Geographic Information Systems 2018/19
Week 4, Topic 1

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In this session...

Raster Data

Idea of continuous data

Raster types

Cell values

Resolution

Raster data model

aka Field-based model

Good option for representing continuous phenomena

Uses regular grid to cover the space

- Value in grid cell represents spatial phenomenon at the cell location

Examples

- Elevation data
- Satellite images
- Digital orthophotos
- Scanned maps

Raster data model

Raster → grid → image

Cell → pixel

Rows (y coordinates) and columns (x coordinates)

Origin of rows/columns is typically the upper left pixel (cell)

Often (but not always) stored in image files such as ***.tiff***

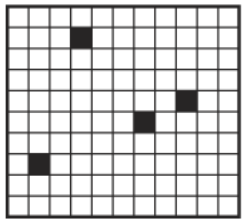
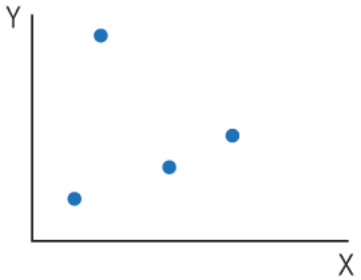
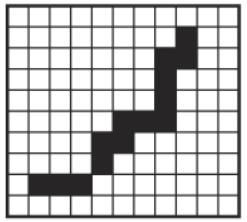
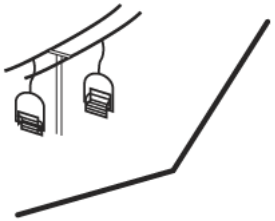
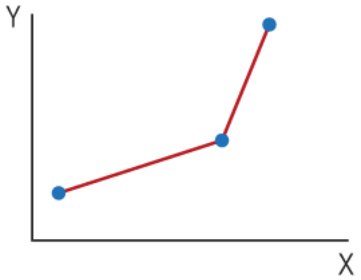
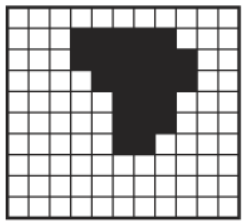
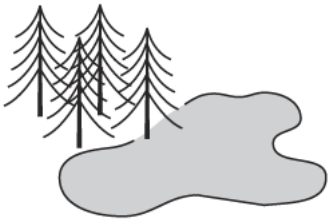
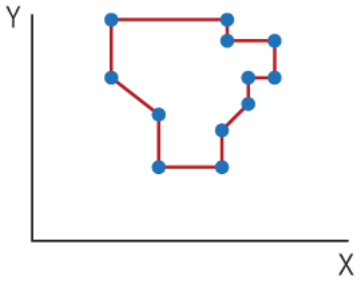
Point → single cell

Line → string of adjacent cells

Area → collections of contiguous cells

Raster can be treated as a matrix with rows & columns, its cell values can be stored in a 2D array. This make it amenable to computation.

Raster and Vector data (HVSA example)

The raster view of the world	Happy Valley spatial entities	The vector view of the world
	 Points: hotels	
	 Lines: ski lifts	
	 Areas: forest	

Cells

- Value
  - Categorical or numeric
  - Integer raster (discrete)
    - Has value attribute table
    - Query & display easier
  - Floating-point raster (continuous)
    - More compute-intensive than integer
    - Lacks value attribute table (due to infinite choices)
    - Difficult to query
  - Binary (1/0)
    - Can contain 1 or 0 only
- Value of cell applies to whole cell
- Size and Depth
  - Resolution
  - Depth refers too size of data values possible

Bands

Rasters can be single band or multi-band

Single band

- Each cell in a raster has only one value
- e.g. Digital Elevation Model

Multiband

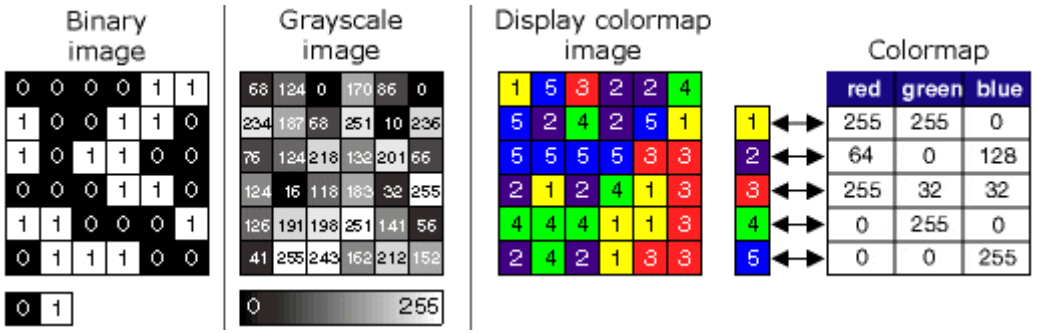
- Each cell associated with more than one value
- e.g. Satellite image

Think of bands like layers

Bands

There are three main ways to display (render) single-band raster datasets

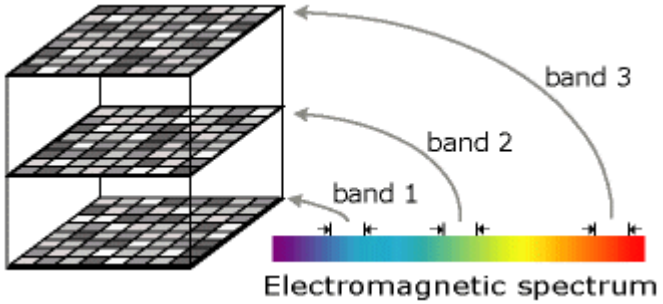
- Using two colors—In a binary image, each cell has a value of 0 or 1 and is often displayed using black and white.
- Grayscale—In a grayscale image, each cell has a value from 0 to another number, such as 255 or 65535. These are often used for black-and-white aerial photographs.
- Color map—One way to represent colors on an image is with a color map. A set of values is coded to match a defined set of red, green, and blue (RGB) values.

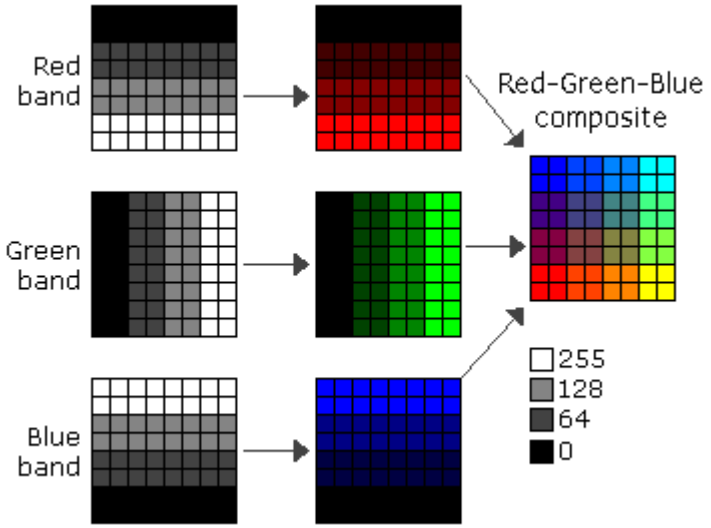


Bands

When there are **multiple bands**, every cell location has more than one value associated with it. With multiple bands, each band usually represents a segment of the electromagnetic spectrum collected by a sensor. Bands can represent any portion of the electromagnetic spectrum including ranges not visible to the eye such as the infrared or ultraviolet sections. The term band originated from the reference to the color band on the electromagnetic spectrum.

When you create a map layer from a raster image, you can choose to display a single band of data or form a color composite from multiple bands. A combination of any three of the available bands in a multiband raster dataset can be used to create RGB composites. By displaying bands together as RGB composites, often more information is gleaned from the dataset than if you were to work with just one band.





Spatial reference

Raster data, like all spatial data, must have spatial reference information to align with other datasets

A raster with associated spatial reference information is said to be **georeferenced**

Example

Rows: 463, columns: 318, cell size: 30 metres

x,y coordinates lower left corner: 499995, 5177175

x,y coordinates upper right corner: 509535, 5191065

Verify: Num Rows = (5191065 - 5177175) / 30 = 463

Verify: Num Cols = (509535 - 499995) / 30 = 318

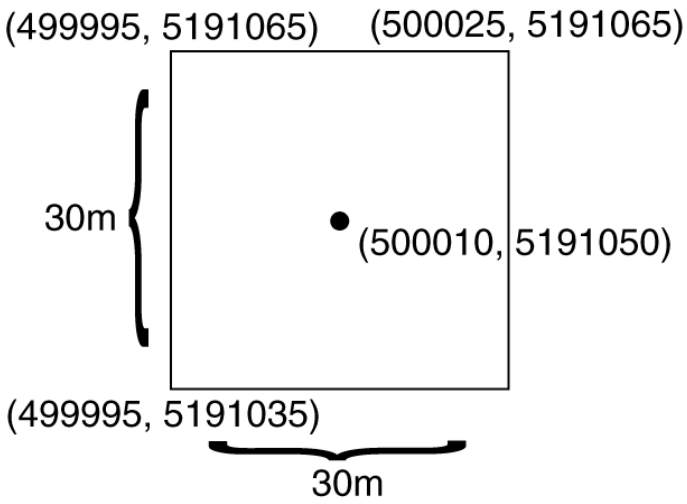
We can derive coordinates for each cell:

Row 1 Column 1

499995, 5191035 (5191065-30) @ LL corner

500025 (499995+30), 5191065 @ UR corner

500010 (499995+15), 5191050 (5191065-15) @ centre



GeoTIFF
Header file (.hdr)

```
Geotiff_Information:
   Version: 1
   Key_Revision: 1.0
   Tagged_Information:
      ModelTiepointTag (2,3):
         0             0             0
         -10.0004162     55.0004171      0
      ModelPixelScaleTag (1,3):
         0.000833333333   0.000833333333   0
      End_Of_Tags.
   Keyed_Information:
      GTModelTypeGeoKey (Short,1): ModelTypeGeographic
      GTRasterTypeGeoKey (Short,1): RasterPixelIsArea
      GeographicTypeGeoKey (Short,1): GCS_WGS_84
      GeogCitationGeoKey (Ascii,7): "WGS 84"
      GeogAngularUnitsGeoKey (Short,1): Angular_Degree
      End_Of_Keys.
   End_Of_Geotiff.
```

GCS: 4326/WGS 84

Datum: 6326/World Geodetic System 1984

Ellipsoid: 7030/WGS 84
(6378137.00,6356752.31)

Prime Meridian: 8901/Greenwich (0.000000/
0d 0' 0.00"E)

PROJ.4 Definition: +proj=latlong
+ellps=WGS84 +to_meter=1.0000000000

Corner Coordinates:

Upper Left (-10.0004162,55.0004171)

Lower Left (-10.0004162,49.9995838)

Upper Right (-4.9995829,55.0004171)

Lower Right (-4.9995829,49.9995838)

Center (-7.4999995,52.5000005)

GeoTIFF

World file (***.tfw***)

Line 1: A: x-component of the pixel width (x-scale)

Line 2: D: y-component of the pixel width (y-skew)

Line 3: B: x-component of the pixel height (x-skew)

Line 4: E: y-component of the pixel height (y-scale), typically negative

Line 5: C: x-coordinate of the center of the upper left pixel

Line 6: F: y-coordinate of the center of the upper left pixel

0.0008333333

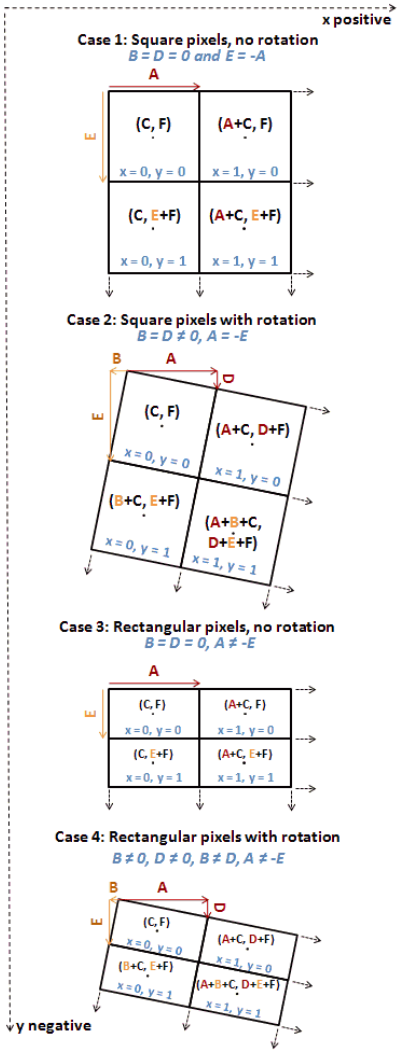
0.0000000000

0.0000000000

-0.0008333333

-9.9999995399

55.0000004601



Coming next...

Digital Elevation Model (DEM)

Example representation

Encoding & compression

Quadtree

Other raster types