# Using GIS to map Community Areas and Census Data

CS 579 Online Social Network Analysis

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10/2/25

# Homework Assignments

- HW #3 – Network Metrics
  - Due by midnight 10/3, no submissions accepted after 5pm 10/6
  - Good prep for Exam 1
- HW #4 – Chicago Community Areas + Census Data
  - You may work in groups up to 4 students (no exceptions) on this hw
  - Assigned this week
- Please contact TAs with questions

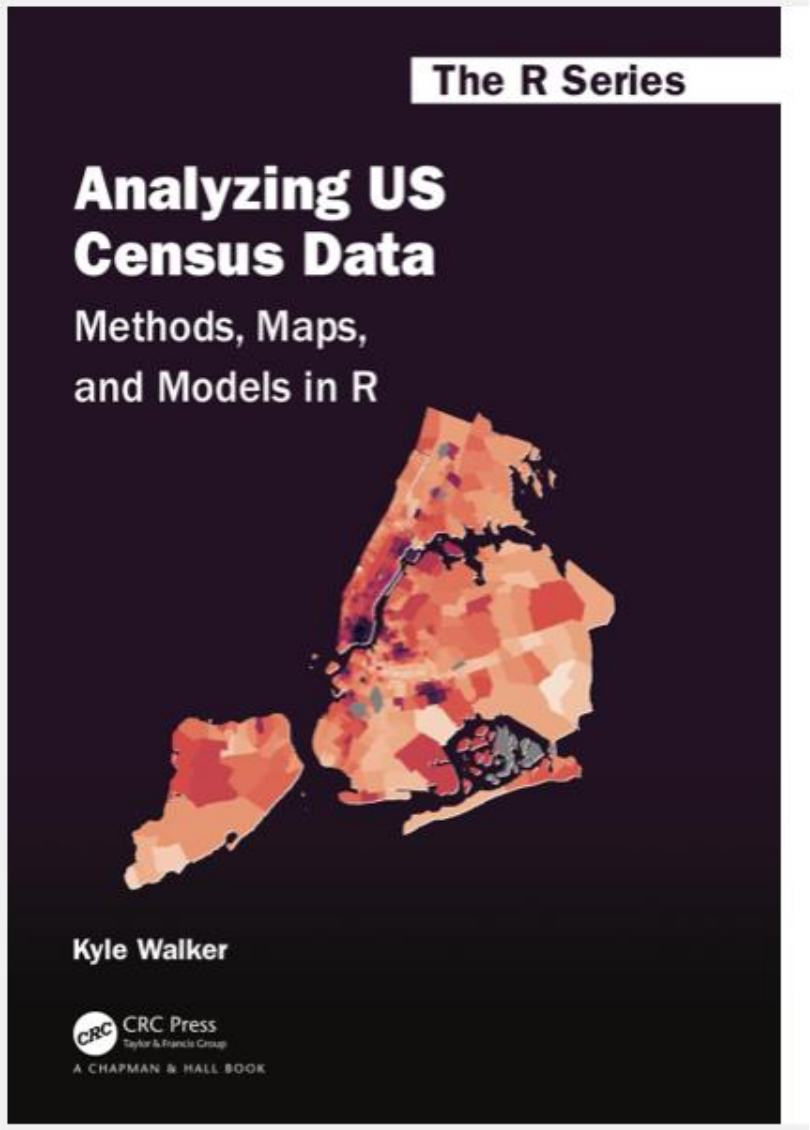
# Exams and Final Project Poster Presentation

- Exam 1 – Oct 9 in class
  - Review in lecture on Oct 7
    - Email questions to me
- Exam 2 – Dec 2 in class

- Final Project Poster Session – Dec 4 in class

- Online students (sections 2 and 3) will have remote options

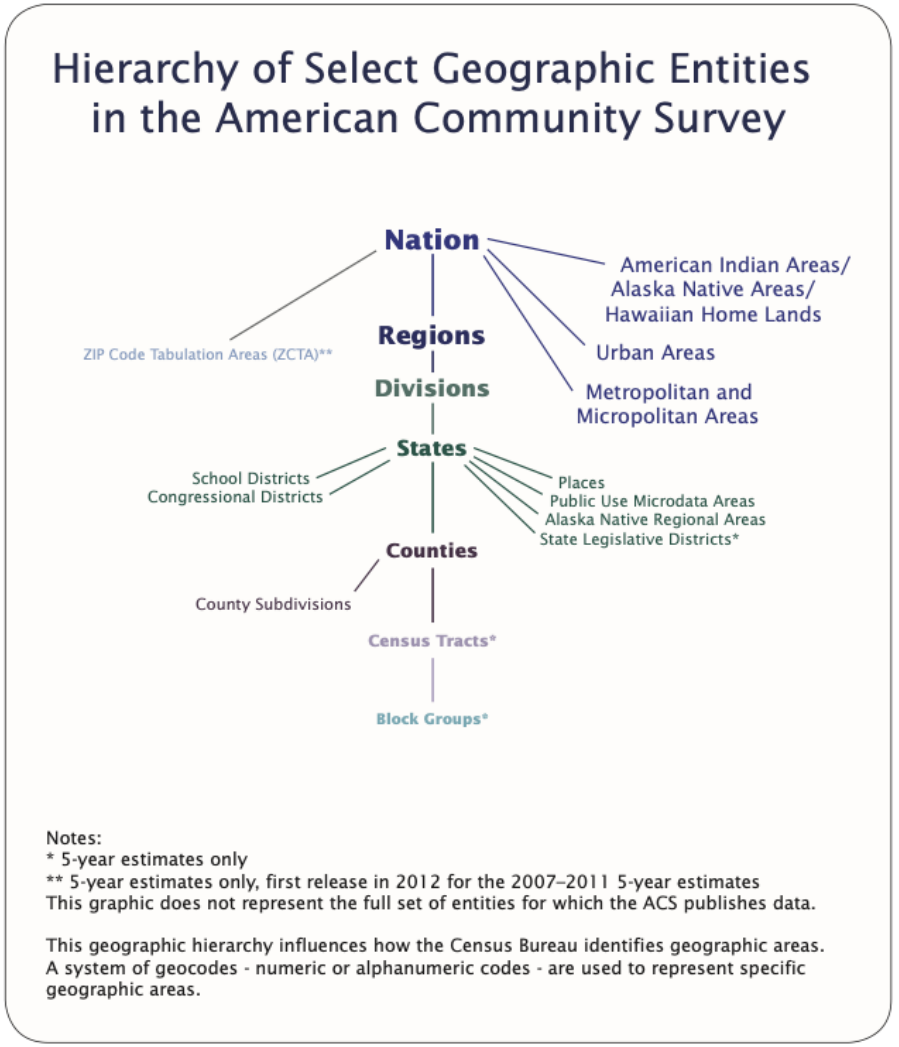
# Reference




https://walker-data.com/census-r/

# What are we trying to do?

- Use census data to understand *composition* of Chicago Community Areas
  - Take advantage of richest dataset available
    - ACS
  - Take advantage of lowest level of data available
    - For ACS this is block group
    - For Decennial survey it is block



# Chicago Community Areas

# What do we need to do?

- Map Census data into Community Areas
  - We have mapping of Census tracts into Community Areas (Chicago Data Guy)
  - Census tracts are comprised on Block groups (census hierarchy)
- We need to get the geographical information (i.e. geometries) for the enumeration units we are interested in to visualize
  - Data exploration
  - Results

# Some GIS Basics

- Feature representation
  - We'll be dealing with vector representations
- Coordinate systems
  - Census uses NAD83
  - States may use different coordinate systems
    - IL uses WGS84
- GIS file formats
  - Shapefile

# GIS Feature Representations

- Vector
- Raster

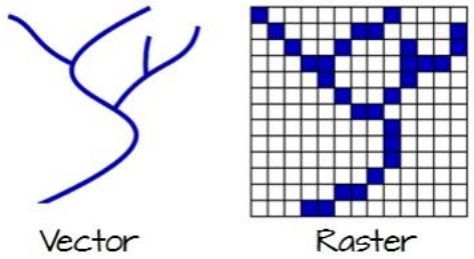



Figure 2.1: Vector and raster representations of a river feature.

https://mgimond.github.io/Spatial/chp02_0.html

# Vector Features

- Vector features can be described in terms of
  - Points
  - Polyline
  - Polygon

## 2.1.1.1 Point

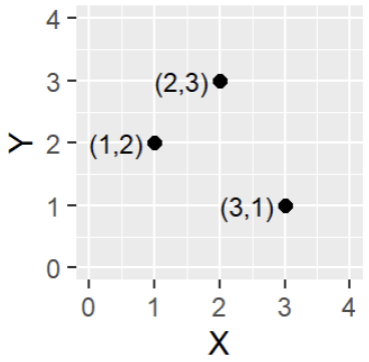



Figure 2.2: Three point objects defined by their X and Y coordinate values.

A point is composed of one coordinate pair representing a specific location in a coordinate system. Points are the most basic geometric primitives having no length or area. By definition a point can't be "seen" since it has no area; but this is not practical if such primitives are to be mapped. So points on a map are represented using *symbols* that have both area and shape (e.g. circle, square, plus signs).

We seem capable of interpreting such symbols as points, but there may be instances when such interpretation may be ambiguous (e.g. is a round symbol delineating the area of a round feature on the ground such as a large oil storage tank or is it representing the point location of that tank?).

https://mgimond.github.io/Spatial/chp02_0.html

## 2.1.1.2 Polyline

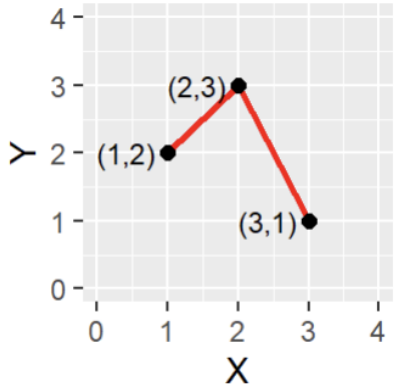



Figure 2.3: A simple polyline object defined by connected vertices.

A polyline is composed of a sequence of two or more coordinate pairs called vertices. A vertex is defined by coordinate pairs, just like a point, but what differentiates a vertex from a point is its explicitly defined relationship with neighboring vertices. A vertex is connected to at least one other vertex.

Like a point, a true line can't be seen since it has no area. And like a point, a line is symbolized using shapes that have a color, width and style (e.g. solid, dashed, dotted, etc…). Roads and rivers are commonly stored as polylines in a GIS.

https://mgimond.github.io/Spatial/chp02_0.html

## 2.1.1.3 Polygon

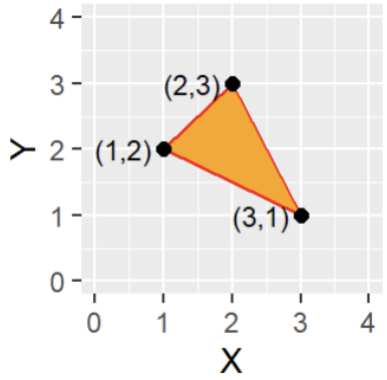



Figure 2.4: A simple polygon object defined by an area enclosed by connected vertices.

A polygon is composed of three or more line segments whose starting and ending coordinate pairs are the same. Sometimes you will see the words *lattice* or *area* used in lieu of 'polygon'. Polygons represent both length (i.e. the perimeter of the area) and area. They also embody the idea of an inside and an outside; in fact, the area that a polygon encloses is explicitly defined in a GIS environment. If it isn't, then you are working with a polyline feature. If this does not seem intuitive, think of three connected lines defining a triangle: they can represent three connected road segments (thus polyline features), or they can represent the grassy strip enclosed by the connected roads (in which case an 'inside' is implied thus defining a polygon).

https://mgimond.github.io/Spatial/chp02_0.html

# Coordinate Reference Systems

## 9.1 Geographic Coordinate Systems

A geographic coordinate system is a reference system for identifying locations on the curved surface of the earth. Locations on the earth's surface are measured in angular units from the center of the earth relative to two planes: the plane defined by the equator and the plane defined by the prime meridian (which crosses Greenwich England). A location is therefore defined by two values: a latitudinal value and a longitudinal value.

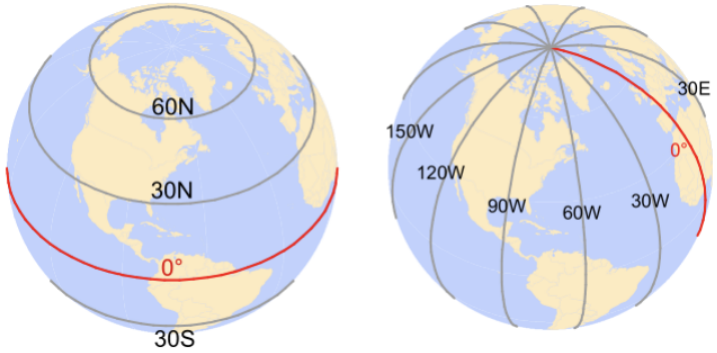



Figure 9.1: Examples of latitudinal lines are shown on the left and examples of longitudinal lines are shown on the right. The 0° degree reference lines for each are shown in red (equator for latitudinal measurements and prime meridian for longitudinal measurements).

# Coordinate Reference Systems

| Geocentric datum | Acronym | Best for | Comment |
|---|---|---|---|
| North American Datum of 1983 | NAD83 | Continental US | This is one of the most popular modern datums for the contiguous US. |
| European Terrestrial Reference System 1989 | ETRS89 | Western Europe | This is the most popular modern datum for much of Europe. |
| World Geodetic System 1984 | WGS84 | Global | Developed by the Department of Defense. |

https://mgimond.github.io/Spatial/chp09_0.html

# GIS file data formats

- Many different file formats

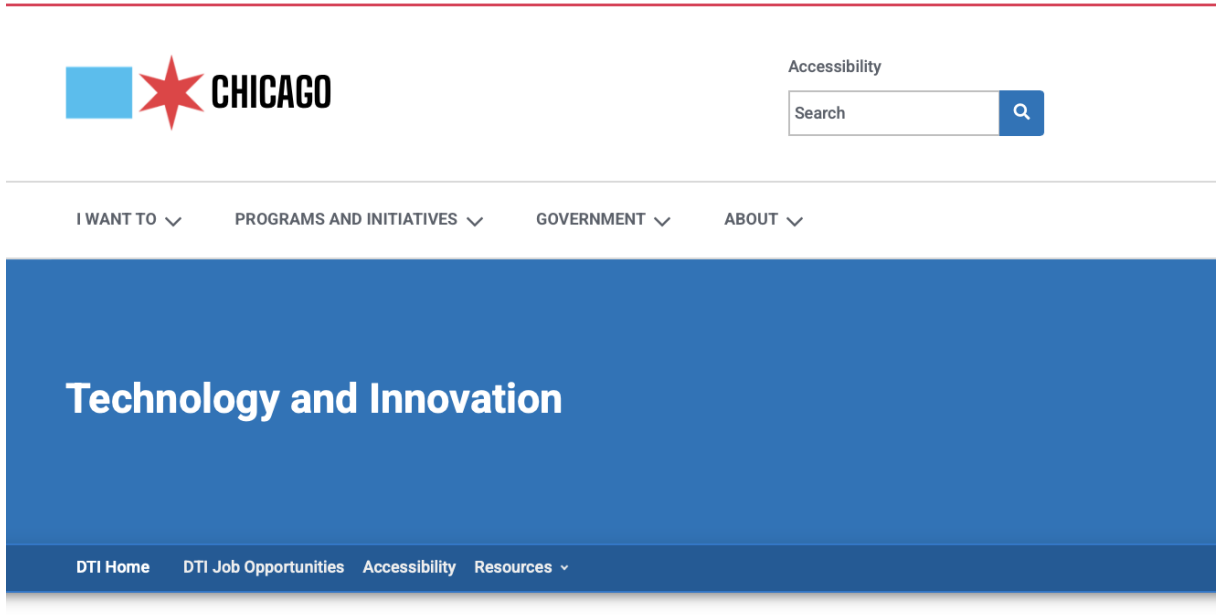
### 3.1.1.1 Shapefile

A **shapefile** is a file-based data format native to ArcView 3.x software (a much older version of ArcGIS Pro). Conceptually, a shapefile is a feature class–it stores a collection of features that have the same geometry type (point, line, or polygon), the same attributes, and a common spatial extent.

Despite what its name may imply, a “single” shapefile is actually composed of at least three files, and as many as eight. Each file that makes up a “shapefile” has a common filename but different extension types.

The list of files that define a “shapefile” are shown in the following table. Note that each file has a specific role in defining a *shapefile*.

| File extension | Content |
|---|---|
| .dbf | Attribute information |
| .shp | Feature geometry |
| .shx | Feature geometry index |
| .aih | Attribute index |
| .ain | Attribute index |
| .prj | Coordinate system information |
| .sbn | Spatial index file |
| .sbx | Spatial index file |




https://www.chicago.gov/city/en/depts/dti/supp_info/geographic-information-systems.html

# ★ INTERACTIVE MAPS ★

### Chicago Interactive Map

Includes police stations, fire stations, schools, clinics and many other facilities as well as political boundaries, transit routes, street closures, TIF districts, liquor licenses and other data of general interest.

### Chicago Ward Map

Chicago has fifty wards. Each ward is a political district, and the voters in each ward are represented by an elected Alderman. The fifty Aldermen make up the Chicago City Council. Ward boundaries change after each United States census in order to reflect population shifts within the city and to ensure that each ward has approximately the same population.

A catalog of PDF files for all Chicago Wards

### Community Area Map

Chicago is divided into seventy-seven (77) Community Areas. These boundaries do not change over time (as political boundaries do), so that information about the city can be consistently collected and analyzed over long periods of time.

### Chicago Neighborhood Map

**Please Note**: Chicago neighborhood names and neighborhood boundaries can change over time. Different people may have different perspectives on the names and locations of specific neighborhoods.

The only map of Chicago neighborhoods approved by the City Council was finalized in 1993, and was based on a survey conducted in 1978. The map that resulted from that process is the neighborhood map available here.

City government does not recognize or use Chicago neighborhood boundaries for any official purposes.

## OTHER RESOURCES

- Board of Elections
- Cook County GIS/Maps

# Chicago Community Area Shapefile

# Lets look at R code