Map Overlay in GIS (review)

Definition: - the process of taking two different thematic maps of the same area and overlaying them one on top of the other to form a new map layer.

“The ability to integrate data from two sources using map overlay is perhaps the key GIS analysis function”.

The Concept of Map Overlay

- Map overlay addresses the relationship of the intersection and overlap between spatial features.
- Map overlay combines the spatial and attribute data of two input themes.

Three input feature types, overlay cover is always polygon:
1) Point-in-polygon, points are output
2) Line-in-polygon, lines are output
3) Polygon-in-polygon, polygons are output

Overlay Methods:
UNION, INTERSECT, IDENTITY

Union
- “or” Boolean operator.
- Creates new coverage by overlaying two polygon coverages.
- The output coverage contains:
  - The combined polygons
  - Attributes of both coverages
  - All coverages must be polygons

What is the combination of the stands and fire area?

Intersect
- “and” Boolean operator.
- Creates a new coverage by overlaying two sets of features.
- The output coverage contains only those portions of features that are in the area occupied by both the input and intersect coverages.

Where do the stands and fire intersect?

Identity
- Creates a new coverage by overlaying two sets of features.
- The output coverage contains:
  - All of the input features
  - Keeps only those portions of identity coverage features that overlap the input coverage.

Where did fire occur in the stands database?
Different Ways of Looking at Polygon Overlay - illustrations

1. Boolean Overlay (exclusionary variables - and, or)- illustration of different ways to pose question that will result in same outcome.
2. Mathematically based overlay - where some input factors may be weighted more than others.

Boolean (Logical) Overlay Process - Potential for Urban Development

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Union</th>
<th>Intersect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas where development not possible...</td>
<td>No Potential IF</td>
<td>Good Potential IF</td>
</tr>
<tr>
<td>1) endangered sp. Habitat</td>
<td>Endangered Spp</td>
<td>Not Endangered Sppand</td>
</tr>
<tr>
<td>2) prime agricultural land</td>
<td>Prime Ag Land</td>
<td>Not Prime Ag Landand</td>
</tr>
<tr>
<td>3) federal land eg national park</td>
<td>Fed Land</td>
<td>Not Fed Land</td>
</tr>
</tbody>
</table>

Union is: ...

INTERSECT is ...

Example that follows: how one might use UNION or INTERSECT to identify land parcels that are suitable for development .... Two ways of asking...
1) Where are areas where development cannot occur (UNION)?
2) Where are areas where development can occur (INTERSECT)?

Another example ... also includes looking at weighted overlay

‘Problem statement’ --

Identify areas where it is possible for housing development to occur.

Criteria:
1) areas of lower slope are better than areas with steeper slope
2) must be outside of riparian zone by at least 1 mile
3) areas of greater distance from incinerator are better than closer areas

Creation of input coverages to model reflects criteria:

SLOPE - criteria 1- areas of lower slope better than areas of higher slope

| Tin | POLYGON with Percent_slope | 1 3 |

Class Slope Value
1 <15% 3
2 16 - 30% 1
3 >=30% 0

Tinarc

RIPARIAN AREAS - criteria 2 - housing must be outside of riparian zones by 1 mile

Reselect and reclassify values

For purposes of model: Higher class values reflect more desirable land.

Class Riparian Value
1 No 1
2 Yes 0

TRIM twr reselect riparian buffer
Creation of input coverages to model reflects criteria:

**Distance to incinerator - criteria 3** - areas greater distance are favoured over areas closer

<table>
<thead>
<tr>
<th>Class</th>
<th>Distance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;1 miles</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1.1 - 2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 2</td>
<td>3</td>
</tr>
</tbody>
</table>

For purposes of model - higher class values reflect more desirable land.

UNION all resultant coverages (keeps all input features)

| Slopes | Riparian | Incinerator |

MATHEMATICAL OPERATIONS

**Addition**

```
1 + 3 = 4
```

**Multiplication**

```
1 * 3 = 3
```

**OR**

```
1 OR 3 = 3
```

Some references of interest (1):


Problems in Map Overlay

- Remember … Themes to be overlaid must be spatially registered before the overlay process (quality control in pre-process).
- Digitzing errors can cause slivers.
- Propagation of errors: errors will accumulate during the map overlay process (ie something is coded incorrectly in attribute table)
- Processing creates many polygons … Consider other commands, CLIP, ERASE, SPLIT, MERGE, DISSOLVE, etc., as essential part of post-processing …. ‘Boundary operations’

Some references of interest (2):

First, Slivers (review)

- Slivers may occur as a result of imperfect digitization of spatial features (review);
- can also be created during Overlay – unions, etc.
- In some cases, slivers can be eliminated by selecting only those features that have a large size; minimum mapping unit.
- Use ELIMINATE command at the arc level

**Eliminate**

- Merges selected polygons with neighboring polygons that have the largest shared border between them, or that have the largest area.
- Uses same kind of syntax as the Arc:reselect command, with a prompt for a logical expression. Output is new coverage
- Most often used to remove ‘sliver’ polygons, but can be used to combine polygons, by ‘absorbing’ one type by another ‘type’ …

eg. ARC: ELIMINATE CARVEGE VEGE2
.resel veg_type = 'Mesophyll Vine Forest'

The 5 vine forest polygons (dark blue wide stripes) have been merged with those neighbouring polygons with the greatest shared boundary - perhaps this vegetation type, for purposes of analysis, was better combined with neighbouring vegetation types.

**Boundary Operations - Coverage Manipulation**

- **Dissolve** - Removes boundaries between polygons that have the same value of a selected attribute.

Map Coverage Manipulation

- **Dissolve** – Removes boundaries between polygons that have the same value of a selected attribute.

Boundary Operations - Coverage Manipulation

- **CLIP**
  - extracts a subregion of a coverage that intersects with a second coverage, called a clip coverage
  - the features of the input coverage, but not the clip coverage, are retained
  - therefore the feature attribute table for the output coverage contains the same items as the input coverage attribute table.
  - topology is rebuilt for the output coverage
  - input features can be polygons, lines or points.
  - Clip cover must be a polygon coverage.
  - the output coverage has the same feature type as the input coverage.
Map Coverage Manipulation

**Clip**
- Includes only those features of the input theme that are within the spatial extent of the clip theme.

- **Clip theme** (Upper Salmon River Watershed)
- **input theme** (Idaho counties)
- **result** (watershed divided into counties)

**Erase** is very similar to Clip, except that the input coverage features that overlap with the erase coverage polygons are erased rather than preserved.

- Again, the input coverage features can be polygons, lines, or points; but erase coverage features must be polygons.
- Output coverage features are of the same class as the input coverage features.

**Erase coverage -2**
- This may be used as part of buffer analysis steps

Criteria requires that housing is outside of streams, but within a set distance of sewer lines (black background chosen to show difference).

You may create buffer polygons around streams and sewer lines as first step...

Output contains only area meeting both stipulations from above

**Map Coverage Manipulation**

- **Clip - 2**
  - Unit of interest is one watershed
  - Desired output for data management, analysis and display

  Create clip coverage (must be polygon) in arcedit by digitizing polygon around watershed (follow height of land?)

  Desired output for data management, analysis and display

  CLIP - arc command which requires using ‘clip’ coverage (boundary of interest) and coverage where features stored ... to output new feature coverage containing only subset of interest

- **Erase coverage**
  - Removes part of the inside of a coverage

  The boundary of an existing coverage is used to erase features from another coverage and create a new coverage.

  Use **erasecov** to delineate areas that are outside of streams, but within specified distance of sewer lines ...

Continued ....
Map Coverage Manipulation

- **Merge**
  - Creates a new theme by piecing together two or more themes;
  - however, the boundaries between the themes remain intact.

Idaho counties

Snake River Plain Aquifer