

# API-231 / Geographic Information Systems for Public Policy Shopping Session

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# What is GIS?

## What are **Geographic Information Systems**?

1. tools for the collection, maintenance, storage, analysis, visualization and distribution of geospatial data
2. a.k.a. “geospatial data science”

### *Policy applications*

1. GIS help us understand
  - a) where social, economic, public health problems occur
  - b) who is affected by them
  - c) how to monitor, manage and mitigate them

### *Scientific applications*

1. GIS help us
  - a) acquire data
  - b) test hypotheses
  - c) make forecasts and predictions



Figure 1: GIS is super cool

## Examples

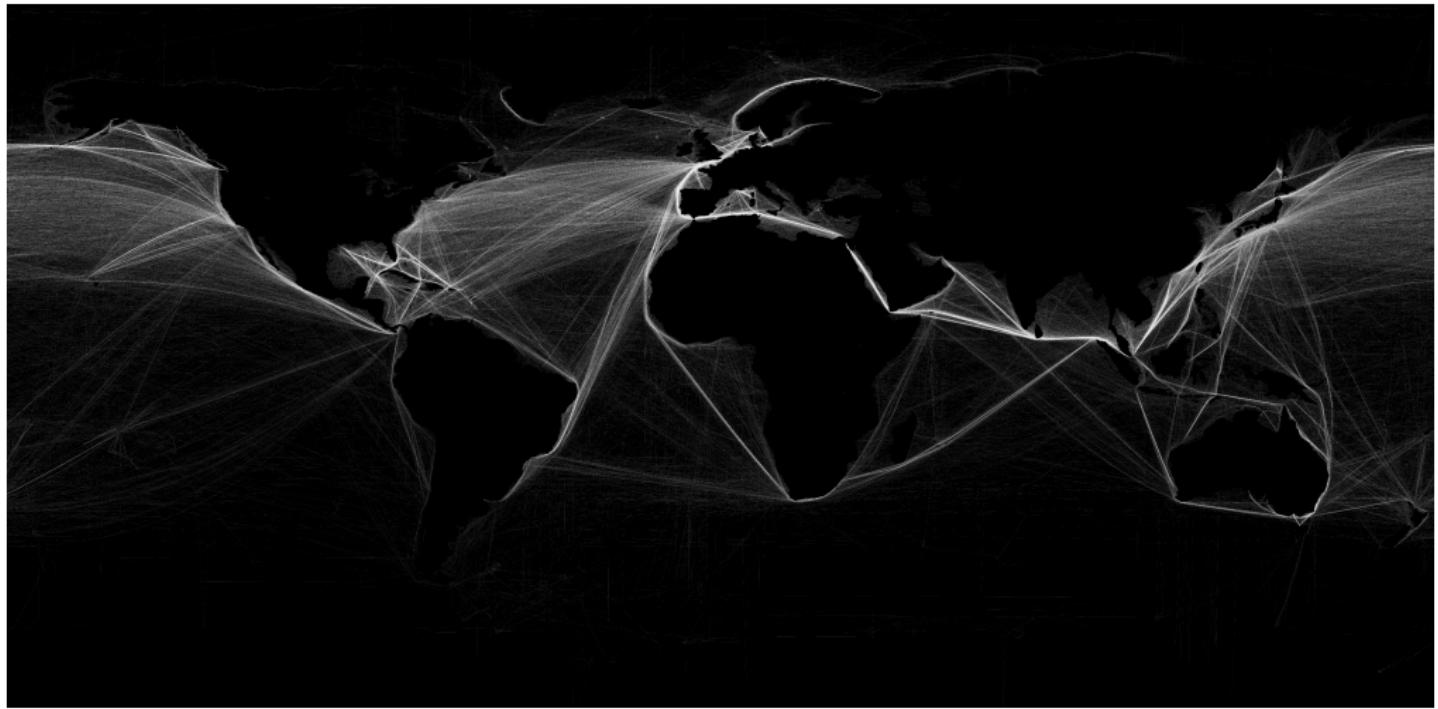


Figure 2: Example: Track international shipping

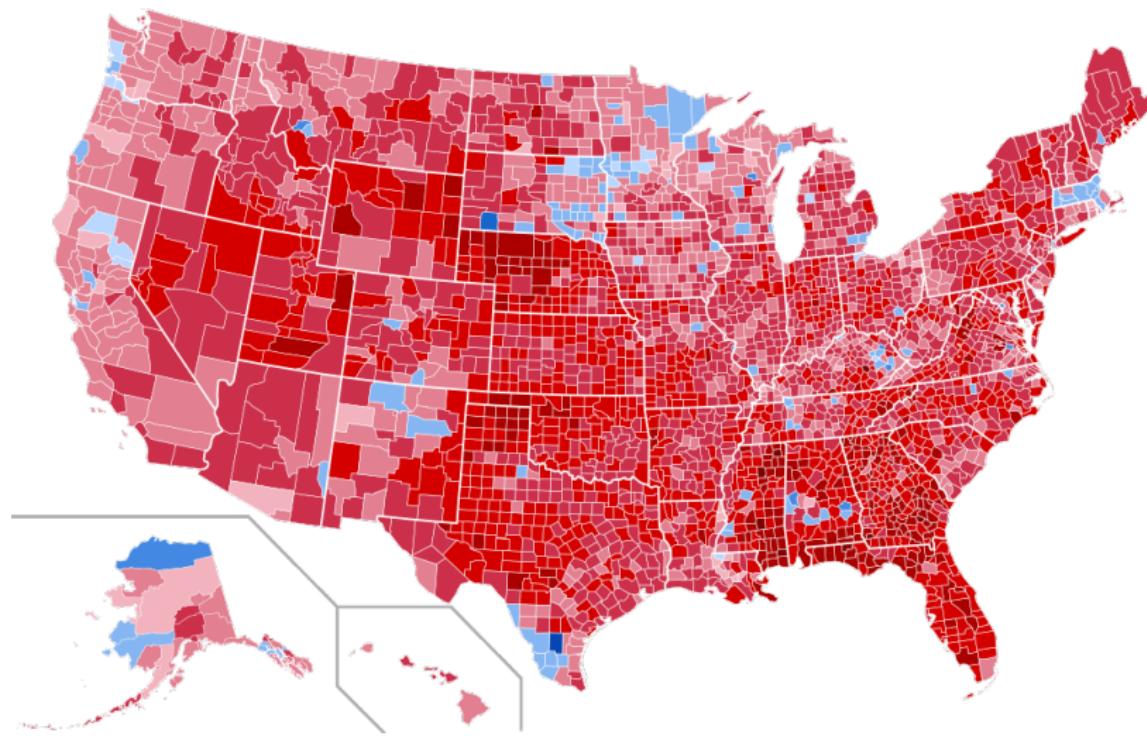


Figure 3: Example: Compare election results (1972: Nixon v McGovern)

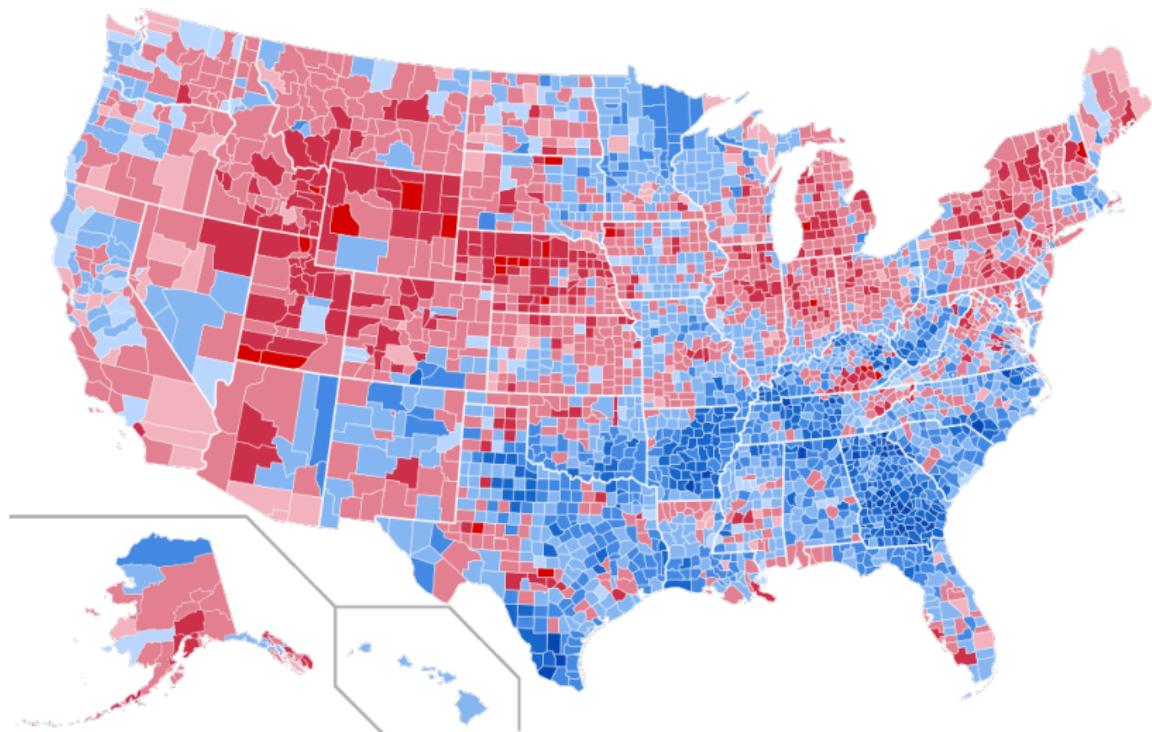


Figure 4: Example: Compare election results (1976: Carter v Ford)

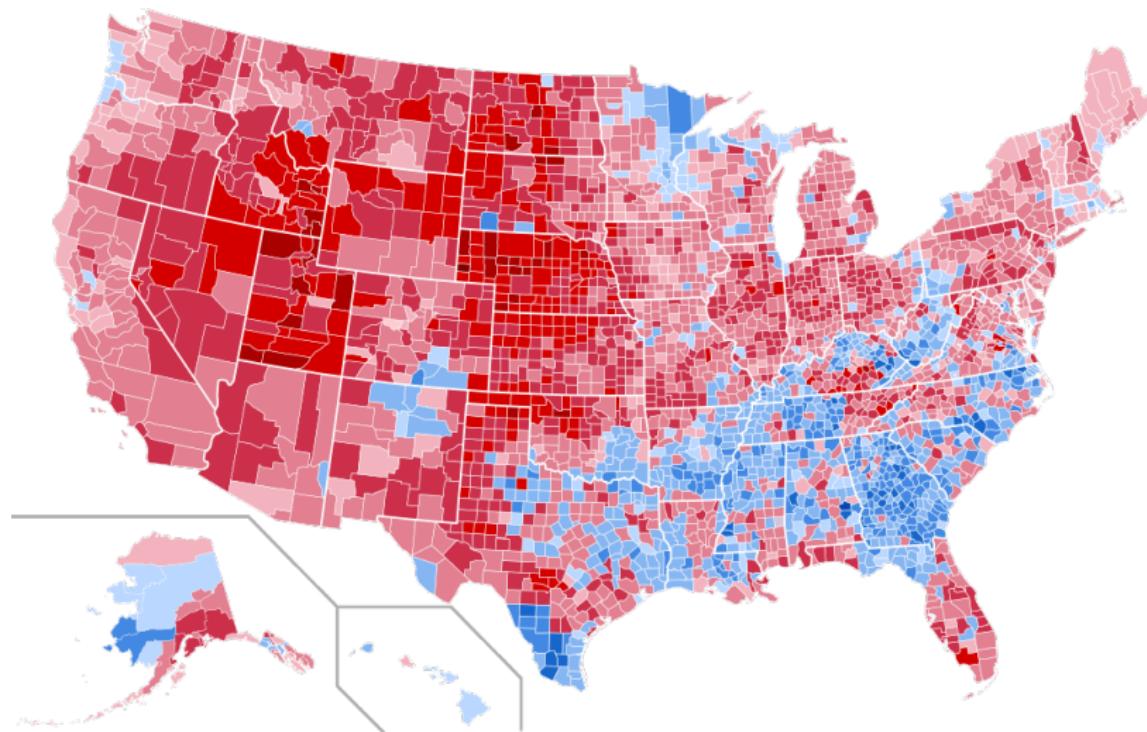


Figure 5: Example: Compare election results (1980: Reagan v Carter)

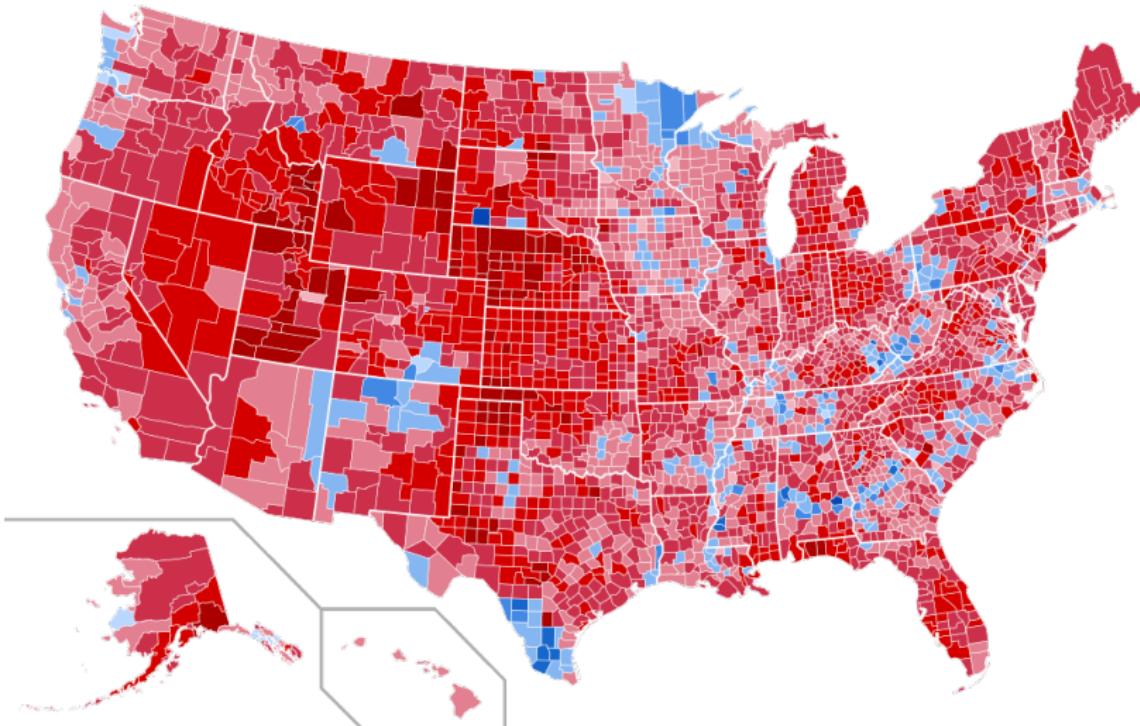


Figure 6: Example: Compare election results (1984: Reagan v Mondale)

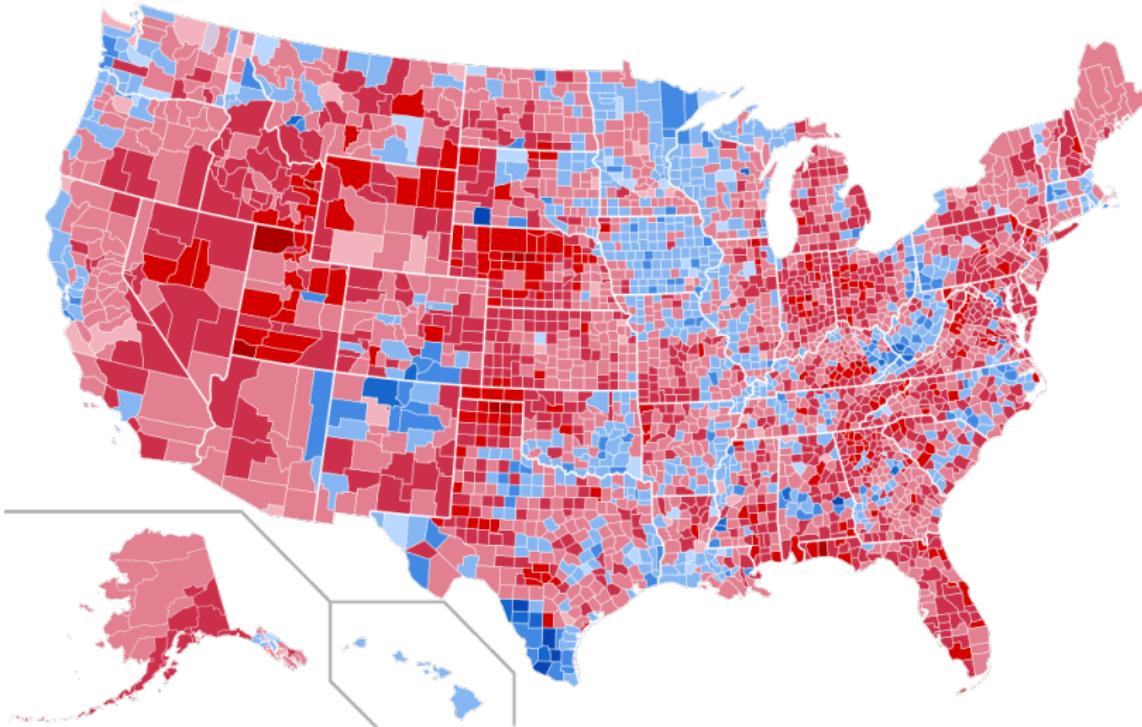


Figure 7: Example: Compare election results (1988: Bush v Dukakis)

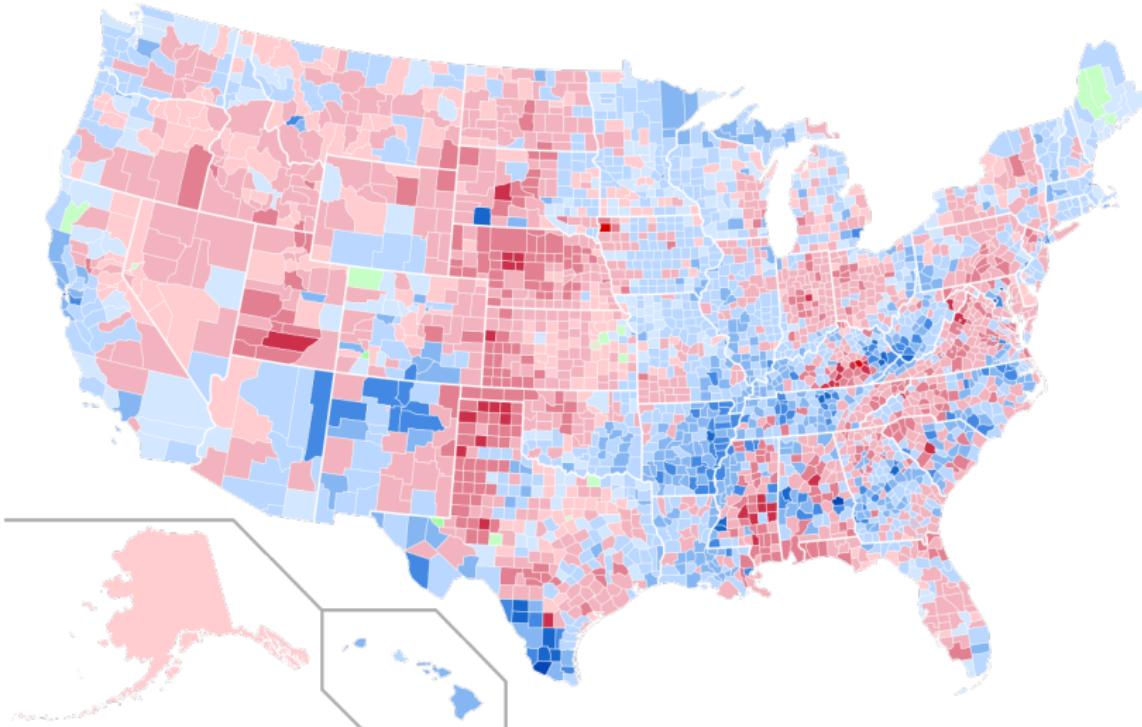


Figure 8: Example: Compare election results (1992: Clinton v Bush)

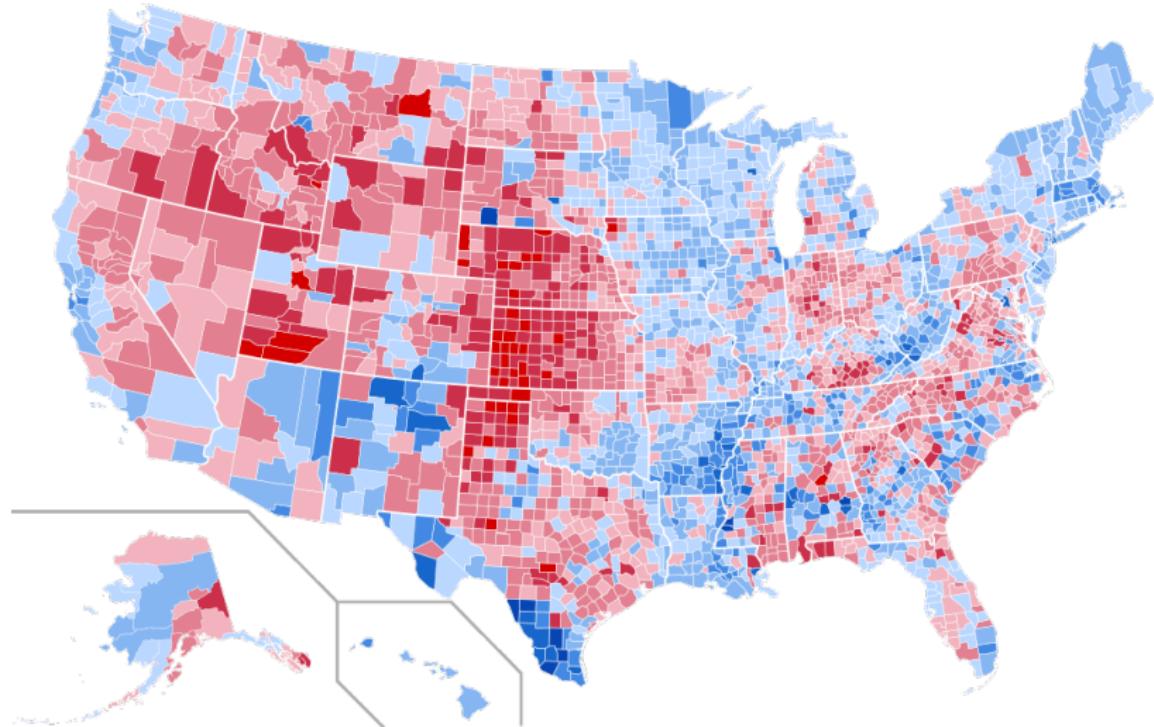


Figure 9: Example: Compare election results (1996: Clinton v Dole)

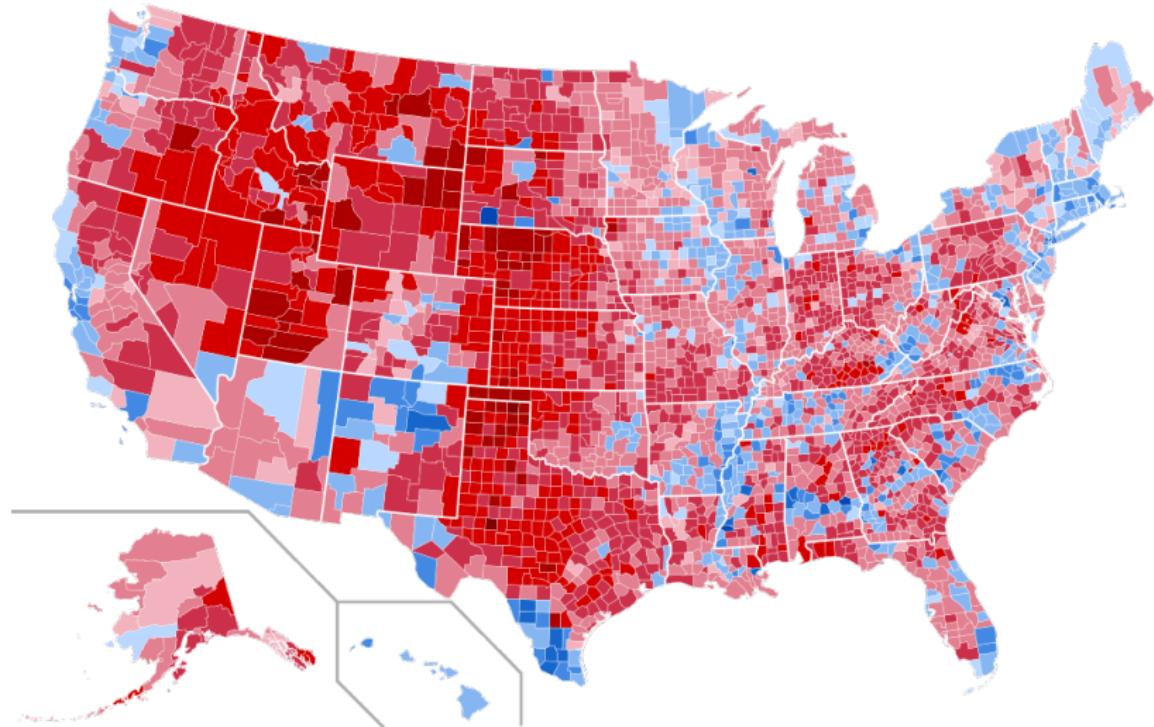


Figure 10: Example: Compare election results (2000: Bush v Gore)

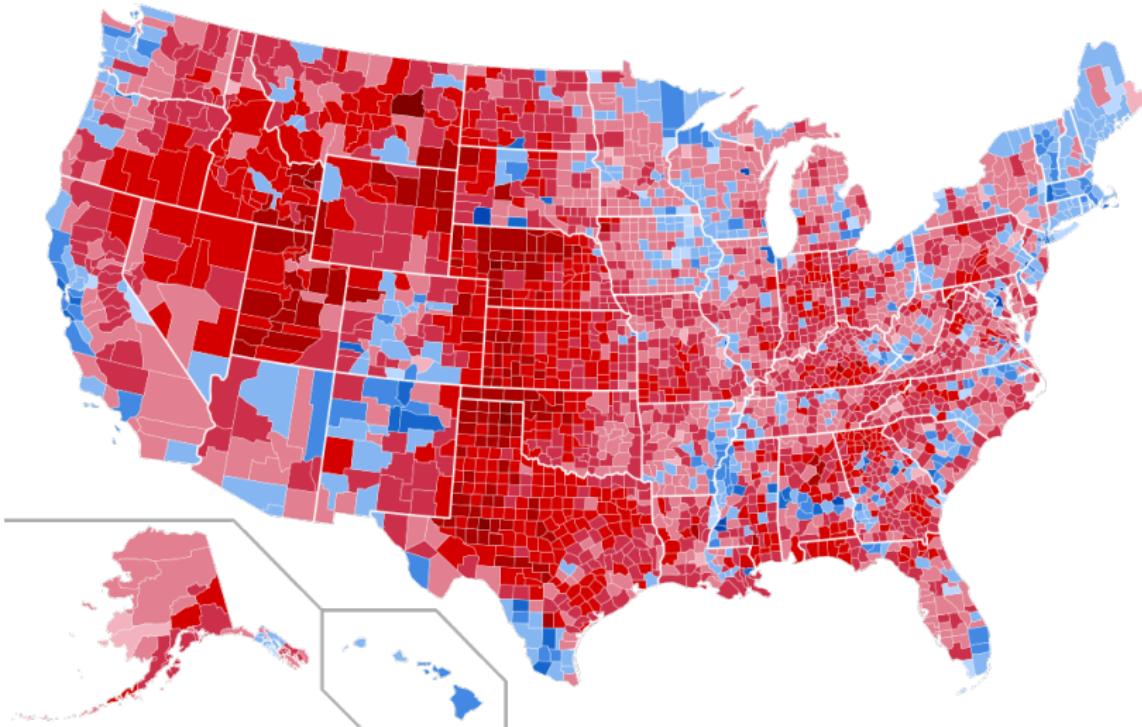


Figure 11: Example: Compare election results (2004: Bush v Kerry)

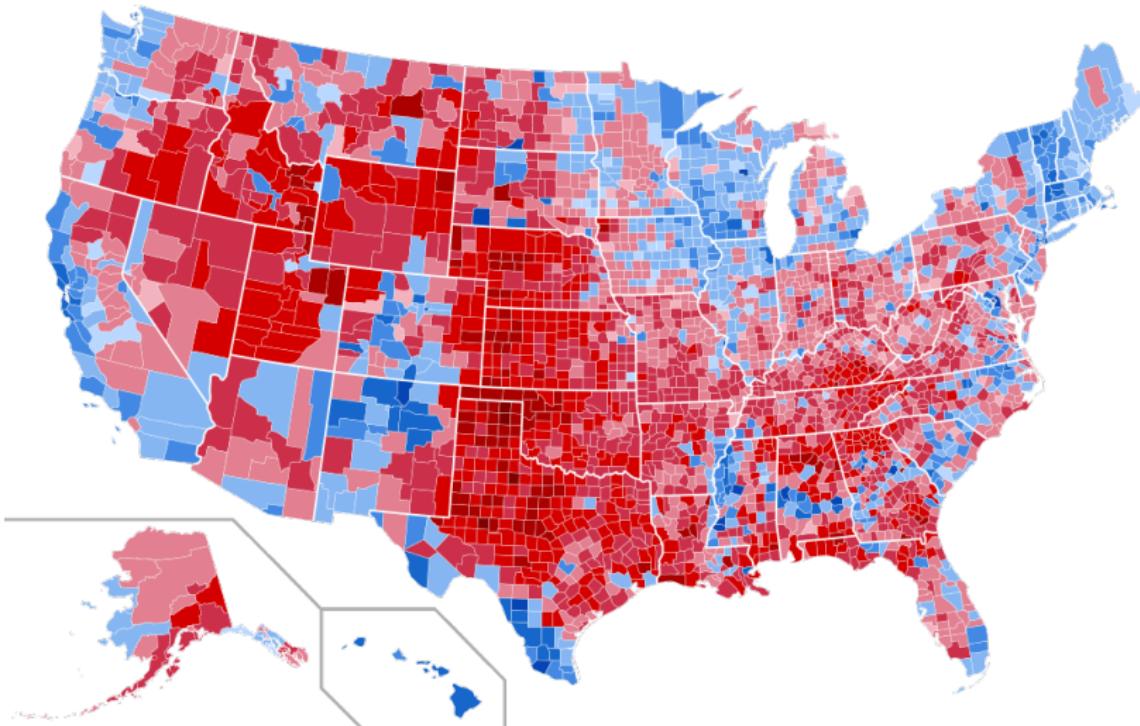


Figure 12: Example: Compare election results (2008: Obama v McCain)

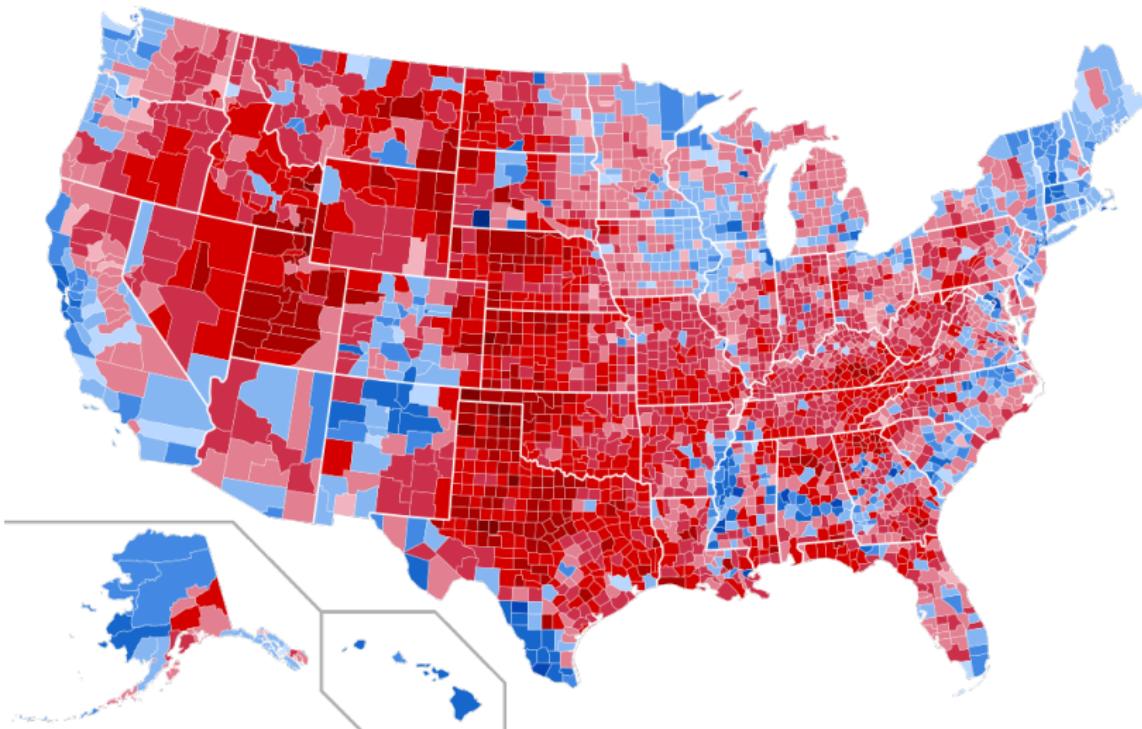


Figure 13: Example: Compare election results (2012: Obama v Romney)

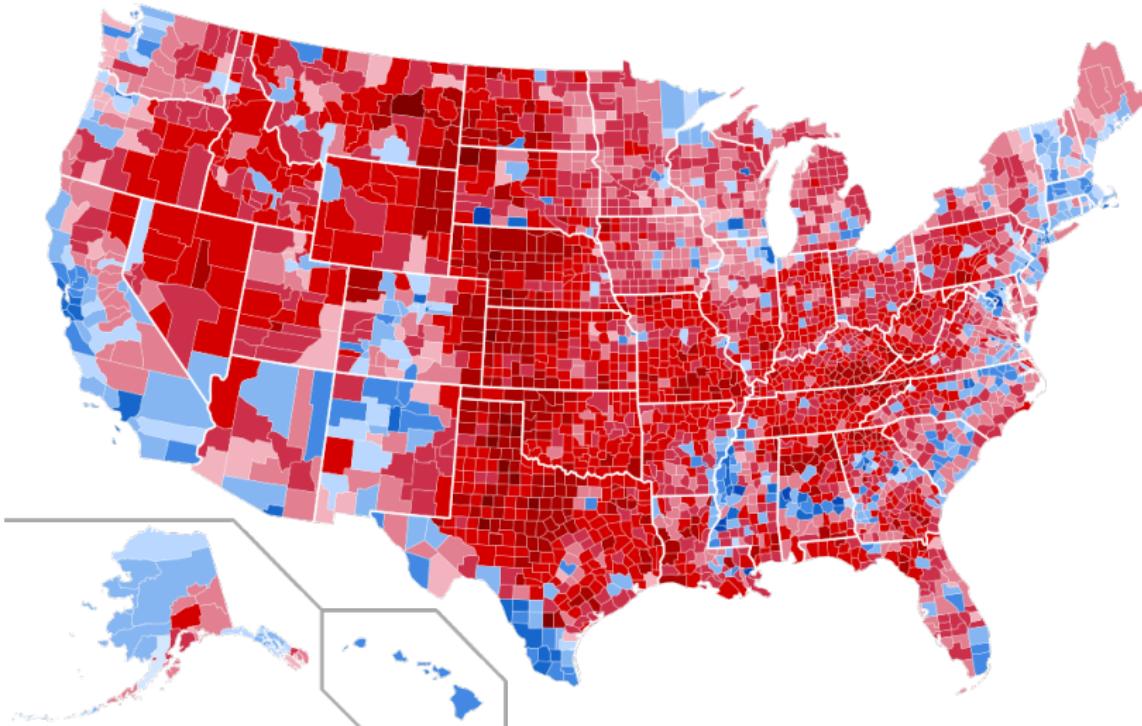


Figure 14: Example: Compare election results (2016: Trump v Clinton)

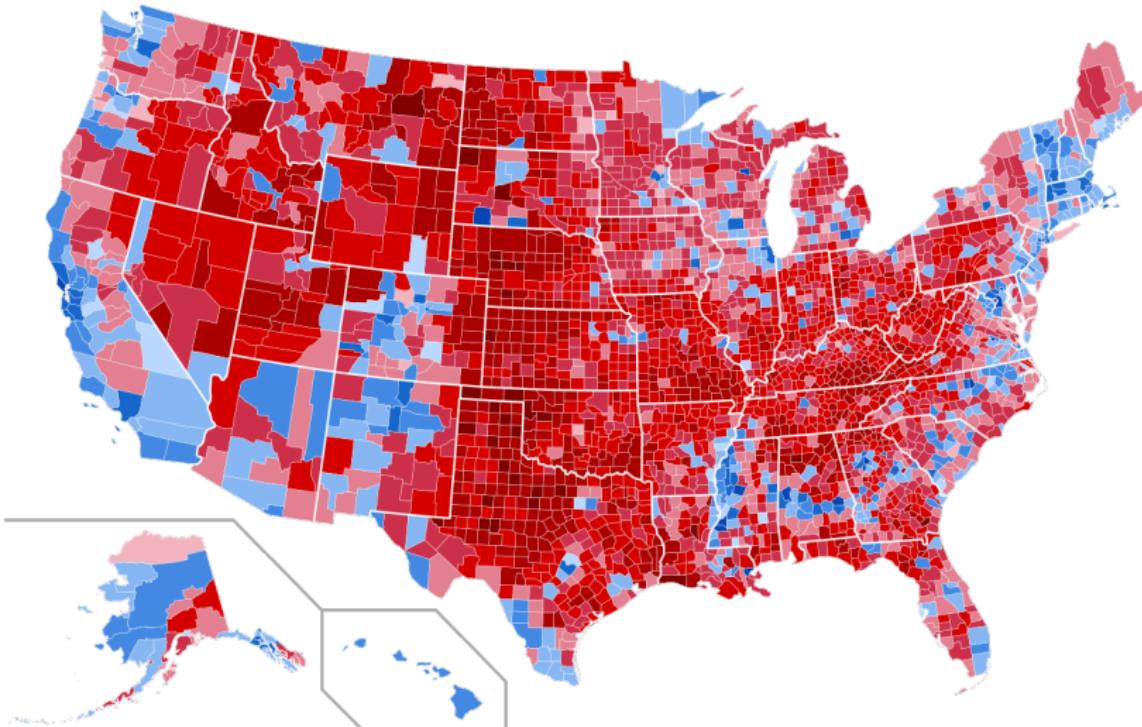


Figure 15: Example: Compare election results (2020: Biden v Trump)

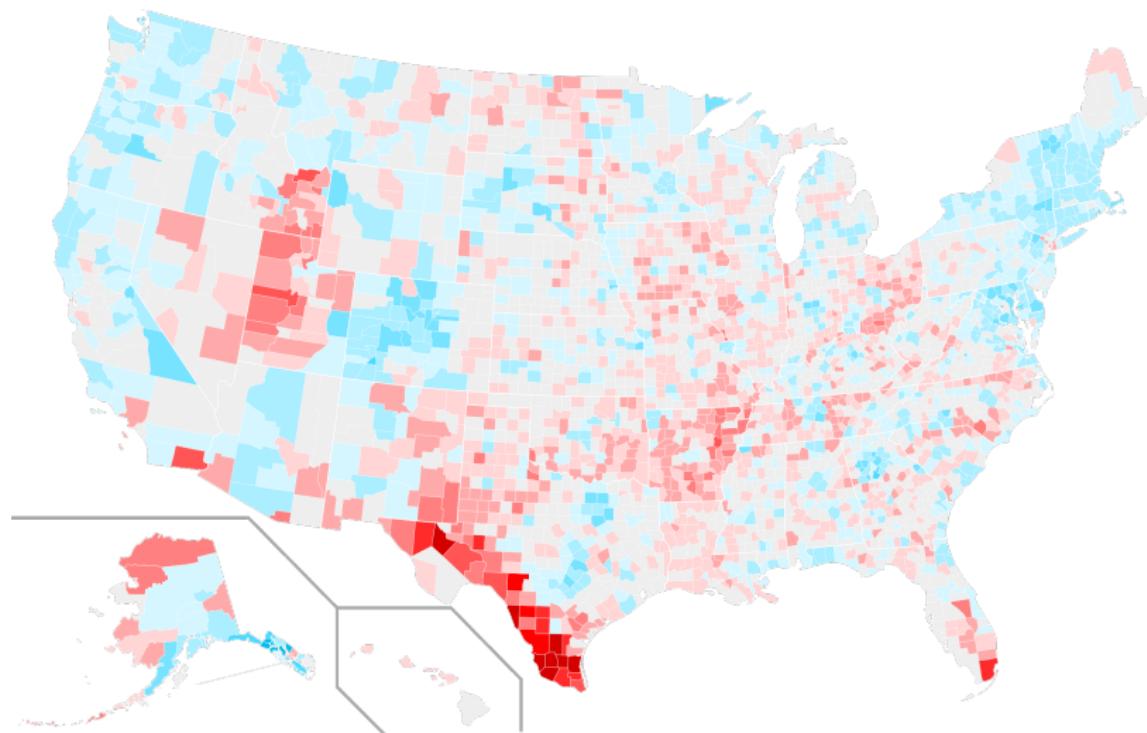


Figure 16: Example: Compare election results (2016 to 2020 swing)

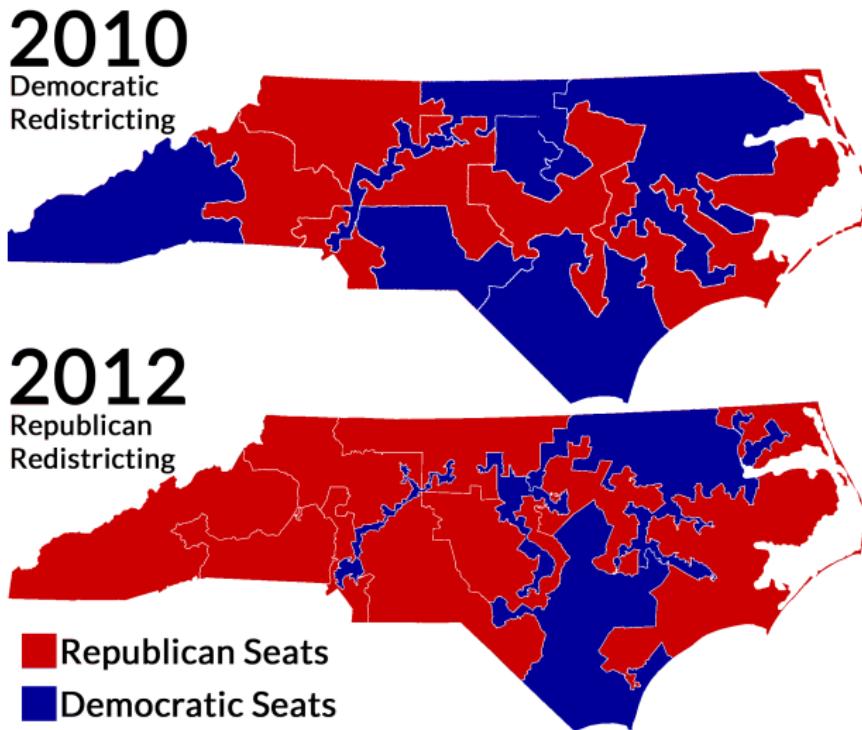


Figure 17: Example: Draw new Congressional districts

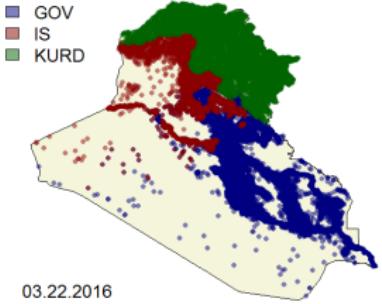


Figure 18: Iraq

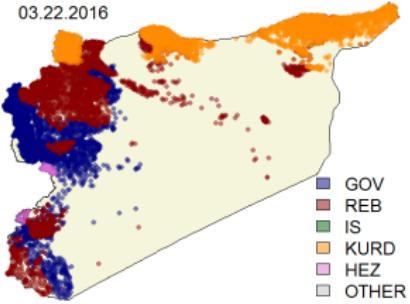


Figure 19: Syria

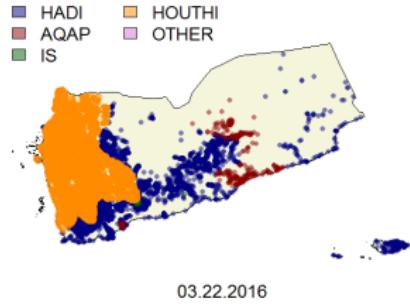


Figure 20: Yemen

Example: Track violence and territorial control in armed conflicts

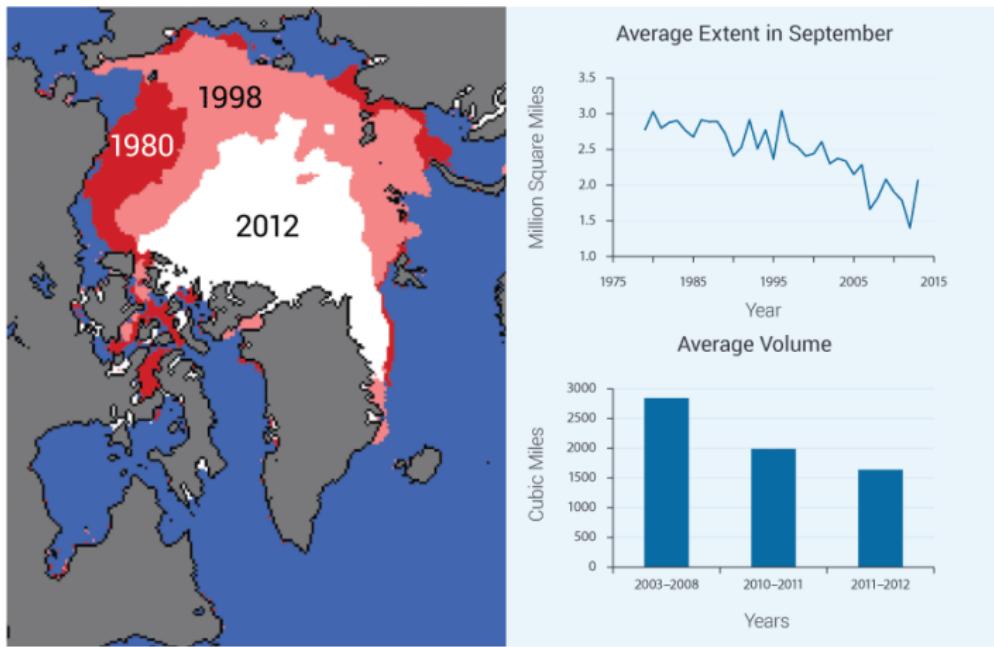


Figure 21: Example: Measure loss of Arctic sea ice



Figure 22: Example: Find your way home

# About the Class

## Goals and Structure

## Goals of the class

1. Introduce basic GIS concepts
2. Provide hands-on experience in using open-source GIS software
3. Find, open and edit geospatial data
4. Visualize geospatial data (make cool maps)
5. Conduct basic geospatial data analyses
6. Create new geospatial data (georeferencing, geocoding)
7. Apply these skills to an original research project



## Who should take this class?

1. Students working on research projects, theses
2. Students interested in data visualization & management
3. Students who want to add new software/programming skills to CV
4. Policy wonks
5. History buffs
6. People who hang antique maps on their walls

No prerequisites!



Figure 23: This could be you

## How will we learn?

1. Methods boot camp
  - a) first half of semester
  - b) weekly lectures (45-75 min)
  - c) weekly computational tutorials
  - d) weekly problem sets
2. Research workshop
  - a) second half of semester
  - b) weekly “walk-throughs” of data collection & analysis on student-selected topics
  - c) no problem sets
  - d) focus 100% on research project



Figure 24: Learn new methods



Figure 25: Apply them to research

## Research “walk-throughs”

### 1. Step-by-step guides

- a) where to find and download data
- b) how to pre-process, integrate the data
- c) how to conduct a very rudimentary analysis of the data

### 2. Options (students select 3 of 10)

- a) agriculture and crop productivity
- b) Congressional redistricting
- c) climate-conflict nexus
- d) crime and policing
- e) international migration
- f) nighttime luminosity
- g) piracy and transnational shipping
- h) political repression
- i) racial and ethnic segregation
- j) Russian-Ukrainian War

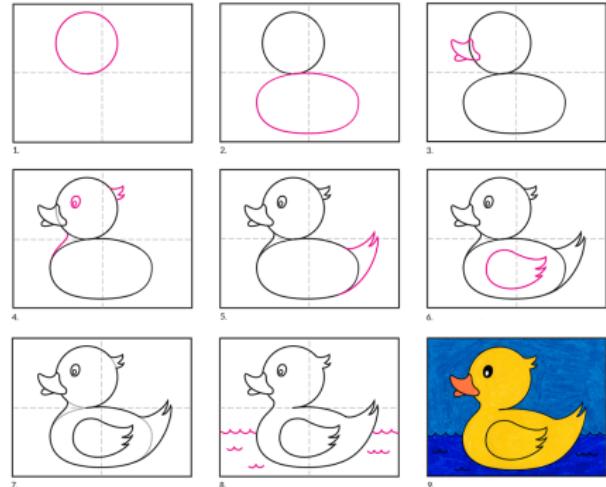


Figure 26: Like this, but for GIS

## Grading

1. Problem sets (40%)
  - a)  $8 \times 5\%$  each
  - b) due no later than 11:59 PM each Sunday
  - c) collaboration encouraged
2. Final project (40%)
  - a) 1-paragraph project abstract
    - due 11:59 PM, 3/8
  - b) 5-minute class presentation
    - 4/23 or 4/25
  - c) 5-7 page report
    - due 11:59 PM, 5/3
3. Attendance & participation (20%)
  - a) show up, ask questions, help others



Figure 27: Don't worry

## Final Project

### 1. Overview

- a) goal: use GIS to answer a *political/social/economic question*
- b) *descriptive question*: answer through mapping & visualization  
(e.g. "Which neighborhoods are the most violent?")
- c) *explanatory question*: answer through analysis of geospatial data  
(e.g. "Why are some neighborhoods more violent than others?")
- d) collaboration/co-authorship permitted

### 2. Project abstract (1 paragraph)

- a) summarize research idea, needed spatial & non-spatial data

### 3. In-class presentation (5 min, 2 slides)

- a) slide 1: Research question
- b) slide 2: Map(s)

### 4. Written report (5-7 pages)

- a) section 1: Research question
- b) section 2: Data & methods
- c) section 3: Preliminary results

# Software

## Software & programming

### 1. QGIS (option 1)

- a) free, open-source alternative to ArcGIS
- b) visualize, manage, edit, analyze spatial data, create maps
- c) intuitive graphical user interface (GUI)
- d) multiplatform (runs on Linux, Mac, Windows, Android)
- e) download it here: [qgis.org](http://qgis.org)

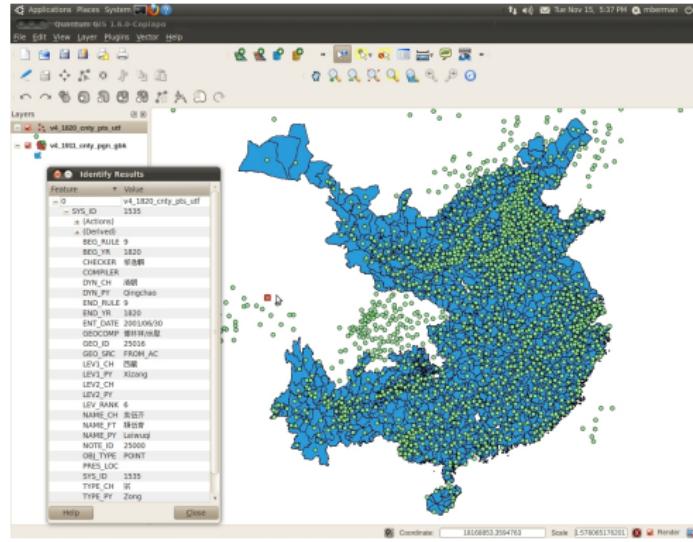
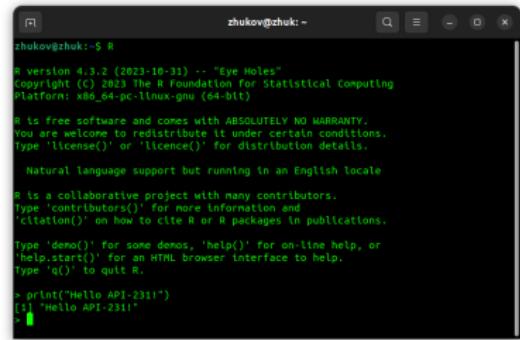


Figure 28: QGIS

## Software & programming

### 2. R (option 2)

- a) open-source statistical programming language
- b) can do (most) of what you can do in QGIS, and lots more
- c) can run R from the command line
  - ... or using source code editor (e.g. Sublime Text, XEmacs)
    - ... or using integrated development environment (e.g. RStudio Cloud)
- d) also multiplatform (runs on Linux, Mac, Windows, Android)
- e) download R here: [r-project.org](http://r-project.org)
  - ... or RStudio here: [posit.co](http://posit.co)



```
zhukov@zhuk:~$ R
R version 4.3.2 (2023-10-31) -- "Eye Holes"
Copyright (C) 2023 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help,
or 'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> print("Hello API-231!")
[1] "Hello API-231!"
>
```

Figure 29: R

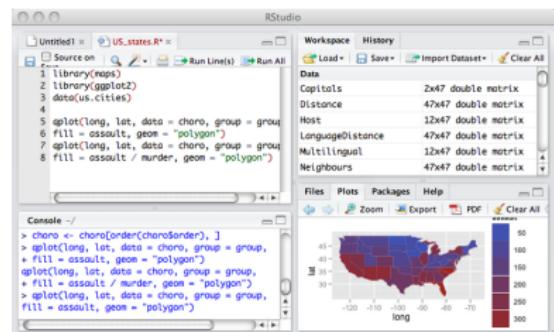


Figure 30: RStudio

## Remember: there are no prerequisites!

- never used QGIS or R?
- never took stats?
- never seen a map?
- no problem

## Help us help you!

- please fill out this survey
- tell us about your research interests and software/programming background  
(even if you have none)
- [tinyurl.com/api231-intro](http://tinyurl.com/api231-intro)



Figure 31: Survey QR Code

## If you're interested...

1. Check out syllabus on Canvas or KNet
  - a) [canvas.harvard.edu/courses/132841](https://canvas.harvard.edu/courses/132841)
2. Send me any course-related questions by email
  - a) [yzhukov@hks.harvard.edu](mailto:yzhukov@hks.harvard.edu)
3. Sign up for my virtual office hours
  - a) [calendly.com/zhukov-hks](https://calendly.com/zhukov-hks)