Brief Intro to Geospatial Data

Modified from "Overview of Geospatial Data"

by Patty Frontiera, Drew Hart, and Hikari Murayama

of UC Berkeley's D-Lab, used under CC BY-NC-SA 4.0.

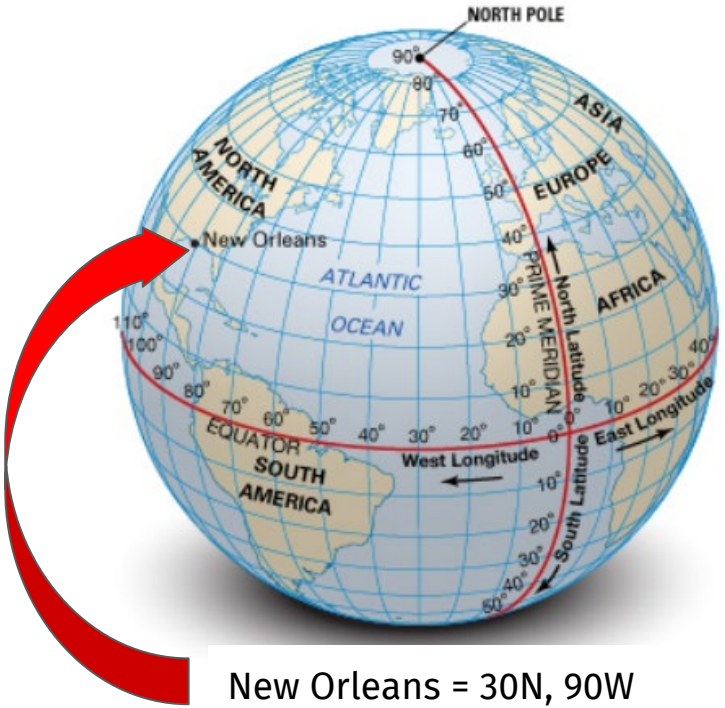
Geospatial data

Anatone, WA: 46.130479, -117.134167

BUT, how do we know that those coordinates reference that specific location?

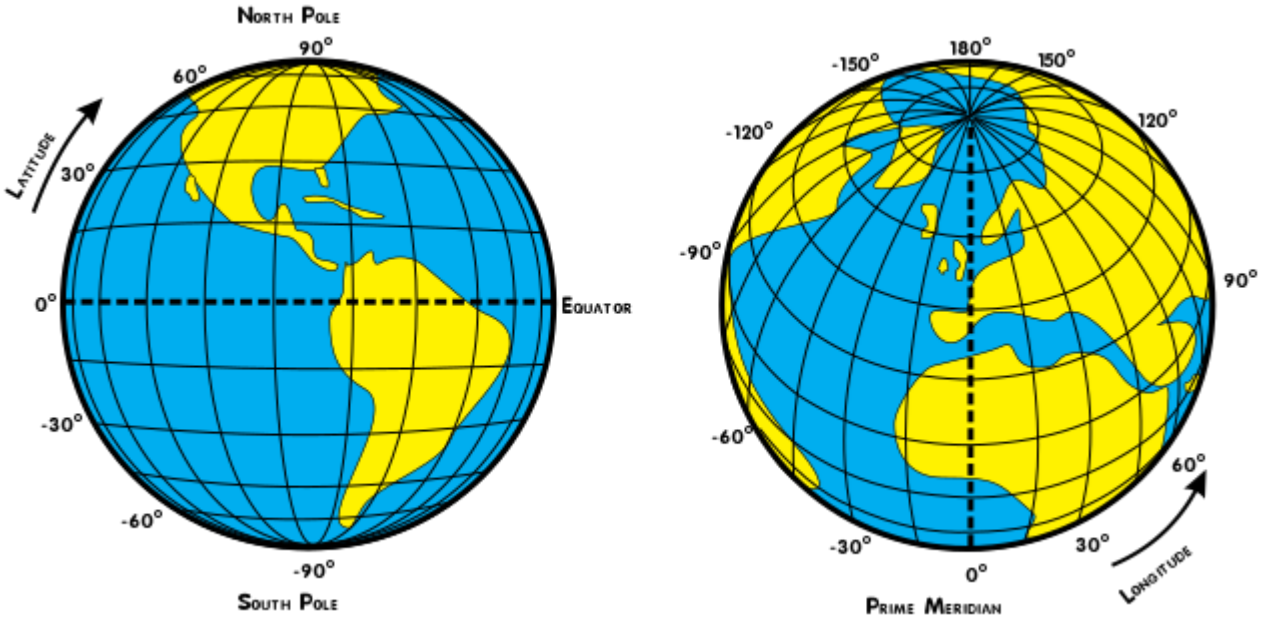
Coordinate Reference Systems (CRS)

A Coordinate Reference System, or CRS, is a system for associating coordinates with a **specific**, **unambiguous** location on the surface of the Earth.



New Orleans = 30N, 90W

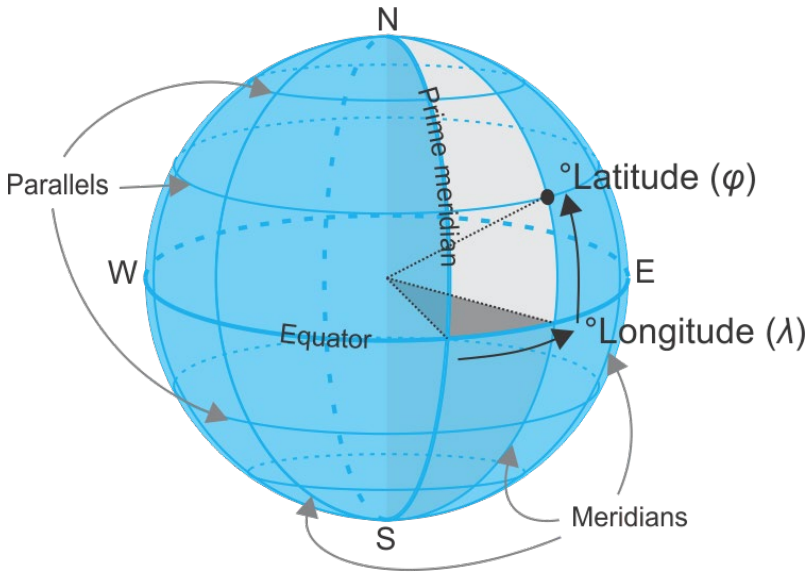
Coordinate Reference Systems (CRS)



Geographic Coordinates: *Latitude* and *Longitude*

http://latitude-longitude.net

Coordinate Reference Systems (CRS)

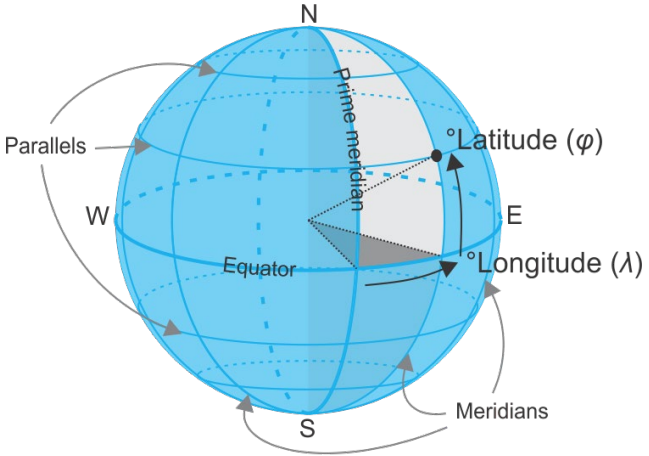


There are **many** CRSs, not just one!

Why? Because our understanding of and ability to measure the shape of the earth has changed over time.

Two Types of Coordinate Reference Systems

Geographic CRS



Angular Units = Degrees (DMS or DD)

Projected CRS

Cartesian Units = Feet or Meters
Good for local & regional mapping & analysis

Geographic Coordinate Systems (GCS)

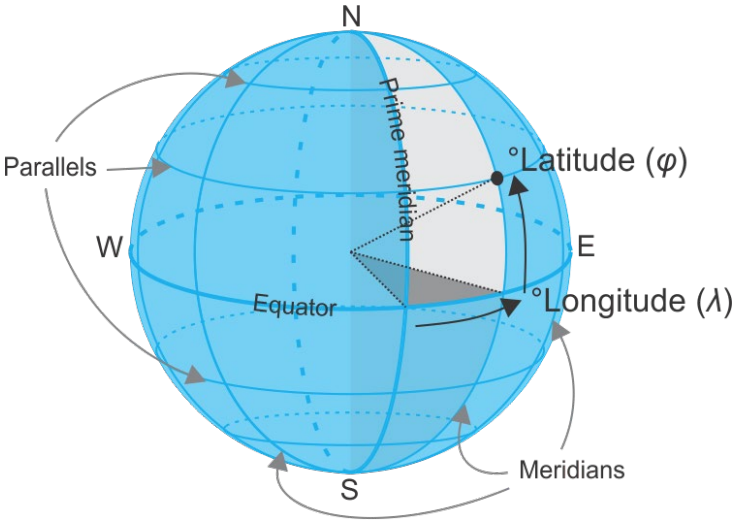
Widely used! Expressed as latitude & longitude

WGS84 (EPSG: 4326)

Based on satellites, used by cell phones, GPS
Best overall fit for most places on earth

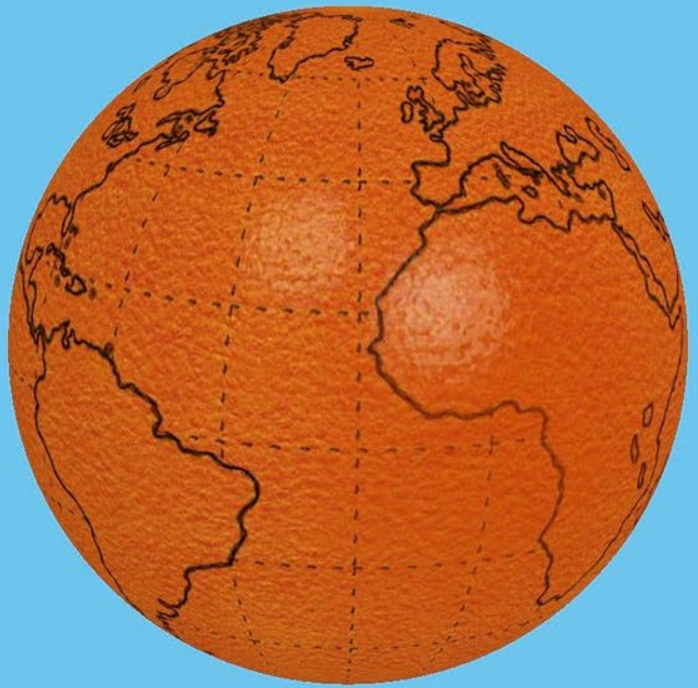
NAD83 (EPSG: 4269)

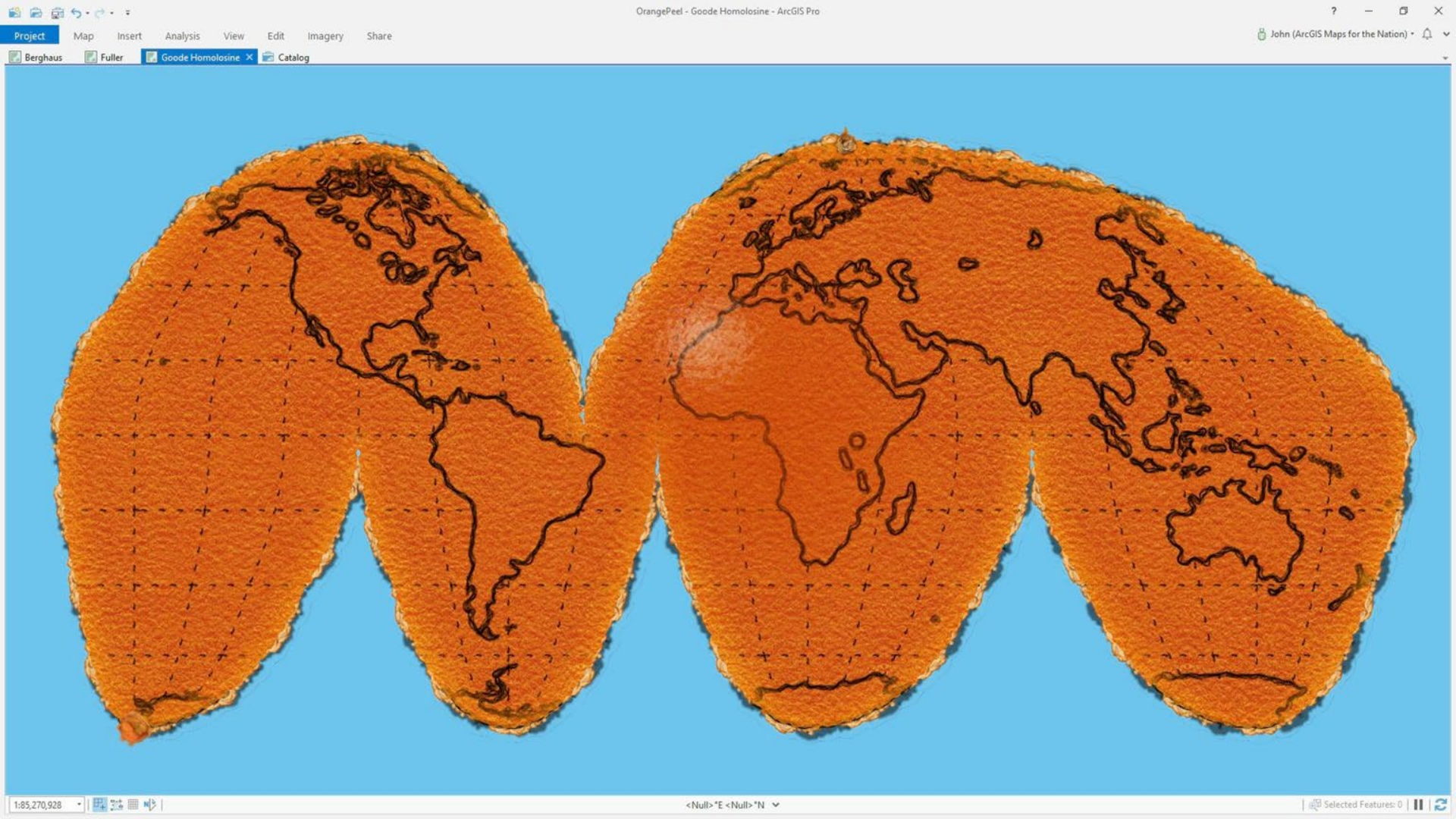
Based on satellites and survey data
Best fit for USA
Used by many federal data products, like Census data



CRSs are referenced in software by numeric codes, often called **EPSG codes**


HI THERE, I'M AN ORANGE!
YOU MIGHT RECOGNIZE ME FROM EVERY PROJECTION METAPHOR EVER.
IF ONLY THERE WAS A WAY I COULD LIVE IN YOUR COMPUTER, AND WARP MYSELF INTO ALL YOUR VIRTUAL PROJECTIONS! AND MAKE THEM SMELL AWESOME.
@John_M_Nelson
photo: Mae Mu, Unsplash

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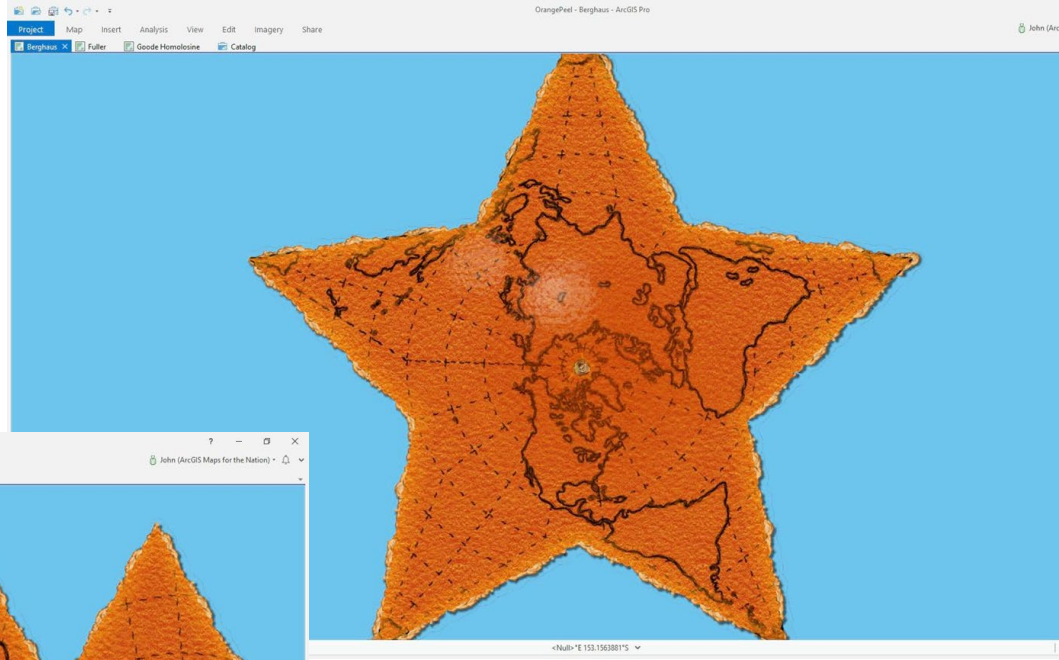
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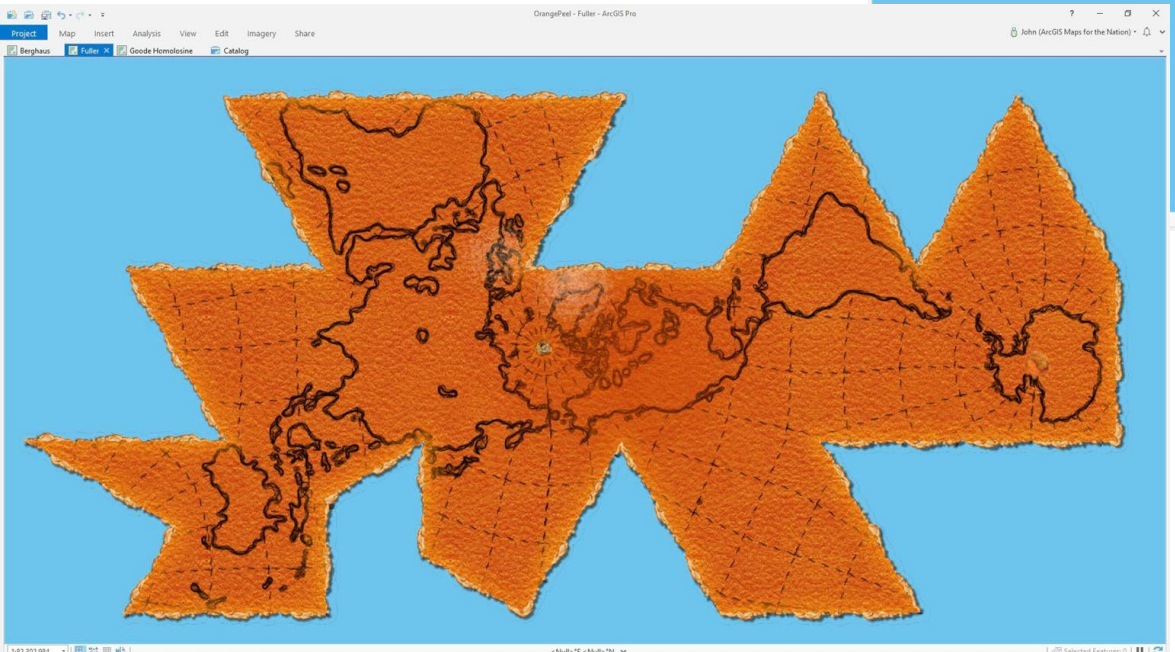
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Projected Coordinate Systems (PCS)

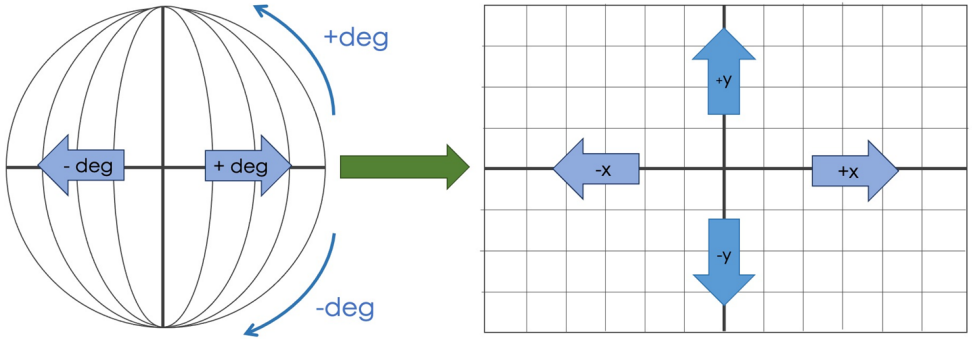
Map Projections transform geographic coordinates (lat/lon) to 2D coordinates (X/Y)

All map projections introduce **distortion** in area, shape, distance or direction.

Specific map projections minimize distortion in one or more properties

You need to know the coordinate reference system of your input data

You need to select the CRS that is most suitable for your data and application.



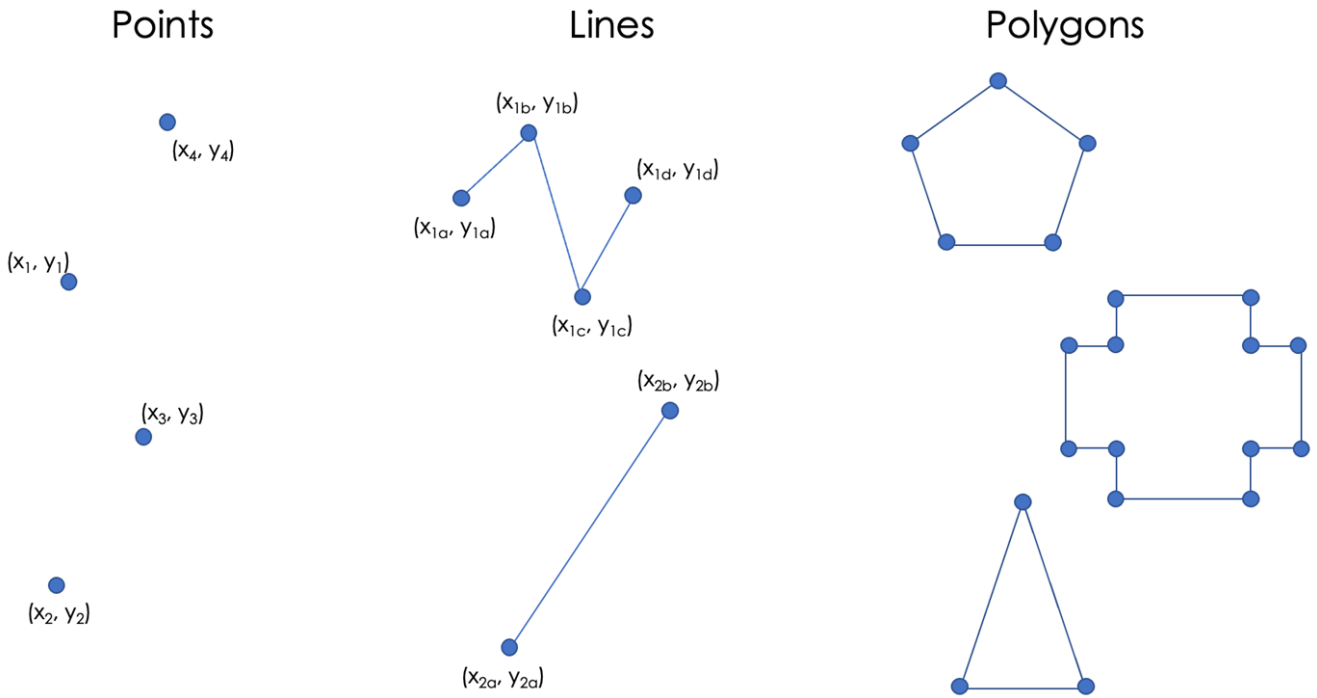
Types of Spatial Data

There are two fundamental types of spatial data:

- Vector
- Raster

Vector Data

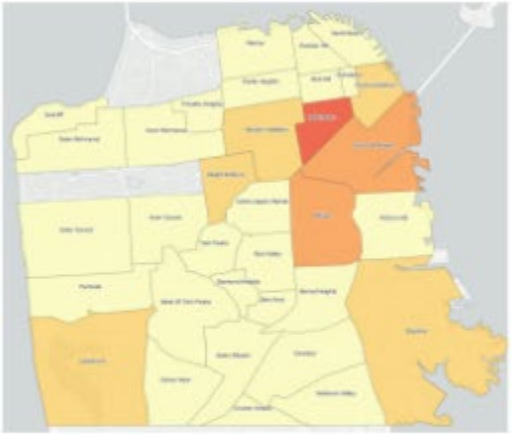
"Connect the dots"



Points, Lines, Polygons

Crime locations

City freeways



Neighborhoods

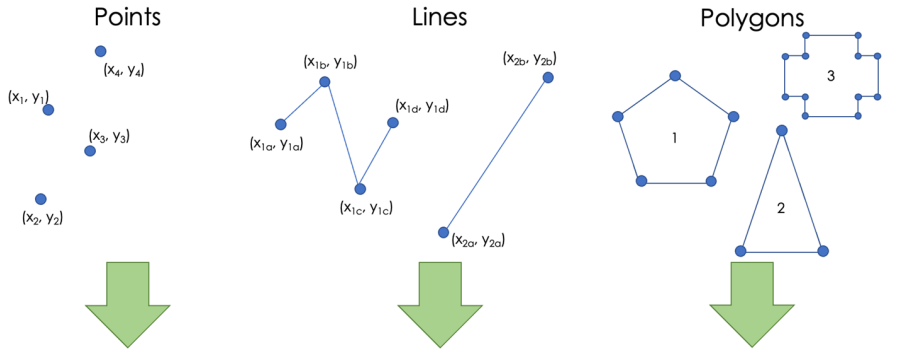
Vector Data with Attributes

Each row represents one geospatial **feature**

Attributes describe the features (*fields* or *columns)*

Each feature has an associated geometry or geometry collection

A group of features is called a **layer**

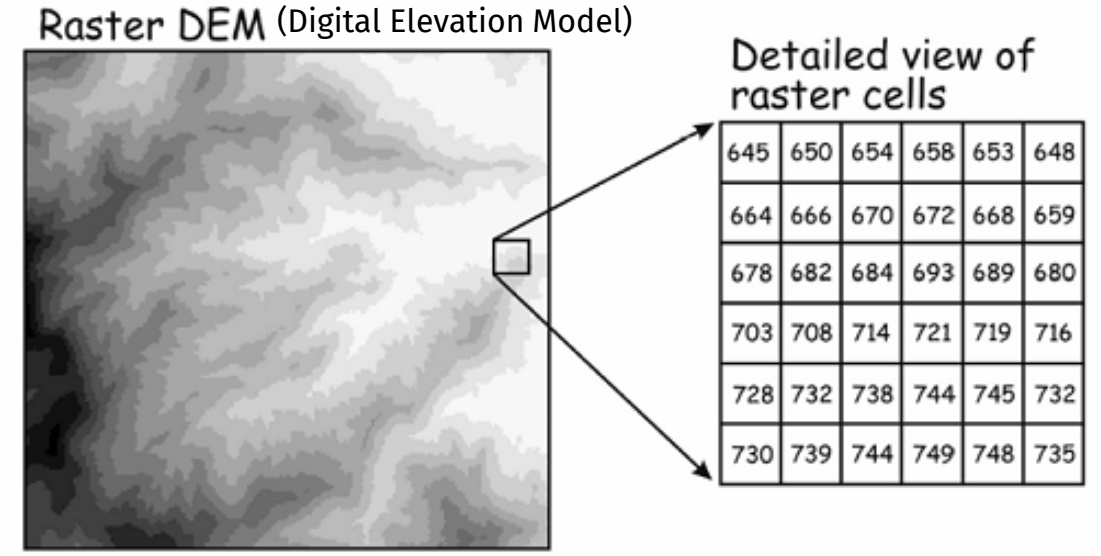


ID	School	# of Students
1	Berkeley High School	1392
2	MLK Middle School	421
3	Walkerville Elementary	130

ID	Bridge	Toll Amount
1	Golden Gate Bridge	$7
2	Bay Bridge	$6
3	Rainbow Bridge	Free

ID	City	Mayor
1	Berkeley	Jesse Arreguín
2	Oakland	Libby Schaaf
3	Narnia	The White Witch

Raster Data - regular grids



A location is represented by a grid cell

Cells have regular size, eg 30x30m

Grid has dimension - fixed number of rows and columns

Each cell has a value that represents the attribute of interest, e.g. elevation

Images are Raster Data

Source: BING Aerial imagery

Vector vs Raster

Vector data are better for **discretely bounded** data
e.g. political boundaries, fire hydrants, rivers, roads, etc.

Raster data are better for **continuous** data
e.g. temperature, elevation, rainfall, etc.

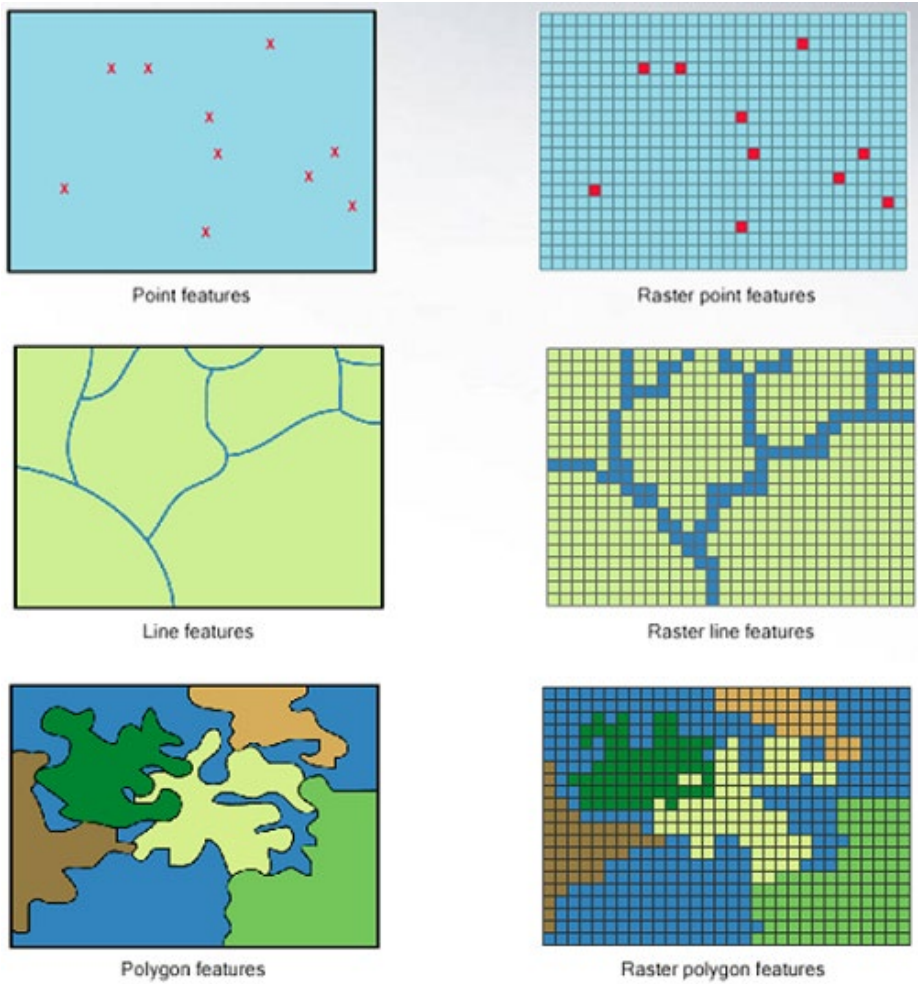


Image: http://gsp.humboldt.edu/

Some Common File Formats

Vector Data

- Shapefile (.shp...)
- GeoJSON, JSON
- KML
- GeoPackage

Raster Data

- GeoTIFF
- netCDF
- DEM

Georeferencing

Data layers in the same **coordinate reference system** can be linked to explore associations