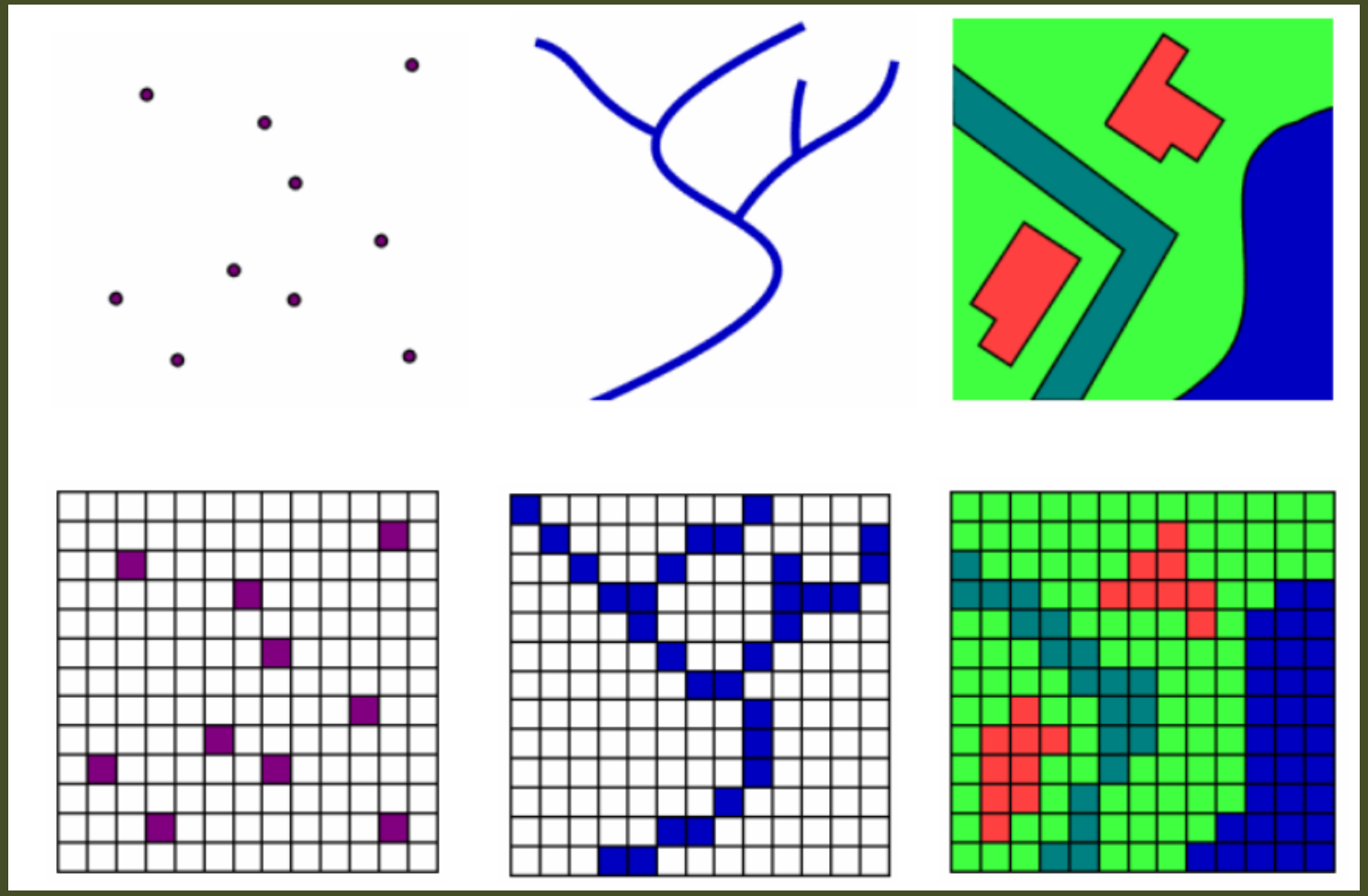
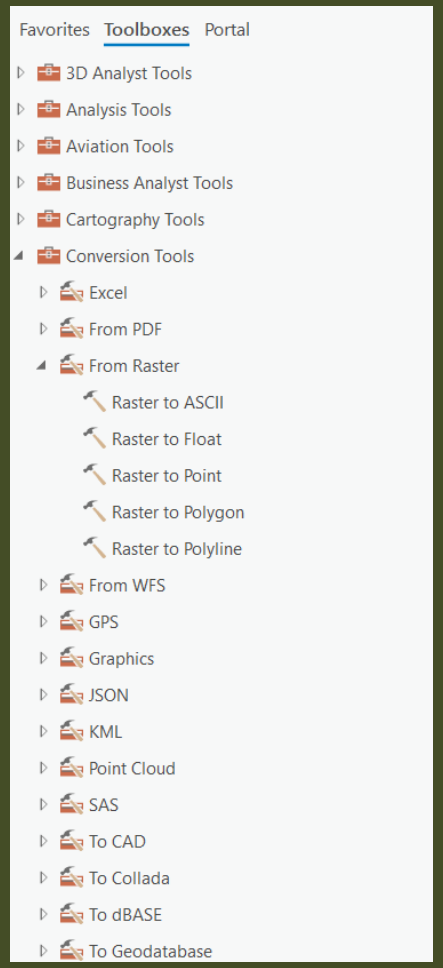
RASTER ANALYSIS – 1

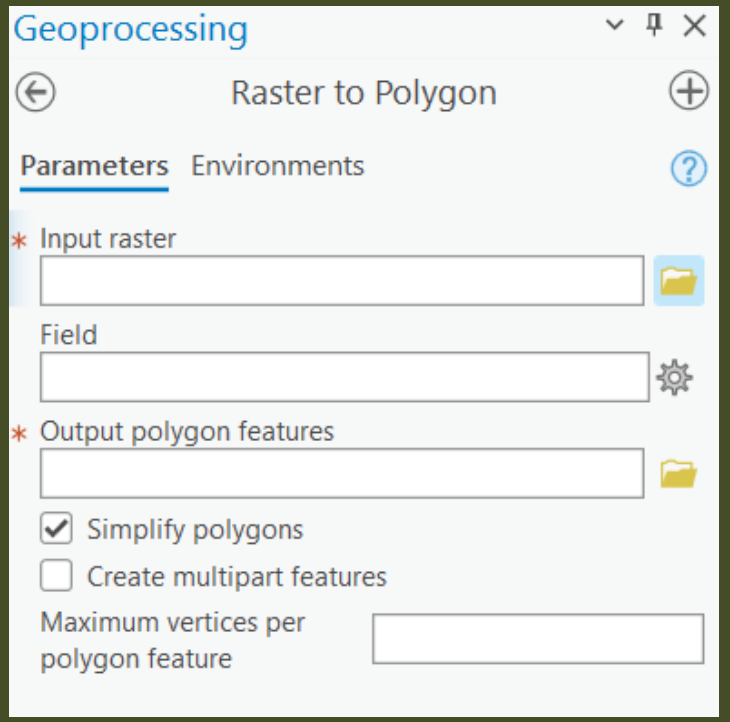
Su Zhang, Ph.D., GISP, CMS-RS

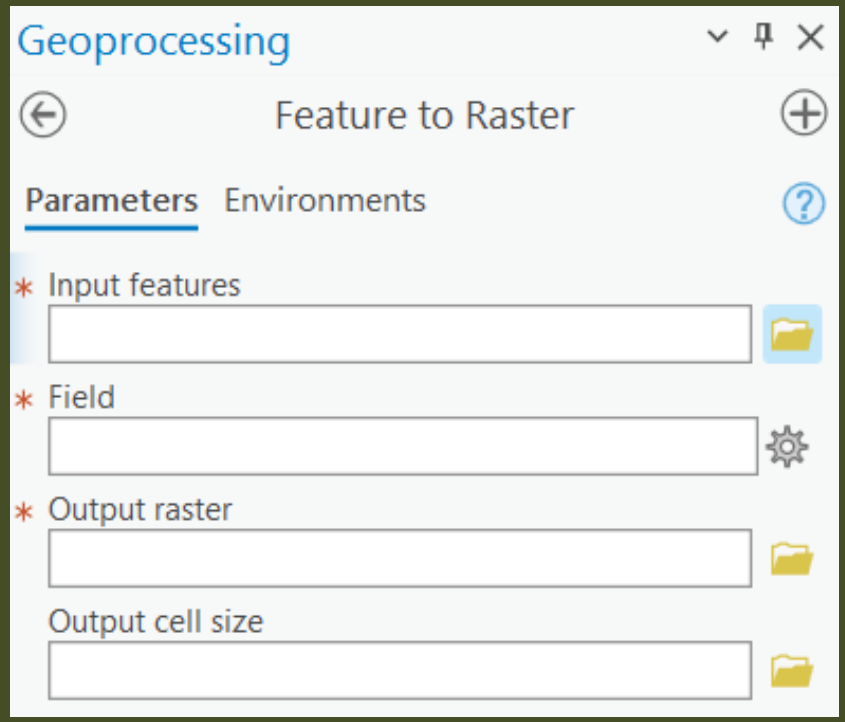
RASTER / VECTOR CONVERSION



RASTER / VECTOR CONVERSION



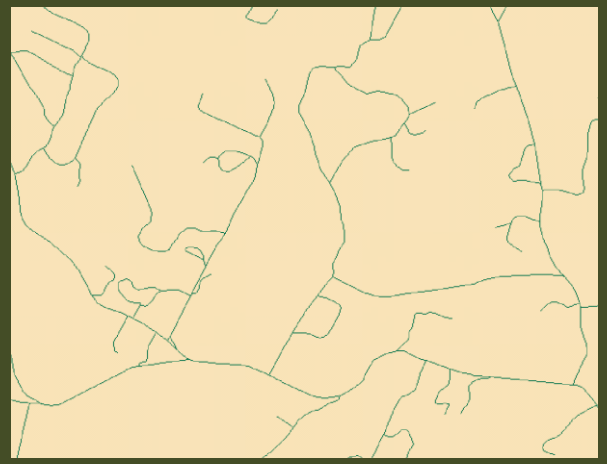




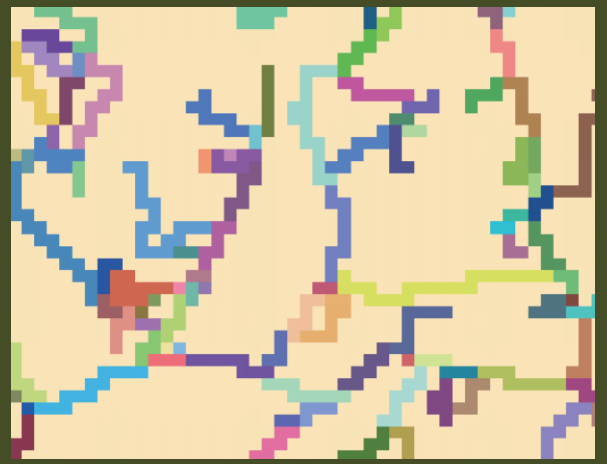
RASTER / VECTOR CONVERSION

Simplified vs. Non-simplified Output

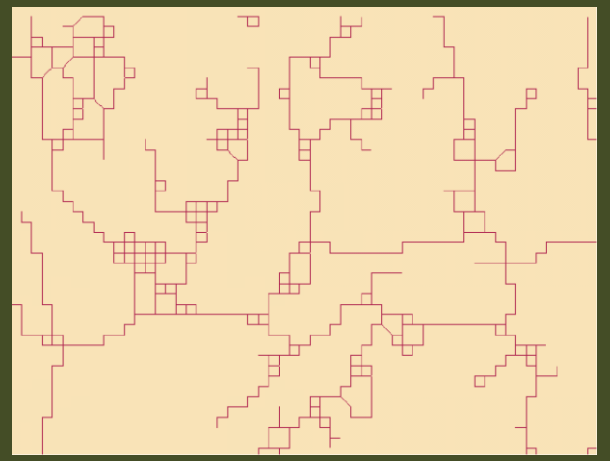
Simplified Output

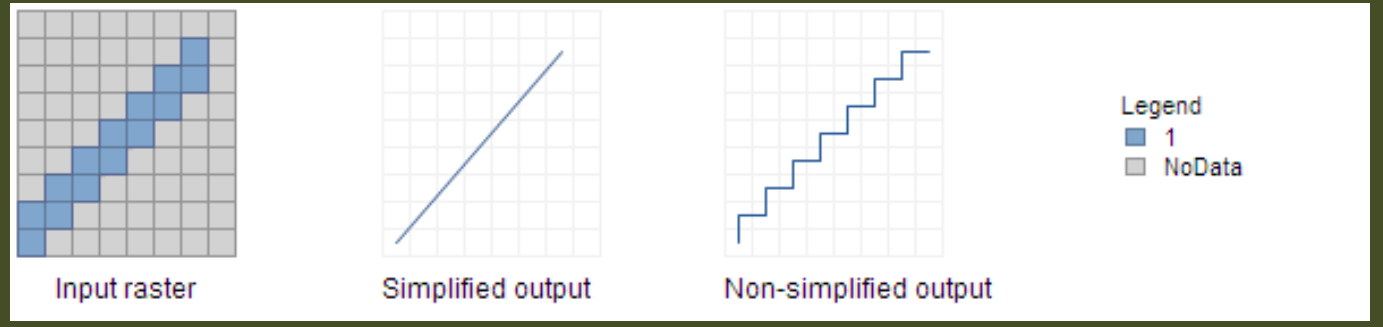


Raster



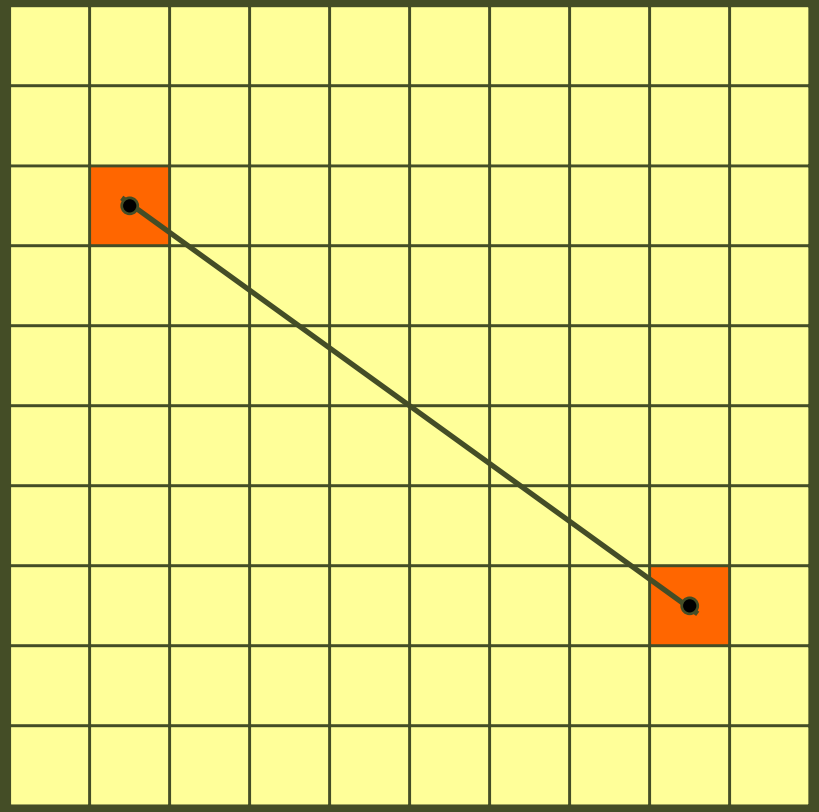
Non-Simplified Output



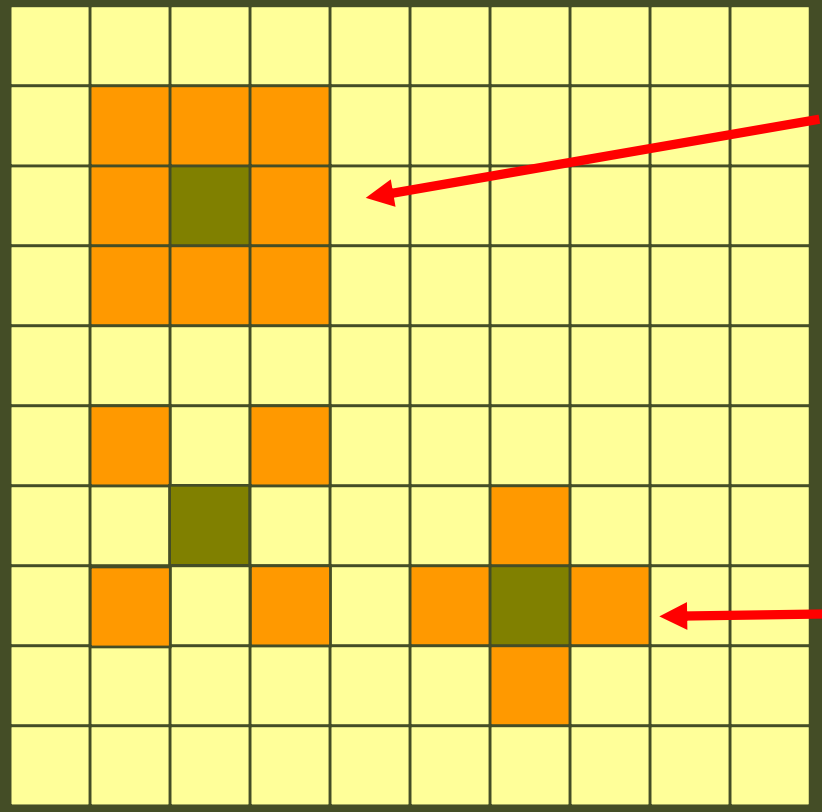


SPATIAL PROPERTIES

Distance

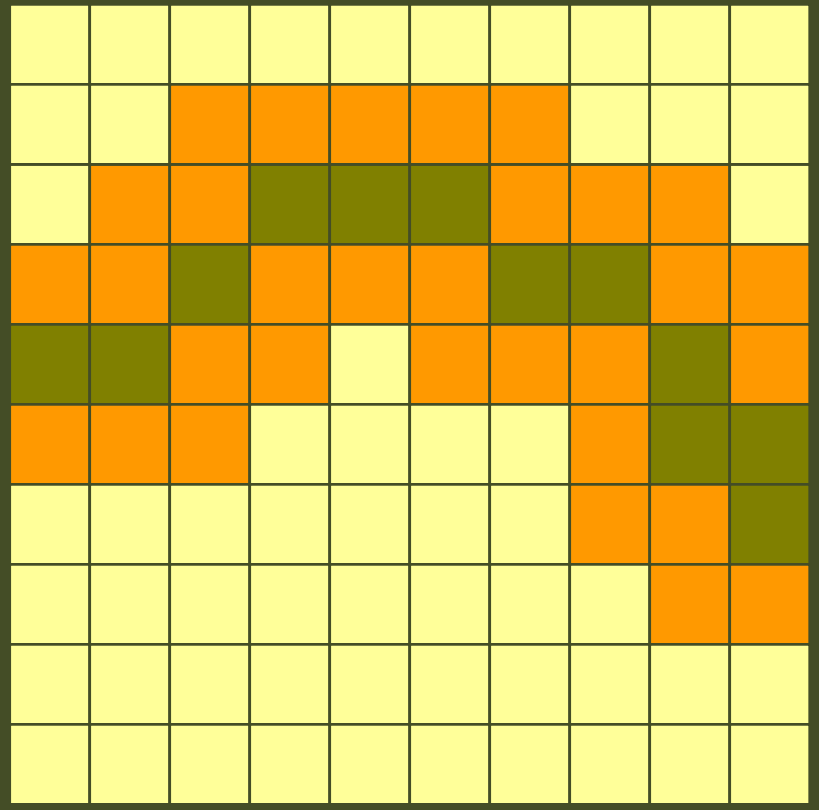


Adjacency

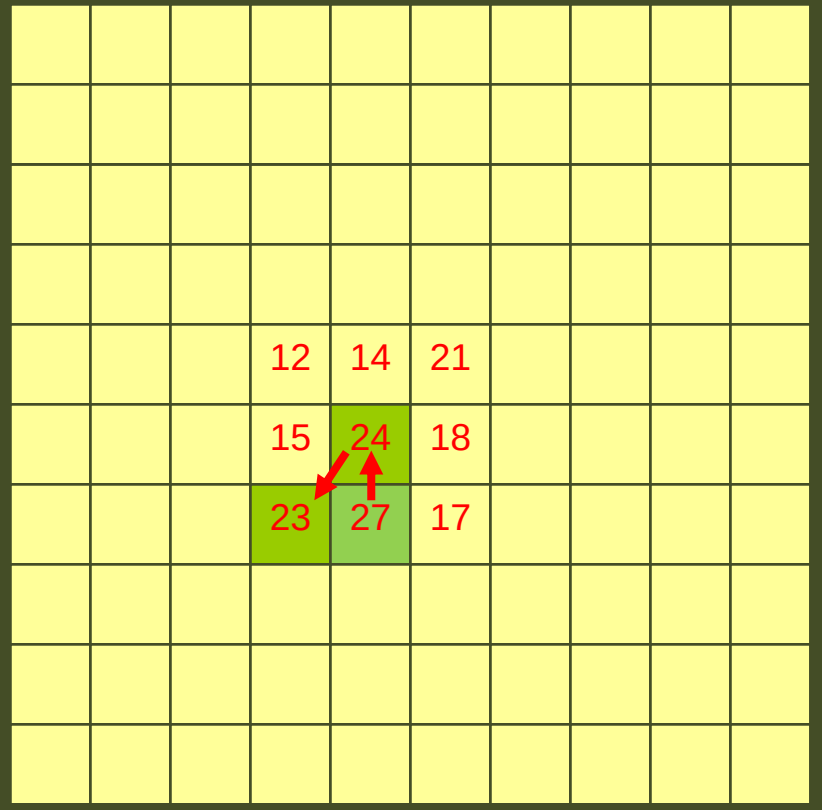


SPATIAL PROPERTIES

Buffer

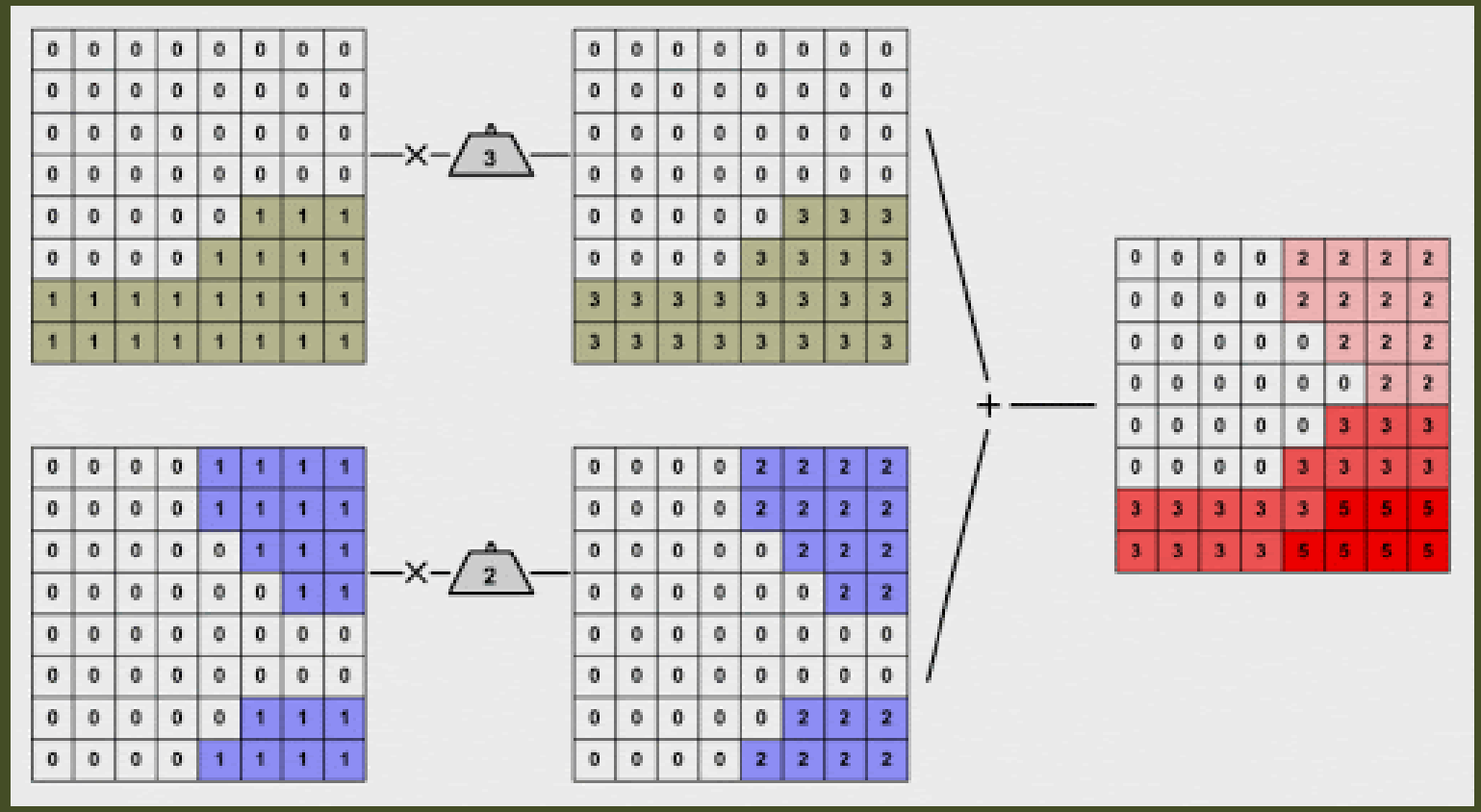


Network



SPATIAL PROPERTIES

Spatial Coincidence – overlaying different raster datasets in order to create a resultant layer that weighs the coinciding factors from each of the datasets

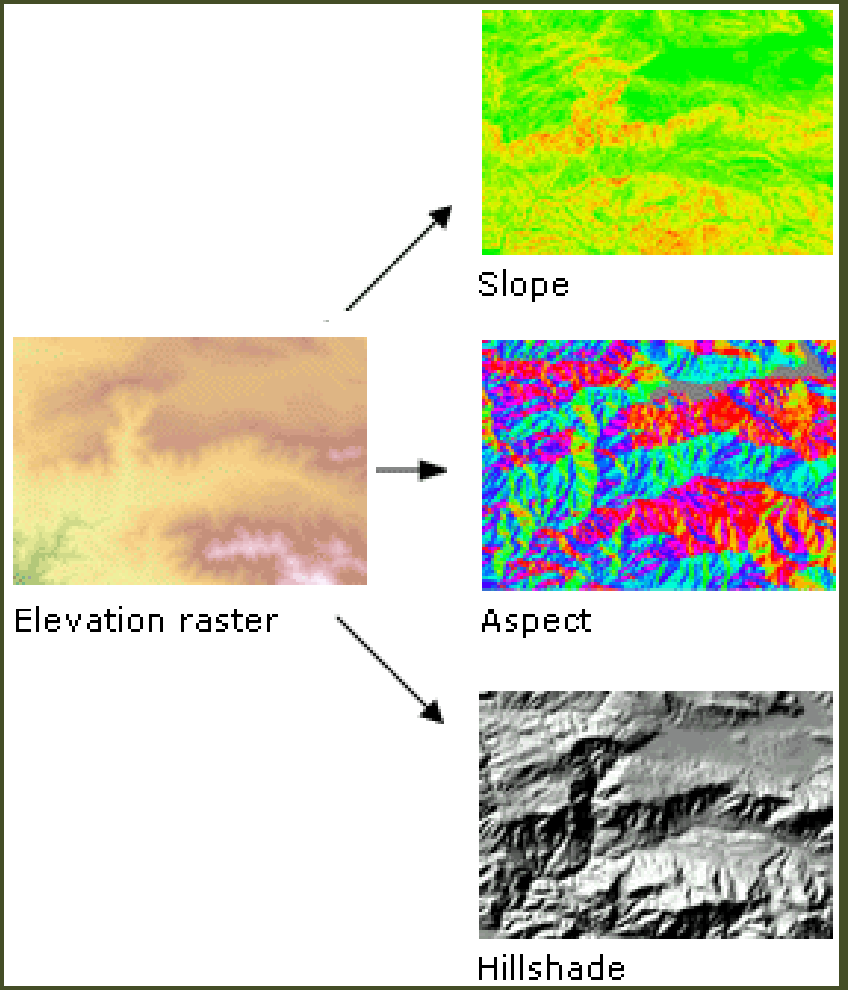


SPATIAL ANALYST EXTENSION

Requires Spatial Analyst License

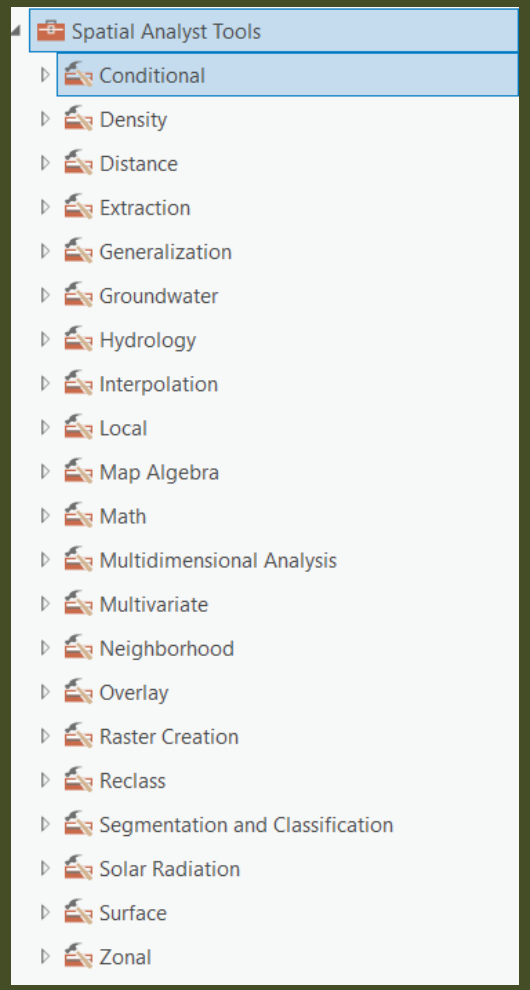
SPATIAL ANALYST AND STATISTICS APPLICATIONS

- Conduct spatial analysis
- Identify suitable locations
- Perform distance and cost-of-travel analyses
- Find the best path between locations
- Perform spatial statistical analysis
- Pixel-based and object-based image analysis
- Interpolation
- Hydrology



SPATIAL ANALYST

Name	Licensed	Expires
Indoors	No	N/A
LocateXT	Yes	7/16/2023
Location Referencing	Yes	7/16/2023
Maritime	Yes	7/16/2023
Network Analyst	Yes	7/16/2023
Production Mapping	Yes	7/16/2023
Publisher	Yes	7/16/2023
Reality	No	N/A
Spatial Analyst	Yes	7/16/2023

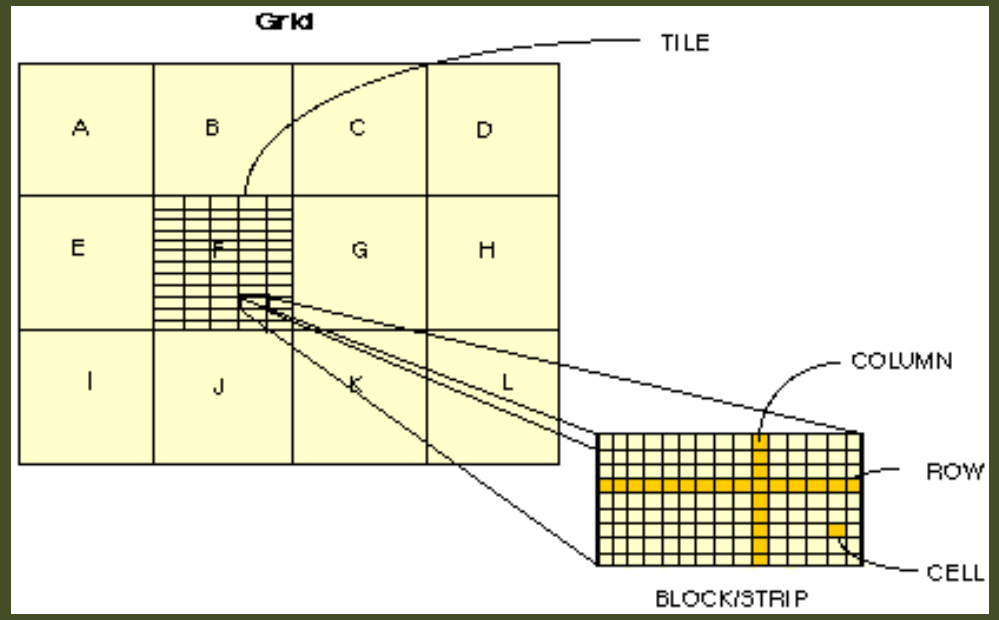


ESRI GRID FORMAT

- Grids are the main raster format of ArcGIS Spatial Analyst
- A grid is a raster data storage format native to ESRI
- Output format created by Spatial Analyst tools; but we normally type in .tif or .img as the output format
- Types of grids:
  - Integer – discrete data
  - Floating point – continuous data

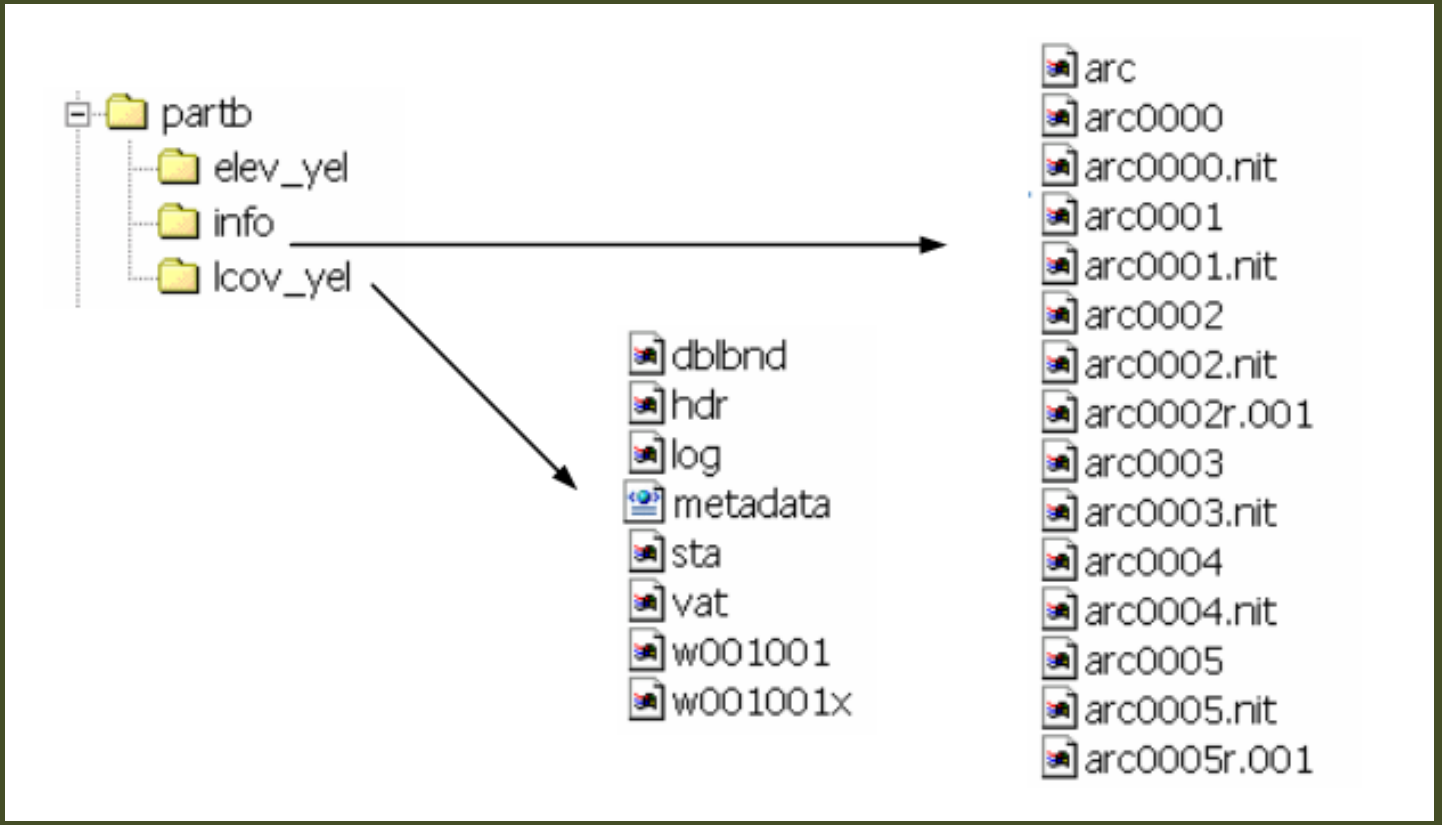
GRID DATA STRUCTURE

- Grids are implemented using a tiled raster data structure in which the basic unit of data storage is a rectangular block of cells
- Tile – blocks stored on disk in a compressed form
- The size of the tile for a grid is based on the number of rows and columns in the grid at the time of creation



WORKING WITH GRIDS

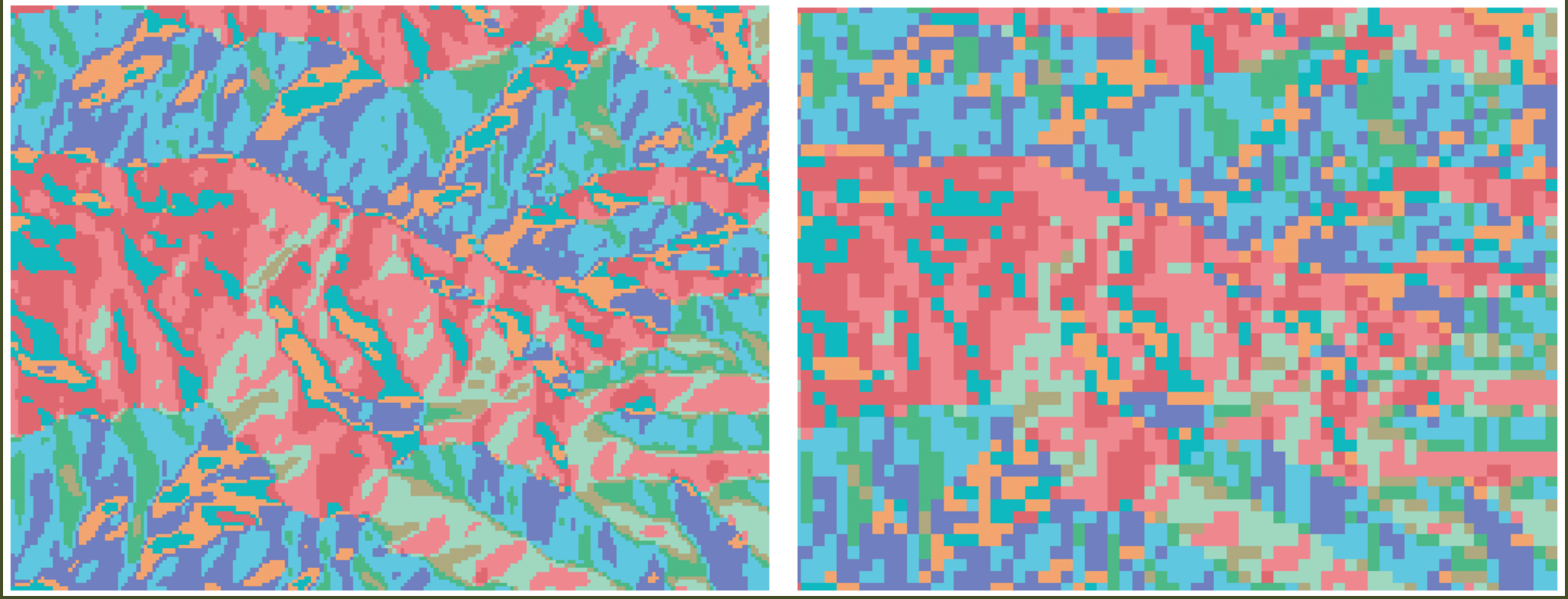
- Grid tables/files
  - BND table
  - HDR file
  - STA table
  - VAT table
  - Tile files
  - LOG file
- Grids are stored very much like coverages. Always set a proper working directory and never delete files manually in Windows Explorer, instead, please use ArcCatalog



NO DATA

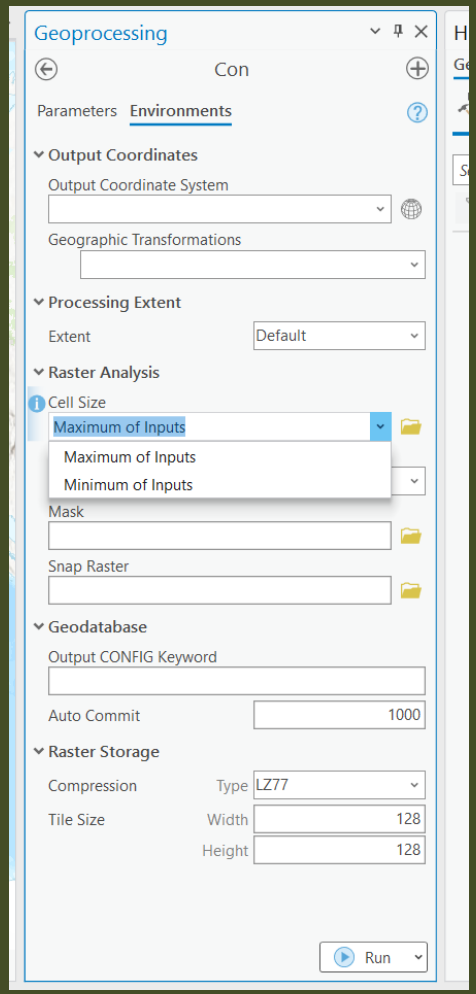
- Every cell location in a raster has a value assigned to it
- When information is unavailable for a cell location, the location will be assigned as NoData
- Note that NoData and Zero are not the same. Zero is a valid numerical value
- If NoData exists in any of the input raster datasets in the operation, the output values will be affected

RASTER RESOLUTION



CELL SIZE

- The output cell size, or raster spatial 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

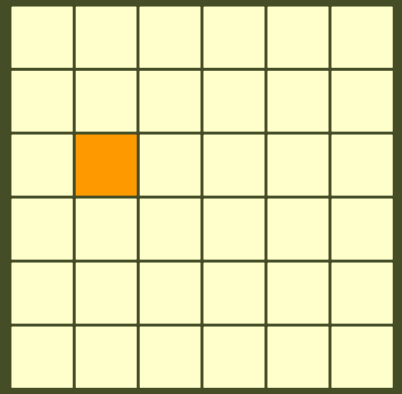


RASTER FUNCTIONS

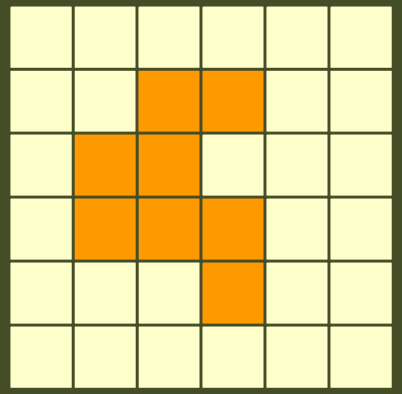
- Analysis – NDVI (Normalized Difference Vegetation Index), Kernel Density, Weighted Overlay,…
- Appearance – Pan-sharpening, Stretch, Contrast, Brightness,…
- Classification –Supervised Classification, Unsupervised Classification, Object-based Classification
- Conversion – Color Model, Spectral, Vector field,…
- Correction – Apparent Reflectance, Geometric, Radiometric, …
- Data Management – Clip, Buffer, Interpolate,…
- Distance – Corridor, Cost Allocation, Cost Distance,…
- Hydrology –Flow Direction, Flow Length, Flow Accumulation, …
- Math – Arithmetic, Conditional, Logical, Trigonometric,…
- Reclass – Reclassify, Reclassify by Table, Lookup, …
- Statistical – Local, Focal, Zonal, Global,…
- Surface – Aspect, Slope, Hill Shade,…

TYPES OF OPERATIONS

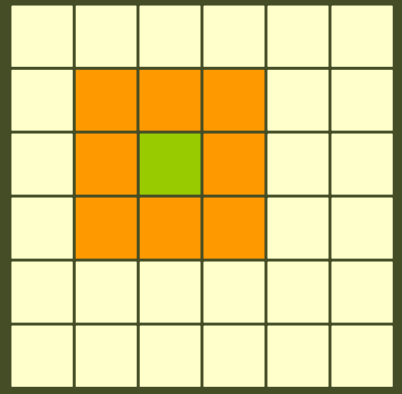
Local



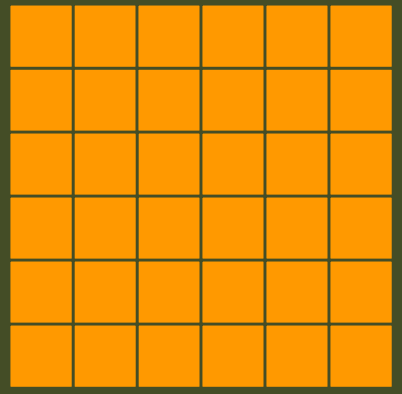
Zonal



Focal

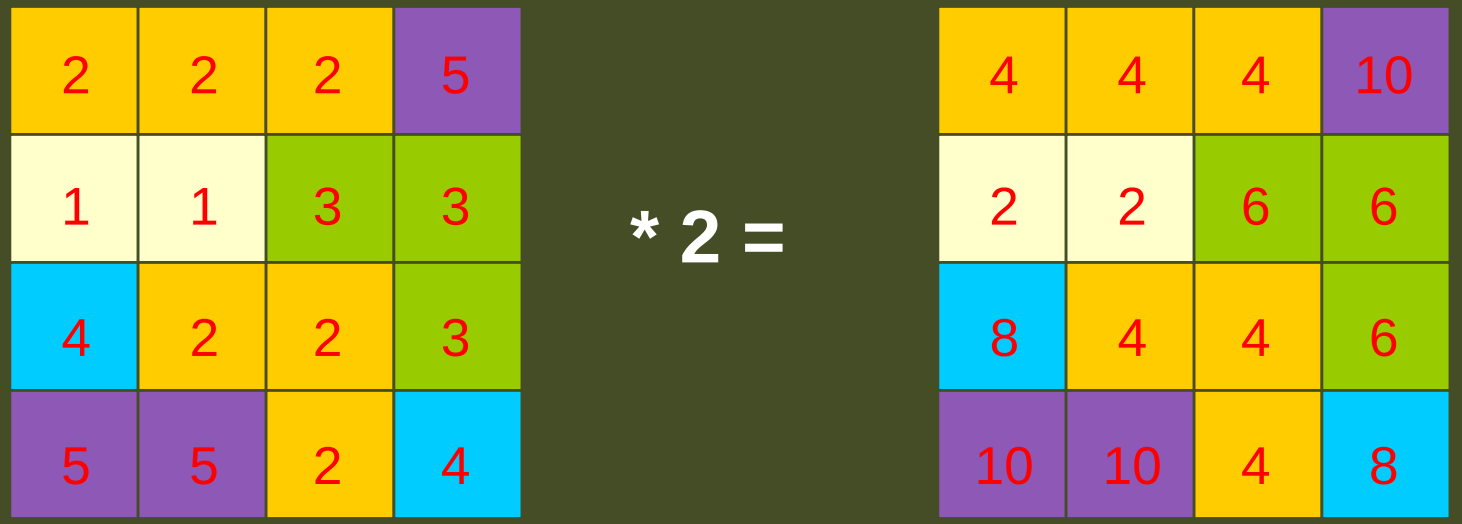


Global



LOCAL OPERATION

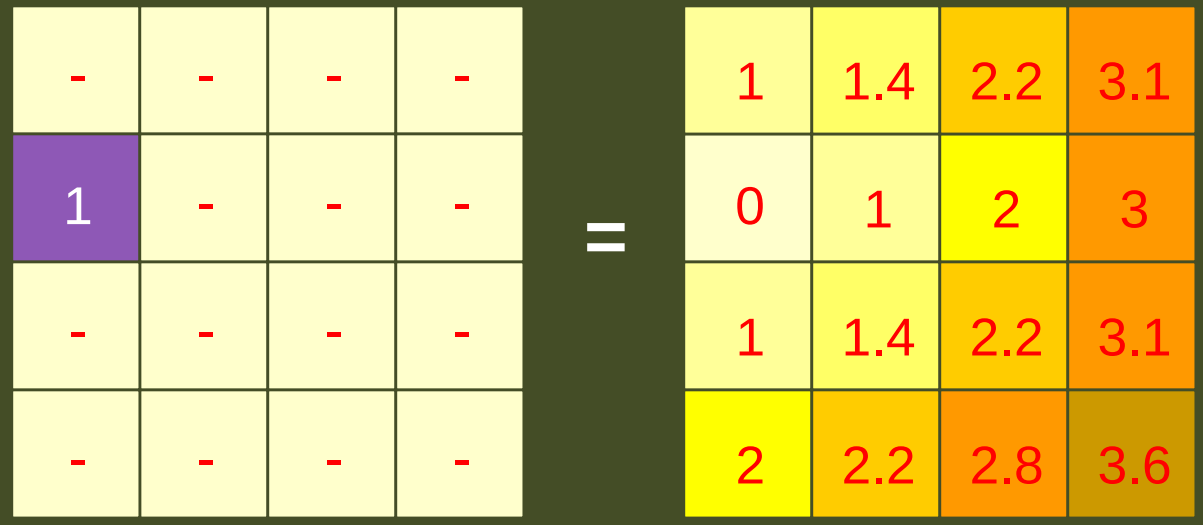
Raster Calculation



GLOBAL OPERATION

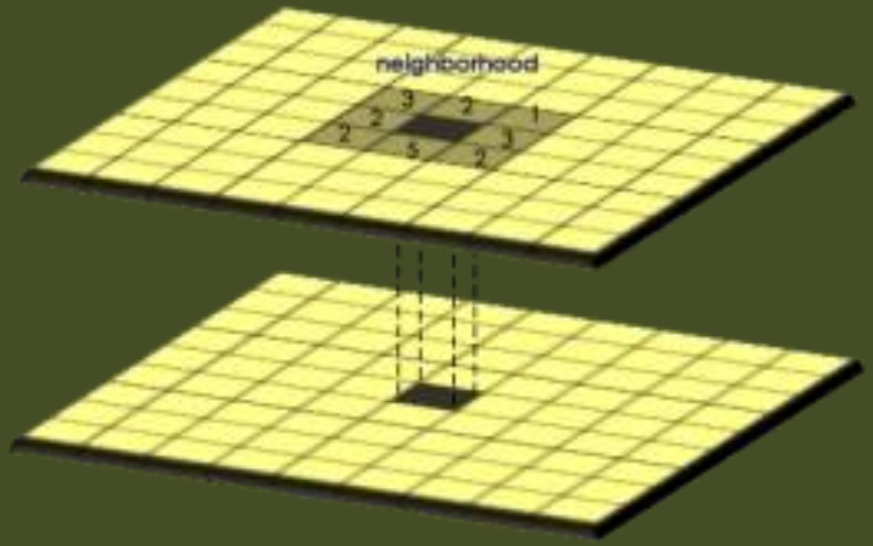
- Straight line/Euclidean distance

Distance of



FOCAL OPERATION

- Also called neighborhood operation
- Typical neighborhood is a 3 by 3 kernel, which incorporates the processing cell and its closest eight neighbors



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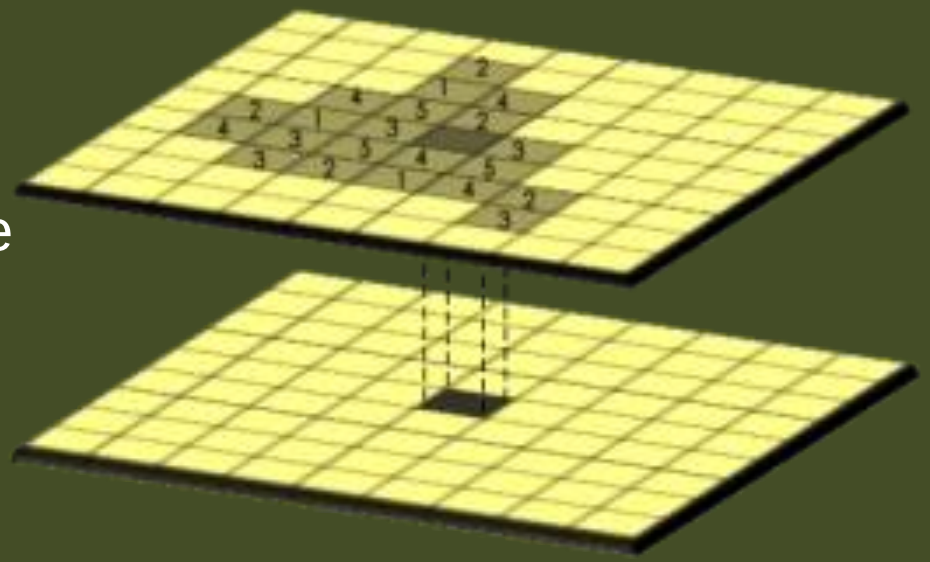
ZONAL OPERATION

- Computes values using the zone in which the cell is located
- Similar to focal except in Zonal operations the configuration is by the zone and not by the neighborhood
- Zones can be defined either as raster or feature data
  - Raster - a zone is all cells with the same value
  - Feature - a zone is all features with the same attribute value (e.g., LandClass = 4)



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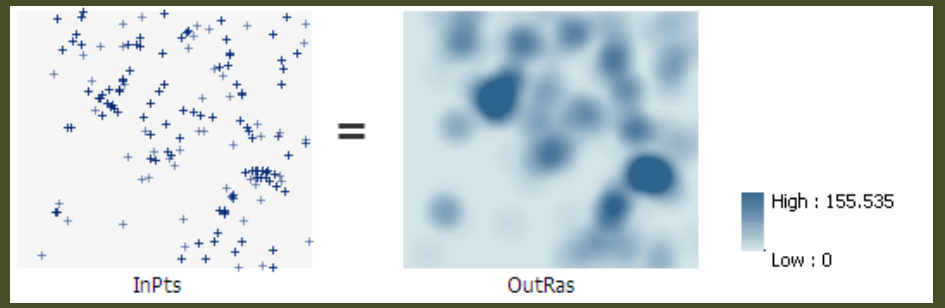
DENSITY

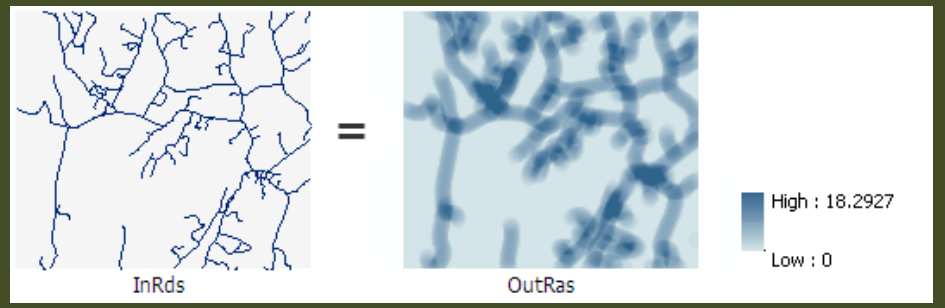
Create Raster Surfaces

DENSITY TOOLS

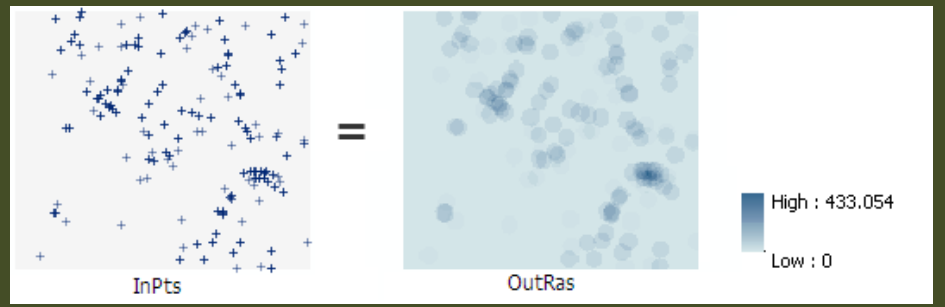
- To find feature concentration
- Calculate the density of input features within a neighborhood around each output raster cell
- ArcGIS Tools
  - Kernal Density
  - Line Density
  - Point Density



Kernal



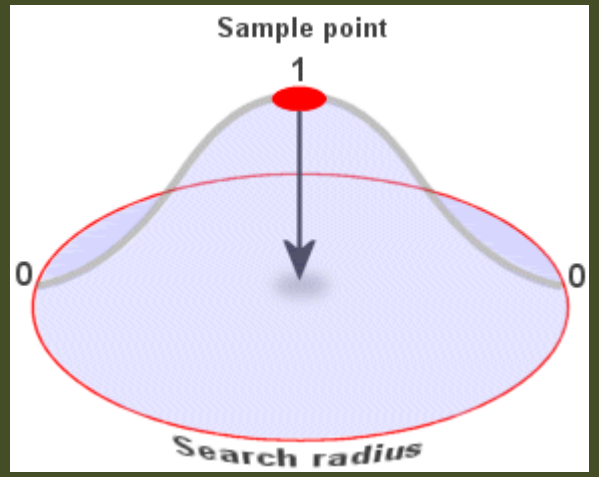
Line

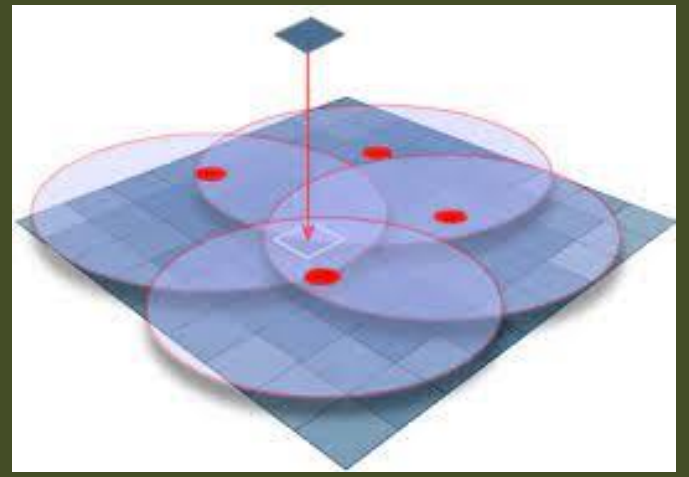


Point

KERNEL DENSITY

- Kernel is a smoothly curved surface that is fitted over each point
- When a kernel function is applied to each data point, the effect is like that of an elevation surface, except that the density value for each cell is calculated by adding the values of all the kernel surfaces where they overlay the cell center
- Kernel density function generally creates a smoother-looking surface than one created with the simple method





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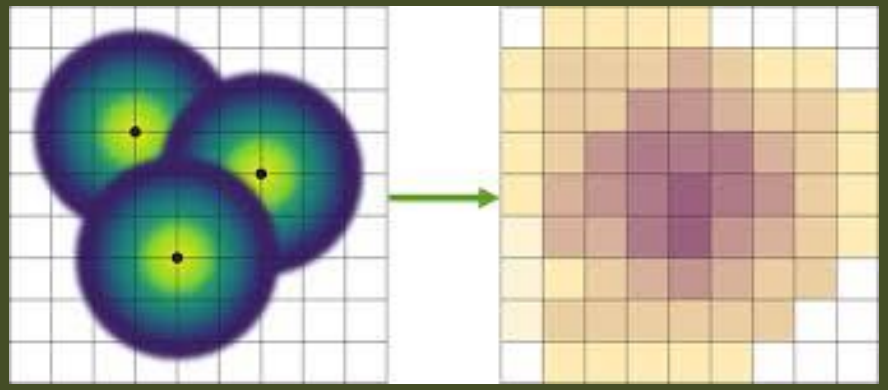

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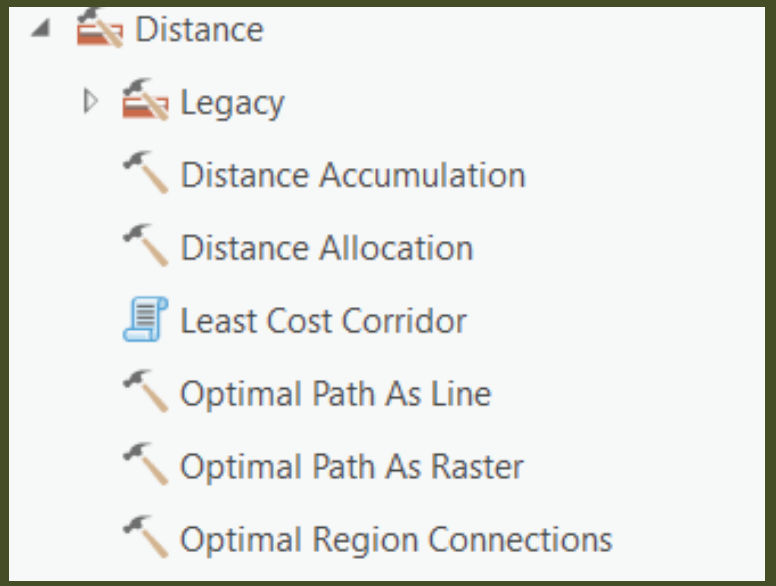
DISTANCE

Create Raster Surfaces

DISTANCE TOOLS

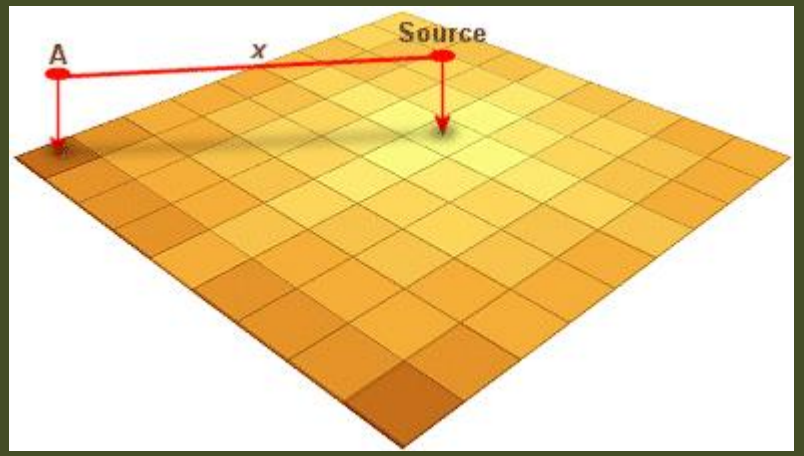
- Perform distance analysis
  - Euclidean distance
  - Cost-weighted distance (with & without restrictions)
  - Least cost of travel

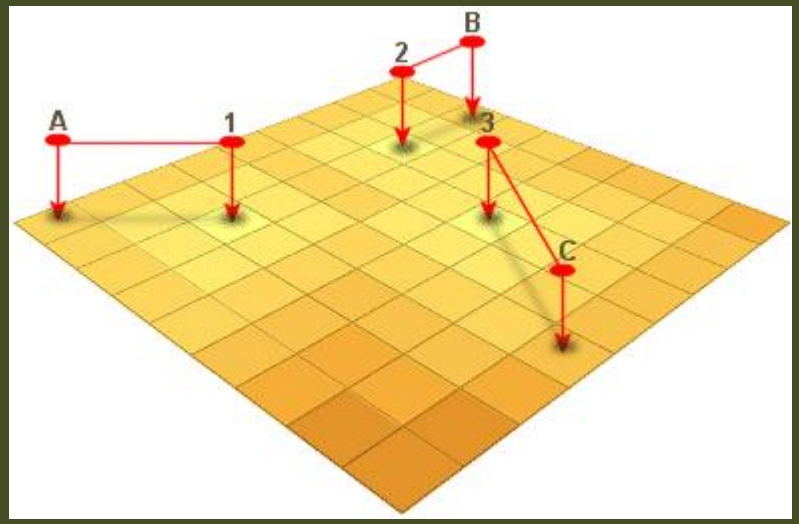


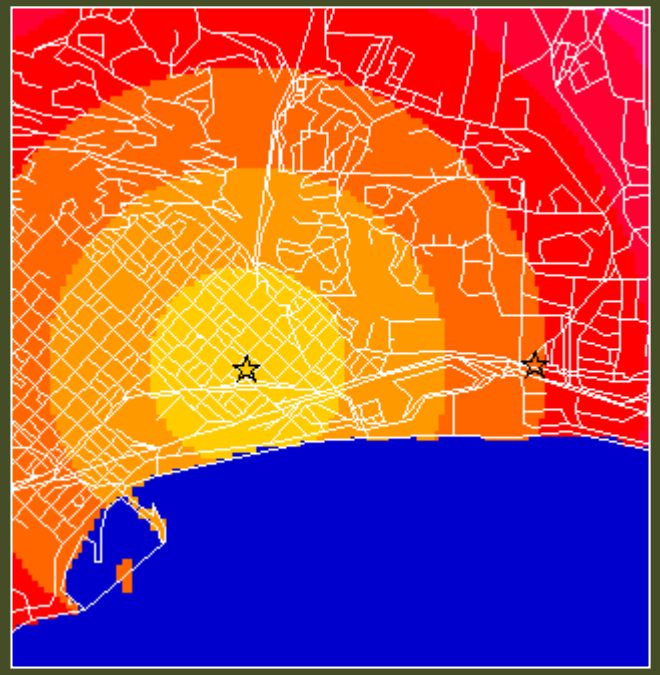
EUCLIDEAN DISTANCE

- The Euclidean distance raster contains the measured distance from every cell to the nearest source
- The distances are measured in coordinate system units, such as feet or meters, and are computed from cell center to cell center
- Limitation
  - The Euclidean distance tools give you information according to Euclidean, or straight-line distance; in reality, it may not be possible to travel in a straight line to a specific location; you may have to avoid obstacles such as a river or a steep slope; in such cases, you should consider using the Cost distance tools to achieve more realistic results

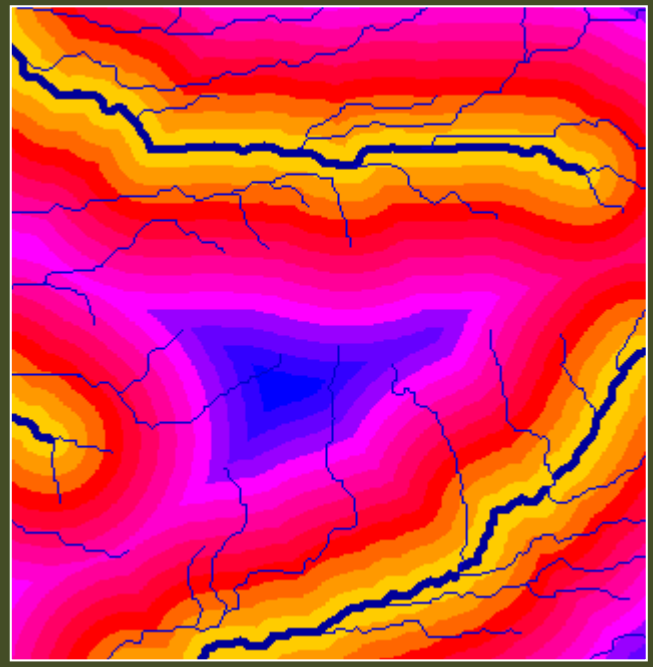
EUCLIDEAN DISTANCE EXAMPLES







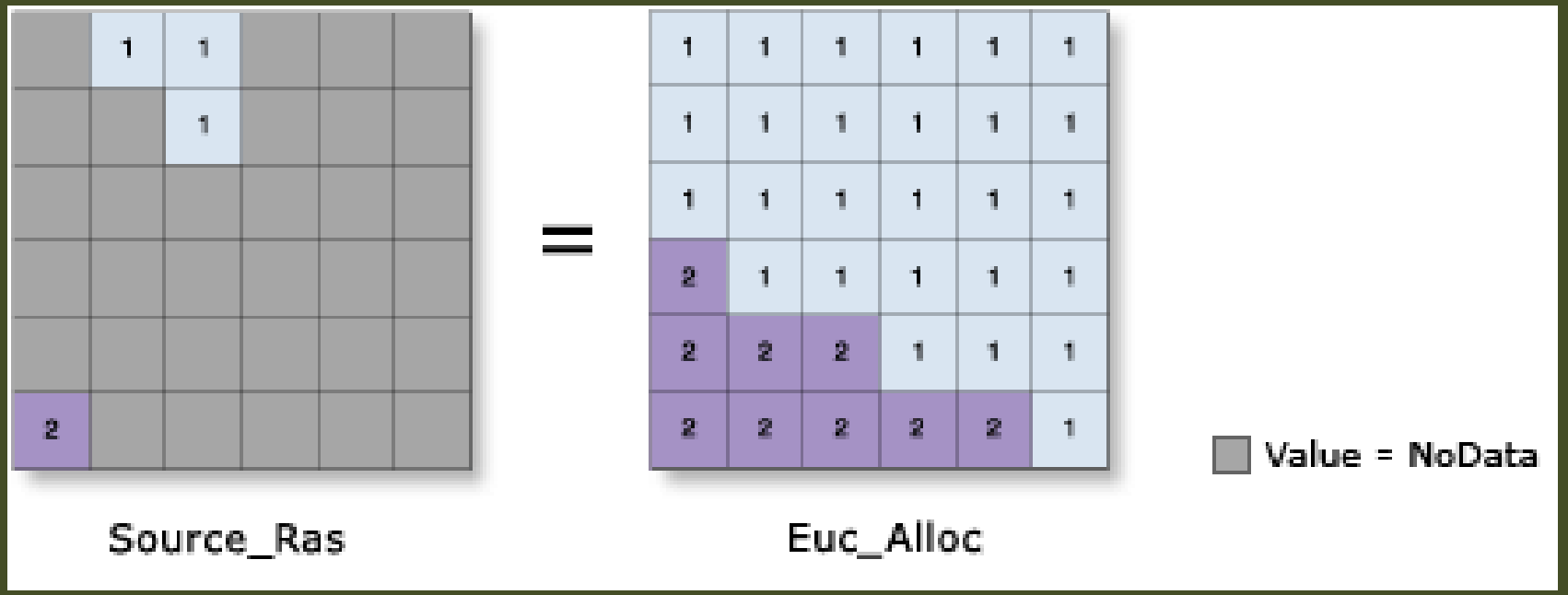
From a Point



For Lines

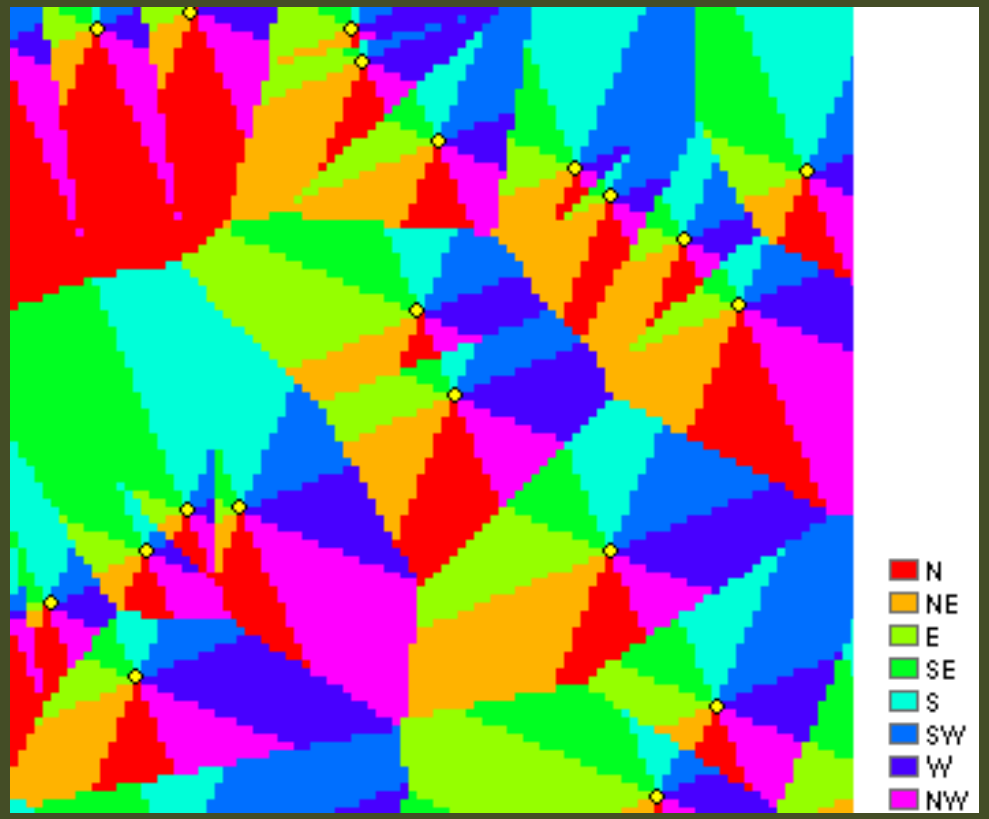
EUCLIDEAN ALLOCATION

- Identifies the cells that are to be allocated to a source based on closest proximity



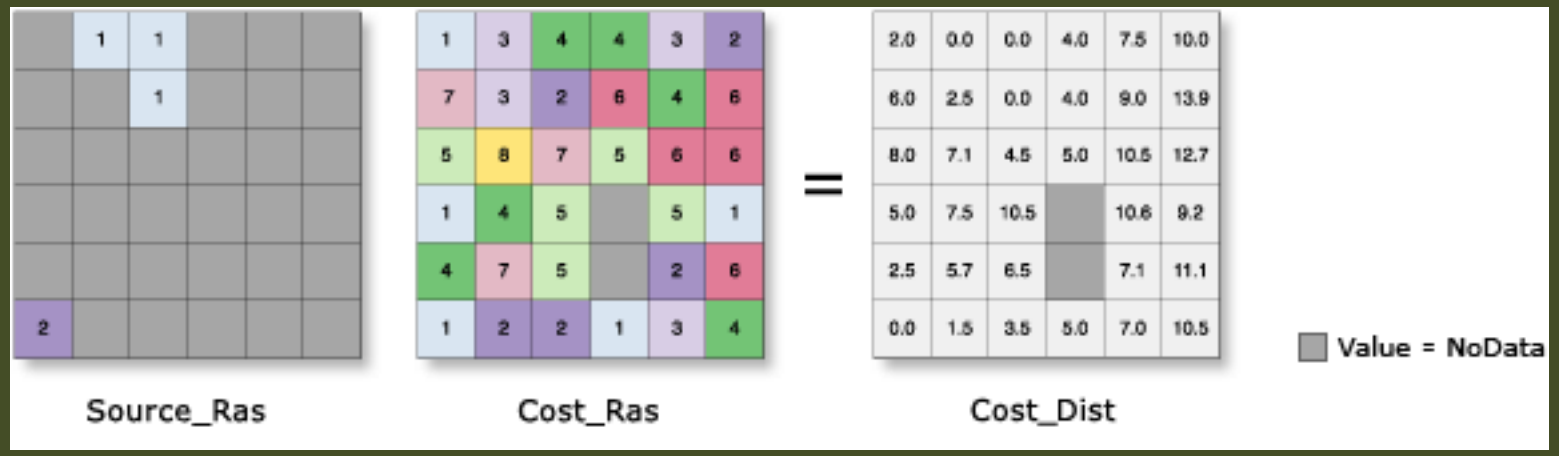
EUCLIDEAN DIRECTION

- Calculates the direction from each cell to a closest source
  - Ex: What is the direction to the closest town?



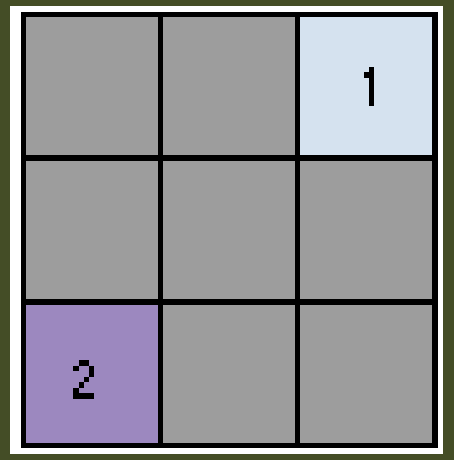
COST DISTANCE

- To determine the least costly path to reach a source for each cell location
- Uses shortest weighted distance (or accumulated travel cost) from each cell to the closest source cell
- Requires source raster and cost raster as inputs

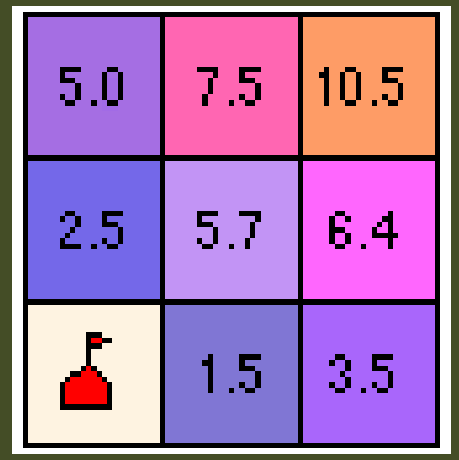


https://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/how-the-cost-distance-tools-work.htm

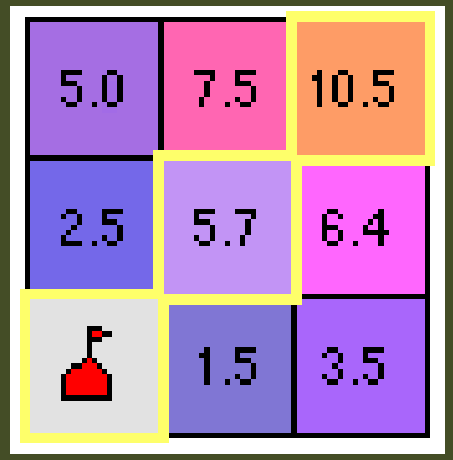
COST DISTANCE EXAMPLE



Input Source Locations



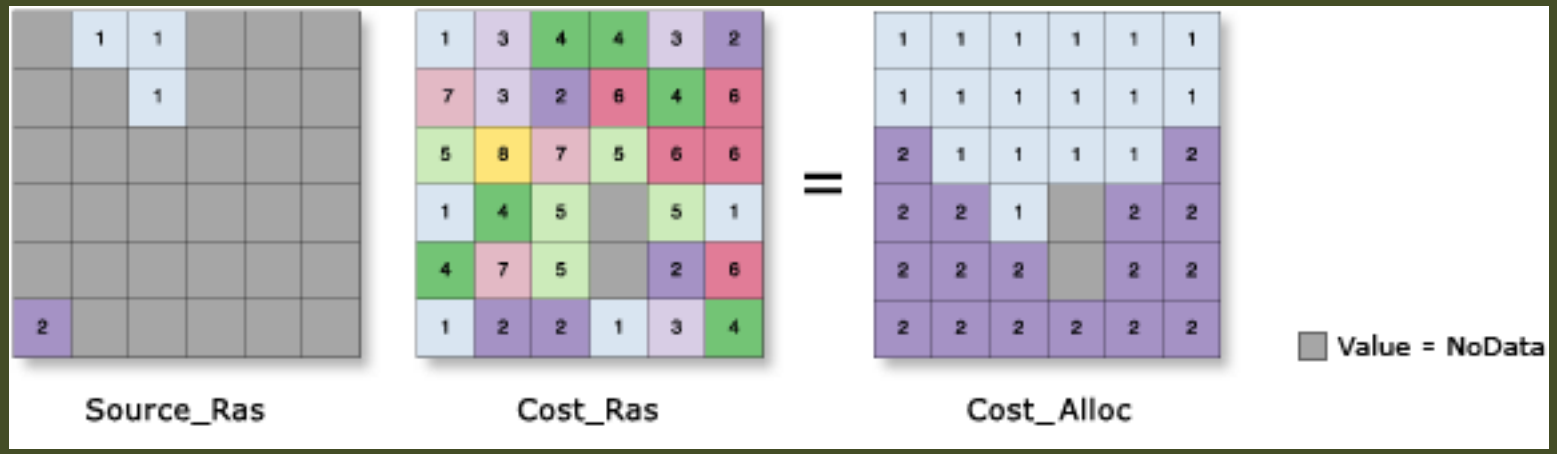
Cost-weighted distance for each cell



Least Cost Path

COST ALLOCATION

- Calculates for each cell its nearest source based on the least accumulative cost over a cost surface



PATH DISTANCE

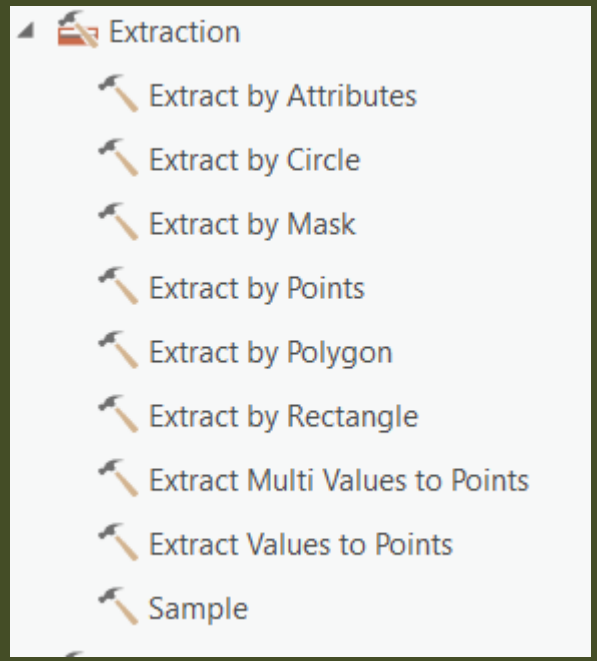
- Similar to Cost Distance tool
- It includes horizontal and vertical factors influencing the total cost of moving from one location to another
- The accumulated cost surface produced by these tools can be used in dispersion modeling, flow movement, and least-cost path analysis

EXTRACTION

Create Raster Surfaces

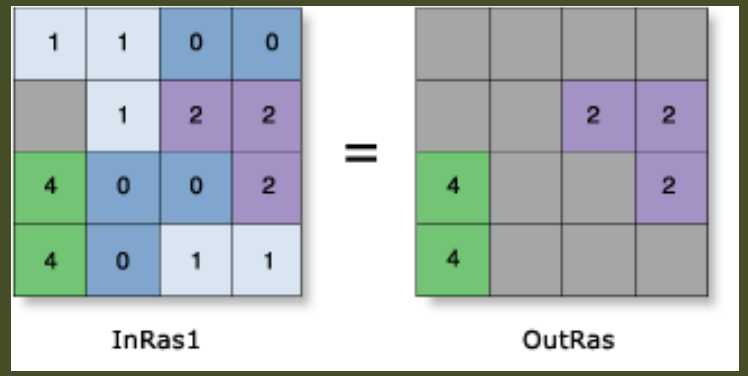
EXTRACTION TOOLS

- To extract a subset of cells from a raster by either the cells' attributes or their spatial location
- Extract cells by –
  - Attributes
  - Geometry
  - Location



EXTRACTION

By Attributes



By Mask