Cell – based GIS

Working with rasters

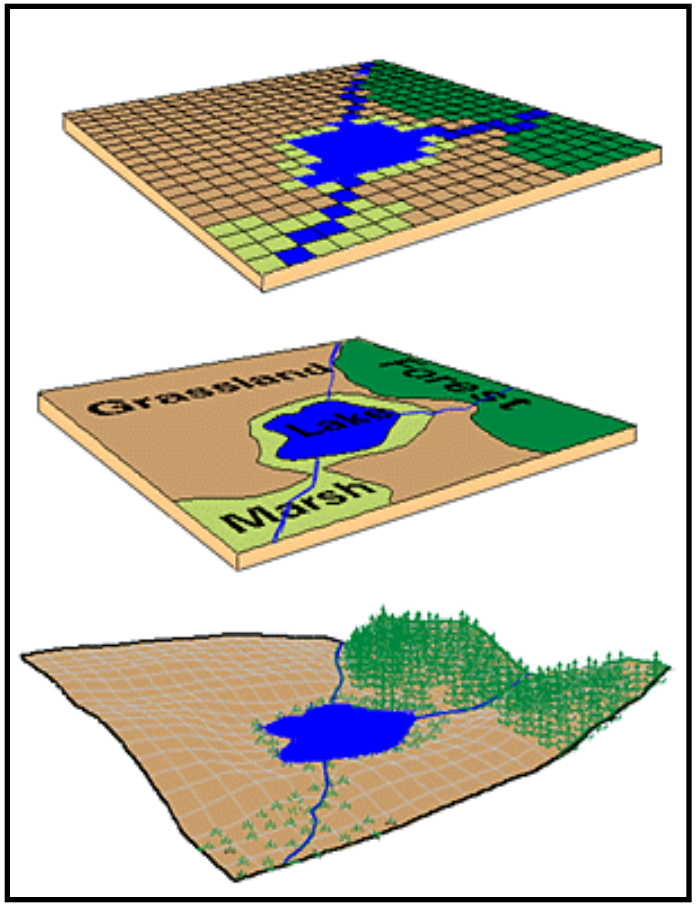
Part I

topics of the week

- Spatial Problems – Modeling
- Raster basics
- Application functions
- Analysis environment, the mask
- Spatial Analyst in ArcGIS

Spatial problems - modeling

- A model is a representation of reality



Raster model

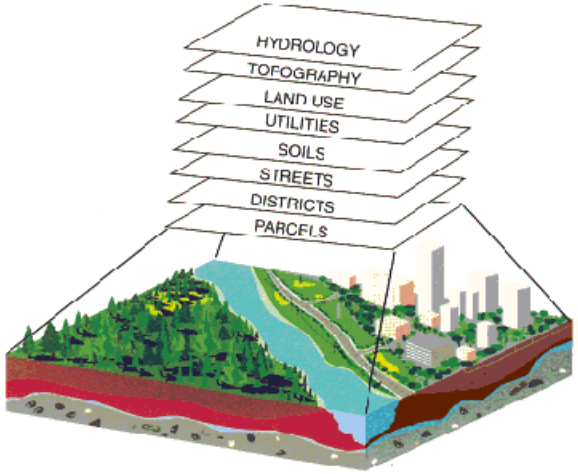
Vector model

Reality

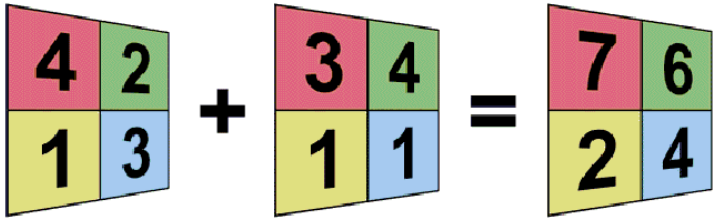
Spatial problems - modeling

THERE ARE TWO TYPES OF MODELS:

- Representation **models or data models or descriptive models which model objects in reality –** *locational models*



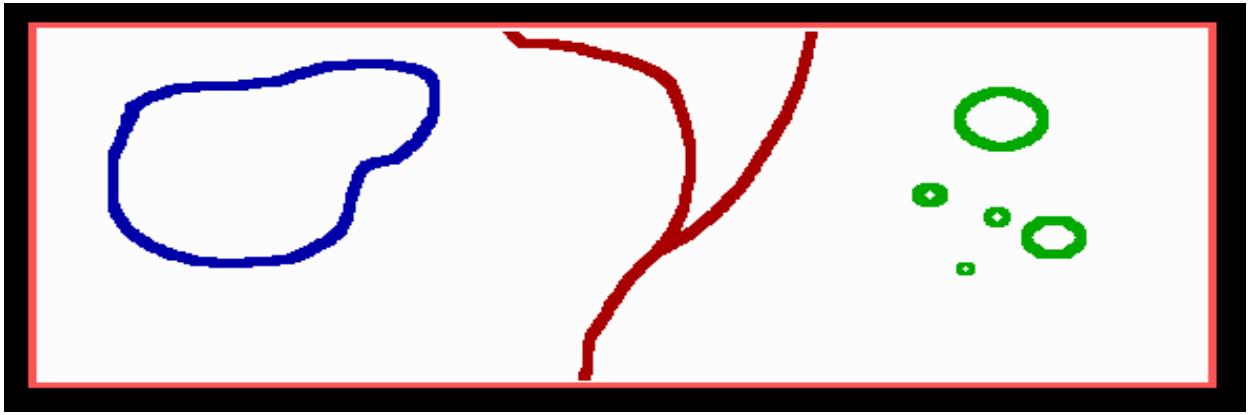
- Process **models which simulate relationships and processes -** *predictive models*



Raster basics

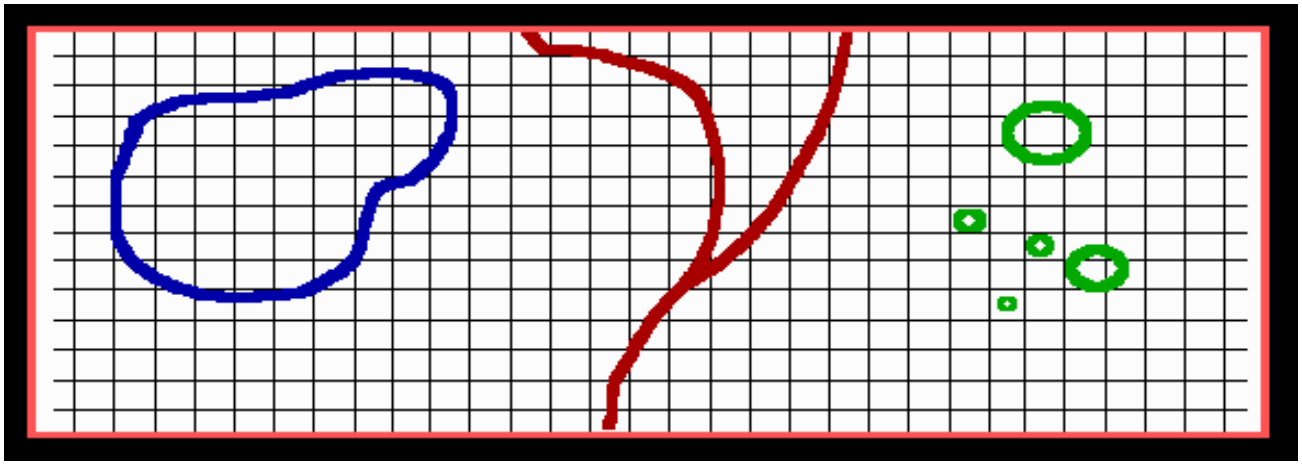
A RASTER (OR GRID) SYSTEM REPRESENTS SPATIAL OBJECTS BY "FILLING IN" GRID CELLS

For example, suppose that our map contains the lines (arcs) and enclosed areas (polygons) as shown below



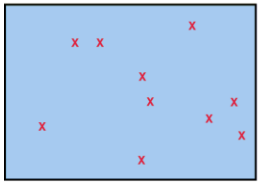
Raster basics

- We can place a grid over these map elements

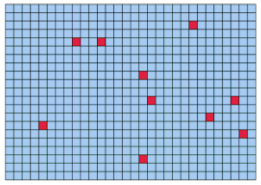


Raster basics

- Map Algebra **language provides tools to perform operations**
- **Raster features**
  - Point data



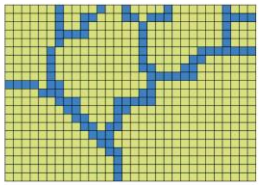
Point features



Raster point features

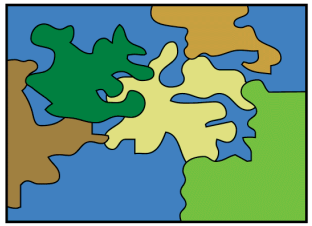
  - Linear data

Line features

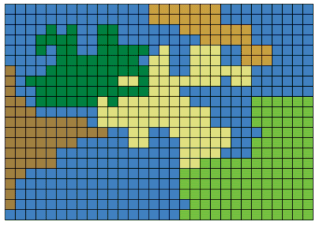


Raster line features

  - Polygon data



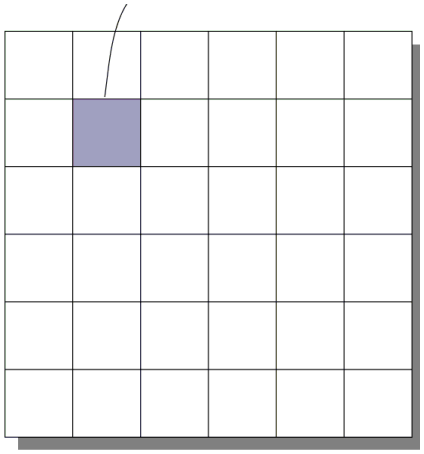
Polygon features



Raster polygon features

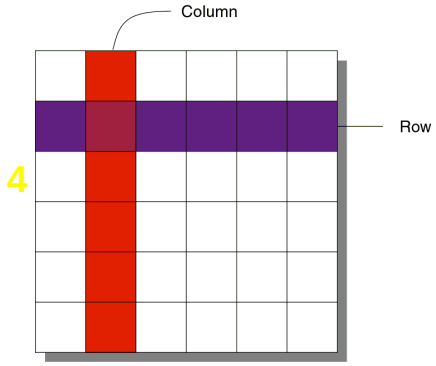
Raster basics

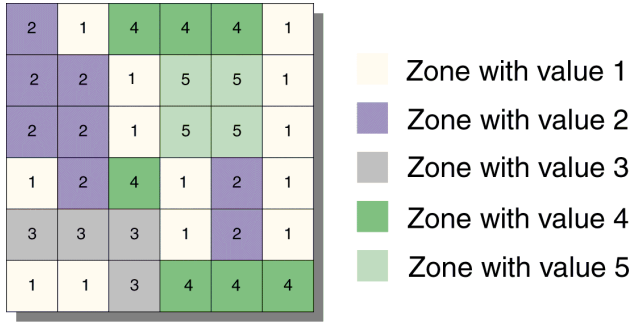
- Raster data: thematic data, image data
- A raster dataset describes features of an area by theme
- A raster dataset is made up of cells. Each cell represents a portion of the area in a square.



Raster basics

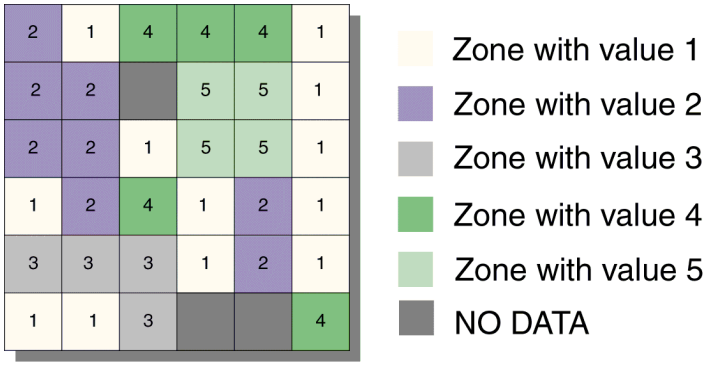
- Rows and columns – **arrangement of cells**
- Values – **each cell has a specific value (integer or floating)**
- Zones – **cells with same value form a zone (connected or disconnected cells)**
- Regions – **connected cells in a zone**





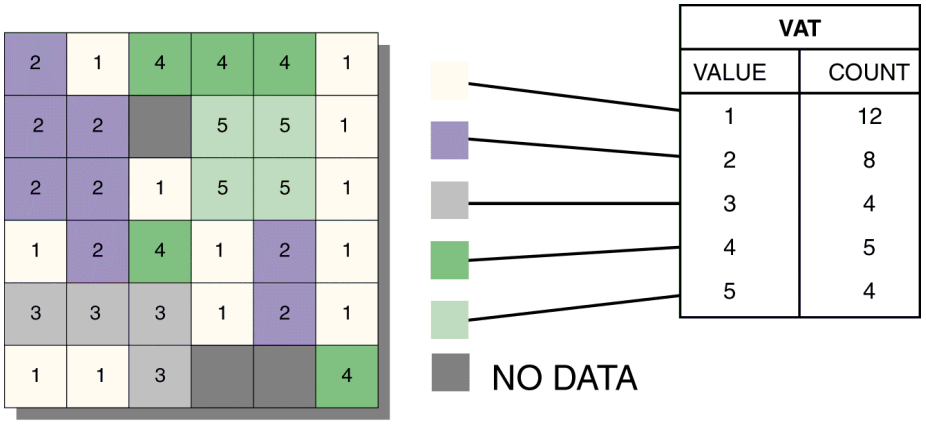
Raster basics

- Nodata value => different from 0 value
- No information for the location the cell represents exists
- Two ways to process the nodata:
  - Ignore it and compute with other existing values
  - Honor it and overwrite other existing values by turning them to nodata



Raster basics

- Attribute table **– only for integer raster data**
- **Two mandatory items in the** attribute table**:**
  - Value **– attribute for each zone**
  - Count **– number of cells for each zone**



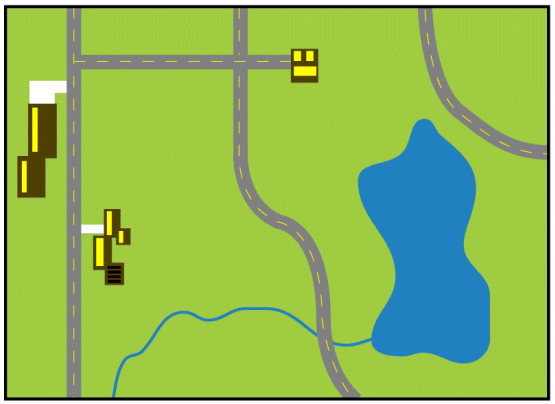
VAT

VALUE	COUNT
1	12
2	8
3	4
4	5
5	4

Raster basics

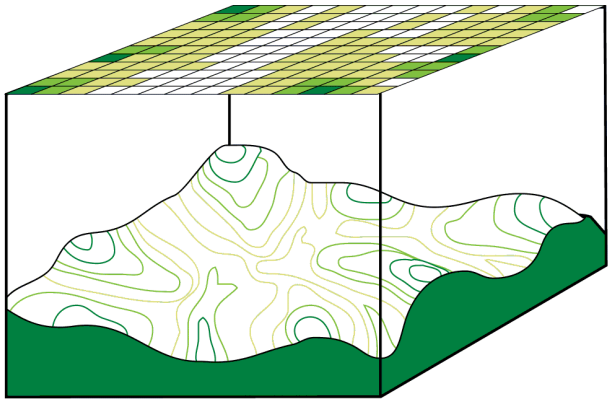
- Discrete data

  represents objects in both the feature and raster data storage systems. A discrete object has known and definable boundaries.



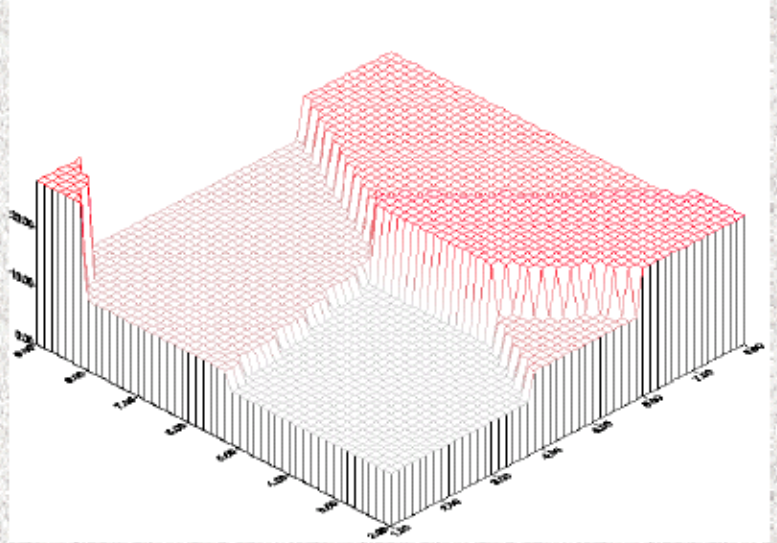
- Continuous or non-discrete data

  represents phenomena where each location on the surface is a measure of the concentration level.



Raster basics

Discrete vs. Continuous Surfaces

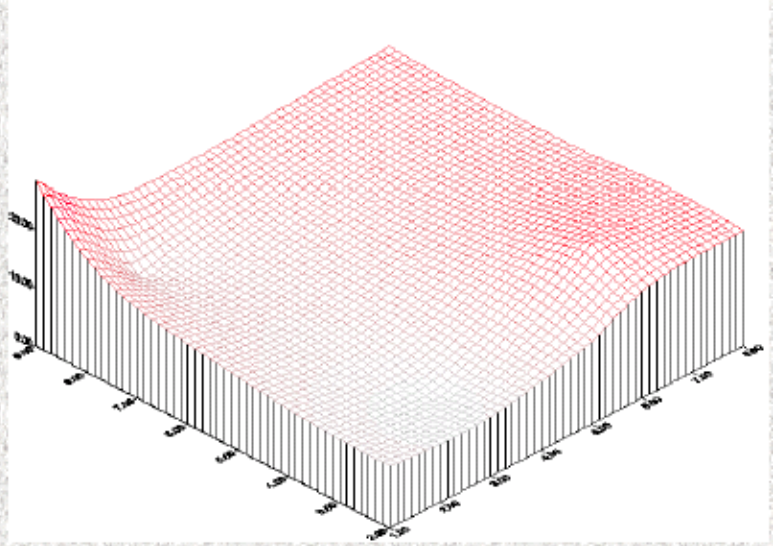


Discrete surfaces are not predictable. There are a finite number of locations that have data - (e.g., TAX RATES BY COUNTY)

The vector model is most suited to discrete data.

Continuous surfaces are somewhat predictable. There are an infinite number of locations that have unique values - (e.g., ELEVATION)

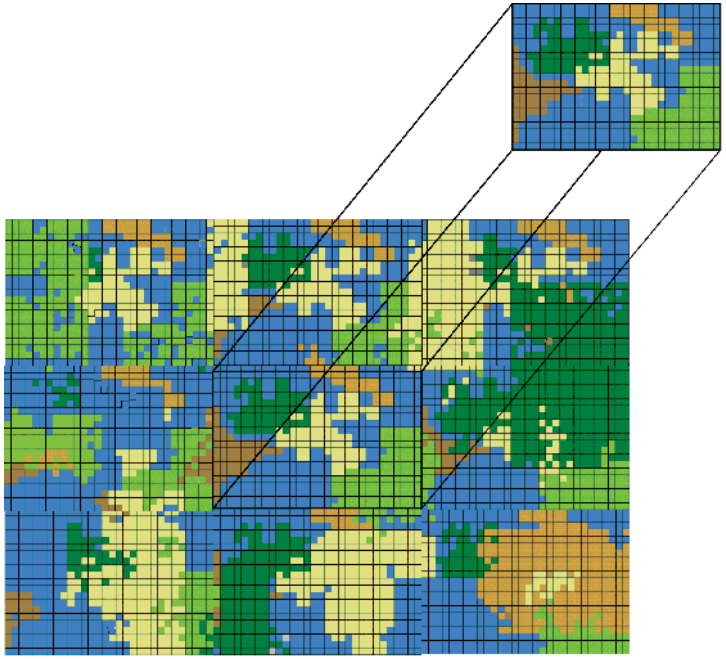
The raster model is most suited to continuous data.



Analysis environment - the analysis extent

- The analysis extent*:*

  An area of interest, may be a portion of a larger raster dataset.



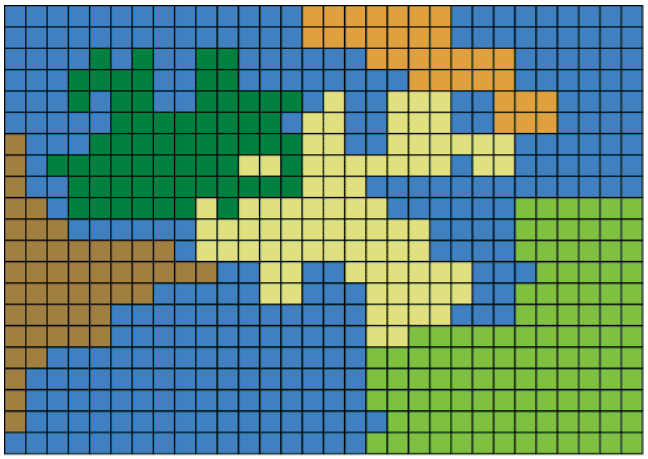
- The cell size:

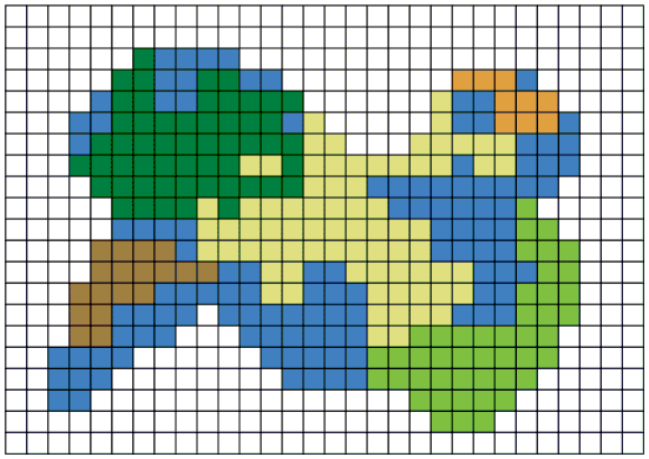
  The output cell size, or resolution, for any operation or function can be set to any size desired. The default output resolution is determined by the coarsest of the input raster datasets.

Analysis environment - the mask

- The mask*:*

identifies those cells within the analysis extent that will not be considered when performing an operation or a function. All identified cells will be "masked out" and assigned to the nodata value on all subsequent output raster datasets.





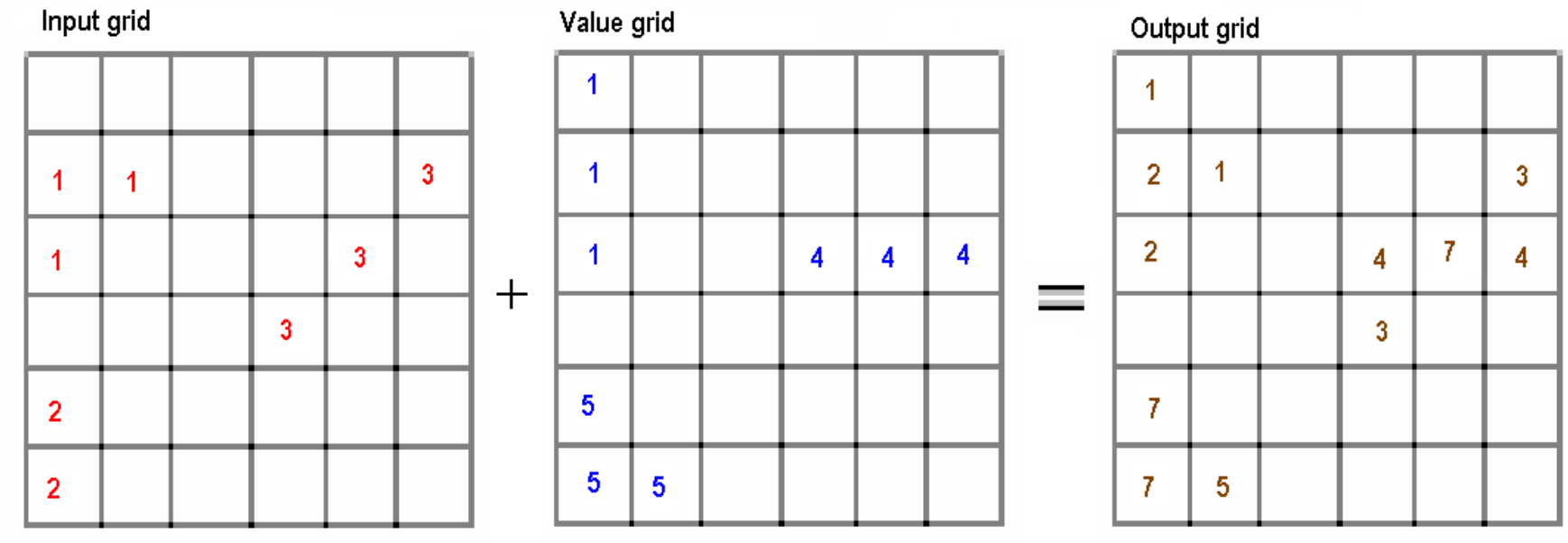
Application functions

Four raster application functions:

- LOCAL FUNCTIONS
- FOCAL FUNCTIONS
- ZONAL FUNCTIONS
- GLOBAL FUNCTIONS

Local functions

or per-cell functions, compute an output raster dataset where the output value at each location is a function of the value associated with that location on one or more raster datasets



Local functions

Value Attribute Tables (VAT):

Value	Count
1	3
2	2
3	3

Input grid

+

Value	Count
1	3
4	3
5	3

Value grid

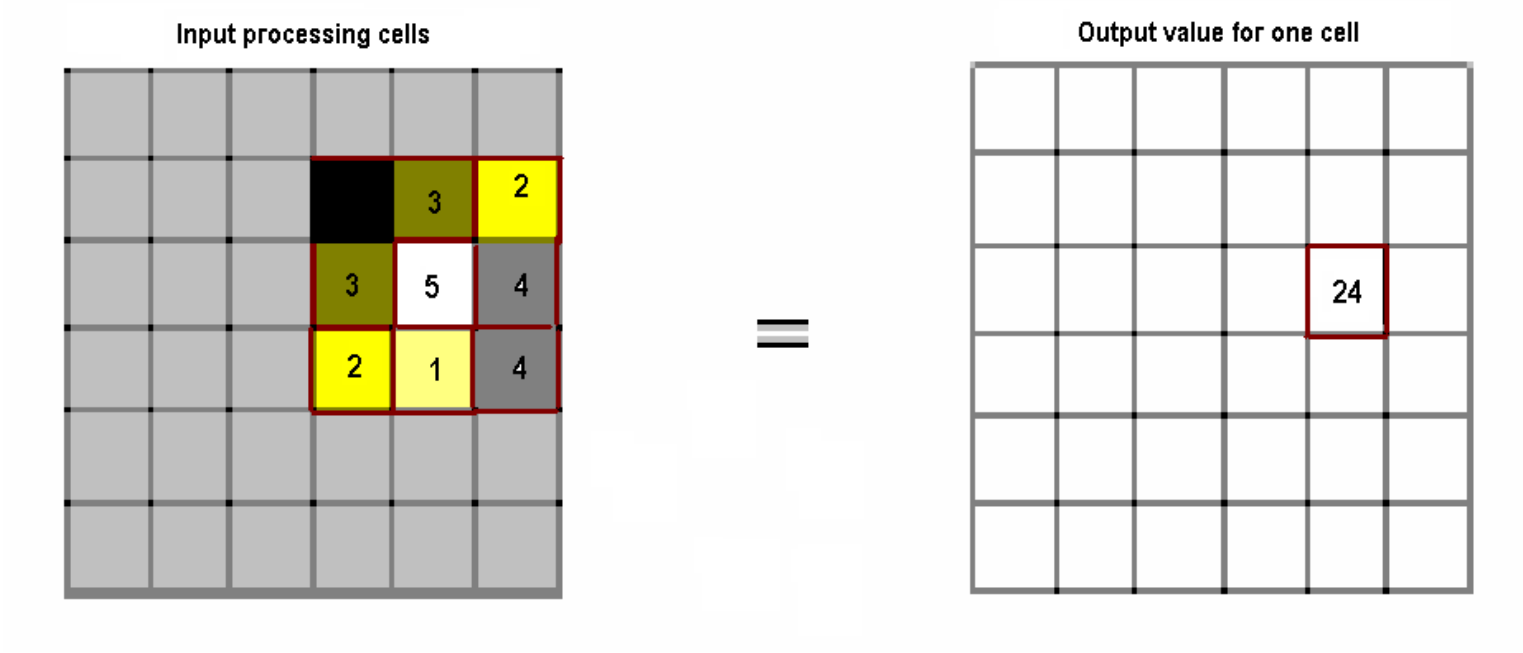
=

Output grid

Value	Count
1	2
2	2
3	2
4	2
5	1
7	3

Focal functions

or neighborhood functions, produce an output raster dataset in which the output value at each location is a function of the input value at a location and the values of the cells in a specified neighborhood around that location



Types of neighborhoods

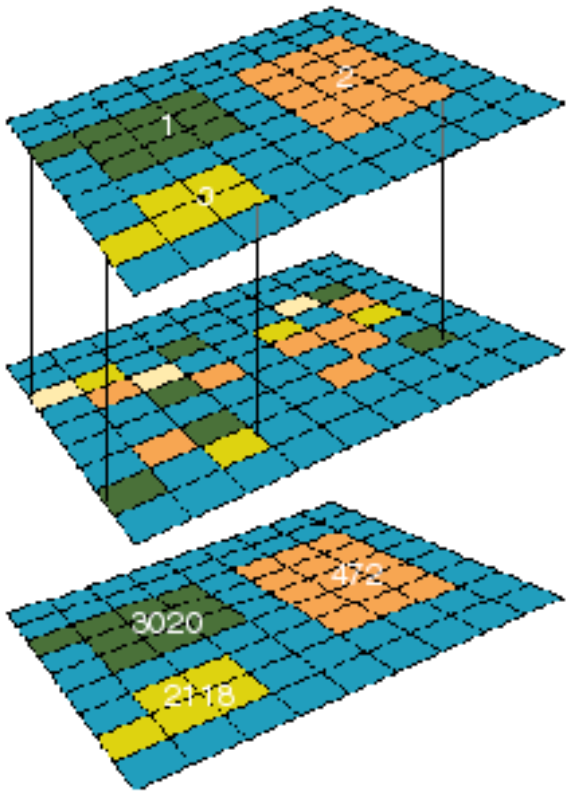
- **Rectangular -** default 3 x 3 cells
- **Circular -** specified radius in cells or map units

(*when in map units, center of cell defines if cell gets included or not***)**

- **Donat –** inner and outer radius in cells or map units
- **Wedge –** radius and angle

Zonal functions

compute an output raster **where the output value for each location depends on (a) the value of the cell at the location in the** value raster **and (b) the association that location has within a zone in the** zone raster



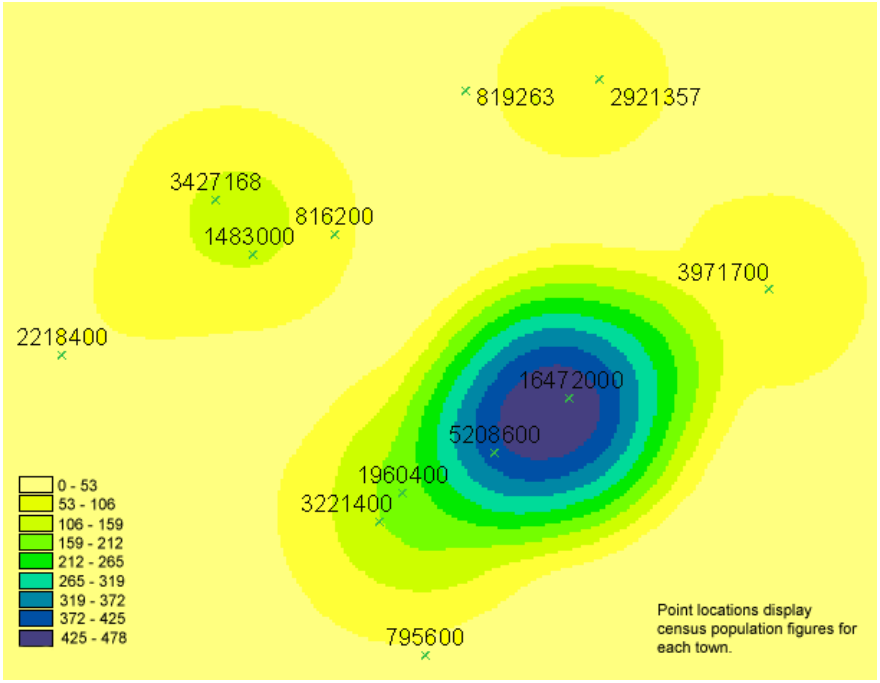
Zone layer:
Defines the zones (shape, values and locations).

Value raster:
Contains the input values used in calculating the output for each zone.

Input zone layer:
The output table can be joined to the zone layer to display a statistic per zone.

Global functions

or per-raster, functions compute an output raster **in which the value at each cell location is potentially a function of all the cells in the** input raster**. There are two groups of global functions: Euclidean distance and weighted distance.**



Density surface illustration

Types of analysis for the application functions

Majority = value that occurs most often on a cell by cell between inputs

Maximum = maximum value on a cell by cell between inputs

Mean = mean of values on a cell by cell between inputs

Median = median of values on a cell by cell between inputs

Minimum = minimum of values on a cell by cell between inputs

Minority = value that occurs least on a cell by cell between inputs

Range = range of values on a cell by cell between inputs

Standard Deviation = standard deviation on a cell by cell between inputs

Sum = sum of values on a cell by cell between inputs

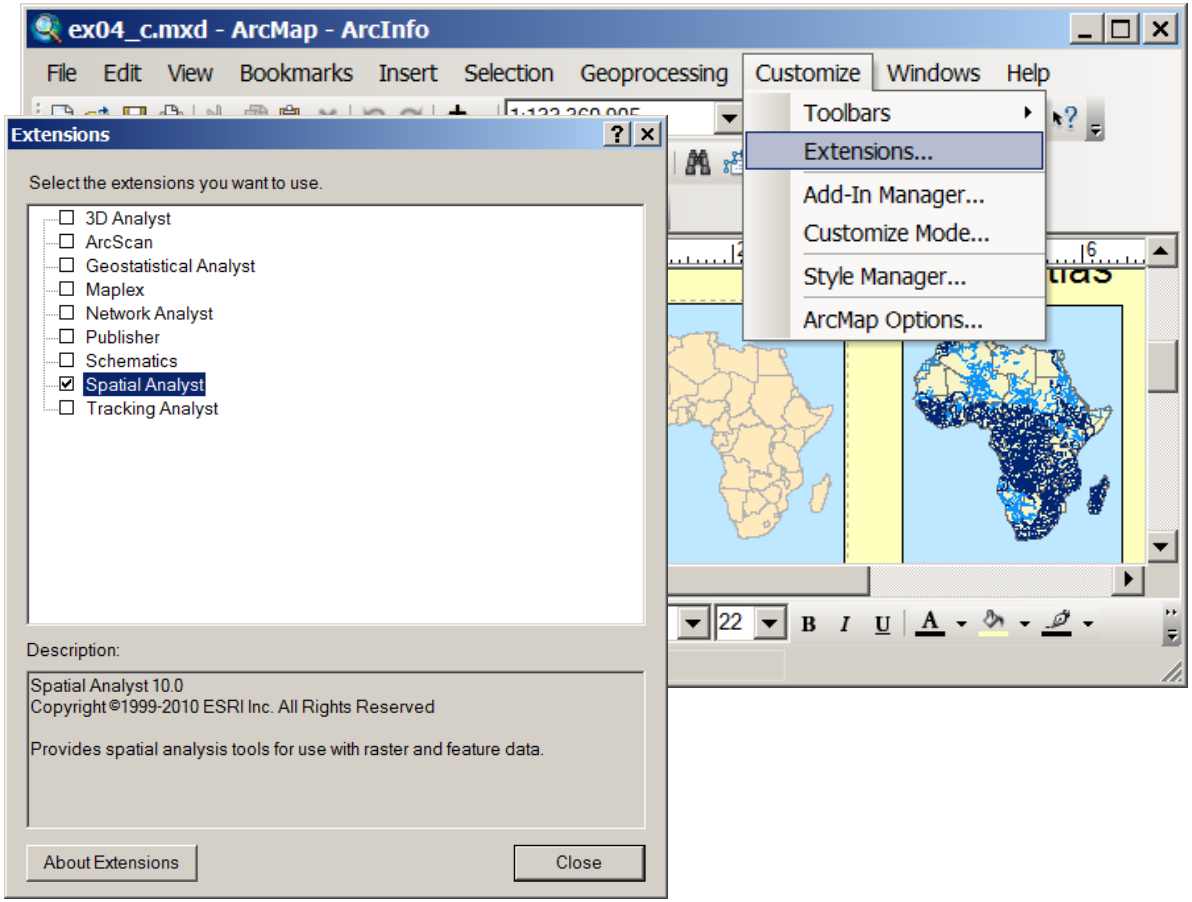
Variety = number of unique values on a cell by cell between inputs

ArcGIS extensions

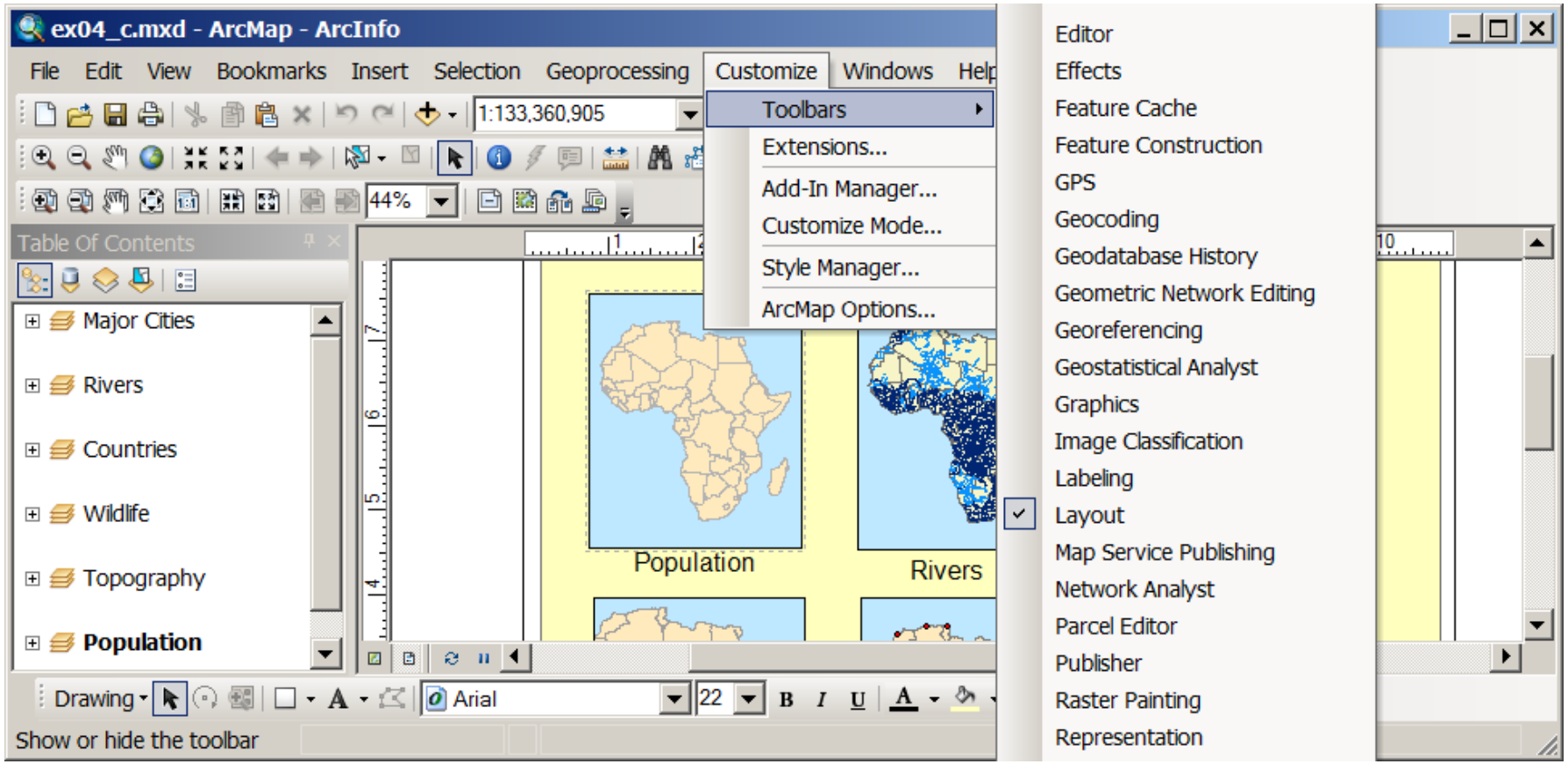
- What are extensions?
- ArcGIS extensions
  - Spatial Analyst
  - 3D Analyst
  - Geostatistical Analyst
  - Network Analyst
- Adding Extensions
  - Loading the engine
  - Enabling the interface

Spatial Analyst extension - loading

Loading the Spatial Analyst Extension



Spatial Analyst extension – enabling interface



Spatial Analyst extension - The tools (170)