



GEO 447 PRINCIPLES OF GIS

- Data
 - Spatial
 - Attribute
- Geometric Primitives
- Spatial Models
 - Raster
 - Vector

Created by JDG 2000

Class slides are based on readings, the current NCGIA Core Curriculum for GIS(ystems) and GIS(cience), Kemp & Goodchild (1991), the NCGIA Core Curriculum Project at UBC, and Foote & Heubner's *The Geographer's Craft*

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Data

- Spatial Data
 - a spatial reference, such as an address or X, Y Coordinate
 - topological information that denotes a specific spatial relationship or relative location (next to, intersecting, within, outside)
- Attribute Data
 - information about a place, person, in space, road, or other feature

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Geometric Primitives

- Point (a single X, Y Coordinate) 0 dimension
 - location in Latitude and Longitude
 - site of a new solid waste facility
 - centroid of a polygon
- Line (two points) 1 dimension
 - Road
 - River
- Polygon (at-least three points) 2 Dimension
 - tree stand
 - county
 - parcel

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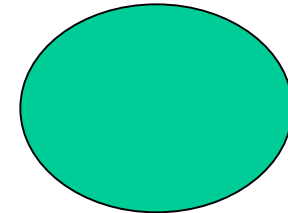
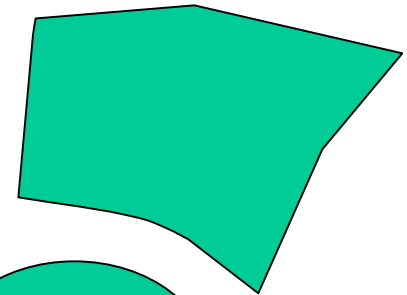
Point



Line

Chain

Arc



Polygon
Area
Shape

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Spatial Data Models

- Assumptions of any spatial data model
 - resolution matters
 - real world can not be digitally reproduced
 - model used depends on software
- Two Models Used in GIS: Raster & Vector

What is Raster?

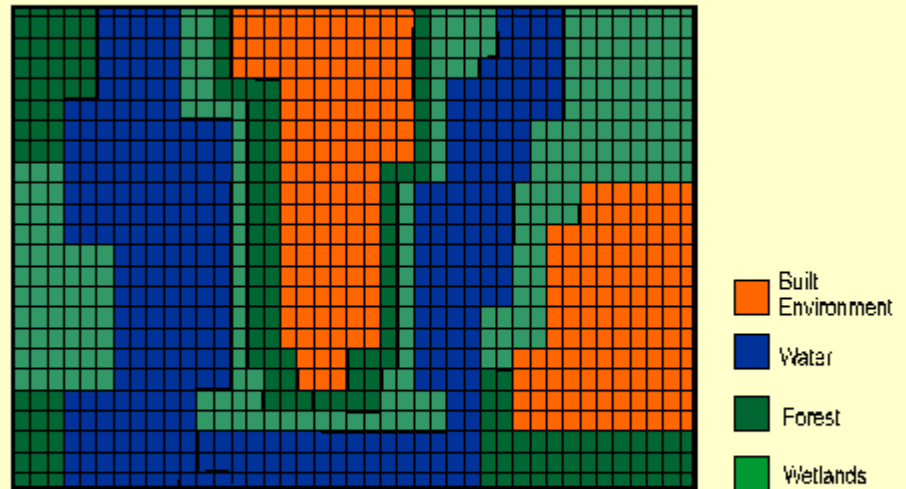
- Cell based
 - for example, a spreadsheet can be a raster
- sequential data access & acquisition from top left cell through bottom right cell
- Space filling
- One cell = One Value = One layer
- On most monitors, one cell of a matrix at the full extent of a raster image equals 1 pixel

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1	0	255
5	7	1
7	5	2

Spreadsheet as Raster Matrix

The Raster View of the World



The Raster GIS references phenomena by grid cell location in a matrix. The grid cell is the smallest unit of resolution and may vary from centimeters to kilometers depending on the application.

From Foote & Huebner's *The Geographer's Craft*

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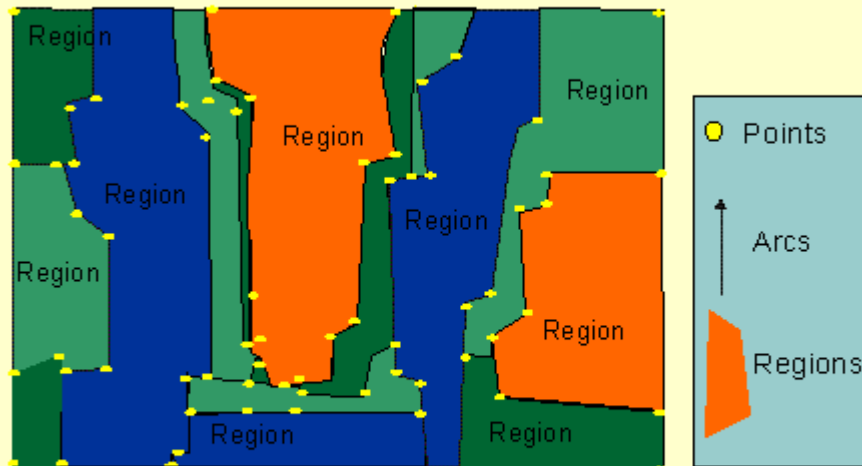
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What is Vector?

- A model based on coordinate geometry (COGO)
 - X,Y coordinates
- An object oriented model dealing with discrete phenomena
- Not sequential and not space filling

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The Vector View of the World



The vector GIS builds a model of the real world from points, lines, and regions. Points are positioned according to a location reference system such as latitude-longitude, UTM, or SPC. The application determines the level of precision.

From Foote & Huebner's *The Geographer's Craft*

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Basics Raster

- A Raster is a single cell within layer
 - other terms for a layer in a raster model include: matrix, array, lattice, or grid
- Each raster has a predefined spatial resolution
 - the minimum linear dimension of the smallest unit of geographic space for which data are recorded (30m x 30m)
- To represent multiple types of attribute information about the same space, a raster model needs an additional layer
 - because raster ‘fills’ space it is inherently limited
- Each cell in a grid represents the dominant or average value in a given space

Basics Raster

- Types of values: real numbers, integers, alpha
- Values in a Raster are represented by a DN 0-255
 - DNs can be classified using qualitative criteria; however, the value expressed or encoded in the array is a DN.

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0	0	1	1	1	2	3	INTEGER VALUES
0	1	1	1	2	2	3	e.g. soil class
0	0	1	1	1	2	2	or # of farms
0	0	0	1	1	1	2	
0	0	0	0	0	0	1	

2.1	2.3	2.4	2.7	2.9	3.2	3.4	REAL (DECIMAL) VALUES
1.9	2.1	2.4	2.6	3.0	3.3	3.4	e.g. elevation
1.8	2.0	2.3	2.5	2.8	3.1	3.2	
1.8	1.9	1.9	2.3	2.5	2.8	3.0	
1.8	1.8	1.8	1.9	2.1	2.3	2.7	

a	a	b	b	c	c	a	NON-NUMERIC VALUES
a	b	b	b	c	c	a	e.g. vegetation class
a	b	b	b	b	c	c	
a	a	b	b	b	c	c	
a	a	a	b	c	c	c	

Raster Data Values

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Basics Vector

- Primary primitive is a point
- Planar Enforcement must be enforced
 - no two polygon objects can occupy the same space in a layer
 - Boundaries between objects are shared lines
- Objects are created by connecting points with straight lines or arcs
 - arcs (opposed chains) are circle-like
- Polygons are defined by lines
 - topology (the next lecture) must be built

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Basics Vector

- Arcs have three types of spatial data (left, right, direction)
- An unlimited amount of attribute data can be attached to a single arc record

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Major Difference: Raster v. Vector

- Raster data occurs everywhere: Vector data occurs in a single location
- Raster requires much more power to perform operations & store a layer relative to the same spatial extent in a single vector layer or layer-layer operation
- Raster is inherently seamless: Vector is not
- Raster cells contain only 1 value: Vector objects contain potentially unlimited values
- Relative Accuracy
 - How is a stream represented in a raster environment?
 - How is variation within a tree stand polygon represented in a vector model?

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Raster & Vector Integration

- The most active field of academic research
- Merges best of both worlds

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