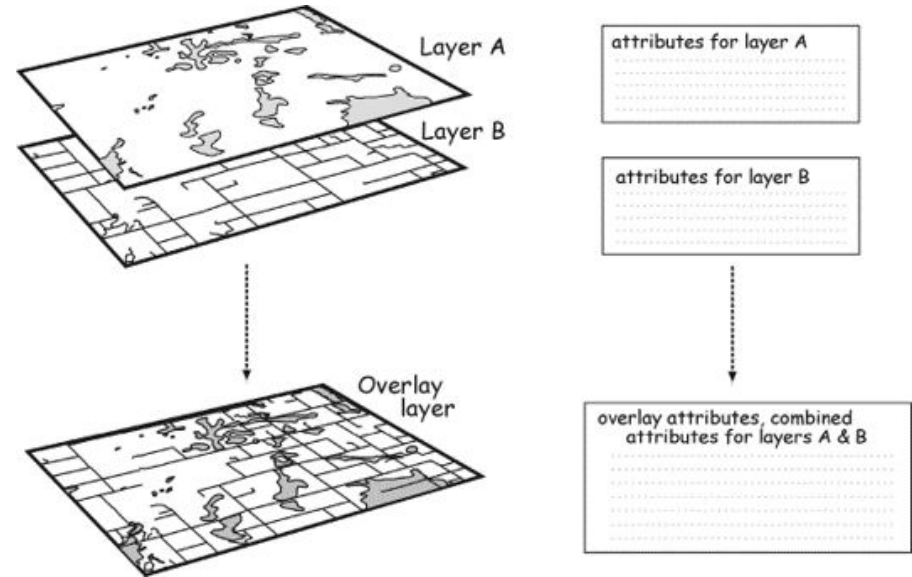
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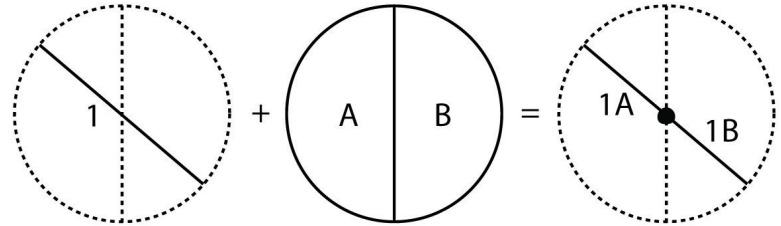
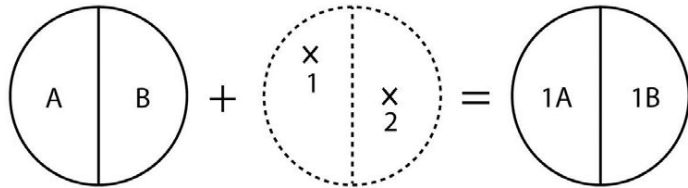
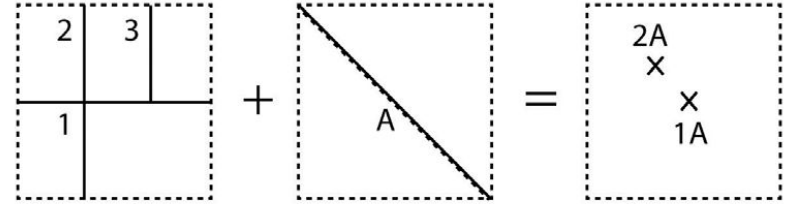
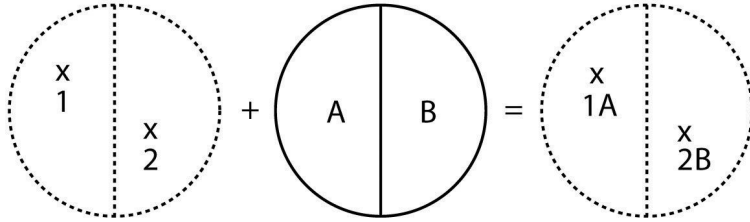


Spatial Overlay

- **Overlay:** The vertical stacking and merger of spatial data layers
- Combines both:
 - Spatial coordinates
 - Attribute information
- Requires data layers use a common coordinate system

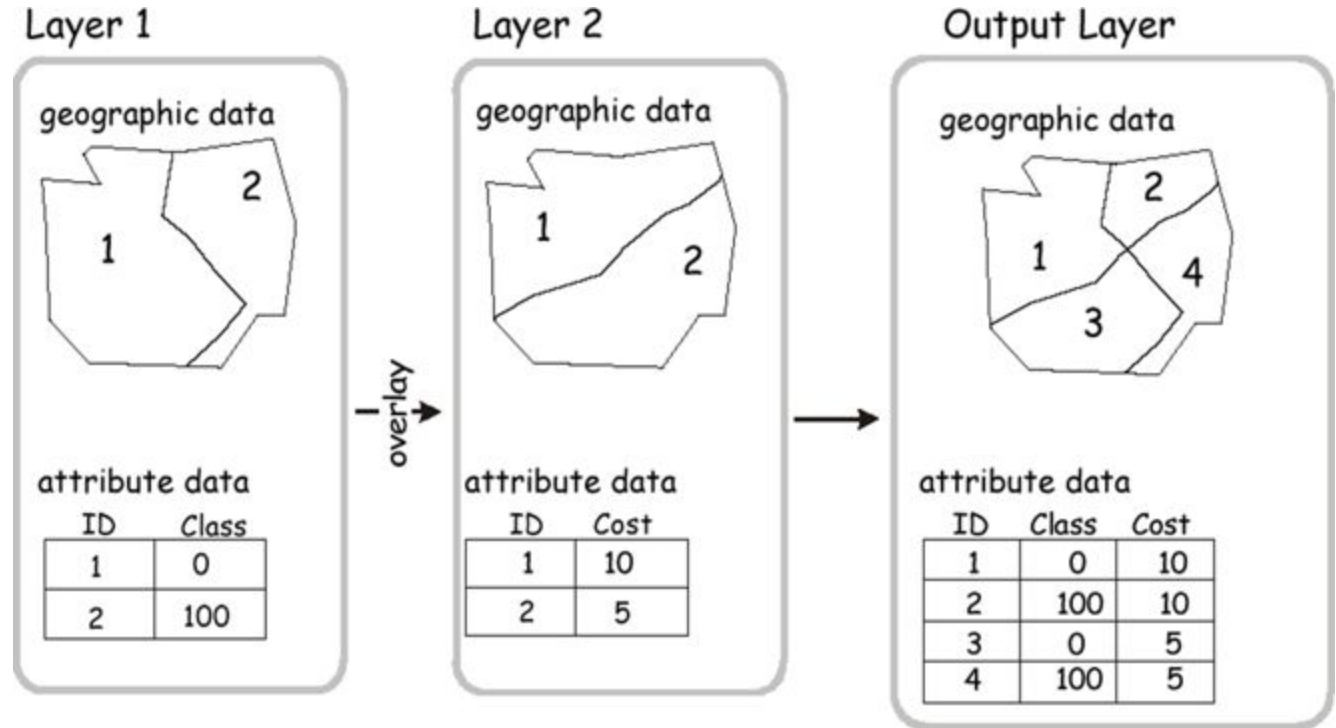


Overlay Operations



Vector Overlay

Feature numbers **increase** in overlay



Source: GIS Fundamentals by Bolstad, 2015.

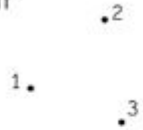
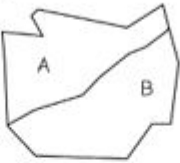

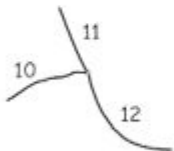
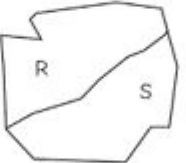

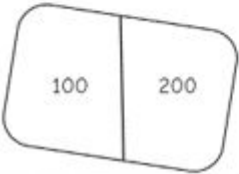
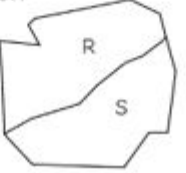
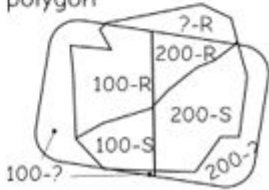
Examples of Vector Overlay

Types of vector overlay

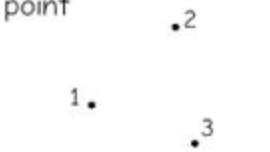
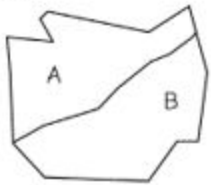

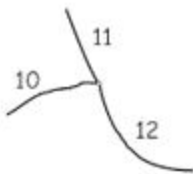
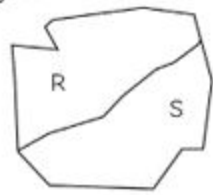
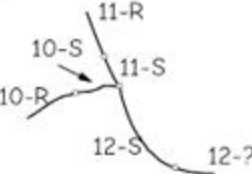
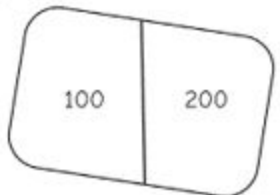
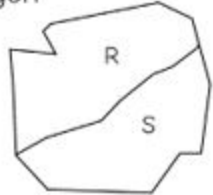
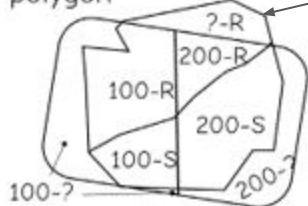
- Point & Polygon
- Line & Polygon
- Polygon & Polygon

Output takes on the lowest dimension of the input:
Point < Line < Polygon

Example: Points + Polygon = Point

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

Source: GIS Fundamentals by Boistad,

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

NULL
or Flag
Values

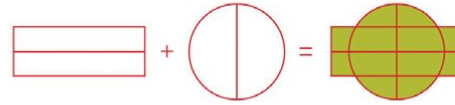
NULL
or Flag
Values

Source: GIS Fundamentals by Bolstad,

2015

Vector Overlay Methods

(a) Union



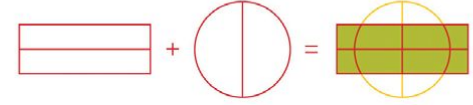
(b) Intersect



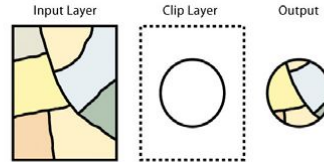
(c) Symmetrical Difference



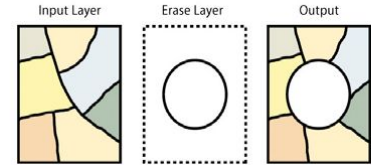
(d) Identity



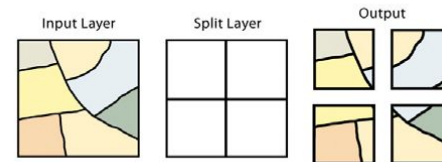
(e) Clip



(f) Erase



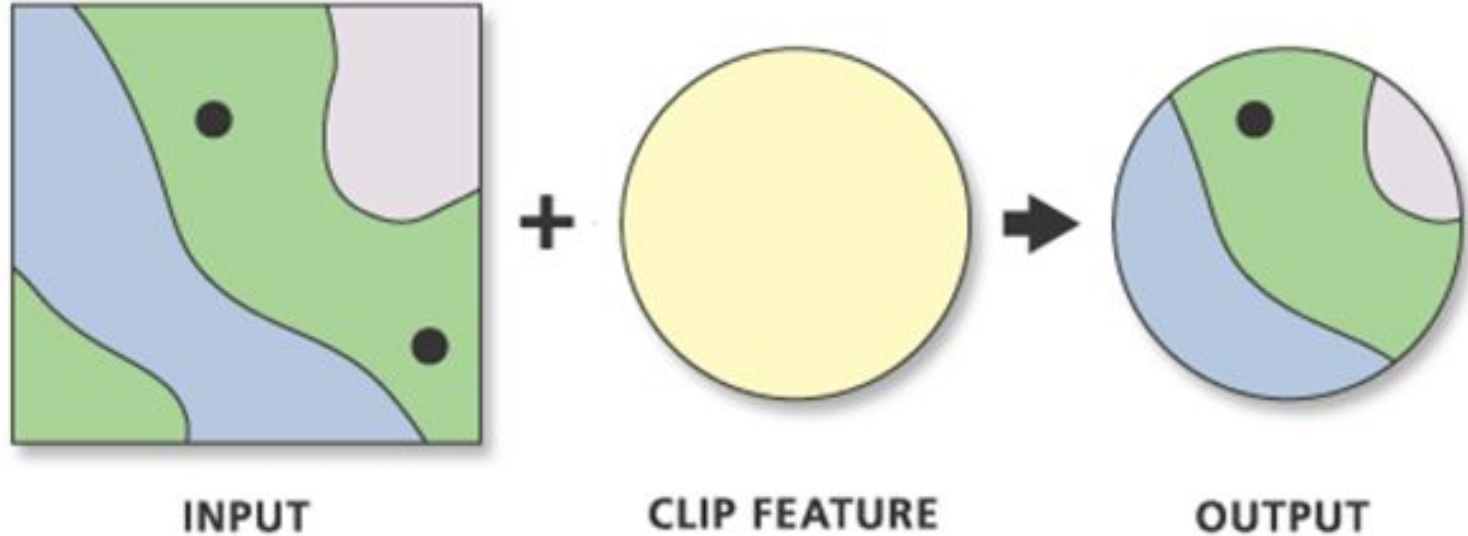
(g) Split



Overlay Operations

- Three Main Overlay Operations:
 - Clip
 - Intersection
 - Union
- Differ in geographic extent and how attribute information are combined

Overlay: Clip



- Extracts input features that overlay the clip features.
- Found in Analysis toolbox ArcGIS Pro

The Clip Tool in Action

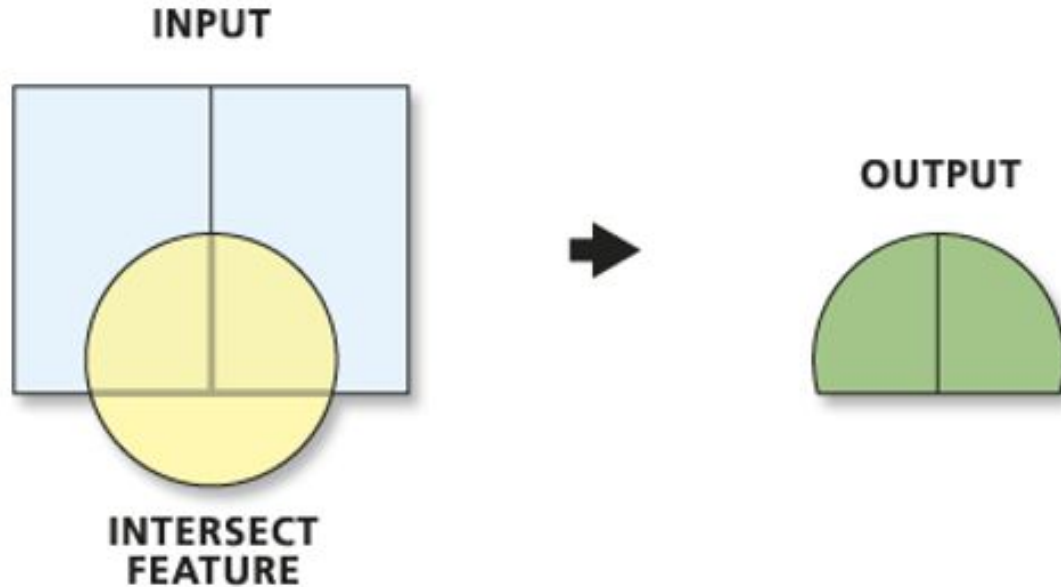


Input - Streams & Creeks covering entire county
Clipping Layer - City Limits



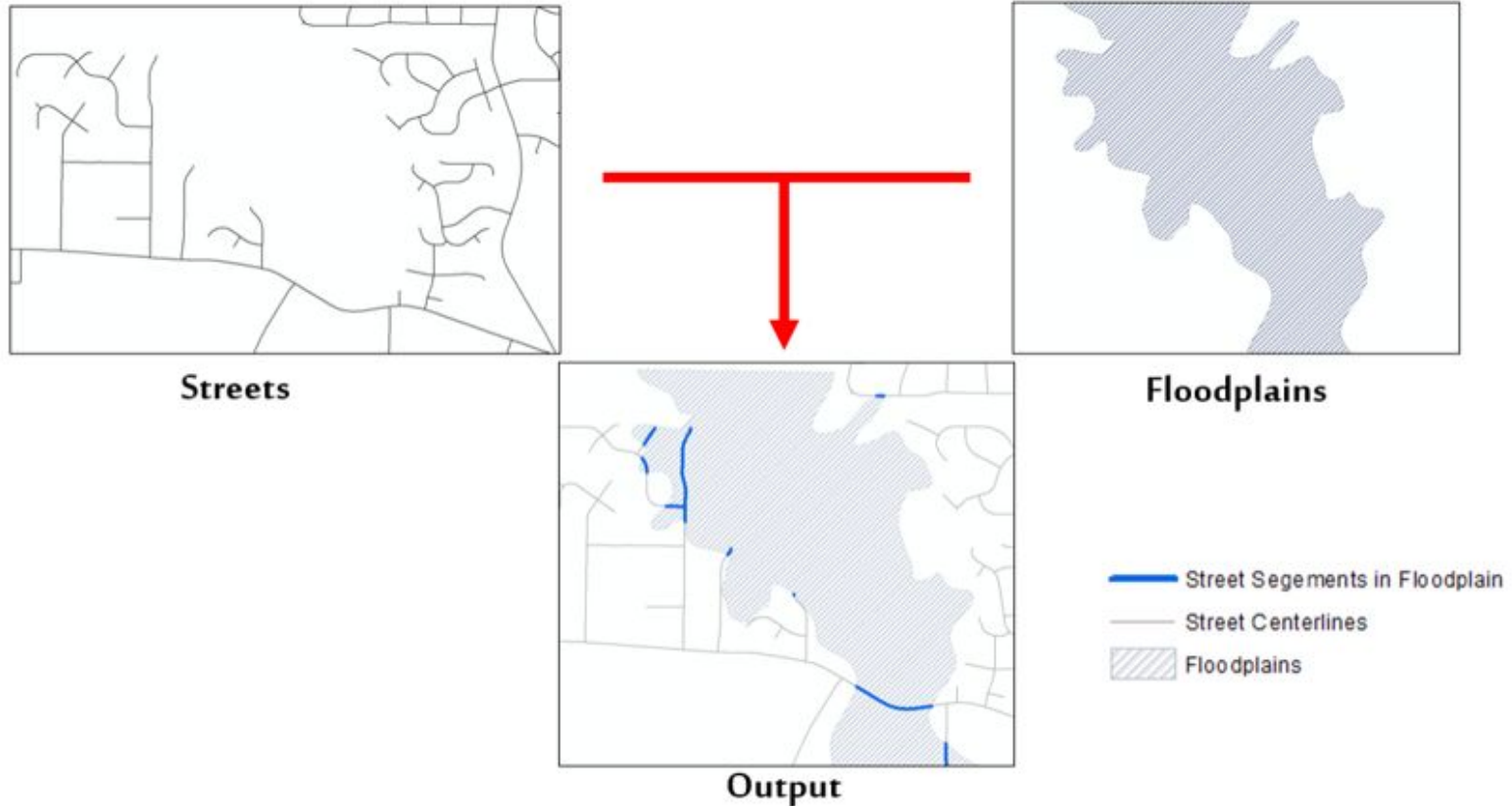
Results - New Streams & Creeks Layer that only contains portions with are inside City Limits

Overlay: Intersection

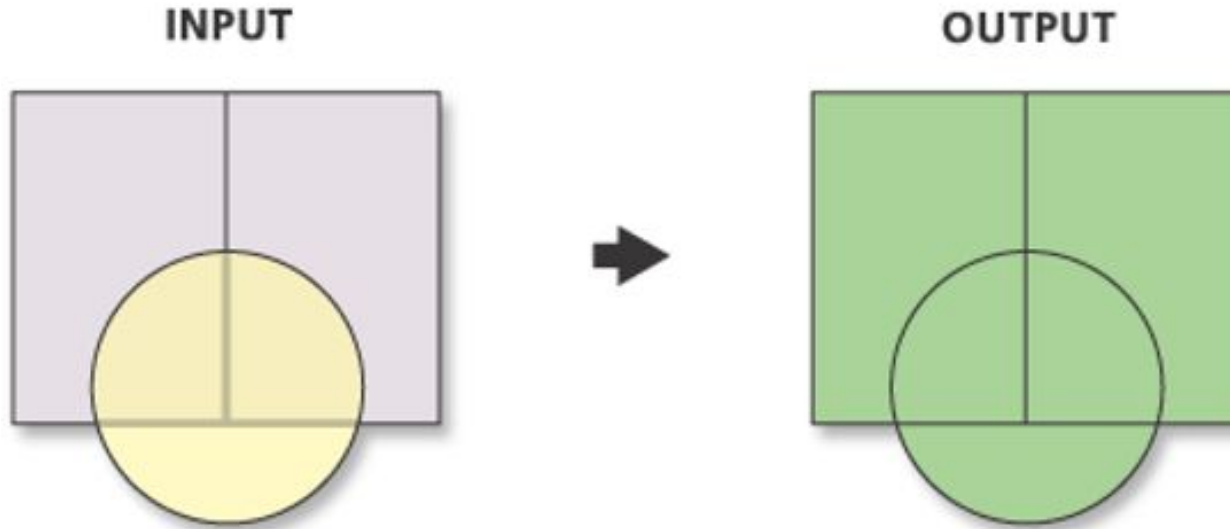


- Features which overlap in all layers will be written to the output feature class.

Intersect Tool in Action

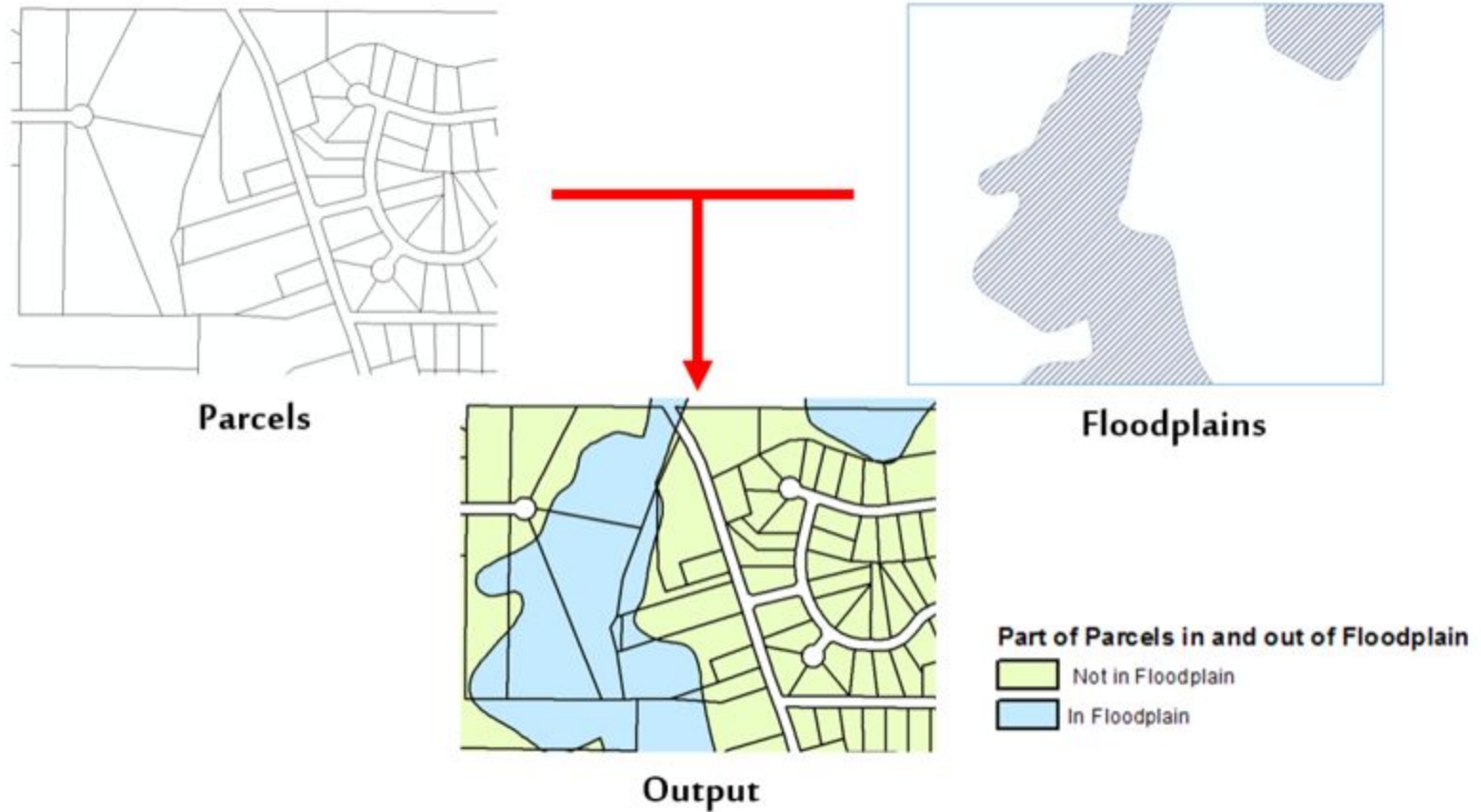


Overlay: Union

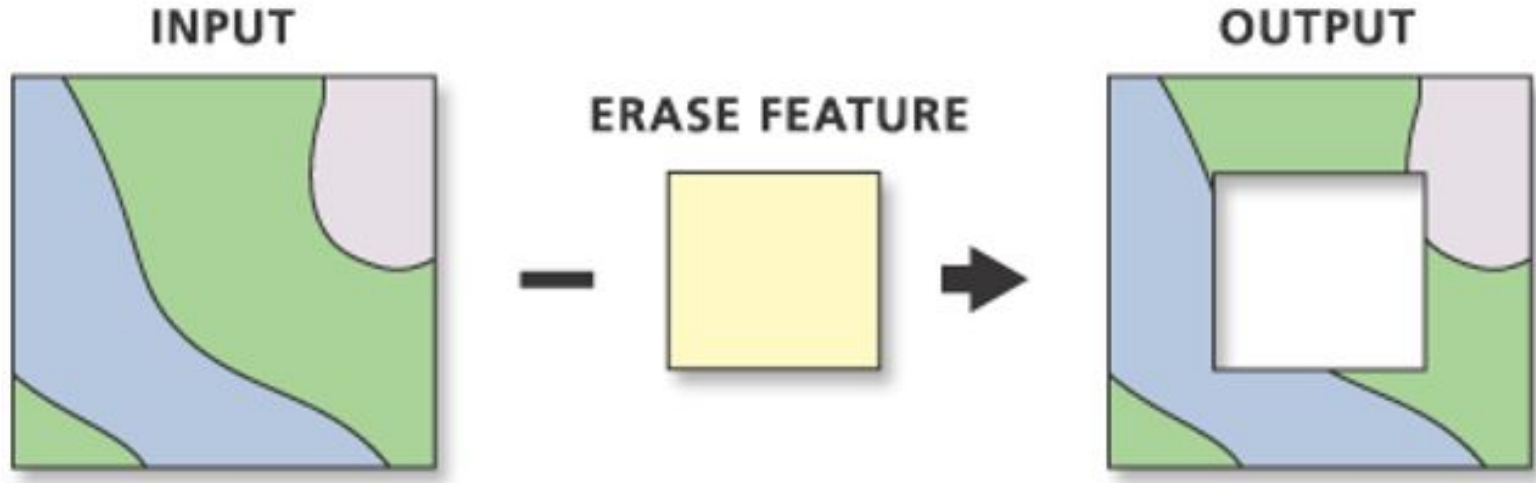


- All features and their attributes will be written to the output feature class

Union Tool in Action



Overlay: Erase

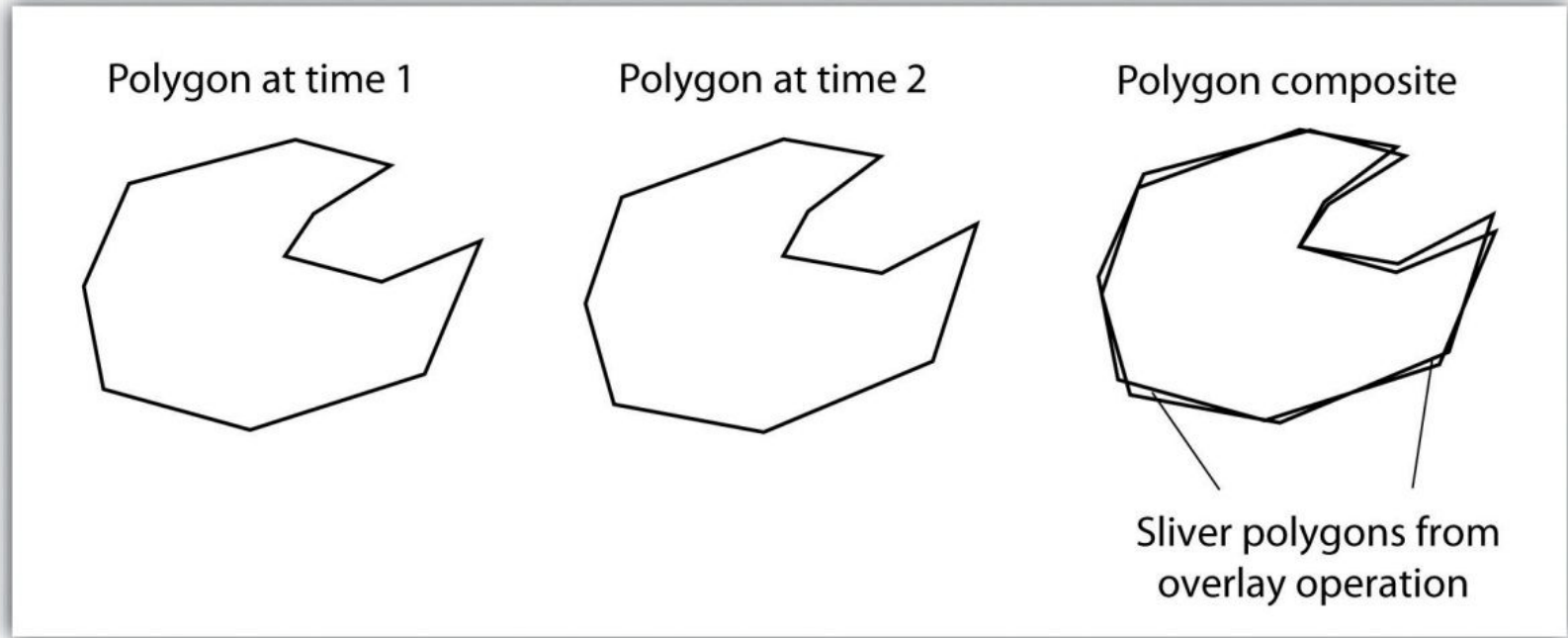


- Only those portions of the input features falling outside the erase features outside boundaries are created

Overlay Toolset

Tool name	Licensing level	Short description
Erase	Advanced	Clips out areas of overlap from input features
Identify	Advanced	Calculates areas of overlap and no overlap
Intersect	Basic	Returns area of overlap only
Union	Basic	Combines total area of input polygons
Update	Advanced	Replaces area of overlap with new features
Spatial Join	Basic	Joins attributes from one feature to another based on spatial relationship
Symmetrical Difference	Advanced	Identifies areas where features do not overlap

Overlay Errors



Vector Overlay: Problems

- TIME CONSUMING
 - Computationally expensive
 - Large # of line intersections
- Polygon Slivers
 - Take up space and are of no interest
 - Increase processing time
 - Solution: snap tolerance



Source: GIS Fundamentals by Bolstad,

2015

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