

Review of Cartographic Data Types and Data Models



ROWAN
UNIVERSITY

A stylized world map in shades of blue and cyan, centered on the Atlantic Ocean, serving as a background for the title text.

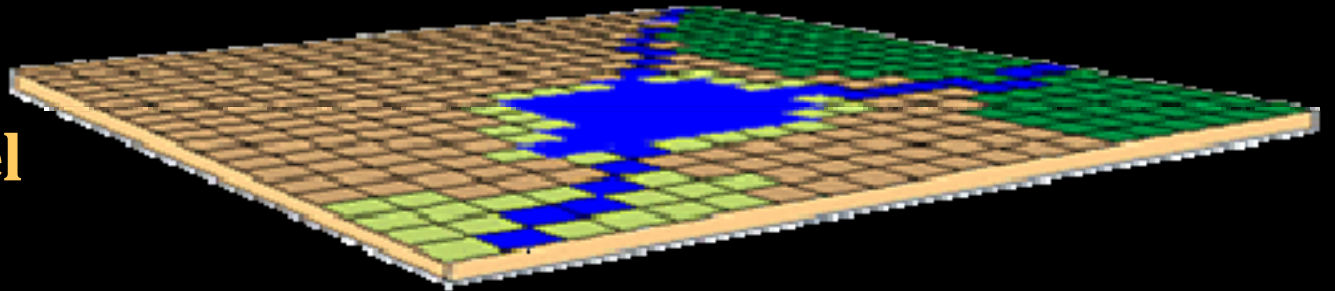
GIS Data Models

Raster Versus Vector in GIS Analysis

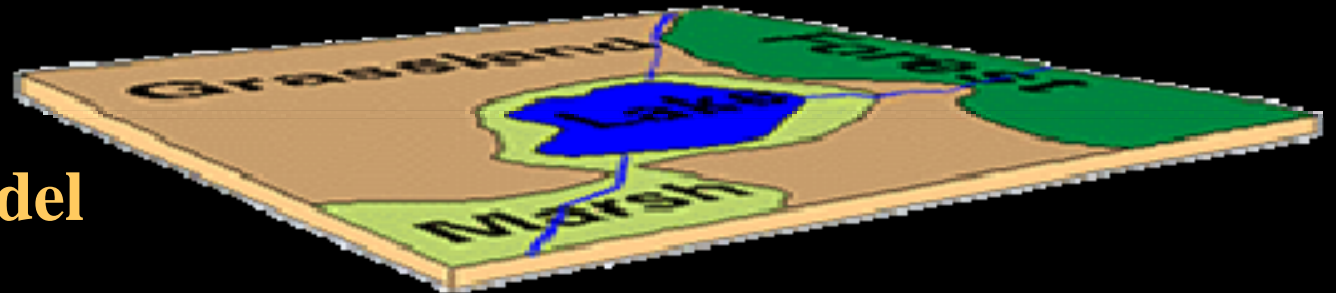
- ◆ Fundamental element used to represent spatial features:
 - ◆ Raster: pixel or grid cell.
 - ◆ Vector: x,y coordinate pair.
- ◆ Area for which data values are stored in each system:
 - ◆ Raster: must store value for each cell of the grid, which covers the entire study area.
 - ◆ Vector: stores locational data only for objects of interest within the study area.

Modeling Geospatial Reality

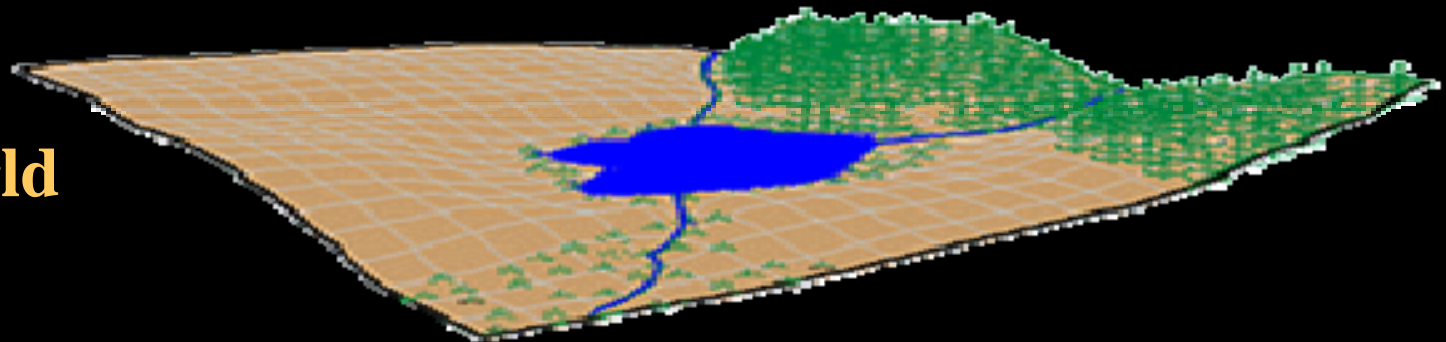
Raster Model



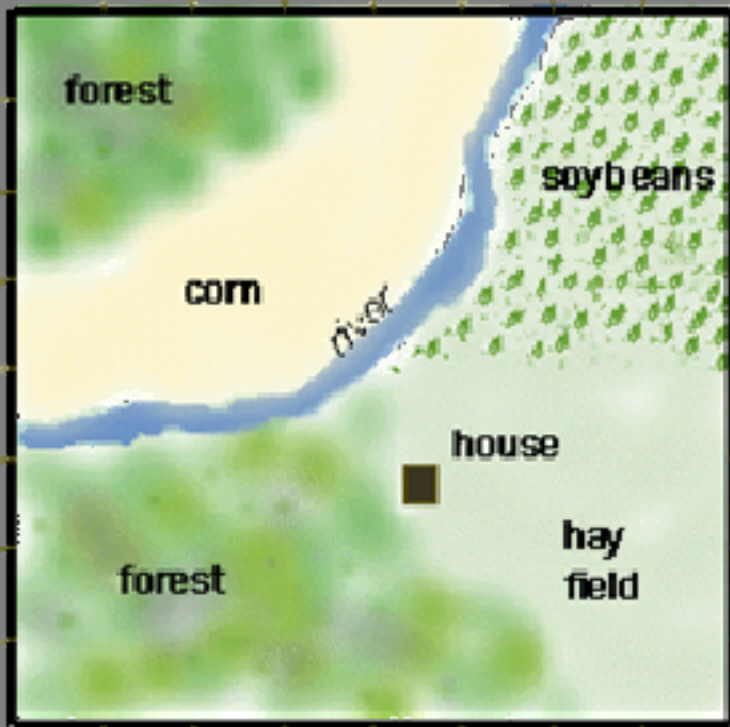
Vector Model



Real World



Coding Vector GIS

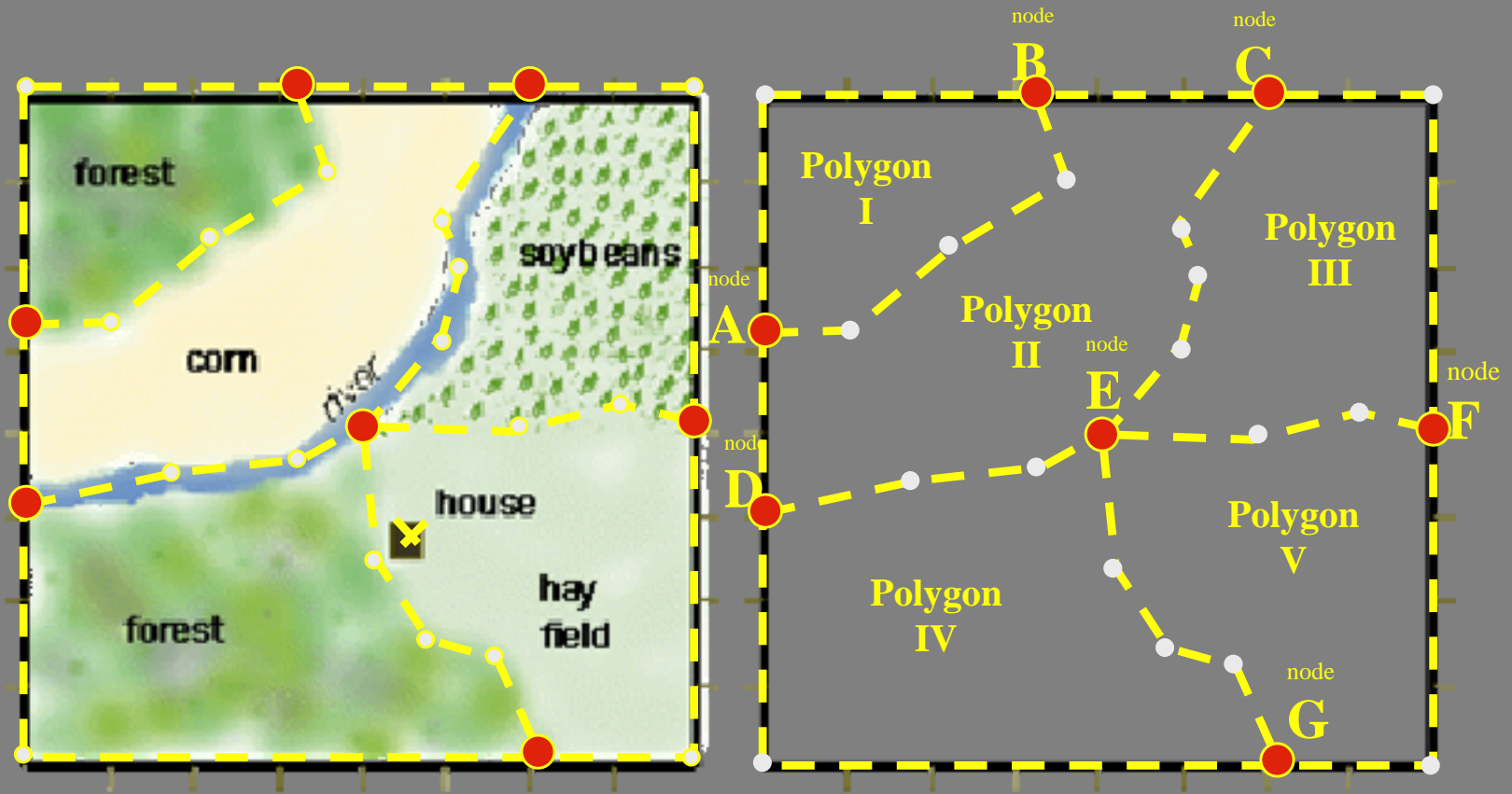


Reality



Vector Mode Model of Reality

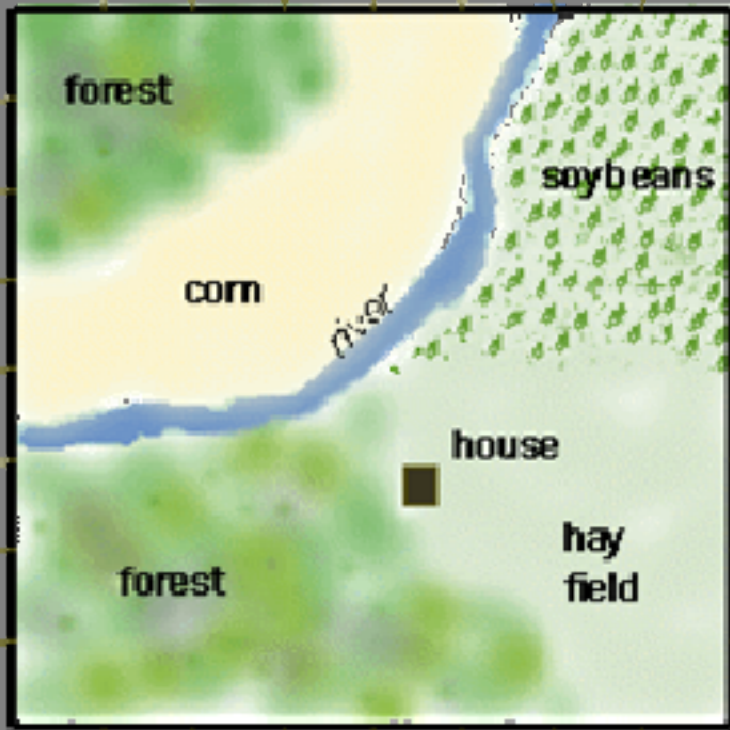
Coding Vector GIS



Reality

Vector Mode Model of Reality

Coding Raster GIS Data

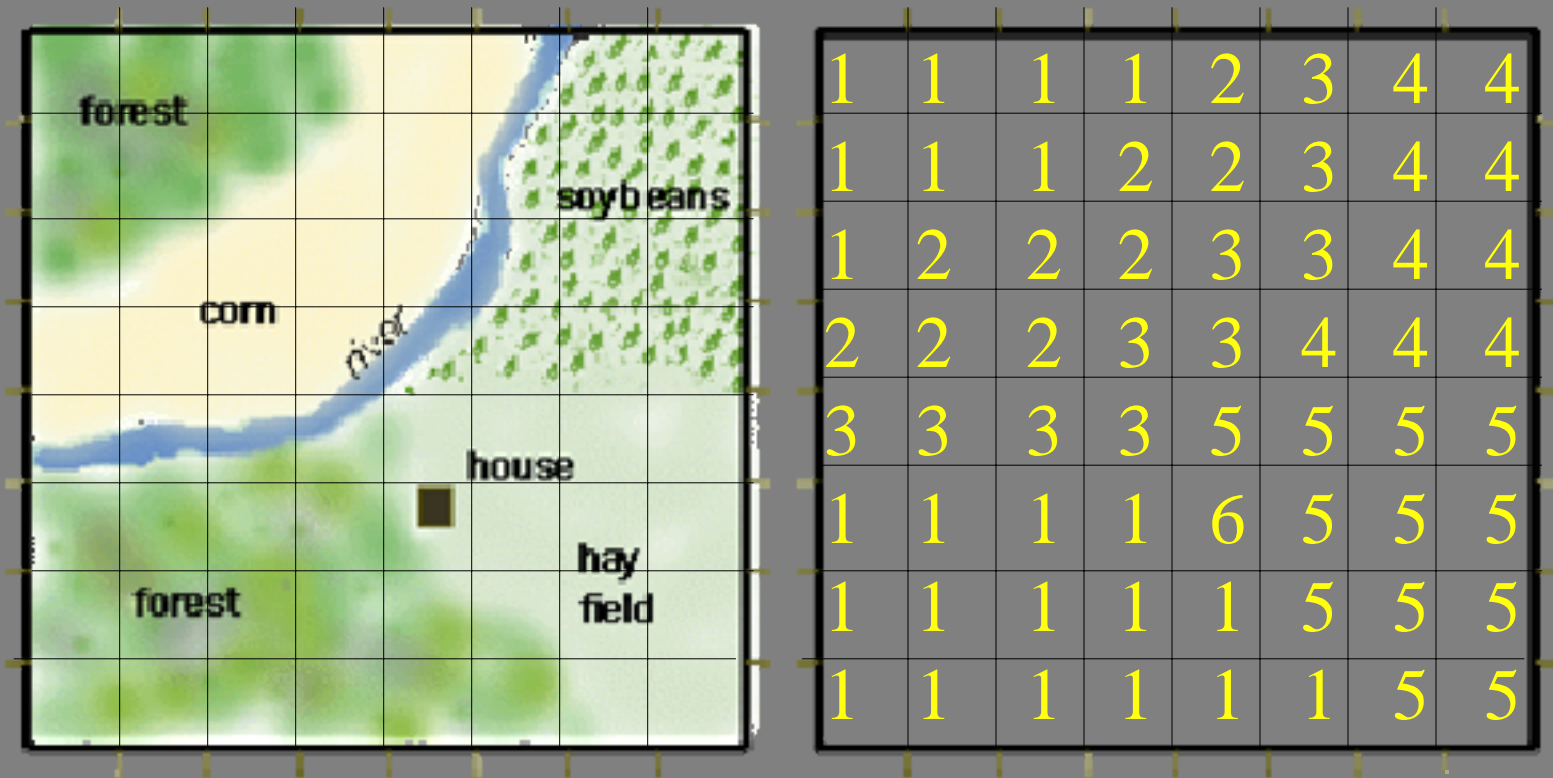


Reality



Raster Mode Model of Reality

Coding Raster GIS Data



Reality

Raster Mode Model of Reality

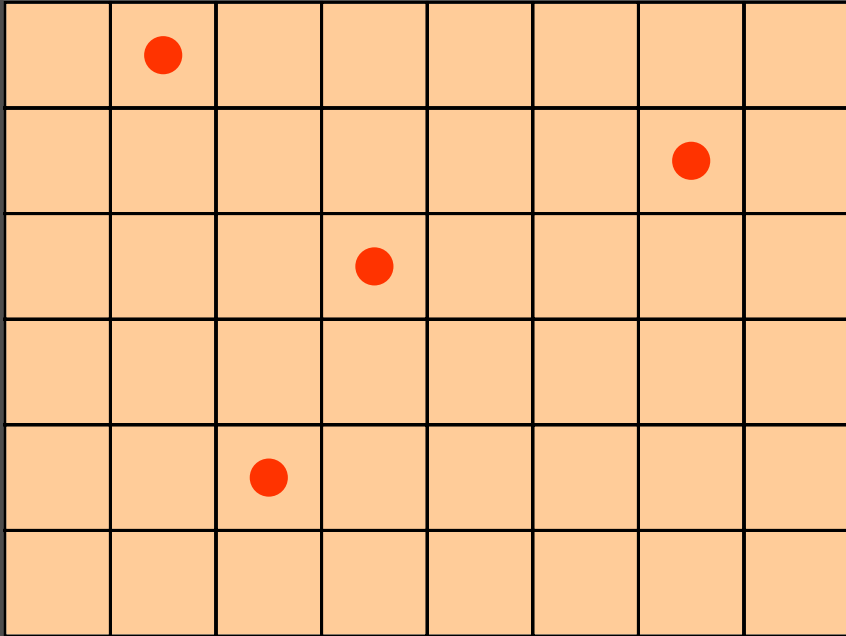
Representing *Value* and *Location* in Space: *Points*

◆ Raster points:

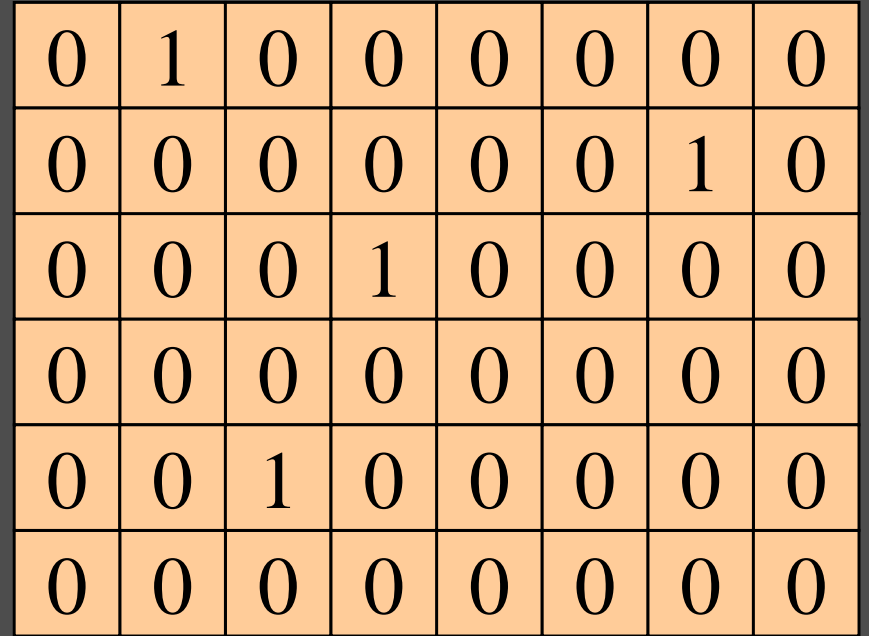
- ◆ **location:** cell position as specified by row and column position within grid, which should be geo-referenced.
- ◆ **value:** specified by the number stored for the cell.

◆ 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.

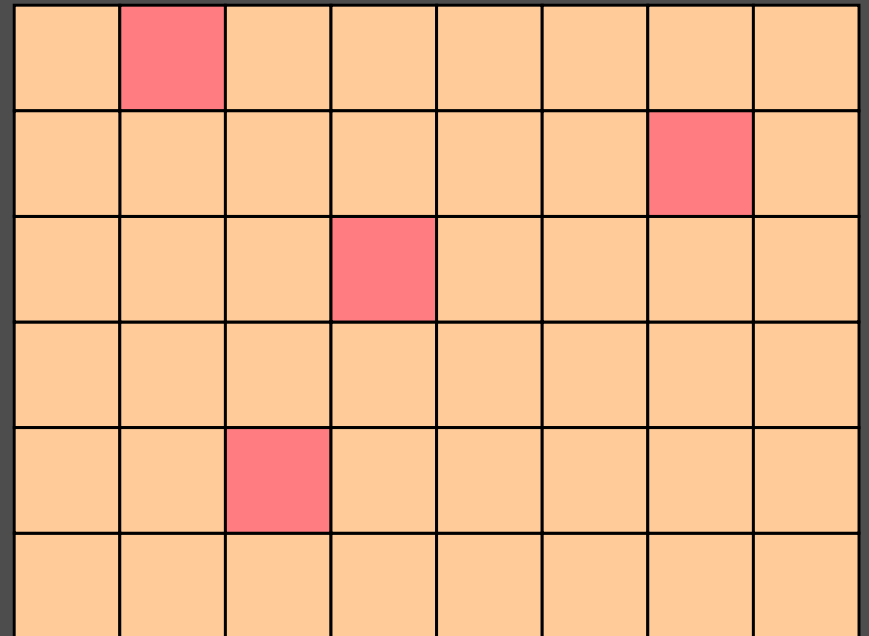


Points in the World Out There

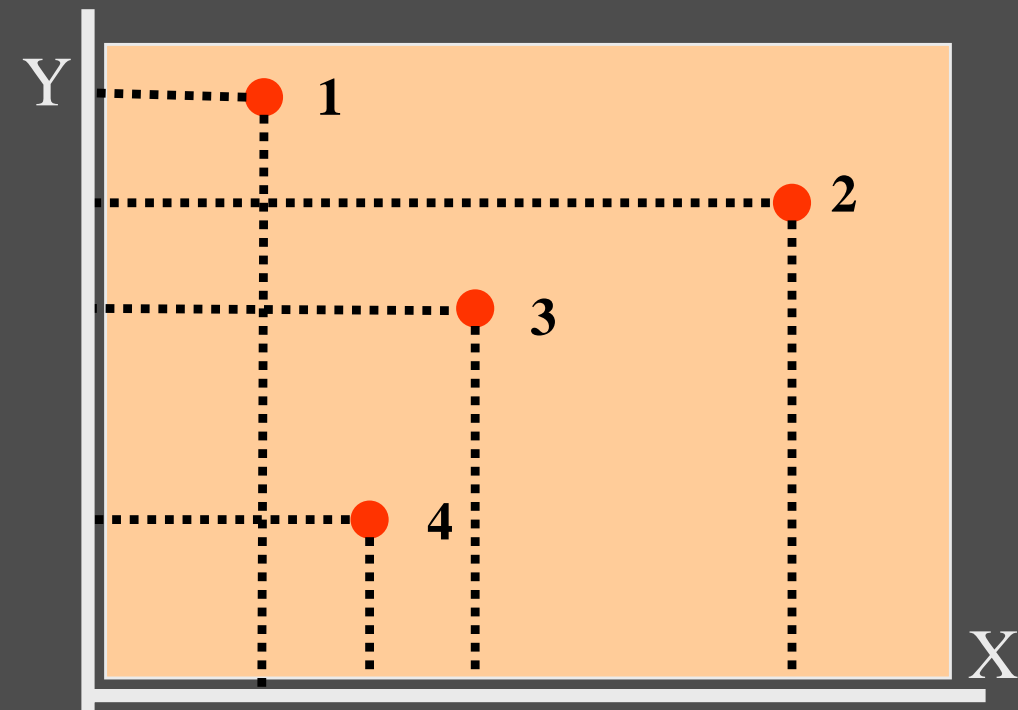


Raster Encoding

Points
Encoded as
Raster



Resulting Image

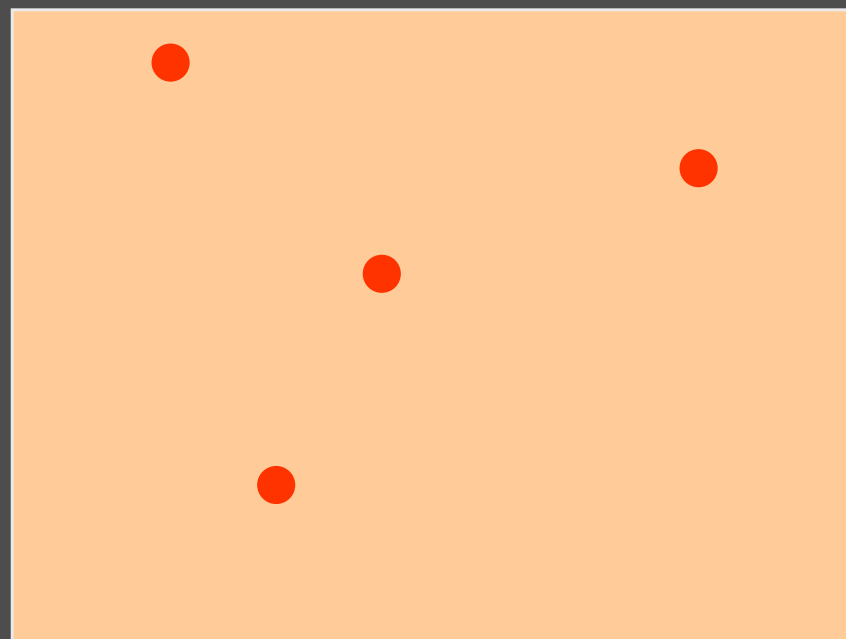


Points in the World Out There

<u>Point</u>	<u>X</u>	<u>Y</u>
1	X_1	Y_1
2	X_2	Y_2
3	X_3	Y_3
4	X_4	Y_4

Vector Encoding

Points
Encoded as
Vector



Resulting Image

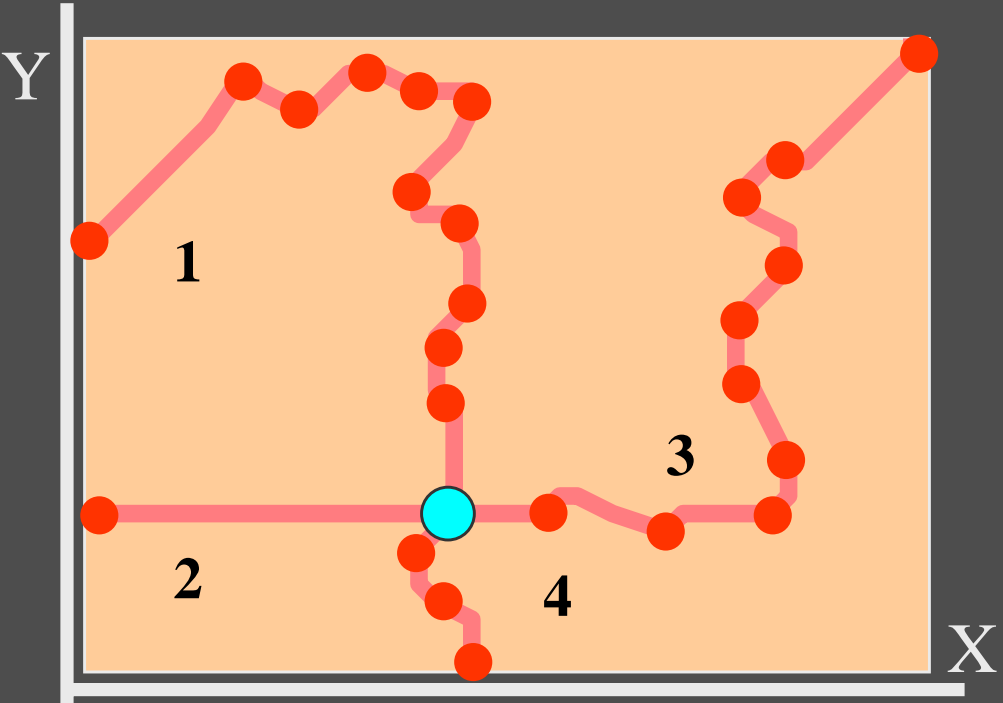
Representing *Value* and *Location* in Space: *Lines*

◆ 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

- Vertex
- Node

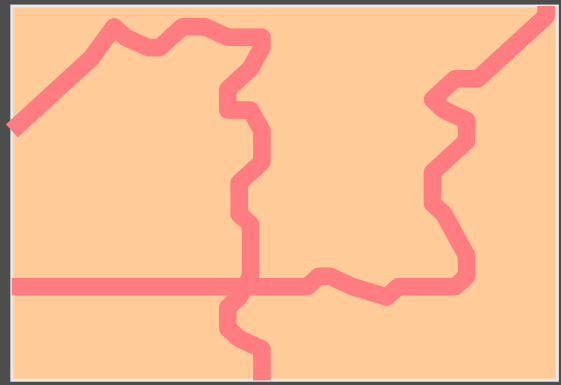
Lines Encoded as Vector

<u>Line</u>	<u>X</u>	<u>Y</u>
1	X_{11}	Y_{11}
	X_{12}	Y_{12}

	X_{1n}	Y_{1n}
2	X_{21}	Y_{21}
	X_{2n}	Y_{2n}
3	X_{31}	Y_{31}
	X_{32}	Y_{32}

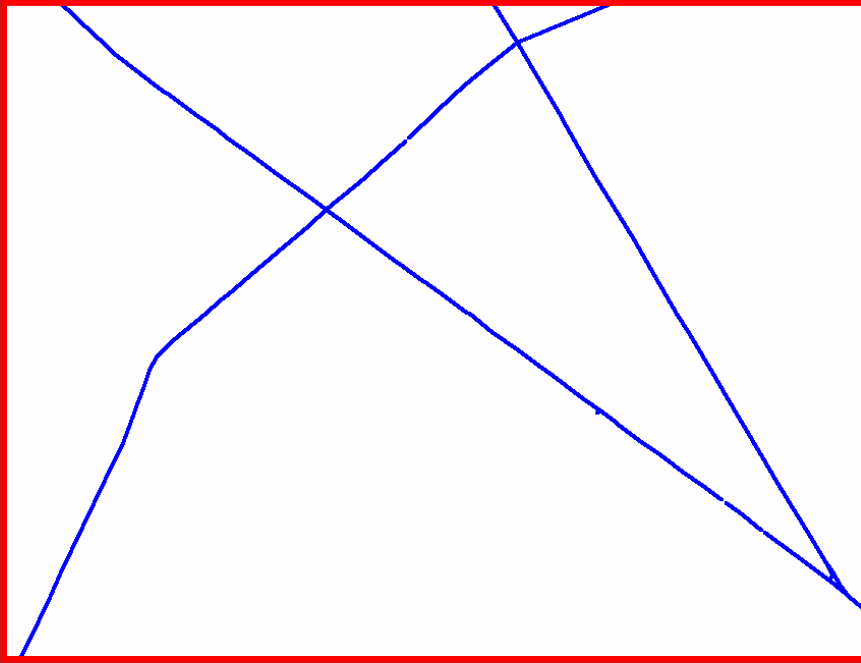
	X_{3n}	Y_{3n}
4	X_{41}	Y_{41}
	X_{4n}	Y_{4n}

Vector Encoding

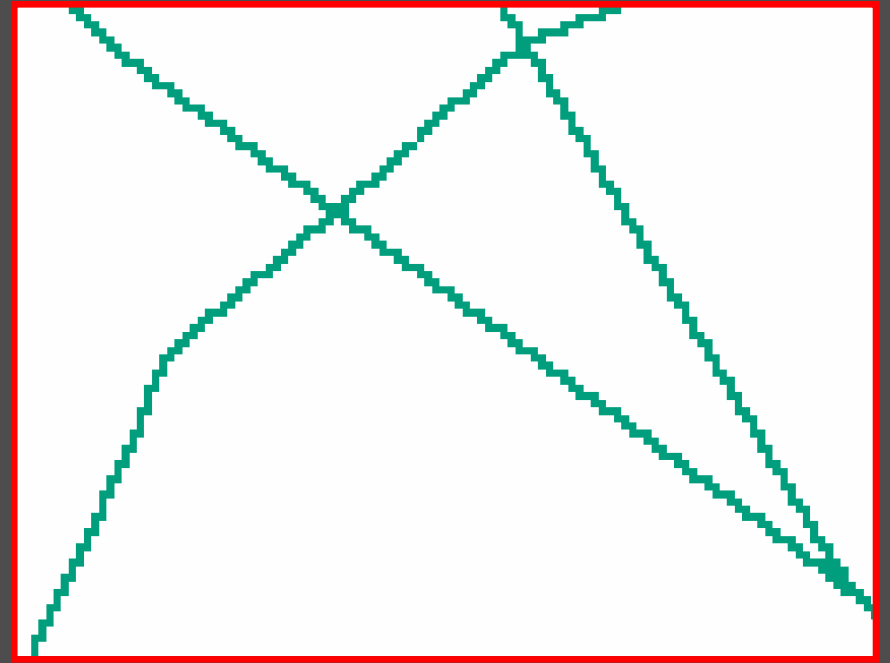


Resulting Image

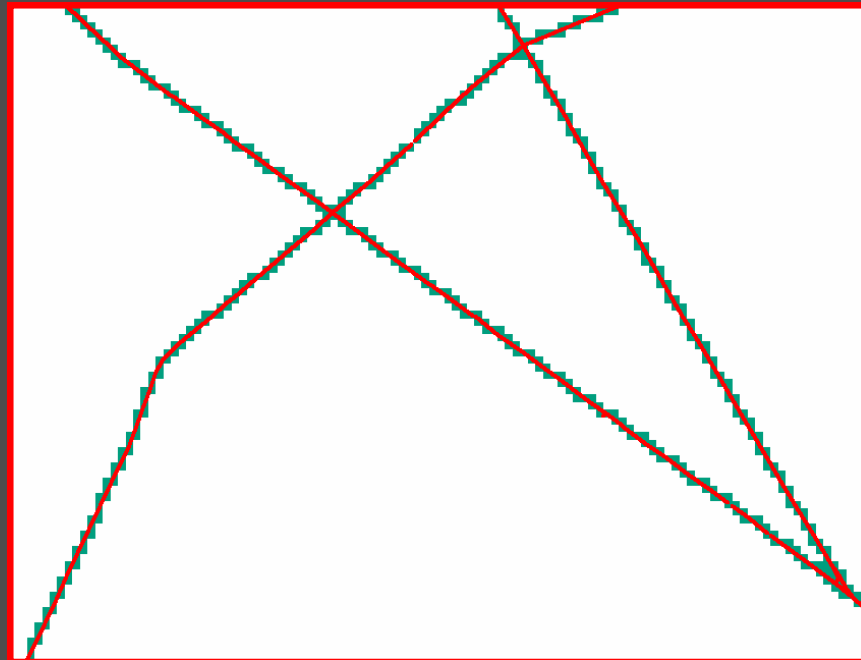
Vector Line Theme



Raster Line Theme



Vector &
Raster Themes



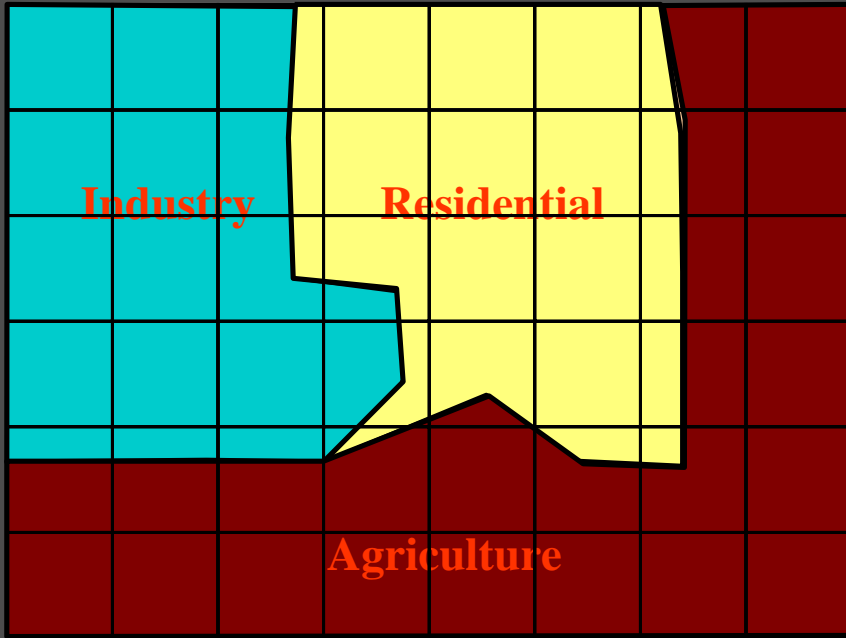
Representing *Values and Location* in Space: **Areas**

◆ 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.

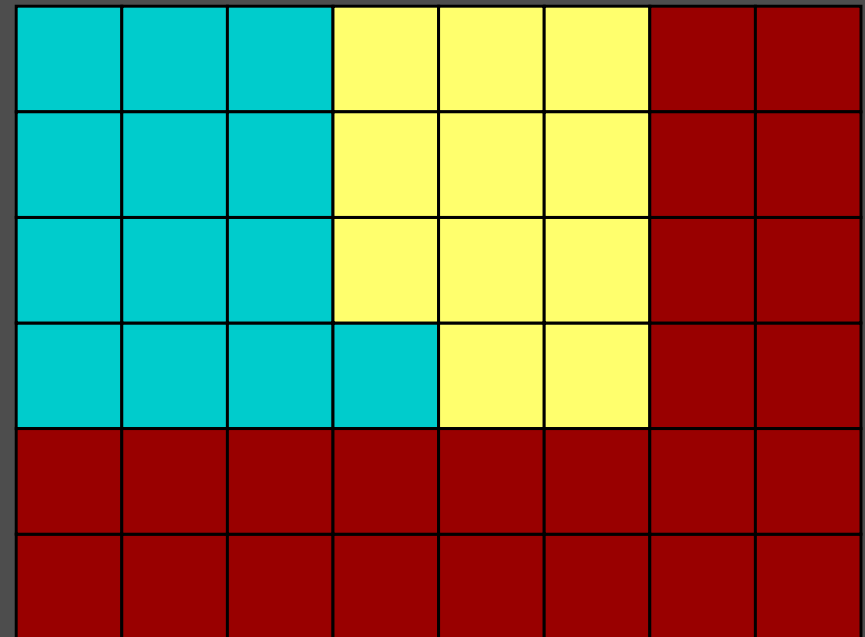


Areas in the World Out There

1	1	1	2	2	2	3	3
1	1	1	2	2	2	3	3
1	1	1	2	2	2	3	3
1	1	1	1	2	2	3	3
3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3

Raster Encoding

Areas
Encoded as
Raster



Resulting Raster Image

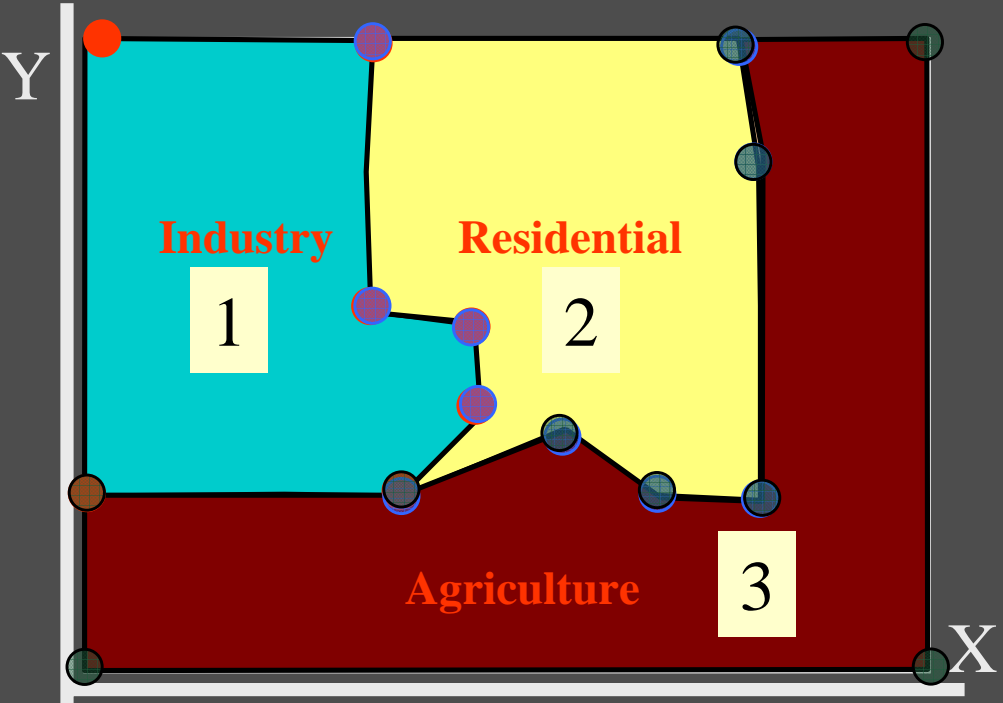


Capturing Vector Data

Y



Digitizing is fun—for a short time

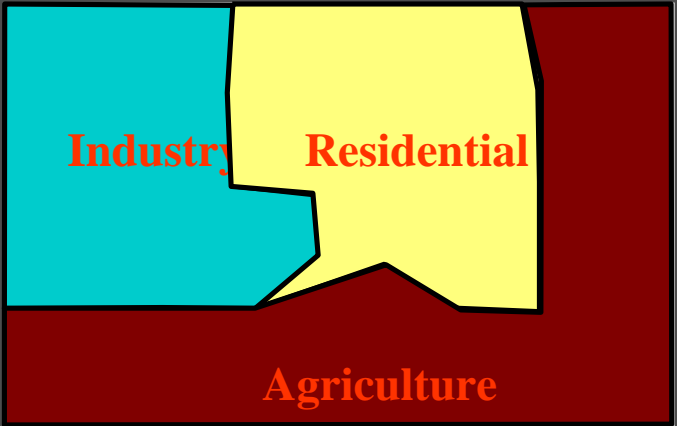


Areas in the World Out There

Area	X	Y
1	X_{11}	Y_{11}
	X_{1i}	Y_{1i}
	X_{11}	Y_{11}
2	X_{21}	Y_{21}
	X_{2i}	Y_{2i}
	X_{21}	Y_{21}
3	X_{31}	Y_{31}
	X_{3i}	Y_{3i}
	X_{31}	Y_{31}

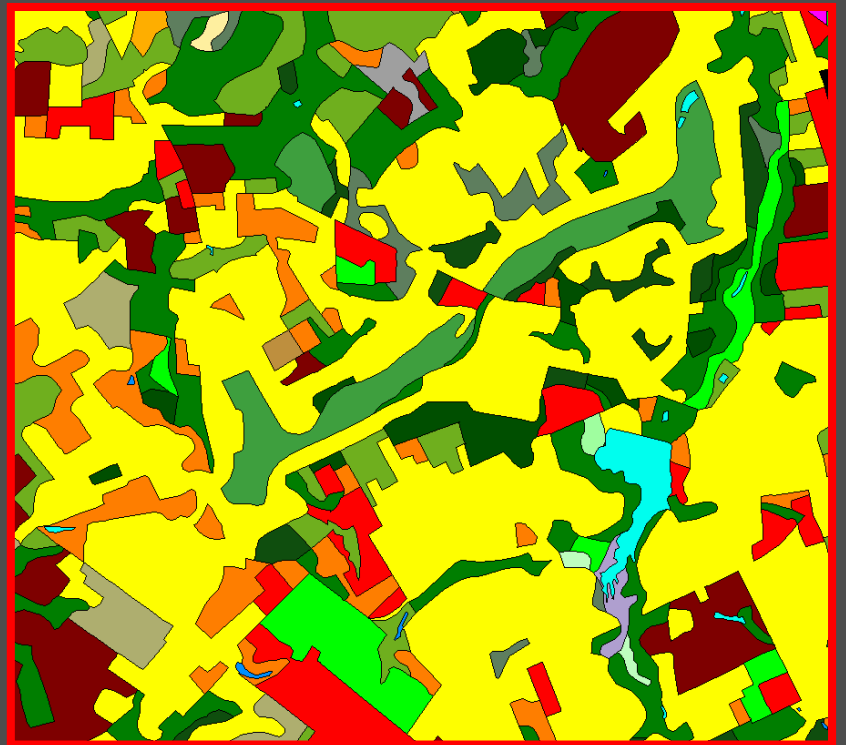
Areas
Encoded as
Vector

Vector Encoding

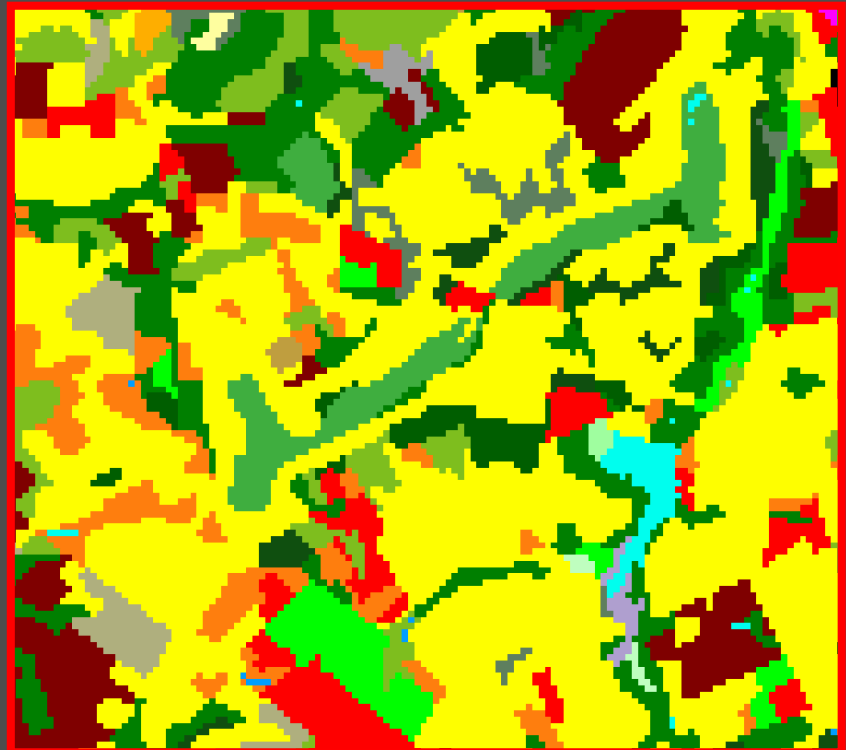


Resulting Vector Image

Vector Area Theme



Raster Area Theme



Representing *Values and Location* in Space: **Volume**

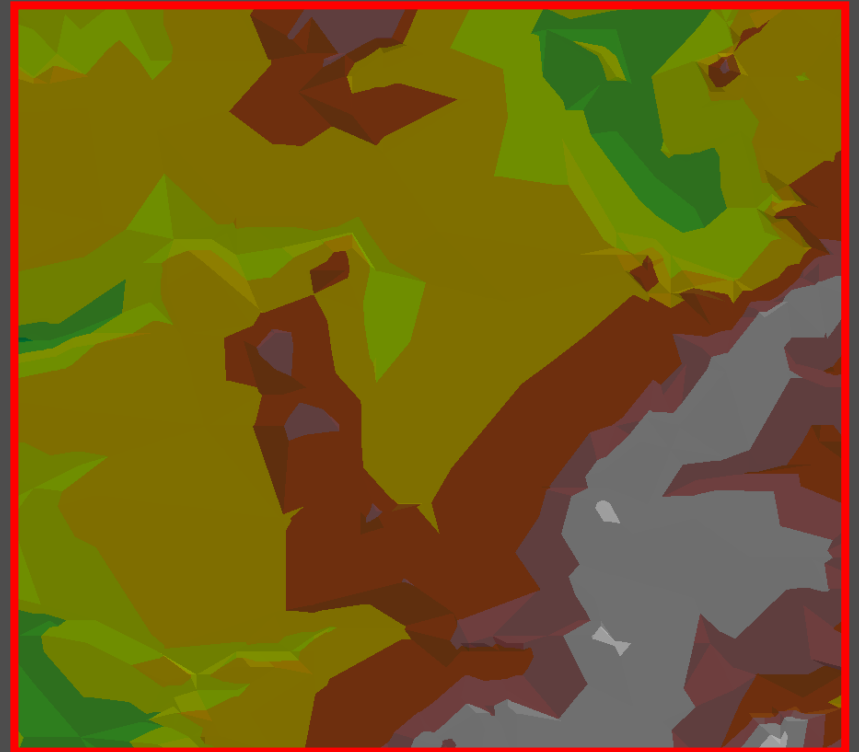
◆ Raster volume:

- ◆ **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.

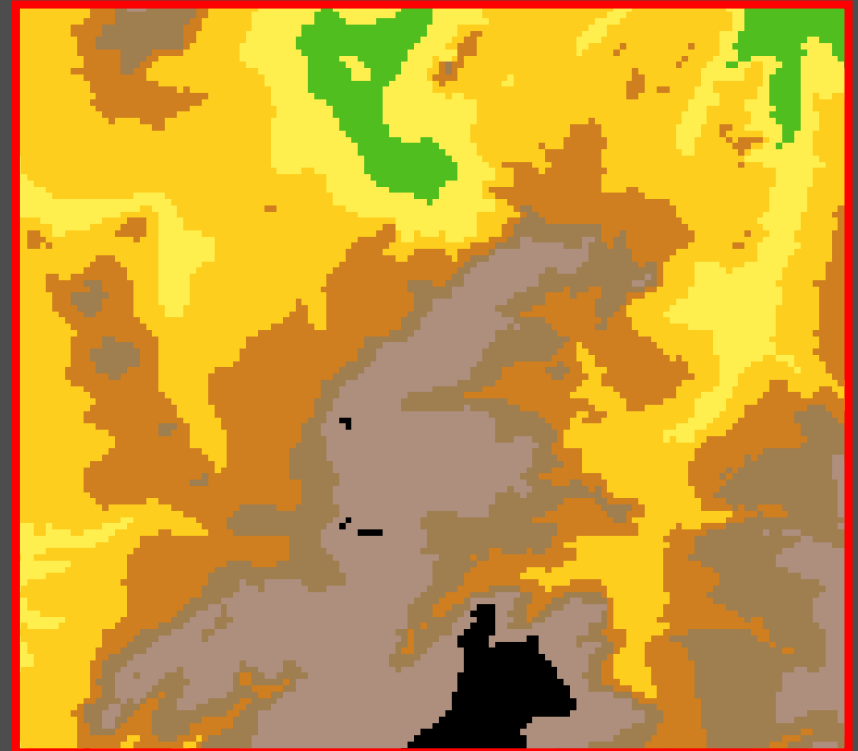
◆ Vector volume:

- ◆ **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



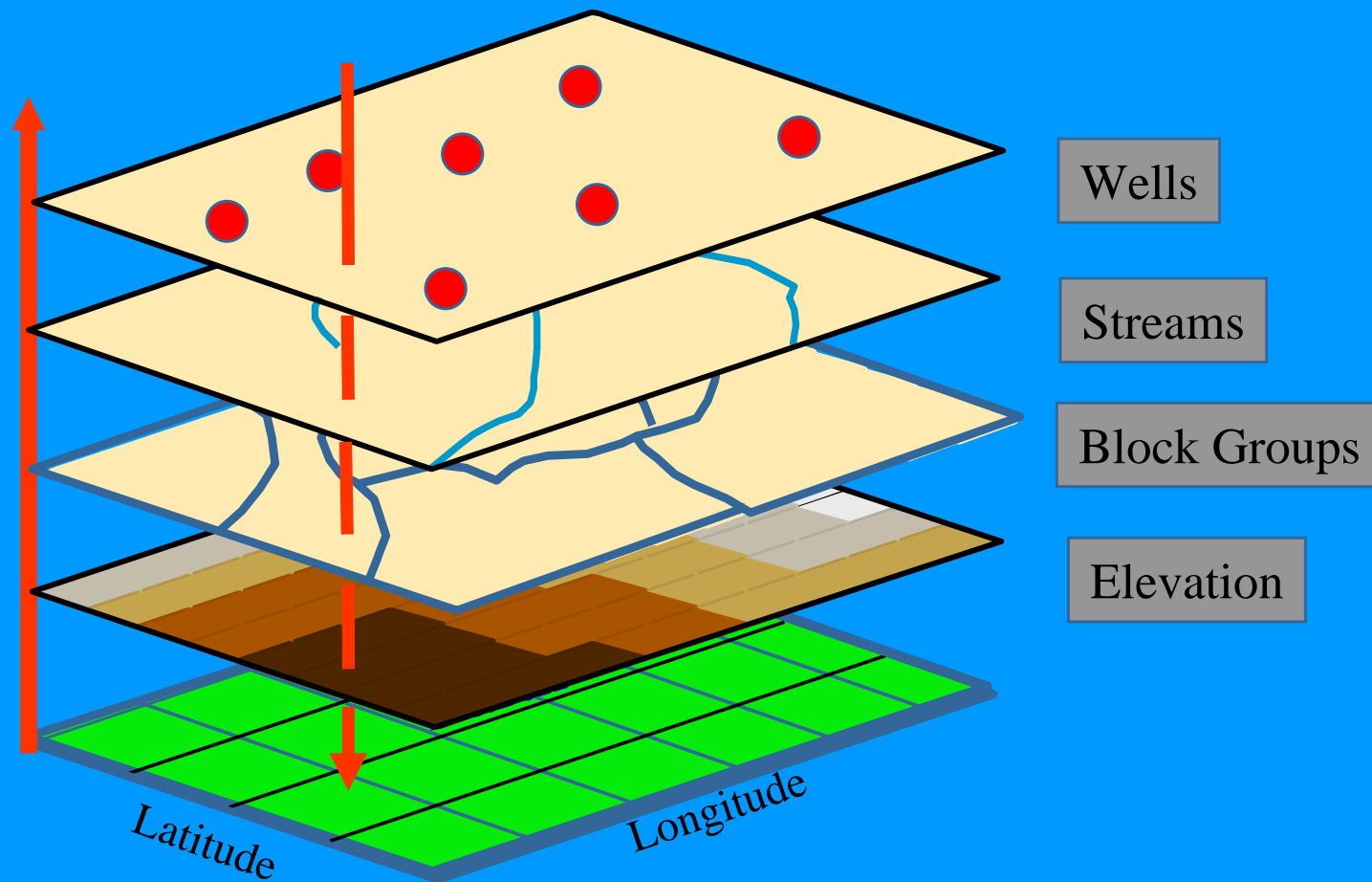


Whether Raster or Vector

All Layers Must Be Geo-referenced
and Rectified

Set of Layers Comprises Database

Layers Must be Rectified



Assign Coordinate Values to Locations

A stylized world map in shades of blue and cyan, centered on the Atlantic Ocean. The map shows the outlines of continents and major landmasses. The title "Raster Conventions" is overlaid on the map in a white, serif font with a drop shadow.

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.



0	1	1	1	0	0	0	2
1	0	0	1	0	0	2	0
0	0	0	1	0	0	2	0
0	0	0	1	0	0	2	0
2	2	2	1	2	2	2	0
0	0	0	1	0	0	0	0

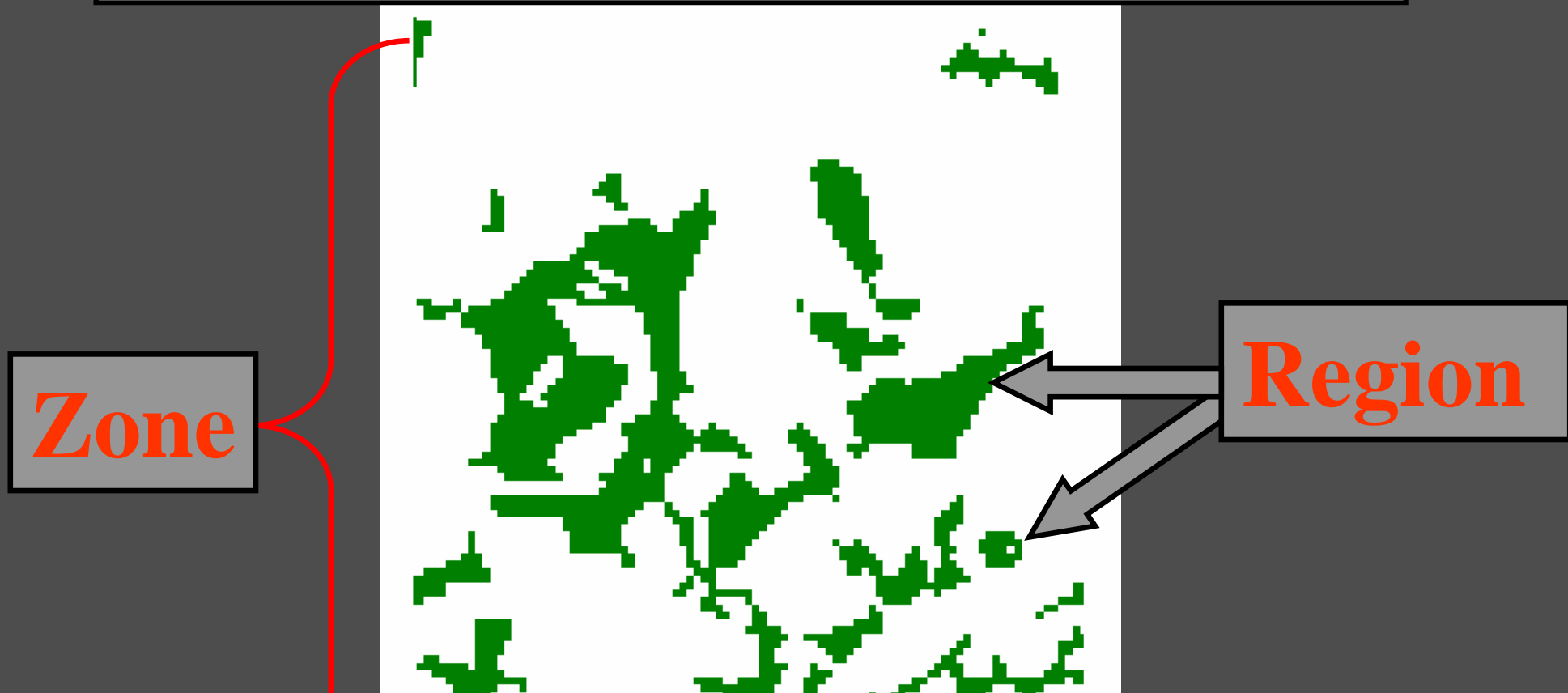
Raster Definitions

- ◆ 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 value¹.

1 In much of the GIS literature Arc Map's region is called a zone and Arc Map's zone is called a class.

Raster Zone and Region

All of the forest taken together represents a single zone.



Each individual set of contiguous forest cells represents a single region.

Forest	
<input type="checkbox"/>	0 No Forest
<input checked="" type="checkbox"/>	1 Forest
<input type="checkbox"/>	No Data

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



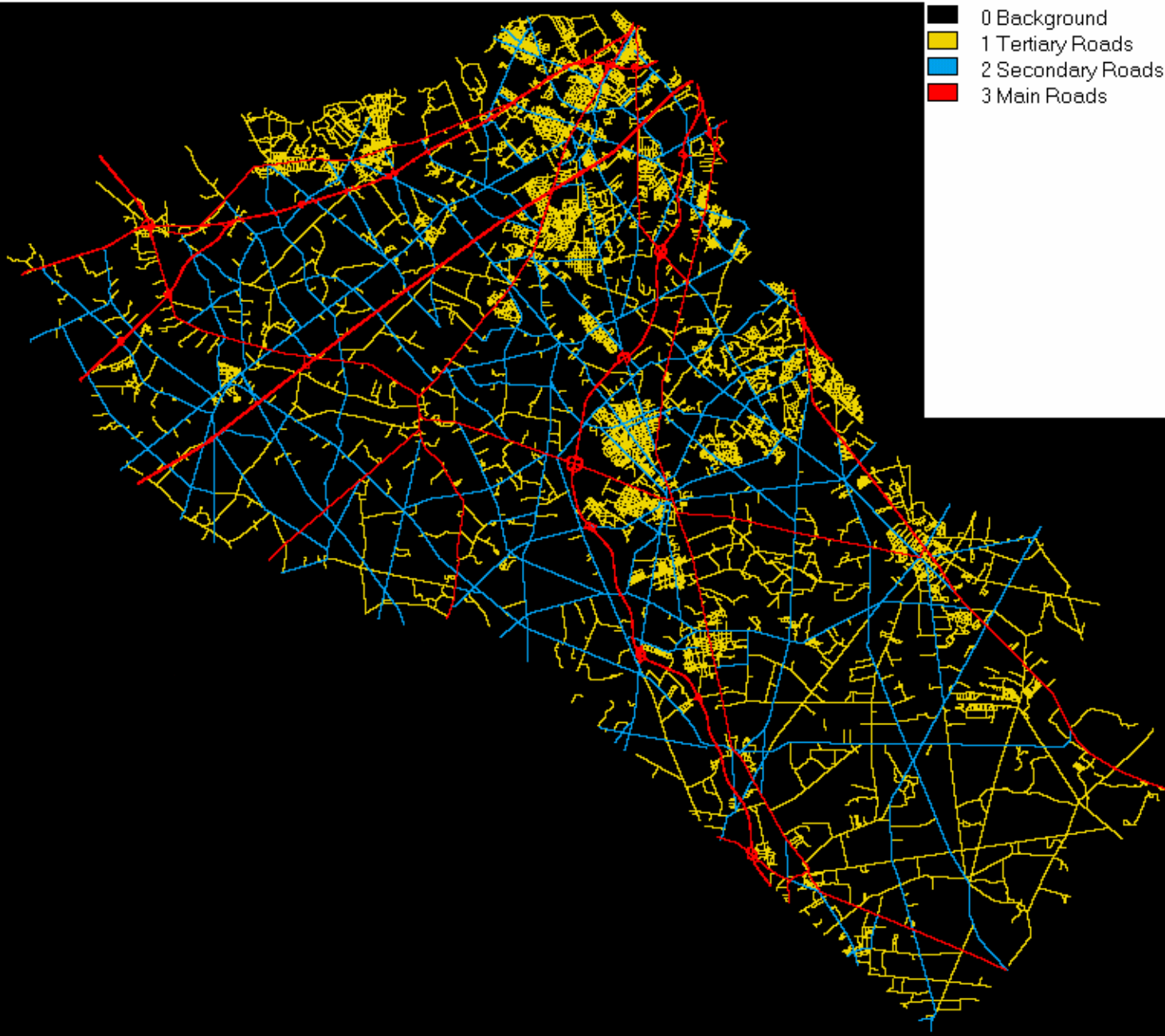
Presence / Absence

Gloucester County Main Roads



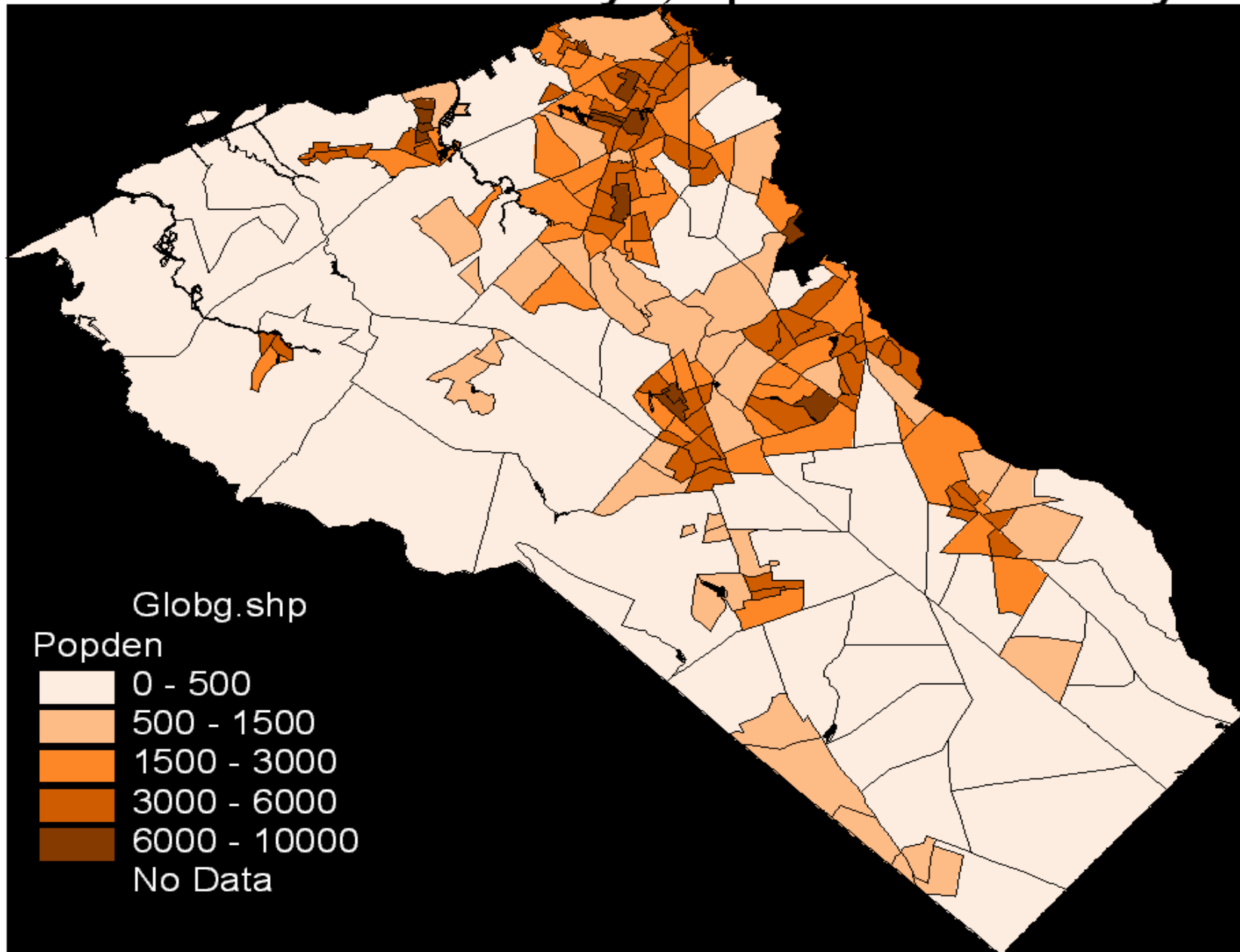
Precedence of Type

Gloucester County Roads



Ratio Value

Gloucester County Population Density



Interpolated Value

