Review of Cartographic Data Types and Data Models
GIS Data Models
Raster Versus Vector in GIS Analysis

◆ Fundamental element used to represent spatial features:
  ◆ Raster: pixel or grid cell.
  ◆ Vector: x,y coordinate pair.

◆ Area for which data values are stored in each system:
  ◆ Raster: must store value for each cell of the grid, which covers the entire study area.
  ◆ Vector: stores locational data only for objects of interest within the study area.
Modeling Geospatial Reality

Raster Model

Vector Model

Real World
Coding Vector GIS

Reality

Vector Mode Model of Reality
Coding Vector GIS

Reality

Vector Mode Model of Reality
Coding Raster GIS Data

Reality

Raster Mode Model of Reality
Coding Raster GIS Data

Reality

Raster Mode Model of Reality
Representing *Value* and *Location* in Space: *Points*

- **Raster points:**
  - **location:** cell position as specified by row and column position within grid, which should be geo-referenced.
  - **value:** specified by the number stored for the cell.

- **Vector points:**
  - **location:** position specified by single x, y coordinate pair.
  - **value:** stored as data values in attribute file and tied to the point by means of a geo-code.
Points in the World Out There

Points Encoded as Raster

Resulting Image
Points in the World Out There

Points
Encoded as Vector

Point | X       | Y       
------|---------|---------
1     | X₁      | Y₁      
2     | X₂      | Y₂      
3     | X₃      | Y₃      
4     | X₄      | Y₄      

Resulting Image
Representing Value and Location in Space: **Lines**

**Raster lines:**
- **location:** linear set of *contiguous cells*, each identified by a row and column location and each having the same data value.
- **value:** data value of each linear feature is represented by the cell value stored for each cell.

**Vector lines:**
- **location:** ordered set of x,y coordinate pairs.
- **value:** a *geo-code* assigned to the line is tied to a *geo-code* in an attribute file where the computer stores the data value or values for the line.
Lines in the World Out There

Lines Encoded as Raster

Raster Encoding

Resulting Image
Lines in the World Out There

Vertex
Node

Lines Encoded as Vector

Vector Encoding

<table>
<thead>
<tr>
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<th>X</th>
<th>Y</th>
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<tbody>
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<td>Y_{11}</td>
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<td>Y_{12}</td>
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<td>Y_{1n}</td>
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<tr>
<td></td>
<td>X_{4n}</td>
<td>Y_{4n}</td>
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</table>
Representing *Values and Location* in Space: **Areas**

- **Raster areas:**
  - **location:** region of contiguous cells all of which have the same data value.
  - **value:** data value stored for each cell is the data value for the area [e.g., for population density, a density of 589 would be represented by assigning each cell comprising the area the value 589].

- **Vector areas:**
  - **location:** closed set of x,y coordinate pairs.
  - **value:** point within area is “tied” by means of a *geo-code* to an attribute file value or values to be assigned to the area defined by the x,y coordinates.
Areas in the World Out There

Areas
Encoded as
Raster

Raster Encoding

Resulting Raster Image
Capturing Vector Data
Digitizing is fun—for a short time
Areas in the World Out There

Areas
Encoded as Vector

<table>
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<tr>
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<th>Y</th>
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<td>X_{1i}</td>
<td>Y_{1i}</td>
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<td></td>
<td>X_{11}</td>
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<tr>
<td></td>
<td>X_{31}</td>
<td>Y_{31}</td>
</tr>
</tbody>
</table>

Resulting Vector Image
Vector Area Theme

Raster Area Theme
Representing *Values and Location* in Space: *Volume*

- **Raster volume:**
  - **location:** row and column position represents position on the surface.
  - **value:** cell data value represents the height of the surface at the location of the cell.

- **Vector volume:**
  - **location:** x,y coordinates position triangles that comprise a TIN.
  - **value:** z data value stored for each x,y coordinate position.
Vector Surface Theme

Raster Surface Theme
Whether Raster or Vector

All Layers Must Be Geo-referenced and Rectified
Set of Layers Comprises Database

Layers Must be Rectified

Assign Coordinate Values to Locations
Raster Conventions
Raster Database Conventions

- Divide entire study area in a regular *grid* of cells.
- Assign one and only one data value to each cell.
- Database consists of a set of maps or *layers* each of which depicts the same well-defined region or study area [Washington Township in Gloucester County].
- Each *layer* describes a single characteristic of each cell within the study area [e.g., land use].
- Describe multiple features with multiple layers.
**Raster Definitions**

- **Orientation:** angle between true north and the direction defined by the columns of the raster.

![Orientation Diagram]

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</tr>
</tbody>
</table>
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Raster Definitions

◆ Region: within a single layer, a set of *contiguous* cells that all have the same value.

◆ Zone: all of the *regions* within a layer that have the same value$^1$.

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$^1$ In much of the GIS literature Arc Map’s region is called a zone and Arc Map’s zone is called a class.
All of the forest taken together represents a single zone.

Each individual set of contiguous forest cells represents a single region.
Cell Value Assignment: Qualitative Data

- Predominant type or majority rules -- category taking up largest proportion of cell determines cell value [land use].
- Cell center value -- cell gets value of category at its center.
- Presence or absence [e.g., if phenomenon is present, cell takes value -- road]
- Precedence of types: assign cell a value reflecting the most important category present.
- Number or proportion [e.g., cell value = number of items present in cell -- wells]
Majority Rules Assignment
Presence / Absence

Gloucester County Main Roads

3 Main Roads
Precedence of Type

Gloucester County Roads

- 0 Background
- 1 Tertiary Roads
- 2 Secondary Roads
- 3 Main Roads
Interpolated Value

Gloucester DEM