Density

Concept

- Mapping data density allows the user to see where there is a larger number of observations or higher values
- Shows the spatial relationship amongst the different locations of data
- Can create predictions from the data as to where other locations or values will be

The concept of mapping density is that it allows the user to see where there is a large number of observations or higher values. Densities show the spatial relationship amongst the different locations data and also allows us to create predictions from the data as to where other locations are values will be.

Why?

- Locate the area with the most hospitals

- The nice survey they ask you to do at the store, asking your zip code, they map the density of where their customers are mostly coming from

- Map population densities

Why would you want to produce a density map? Let's consider a few examples. First, it may wish to locate the area with the most or least hospitals which may be an indicator of health care coverage. The survey they ask you to do at the store ask your ZIP Code, phone number, address, or other things allow the store to map the density of where their customers are mostly coming from which may allow them to do targeted marketing. And lastly, mapping population densities to make determinations of where the population lives, where public services may be needed, or where workers are traveling to and from.

3 Types of Density Analysis:

- Point Density
- Line Density
- Kernel Density

There are three types of density analysis point density, line density, and kernel density.
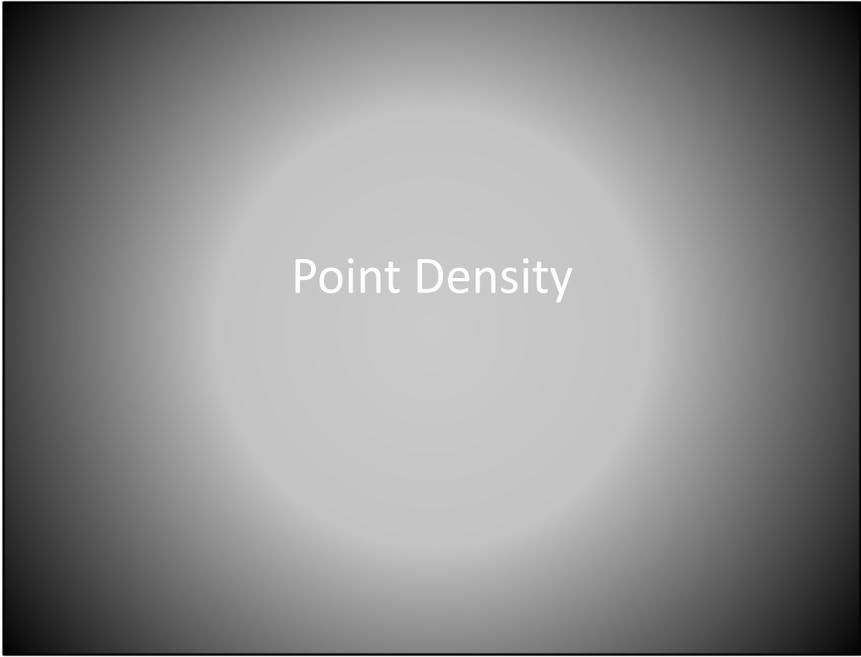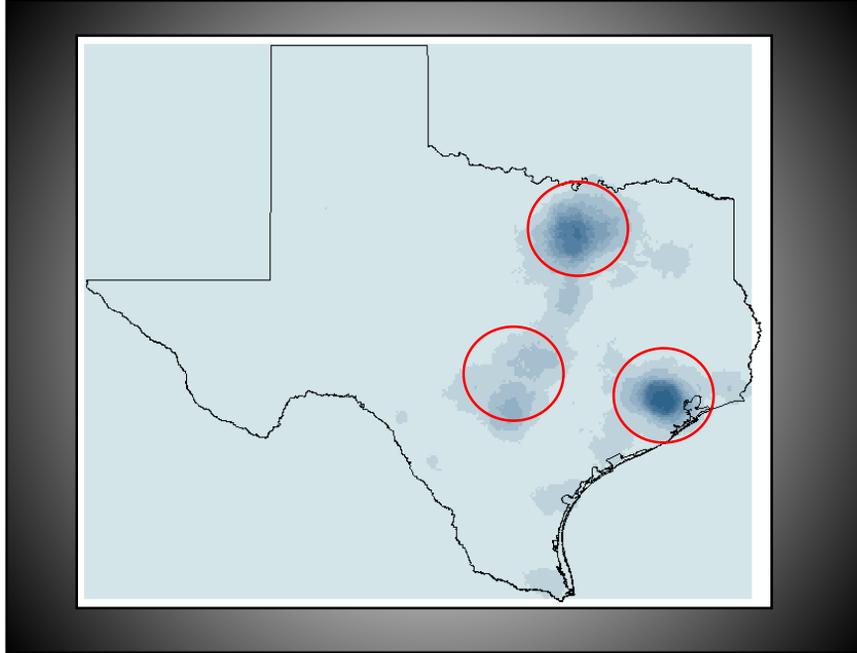
Point density.

Definition

- Calculates the density of point features across a specific area
- Does this by adding the points in the specified study area and dividing the total by the area of the study area
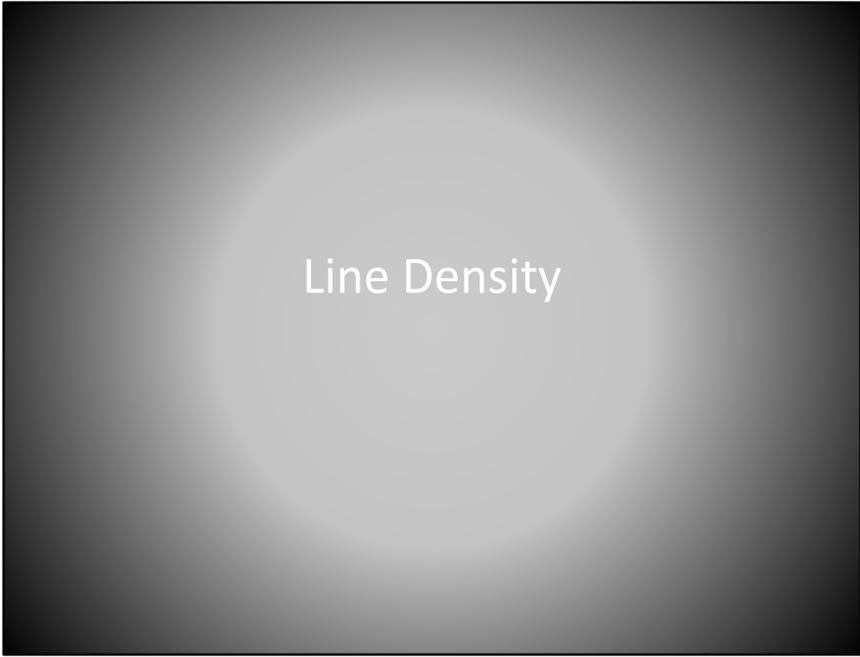
Point density calculates the density of point features across a specific area. It accomplishes this by adding the point to the specified study area and dividing the total by the area of the study area.
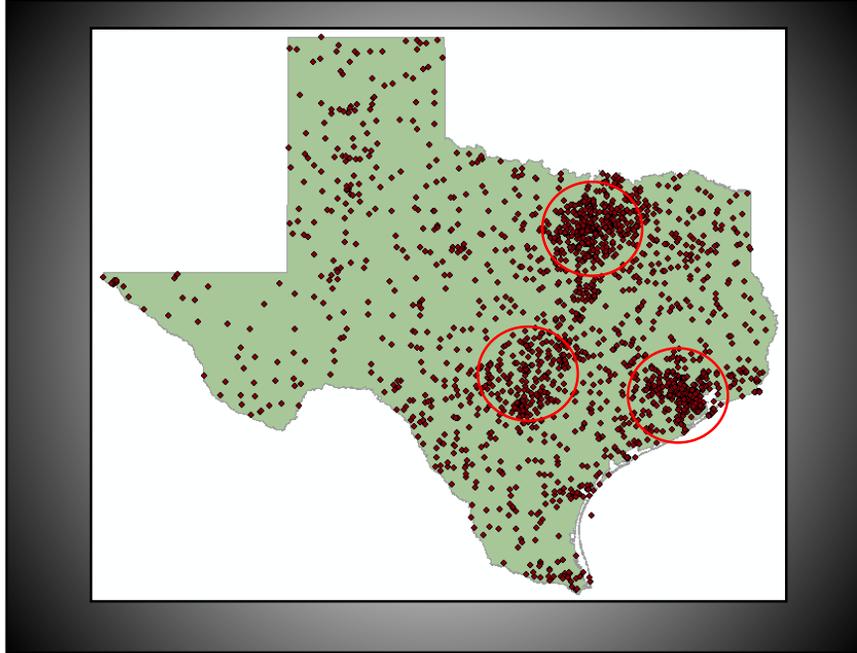
For example, if we consider this data set showing the locations of cities in Texas, we can visually see that there are dense groupings of dots, however, it may be difficult to visually discern which of the three major areas are more dense.

If we run a density analysis, the results assist us in visually determining where the most dense areas are located. This density map is derived from the point locations of all the Texas cities, and clearly show that the Houston area as the most concentrated density of cities with the Dallas-Fort Worth area coming second and the Austin/San Antonio area coming third.
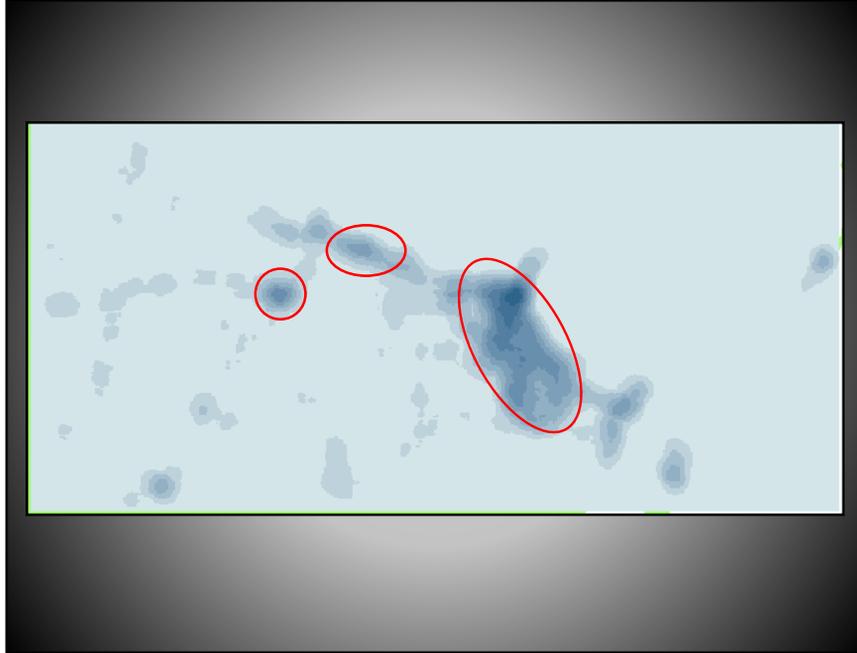
Line Density

Line density.

Definition

- Similar to point density, calculates the denser vs. less dense areas containing line features
- Calculates the areas that pertain more line features than those that don't

Line density is similar to point density as a calculates the more dense versus less dense areas containing line features.

This data set shows all the locations of streets in Nueces County, Texas. Circled in red are what appear to be three most densely paved portions of the county. If we run a line density analysis on the streets, we can get a simpler representation of where the roads are most dense in this county.

This line density raster confirms that the three circles encompass the most densely paved portions of the county. What is interesting to note on this density map, is that it generally shows the connectivity between the different cities in the county and how strong those connectivity czar with regards to roads.
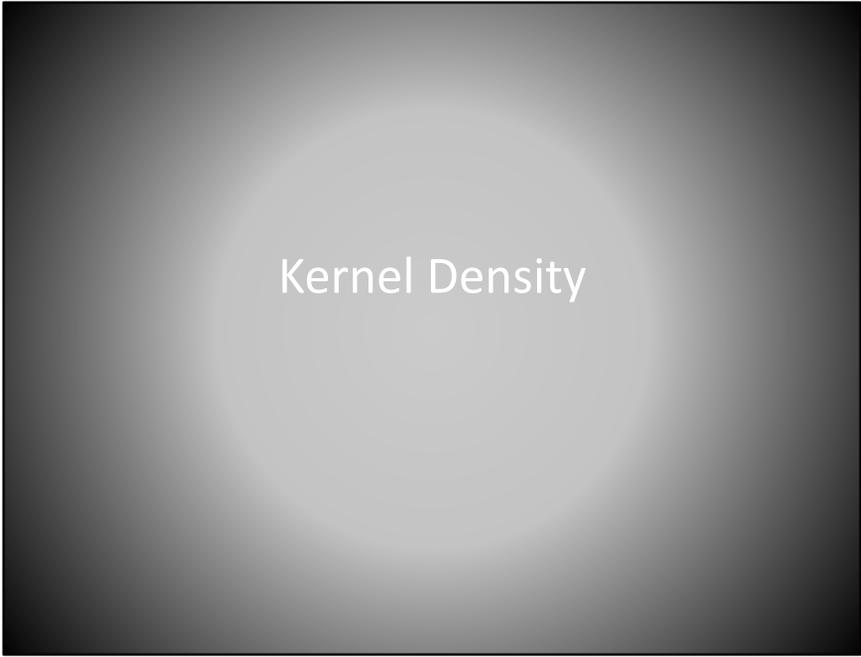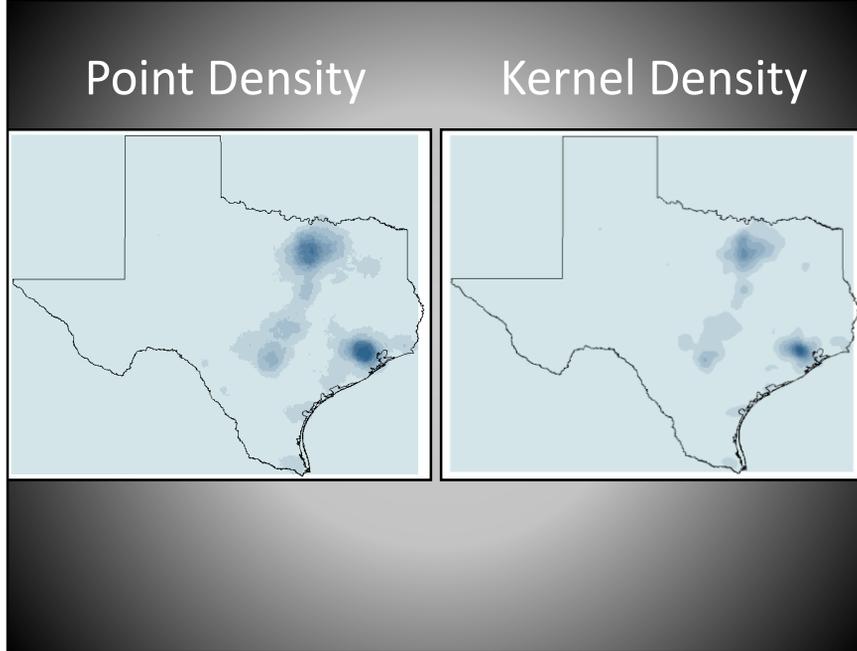
Kernel Density

Kernel density.

Definition

- Can calculate density of either line or point features using a kernel function
- Allows some features to hold more weight than others based on specific values
  - Ex. When searching for the density of fire hydrants in an area, some hydrants allow for more water pressure, covering a wider area than others, these will hold more weight than those that have a lower water pressure

The kernel density function can calculate density of either line or point features using a kernel function. The kernel density function allow some features to hold more weight than other features based on specific values. For example, when searching for the density of fire hydrants in an area, some hydrants allow for more water pressure, covering a wider area than others, these fire hydrants will hold more weight than those that have a lower water pressure with the kernel density function is executed.

Differences

- Smoother density formations
- Omits the no data values
- The highest values are at the center of the point/line and taper out to 0 at the edge of the search radius

There are a few important differences between kernel density and point and line density functions. Kernel density tends to create smoother density formations. The kernel density can also emit features with no data values, essentially giving them a weight of zero. Lastly, in a kernel density, the highest values are at the center of the point or line and taper out to zero at the edge of the search radius.

Point Density   Kernel Density

To illustrate the kernel density, and how it produces different results than a point density, consider these two maps. Note that the kernel density function creates a smoother density map in the densities are not as dispersed as the point density map.

Converting Between Vector and Raster Data

Converting between vector and raster data.
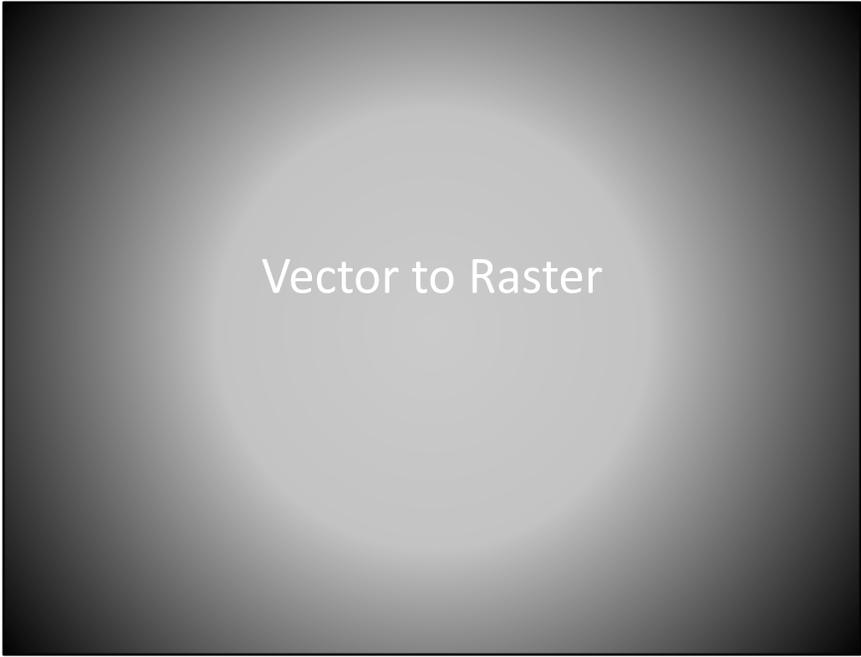
Vector to raster.

Concept

- Can convert points, lines, and polygons to rasters
- Allows the user to get a continuous view of the data
- Also degrades the accuracy of the data at the same time due to the logistics of converting a small point to a cell, a small line to a whole cell, or a misconception of areas

You can convert points, lines, and polygons to rasters. You may want to do this if you wish to allow the user to get a continuous view of the previously discrete data. One major issue to keep in mind, however, is that converting vector two raster may degrade the accuracy of the data due to the logistics of converting a small point to an entire cell, a small line, or a misconception of where areas exist.

Point to Raster

- If there is more than one point in a cell when creating the raster, the point with the most common value will be selected. If there are multiple with the same amount of values than the lowest FID will win out, or the values can be determined in an alternate manner.
- Priorities can be set as well, highest priority will be selected above all others

Let's first consider point to raster conversion. When converting a point to a raster, if there is more than one point in a cell when creating the raster, the point with the most common value will be selected. If there are multiple points with the same amount of values, the be points with the lowest FID will win out. Otherwise, the value of the cell can be determined in an alternate manner your choosing. Priorities of which point will be set as the raster's cell value can be set. Points with the highest priority will be selected above all others.
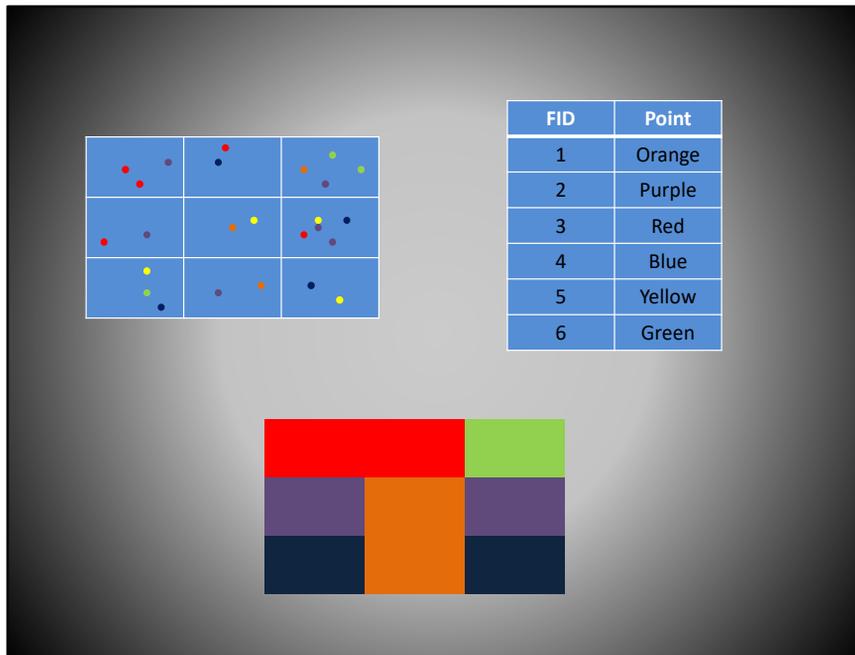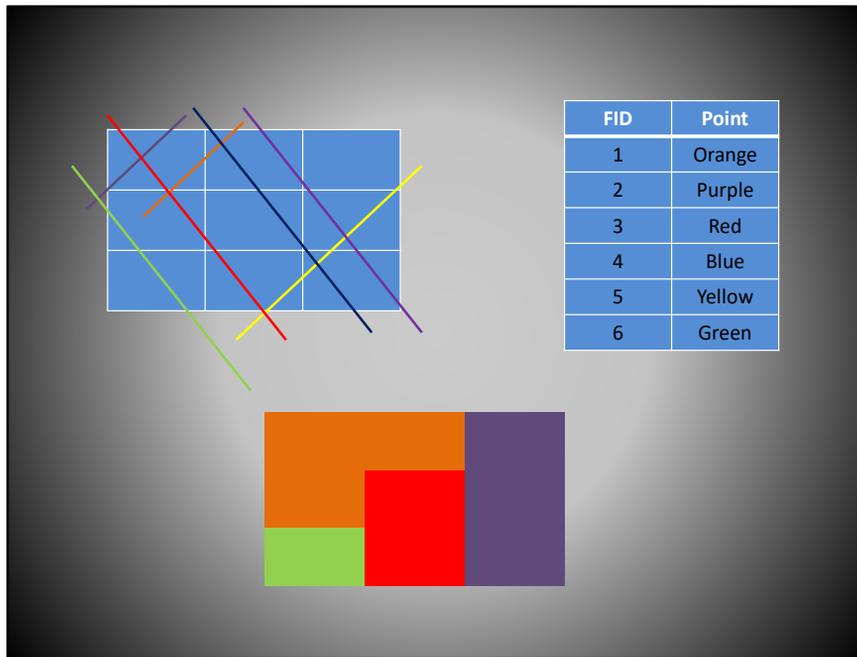
Take a few minutes to study this example of converting points to a raster. Note that when there are multiple points in a cell, the cell takes on the value of the points with the most common value. If there is a tie, then the cells value will be equal to the point with the lowest FID value

Line to Raster

- If there are multiple lines in a cell the lowest FID will again be selected
- If there are priorities, again, the highest priority is selected
- Can also select based on longest length being the highest priority

When converting lines to raster, if there are multiple lines of a cell, the lowest FID will again be selected. If there are priorities, again, the highest priority is selected. A common priority is to select lines based on the longest length being the highest priority.

FID	Point
1	Orange
2	Purple
3	Red
4	Blue
5	Yellow
6	Green

Taking another few minutes to study this example of converting lines to a raster.

Polygon to Raster

- Multiple methods to polygon selection:
  - Maximum Area
  - Maximum Combined Area
  - Cell Center

Finally, you can convert polygons to raster, however, the determination of which polygons value set to the output rasters cell value is a little more complicated and there are three predominant methods of making this determination. The three methods are maximum area, maximum combined area, and cell center

Maximum Area

- The polygon with the highest area that is greater than 50% is selected, as long as no priorities are set.
- If there are some with the same size area then the lowest FID is selected
- Highest priority always takes precedence

The maximum area method chooses the polygon with the highest area that has greater than 50% of the cell cover as long as no other priorities are set. If there are multiple polygons with the same area covered, the be polygon with the lowest FID is selected. There are other priorities that you can set, and those priorities always take precedence over area covered.

Maximum Combined Area

- The feature that has the most area that overlaps by more than 50% will be selected
- If more than one feature has the same size, again, lowest FID wins
- Highest priorities are always selected first
- If the priorities are the same as well as the area then lowest FID is selected

The maximum combined area method considers how much coverage a feature layer happens cell. This means that, if one feature layer has to polygons inside the cell that cover more than 50%, but neither feature cover more than 50% alone, and since both polygons are inside the same feature layer, the polygons within that feature layer of the selected instead of competing true layers. If more than one feature has the same size, again, the lowest FID wins. Highest priorities are always selected first, and if the priorities of the same as well in the area with the lowest FID is once again selected.

Cell Center

- The polygon within the center of the cell is selected, as long as no priorities are set to justify it otherwise.
- If multiple polygons fall within the center the lowest FID is selected
- Highest priority takes precedence if it also falls within the center of the cell

The third method for polygons raster conversion is the cell center. In this method, the polygon that covers the center of the cell the selected as long as no priorities are set to justify otherwise if multiple polygons fall within the center of the cell, the polygon with the lowest FID is selected.
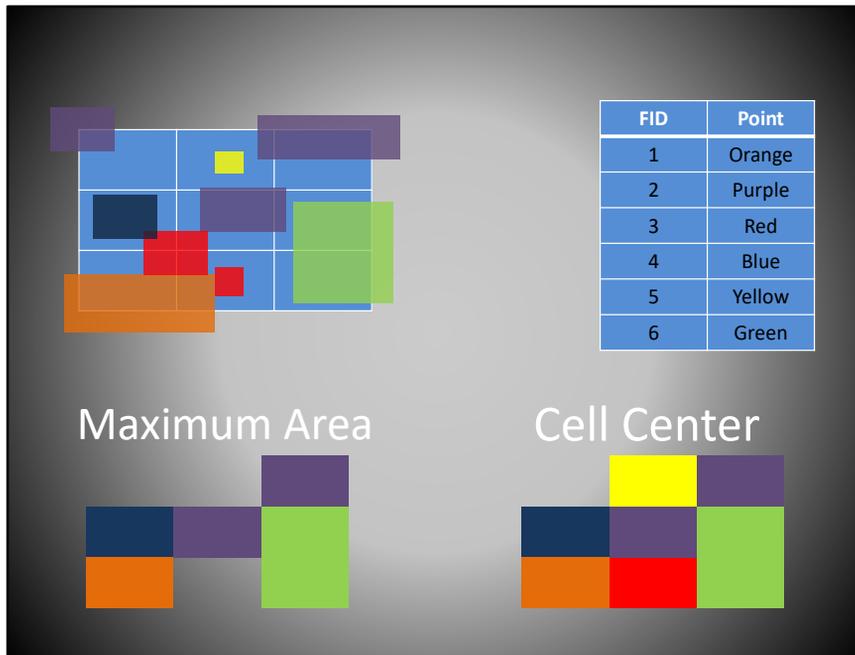
Consider the input polygons in the top left, it's associated entry table on the top right, and the maximum area and cell center methods on the bottom. Note that even though the input is the same, choosing maximum area versus cell center creates significantly different output rasters.
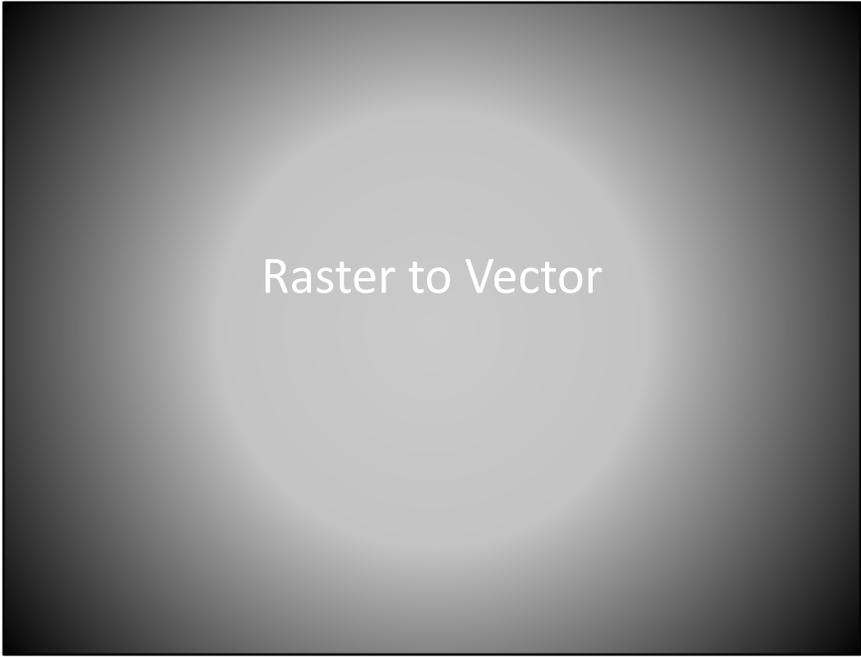
Raster to Vector

Raster to vector.

Possibilities

- Can convert the raster to a point, line, or polygon
- Allows the user to complete different analysis by having it in a vector format

It is possible to convert a raster to a point, line, or polygon. This allows the user to complete different analysis by having any vector format.

Point

- For each cell 1 point is created
- The 1 point will be created at the center of the cell
- Any cell size will work

When converting a raster to a point, cell in the raster, one point is created. The point will be created at the center of the cell. Any cell size will work for this conversion. Outputted points will contain the value of the cell
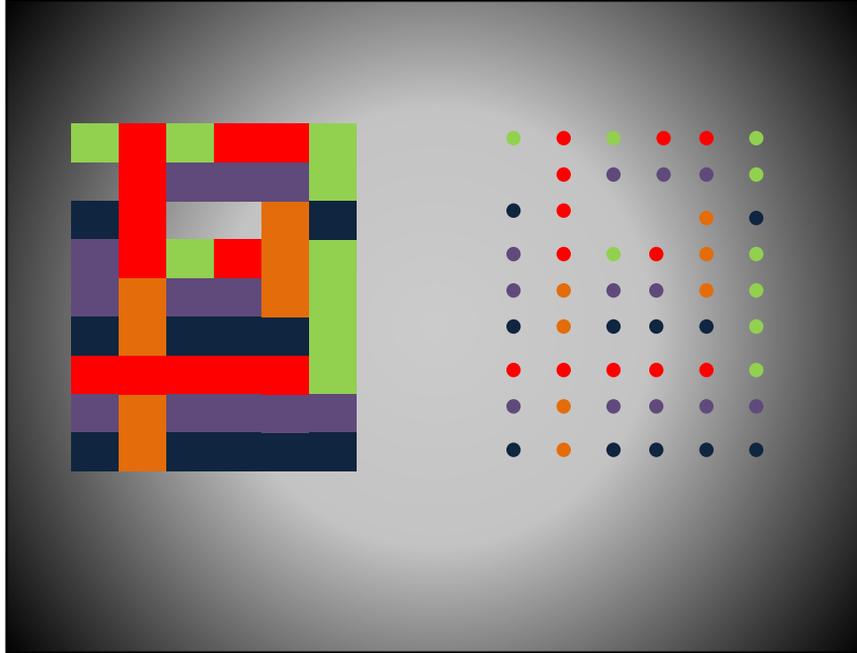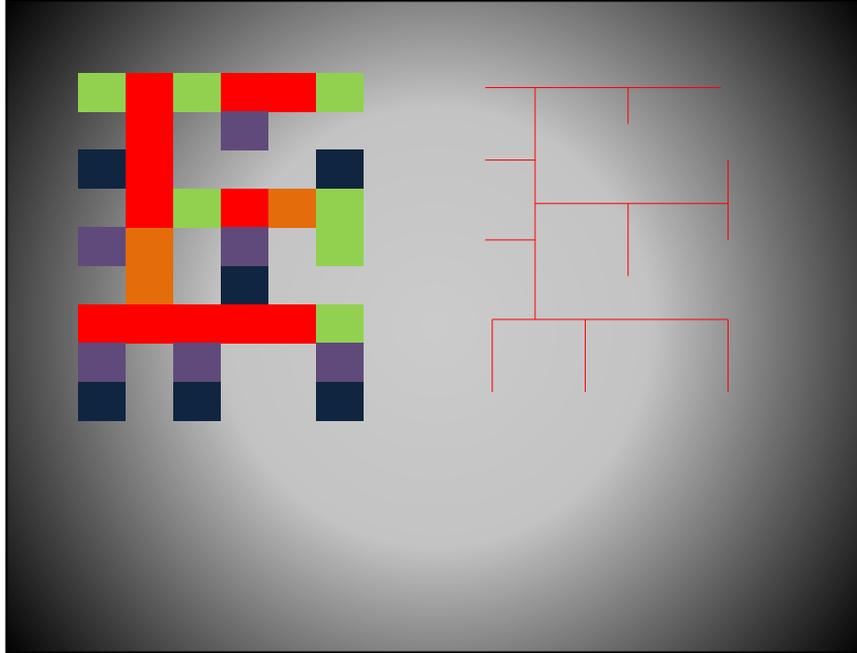
This is an example of a raster converted to a point. Note that each point that is created as the same value cell it was derived if a raster cell has no data, did no point is created.

Line

- Any cell size greater than 0
- Line passes through the center of the cell
- No data values don't become features

When converting a raster to a line, any cell size greater than zero be successfully converted. The outputted lines will pass through the center of the cells. No data values do not become features.

This is an example of a raster that is the converted to a line. Note that the lines do not exist were cells had a no data value.

Polygon

- Can choose which attribute of the raster to use for the output feature class
- Any cell size is acceptable

When converting a raster to a polygon, you can choose which attribute to the raster to use the output feature class cell size is acceptable. The output polygon will be the same size as the inputted cell.
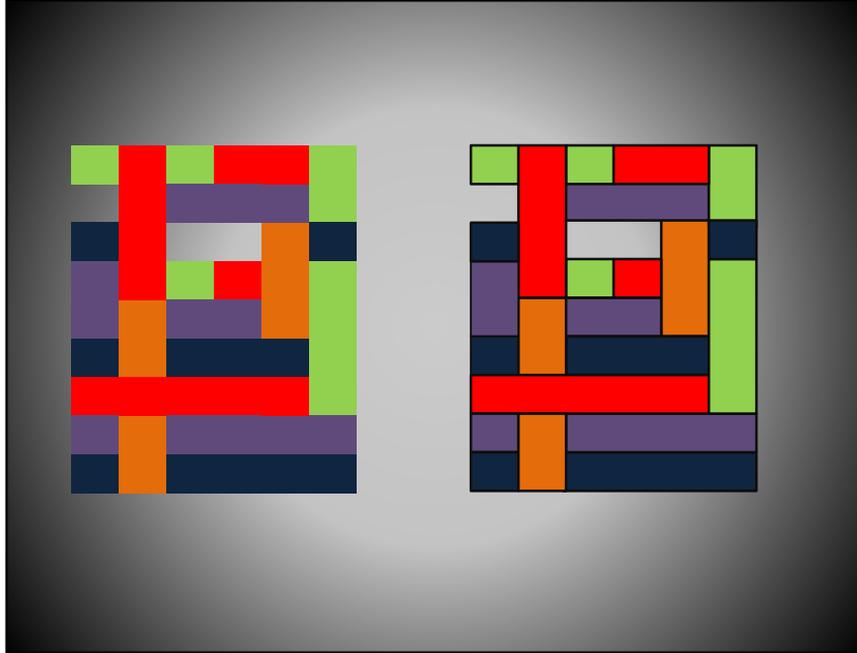
The input raster is on the left, and the outputted polygon is on the right. Again, note that where a cell had no value, no polygon is created. Additionally, note that cells that are adjacent that have the same value, create a larger contiguous polygon.