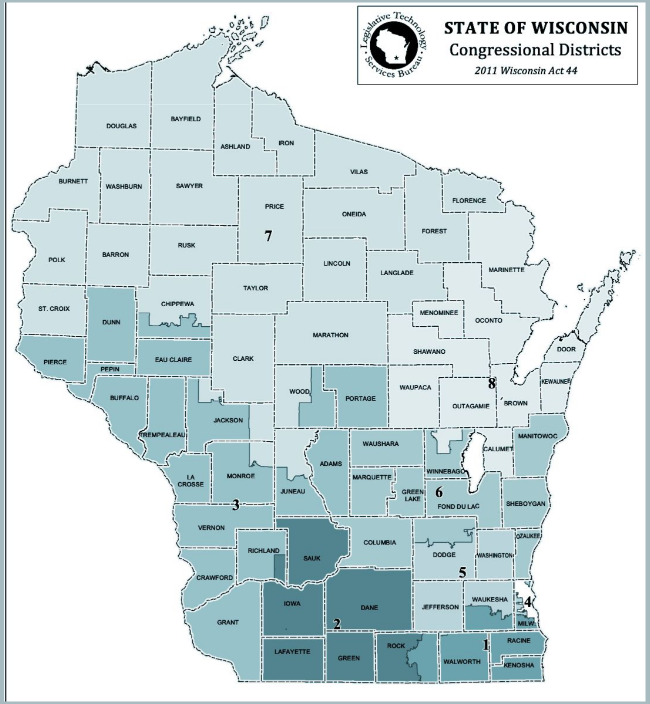
Redistricting



DATA 400

Edie Neuville

Background

➔ States are divided into districts

➔ Wisconsin has 8 congressional districts

➔ Each district elects one representative

➔ Districts must represent equal populations

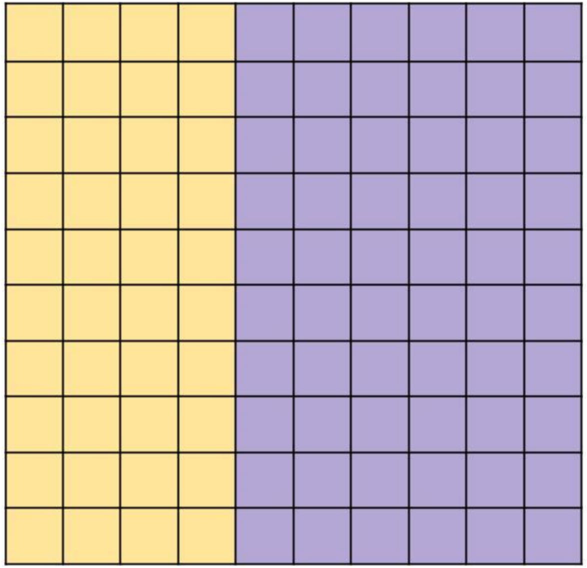
Why Redistrict?

- ➔ Population changes over time
- ➔ Some areas grow, others shrink
- ➔ Redrawn every 10 years after the United States Census
- ➔ Apportionment of representatives

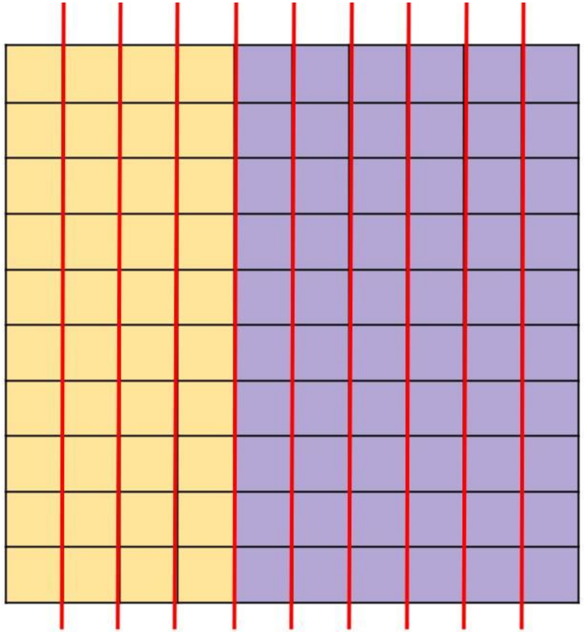
Gerrymandering

- ➔ Drawing districts to favor a party
- ➔ Happens during redistricting

District Lines Matter

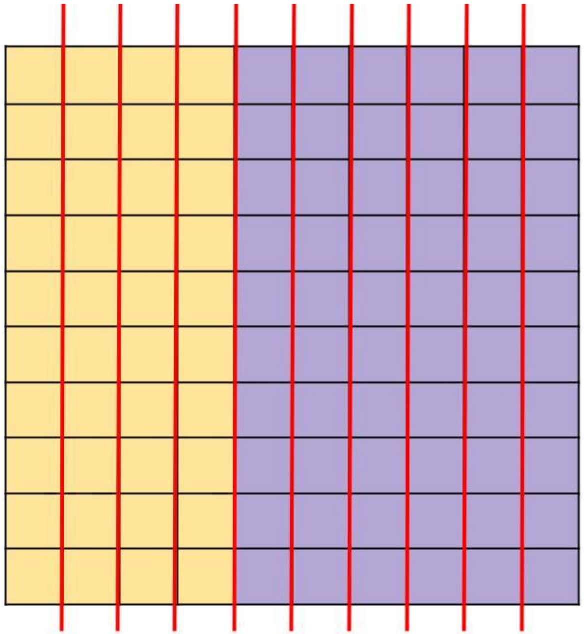


District Lines Matter

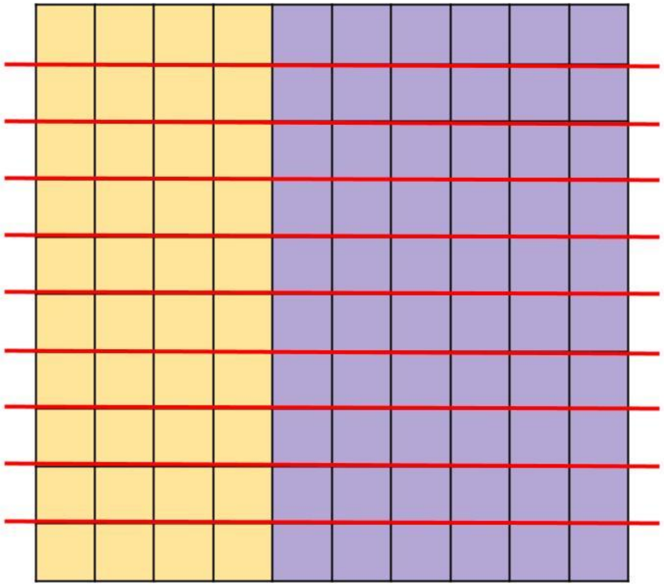


District Lines Matter

4 Yellow Seats
6 Purple Seats

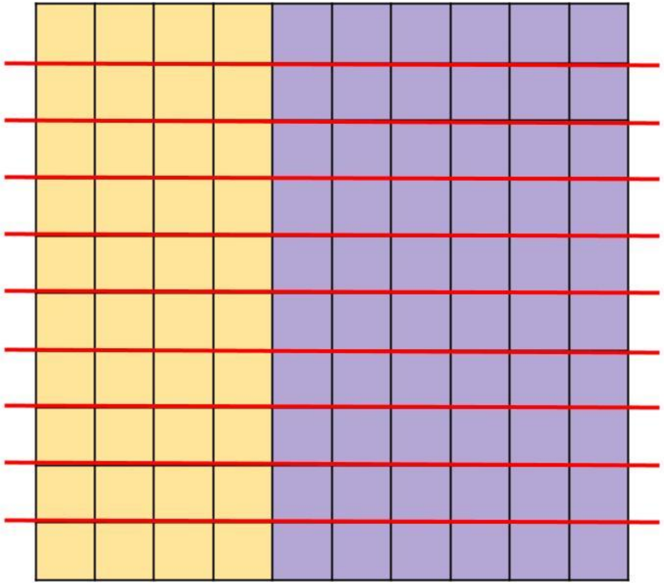


District Lines Matter

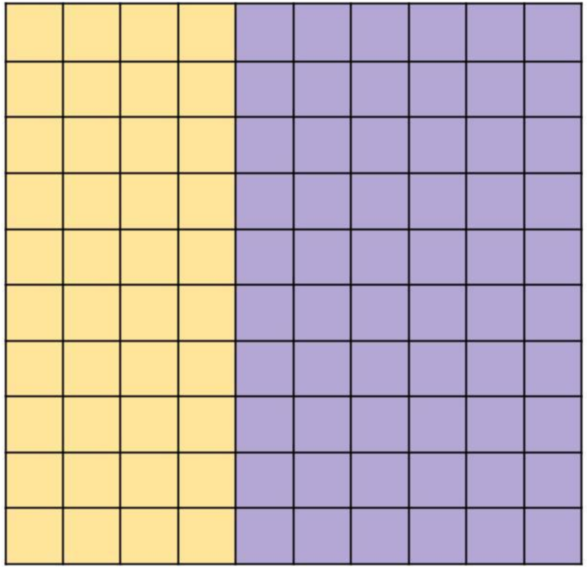


District Lines Matter

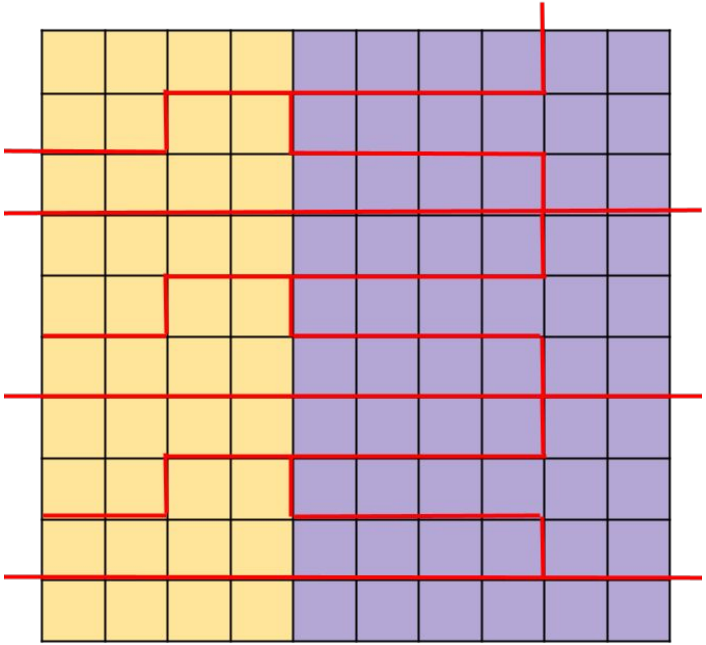
10 Purple Seats - ⅗ Majority Per District



Suppose you are the yellow party..

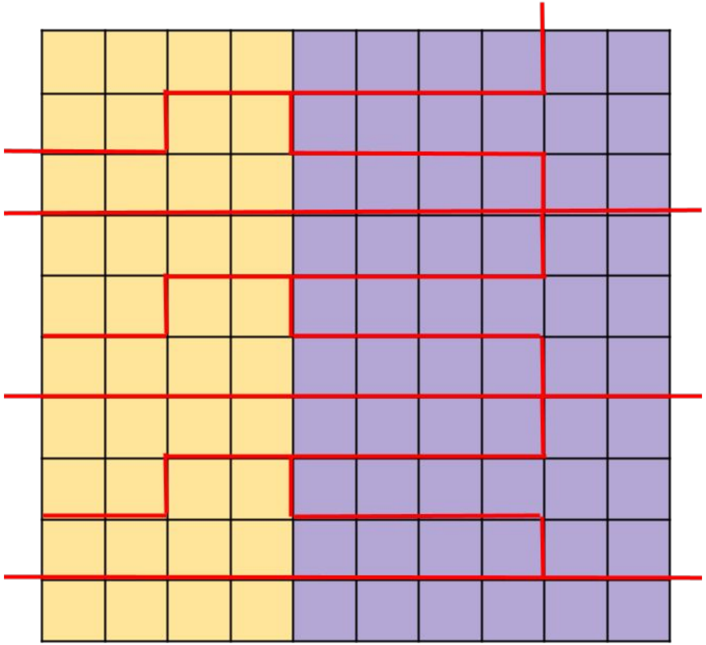


District Lines Matter



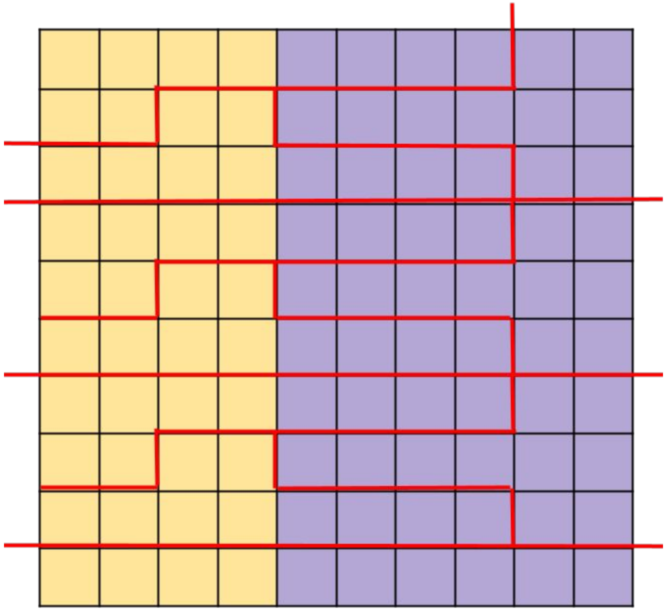
District Lines Matter

6 Yellow Seats
4 Purple Seats

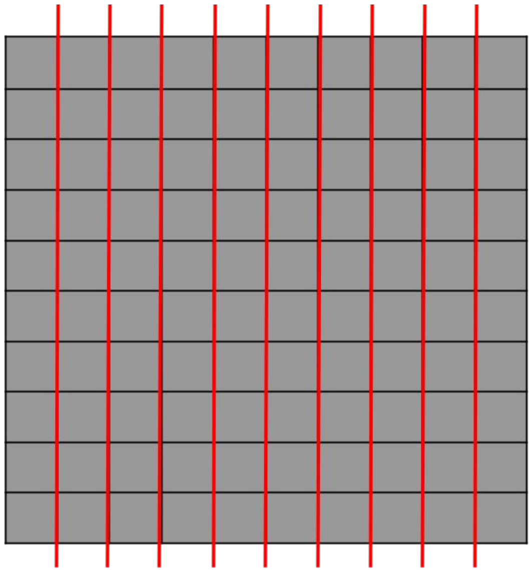


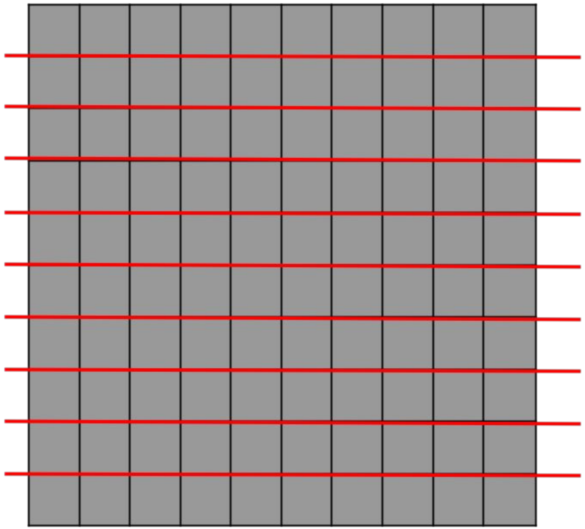
District Lines Matter

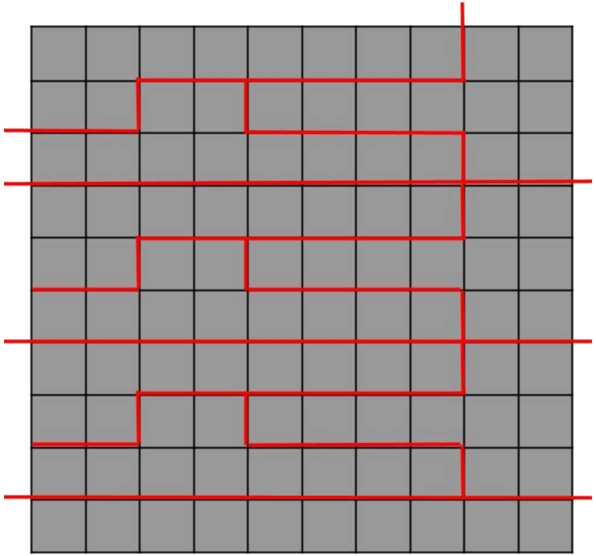
- ➔ Common Gerrymandering strategies:
  - ◆ Packing
  - ◆ Cracking



District Lines Matter







This Project

- ➔ Generate a sample space of possible district maps
  - ◆ Legislature allows for a 1% population tolerance between districts
- ➔ Analyze partisan and demographic outcomes across the distribution

Constraints

01	Districts must be contiguous
02	Population must be balanced across districts
03	Districts should resemble something human would draw

Method Description

01 Start with a district map

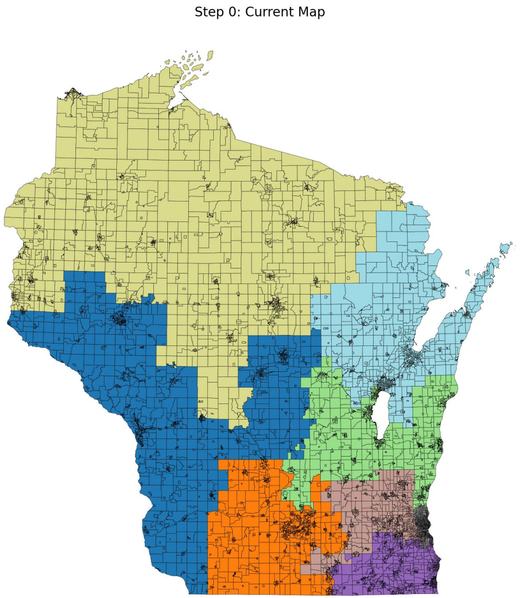
02 Merge two adjacent districts

03 Split the merged district in a new way

04 Repeat steps 2 and 3

Example

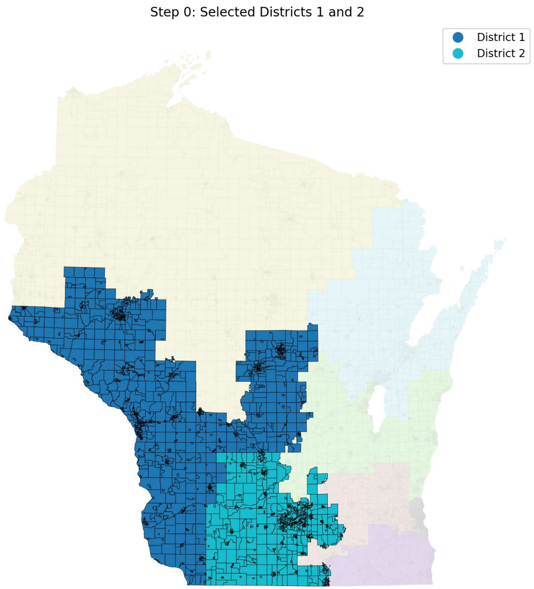
➔ Start with an existing district map



Example

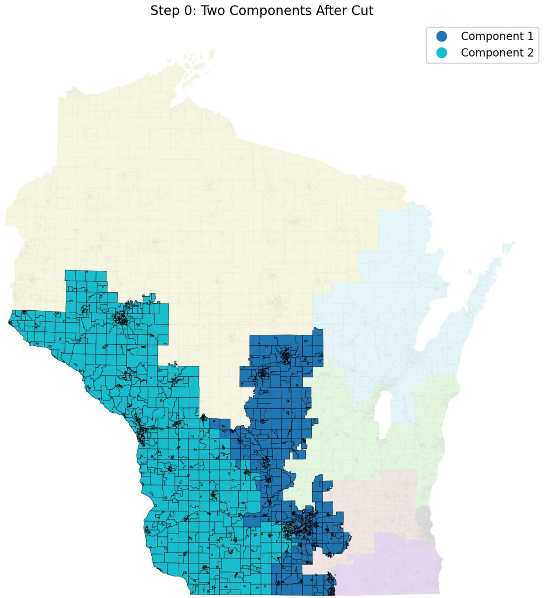
➔ Randomly select two adjacent districts

➔ Combine them into one large district



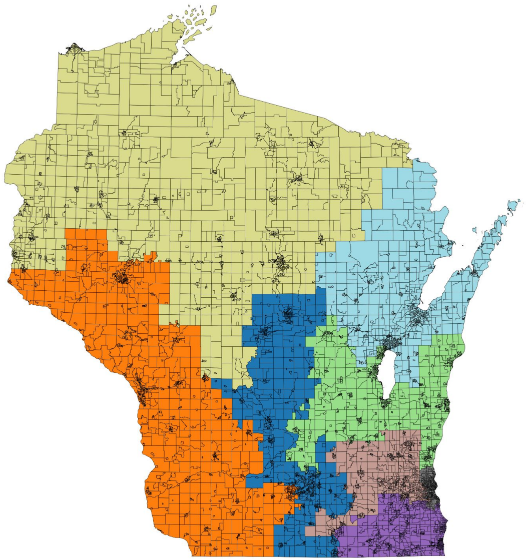
Example

➔ Split the merged district in a new way

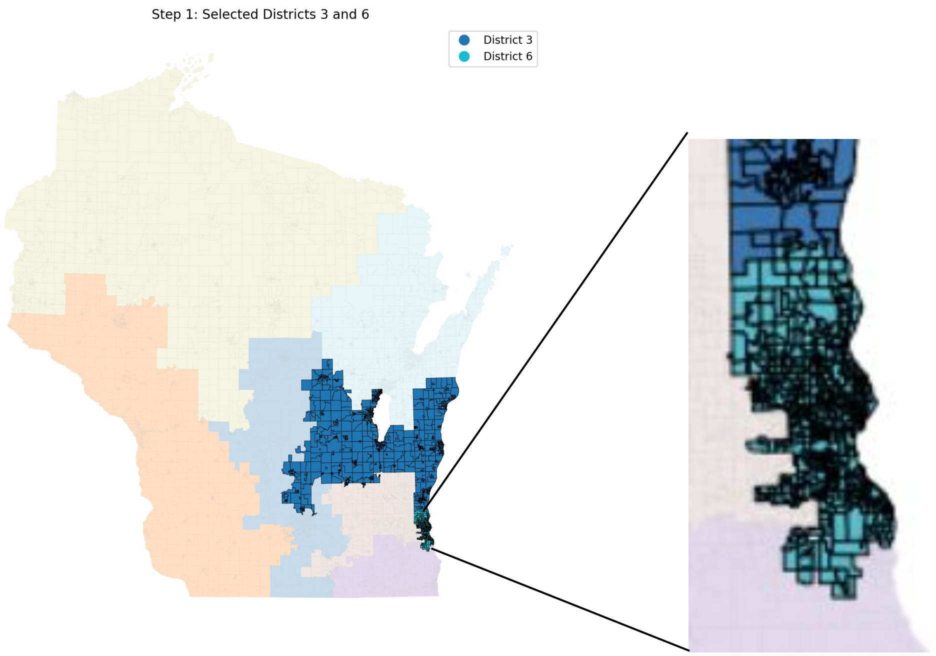


Example

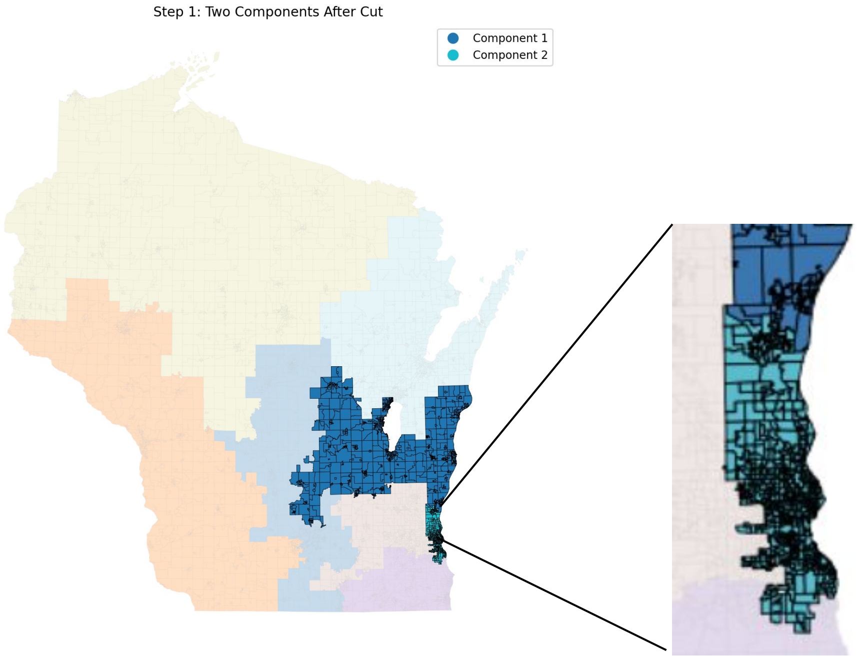
Step 0: After ReCom



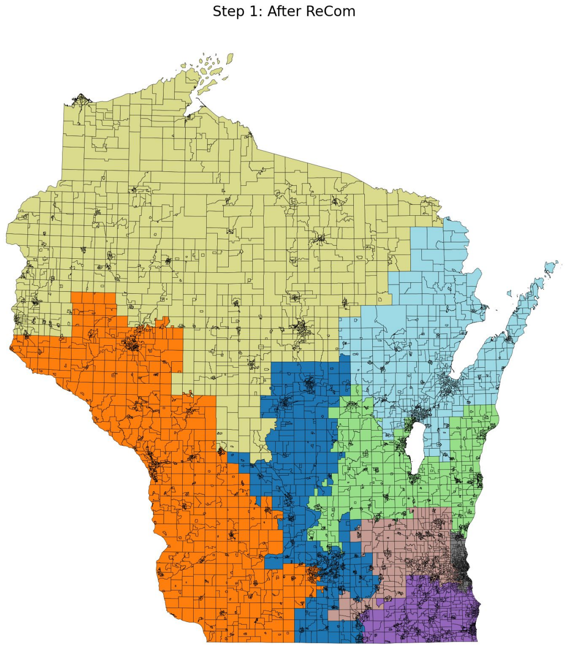
Example



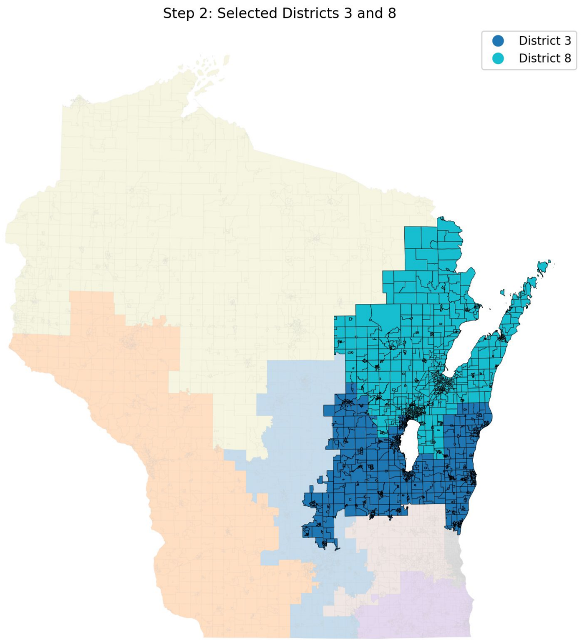
Example



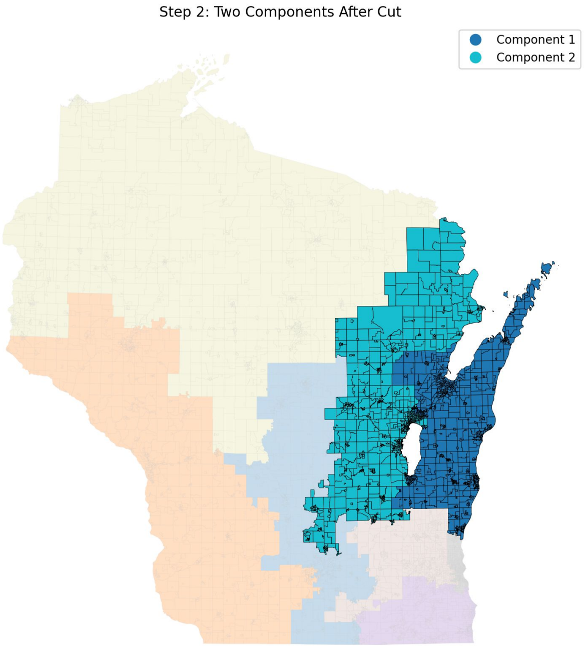
Example



Example

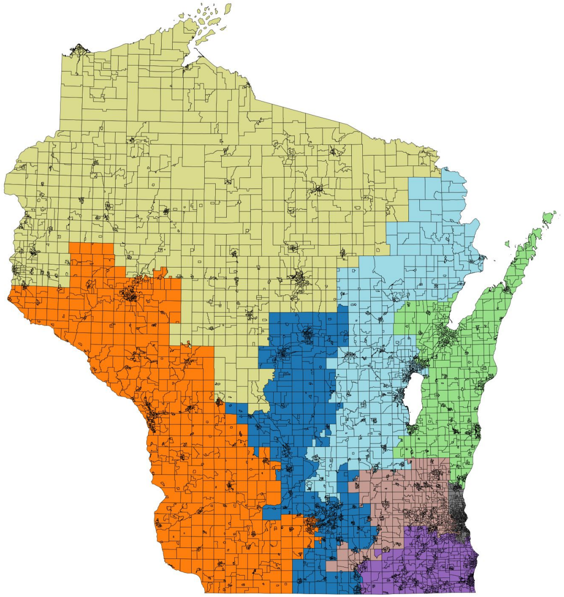


Example



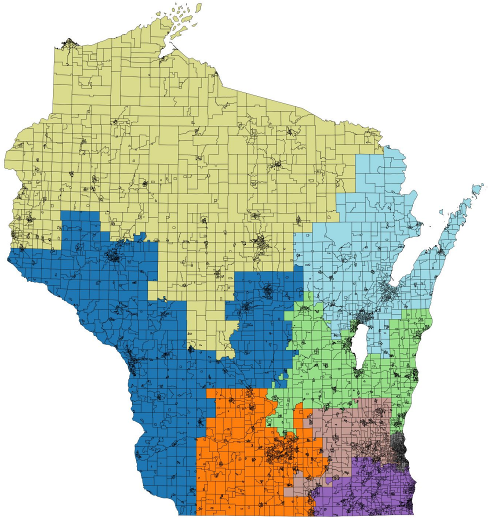
Example

Step 2: After ReCom

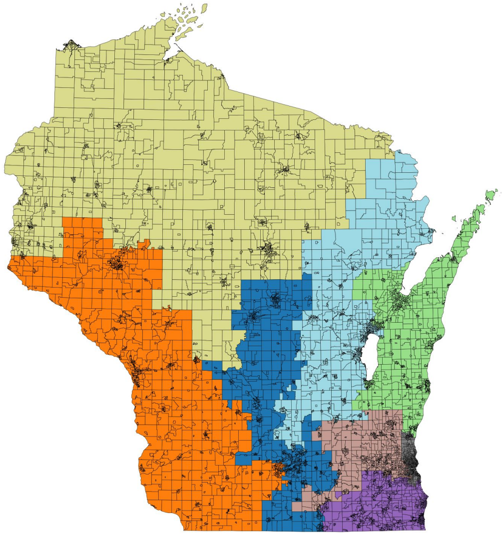


3 ReCom Steps

Before



After



Simulation

- ➔ Use the the algorithm described to create 1,500 maps
- ➔ Each map uses the prior map as it’s initial state
- ➔ 1% population difference allowed between districts
- ➔ 10 accepted ReCom steps between maps
  - ◆ 15,000 total ReCom steps

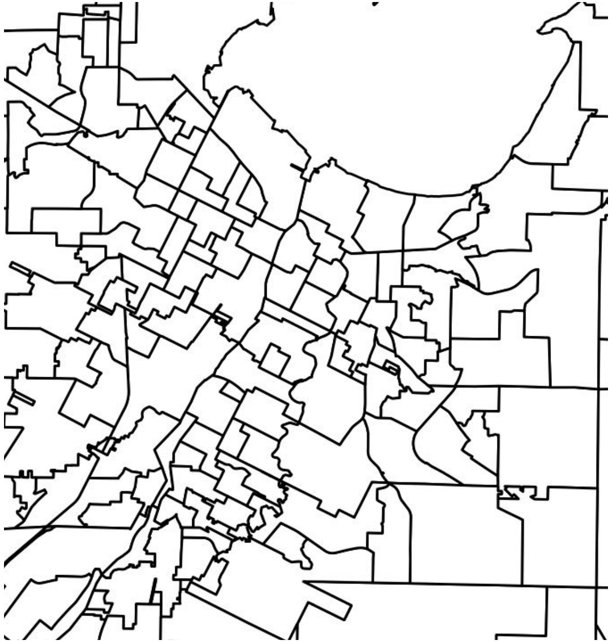
Method Description

01	Build an adjacency graph on WI wards
02	Merge two adjacent districts
03	Construct a spanning tree
04	Randomly cut an edge that produces equal components
05	Repeat

01 Build an Adjacency Graph

Smallest Geographic Unit

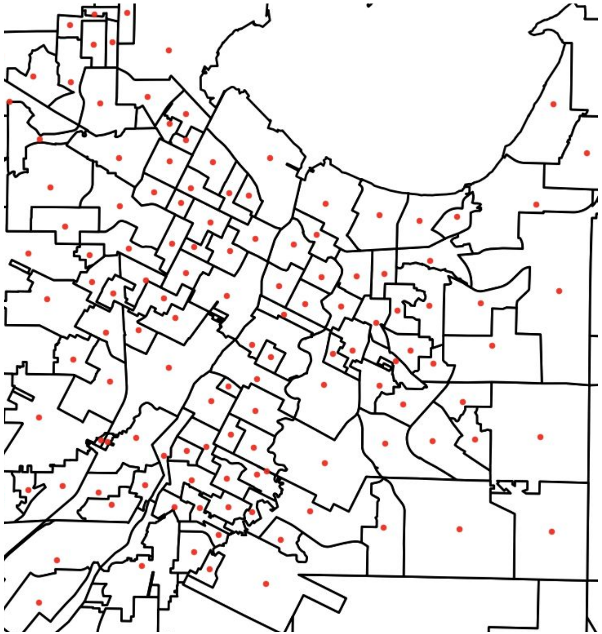
➔ Municipal Wards



Adjacency Graph on Green Bay

01 Build an Adjacency Graph

➔ Vertices = wards



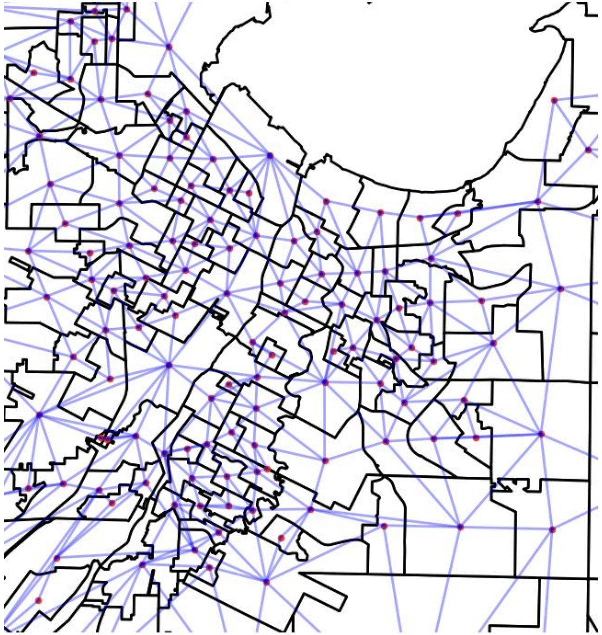
Adjacency Graph on Green Bay

01 Build an Adjacency Graph

➔ Vertices = wards

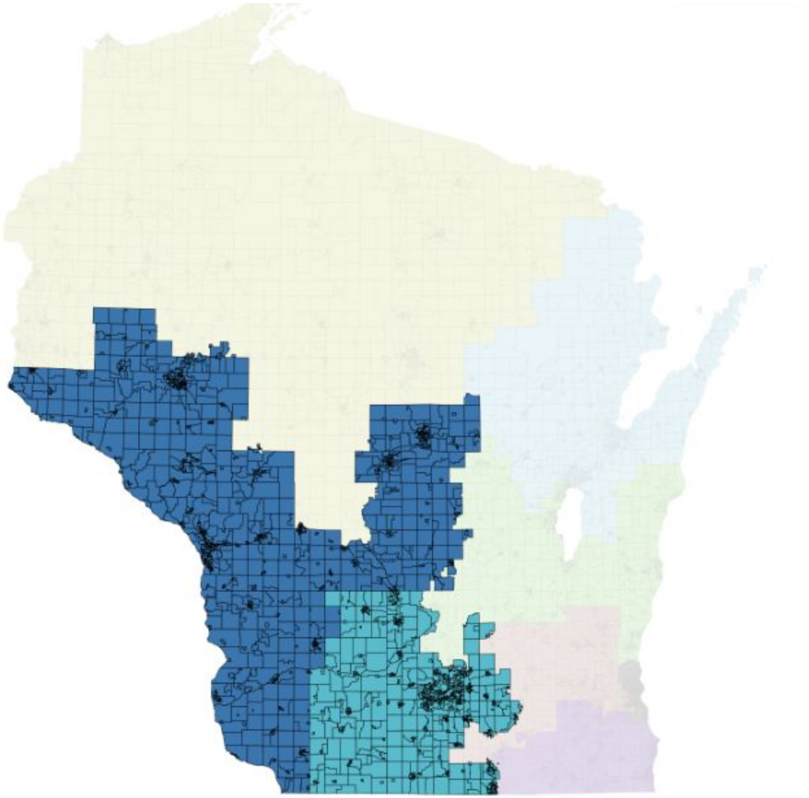
➔ Edges connect adjacent wards

- ◆ Adjacent wards must share a non-diagonal border



Adjacency Graph on Green Bay

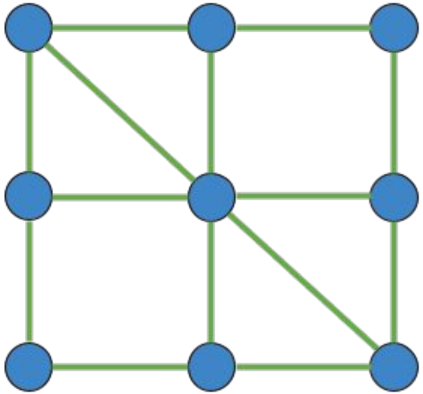
02 Merge Adjacent districts



Redistricting WI

03 Construct a Spanning tree

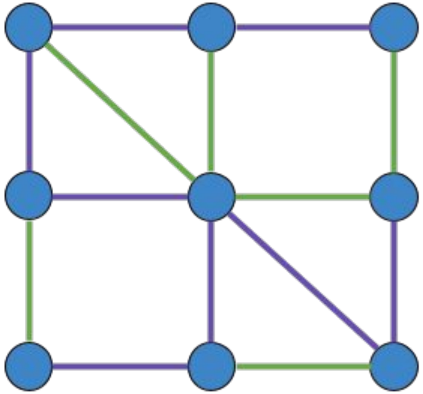
What is a Spanning tree?



03 Construct a Spanning tree

What is a Spanning tree?

➔ Connects all vertices in the graph

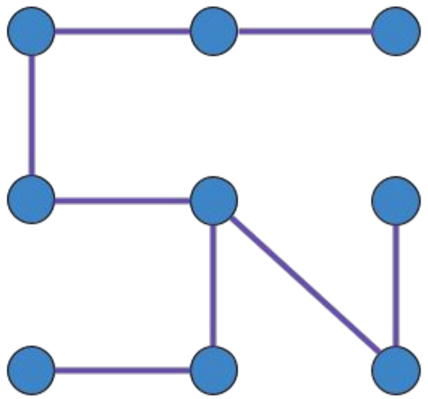


03 Construct a Spanning tree

What is a Spanning tree?

➔ Connects all vertices graph

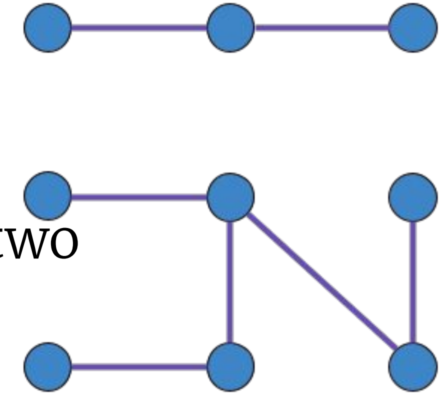
➔ Minimally connected



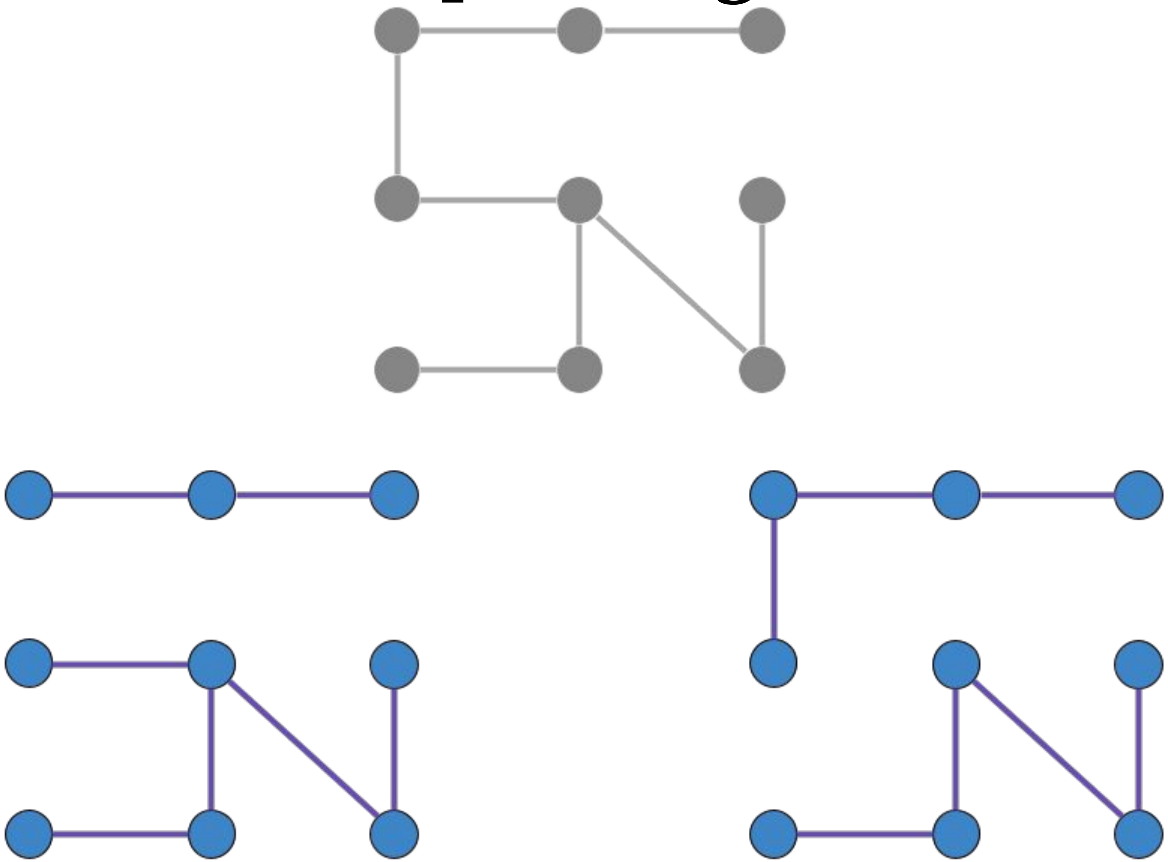
03 Construct a Spanning tree

What is a Spanning tree?

- ➔ Connects all vertices graph
- ➔ Minimally connected
  - ◆ Removing any edge splits the tree into two parts

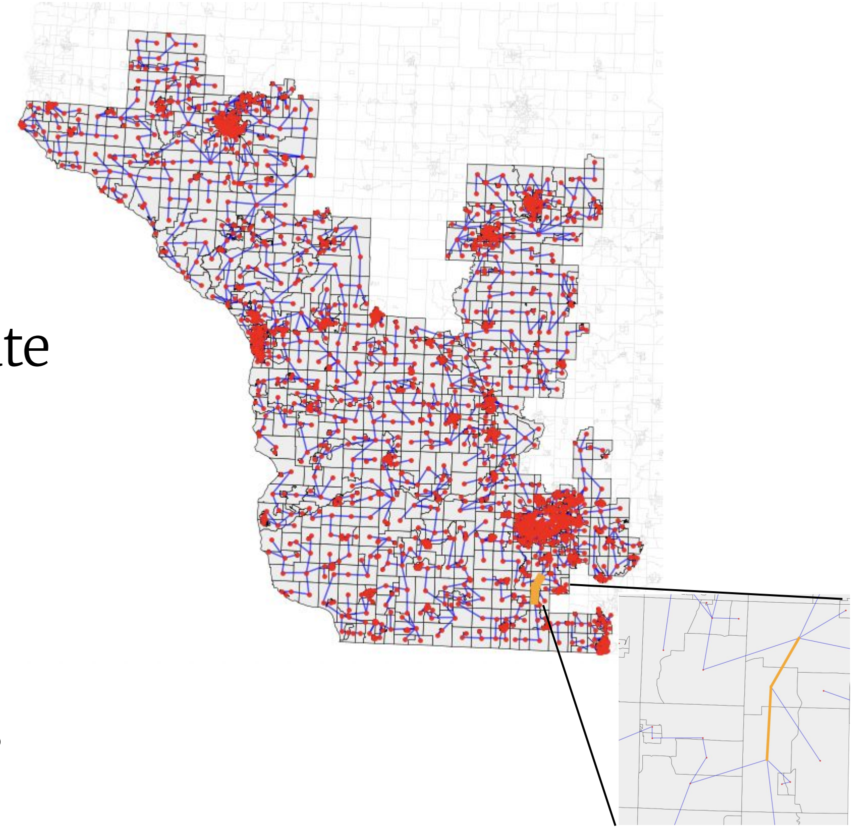


03 Construct a Spanning tree



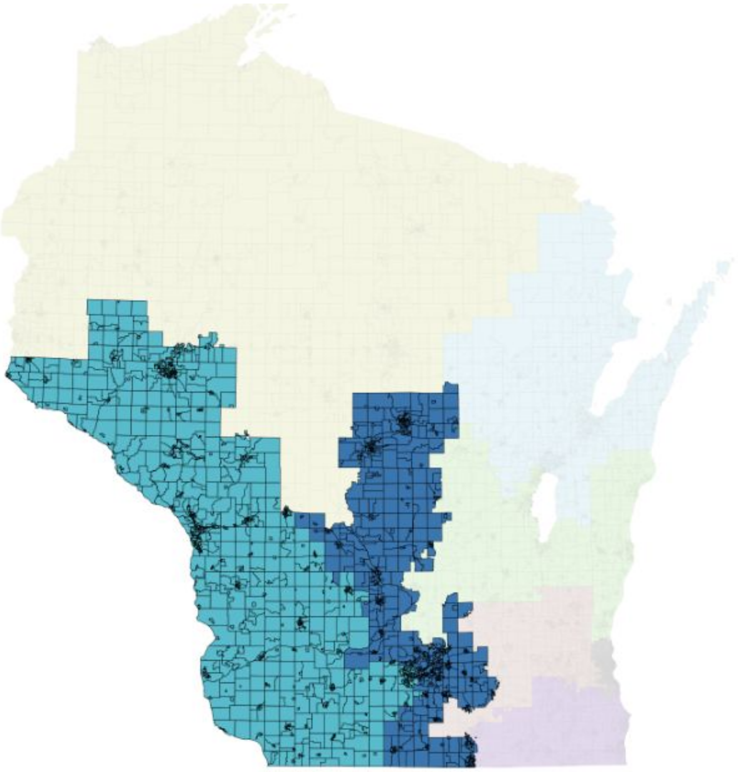
03.2 Construct a Spanning tree

- ➔ Use Wilson's algorithm to generate a spanning tree
  - ◆ Equally likely to generate any spanning tree
- ➔ Save cut edges that would produce equal components

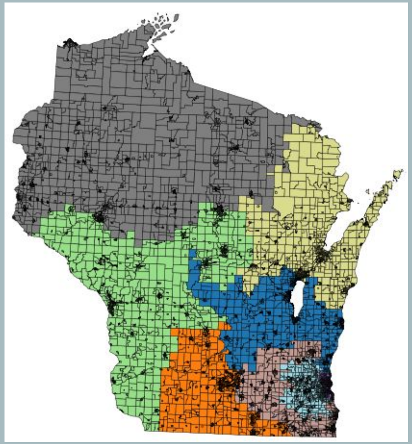


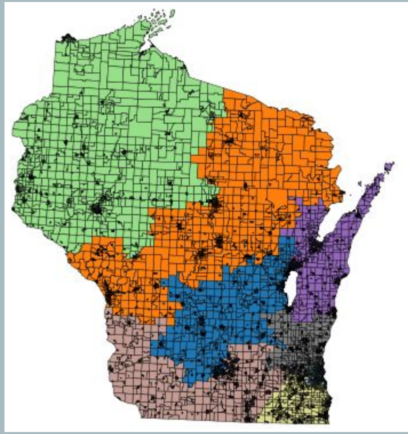
04 Cut an Edge that Produces Equal Components

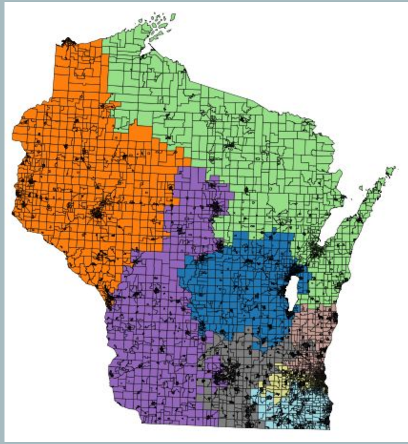
- ➔ Randomly select a valid cut edge from the set
- ➔ Celebrate; New districts have been draw!

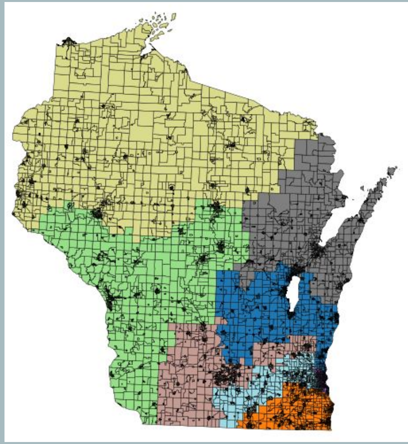


Gallery









The Data

2020 Shapefile compiled by MIT

➔ Ward level vote counts

- Presidential 2012, 2016
- Gubernatorial 2012, 2014, 2018
- Senatorial 2012, 2016, 2018
- US House 2012, 2014, 2016, 2018

➔ Ward level racial demographics

Map Distribution

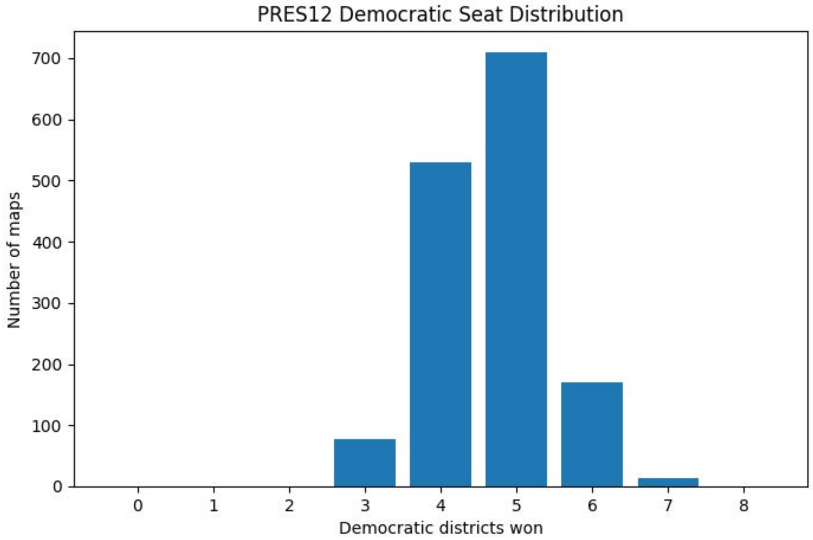
Presidential Elections as a proxy

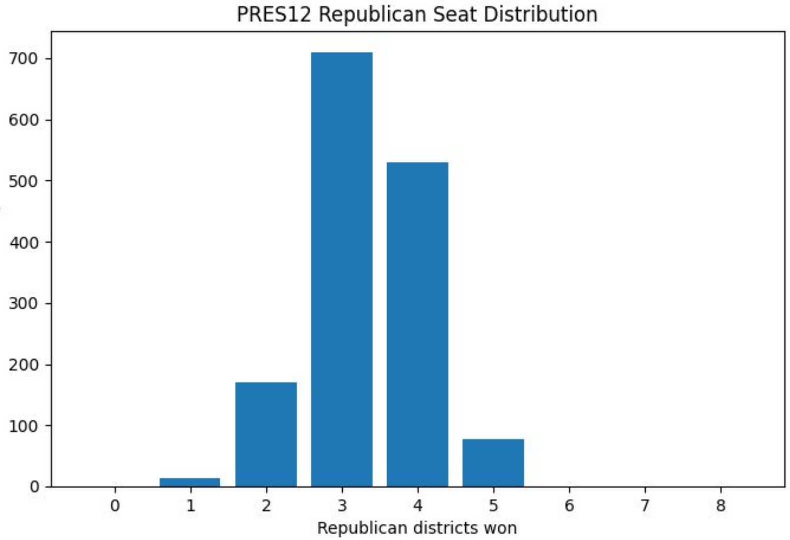
- ➔ Contested
- ➔ Typically the best voter turnout

See other elections on my webpage!

2012

✔ Barack Obama	Dem.	1,613,950
Mitt Romney	Rep.	1,408,746





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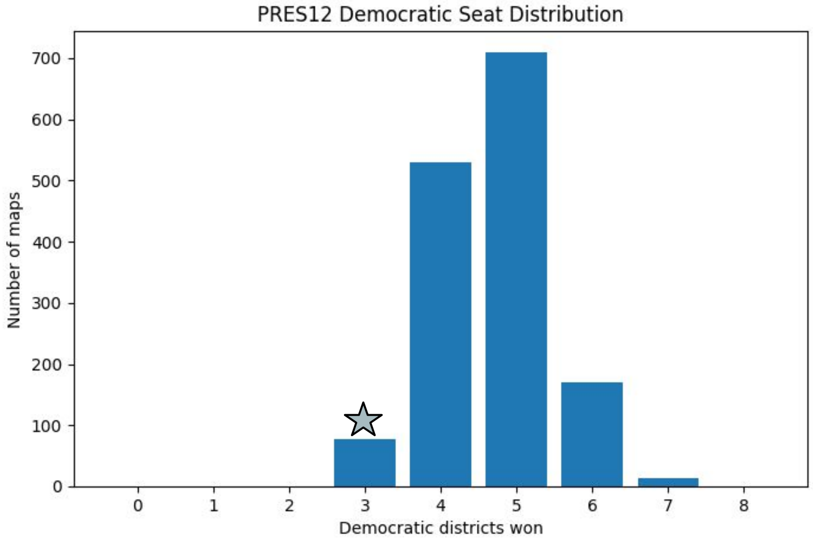
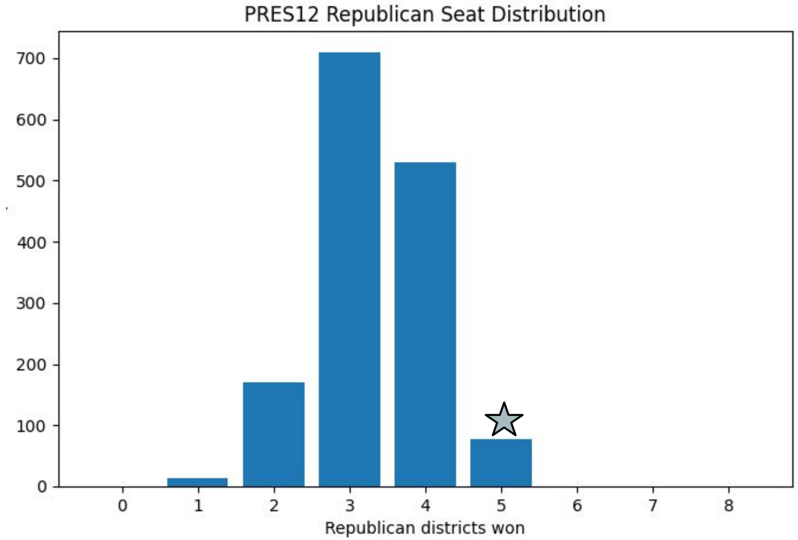
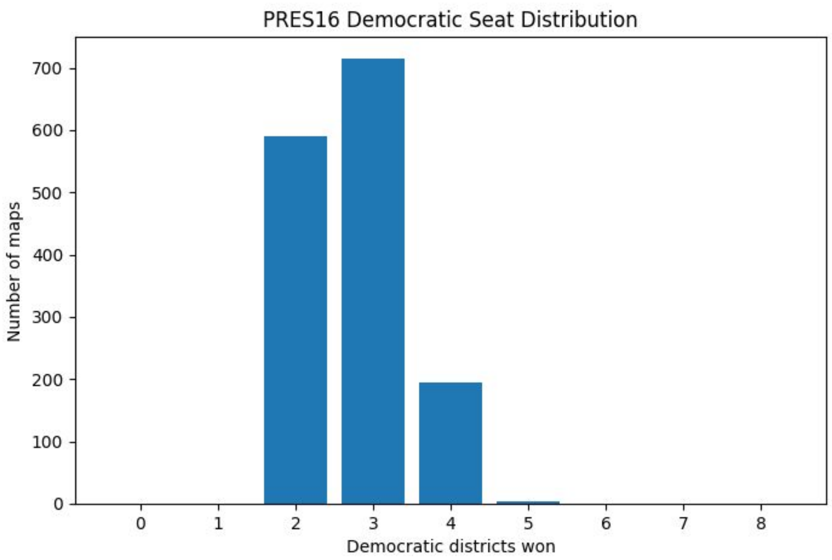


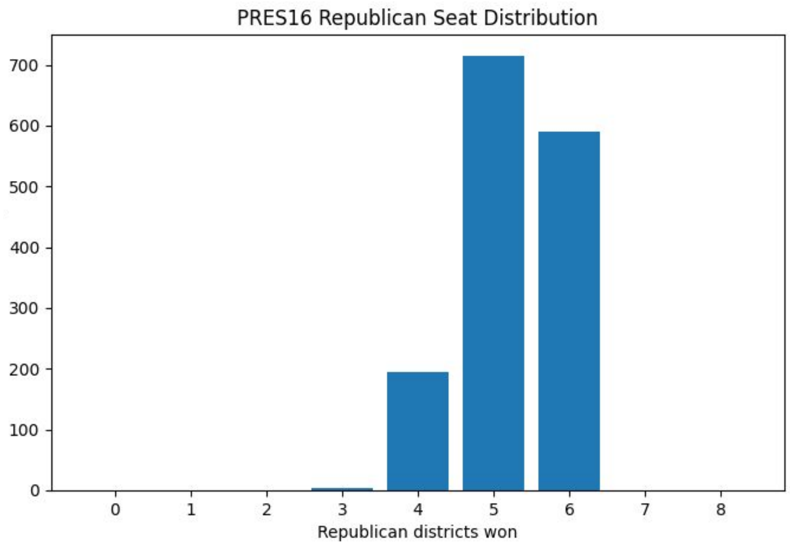


	Party	After the 2012 Election
	Democratic Party	3
	Republican Party	**5**

2016

✔ Donald J. Trump	Republican	1,405,284
Hillary Clinton	Democrat	1,382,536





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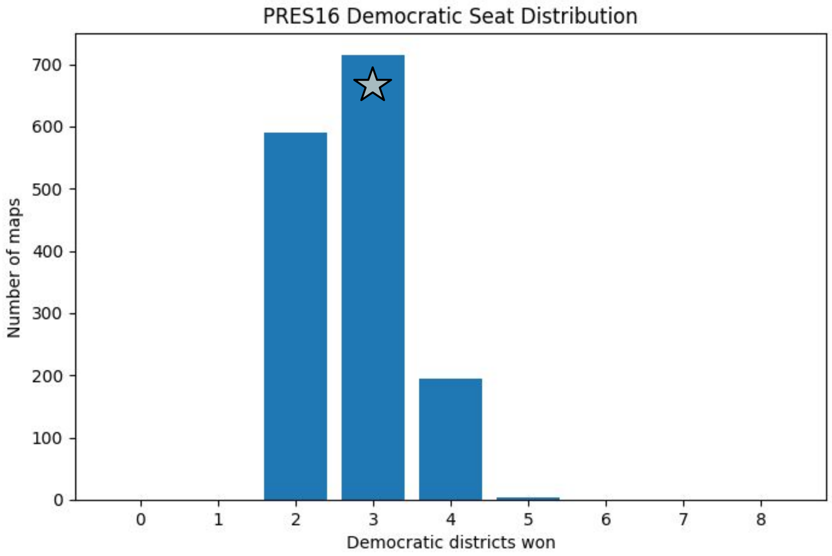
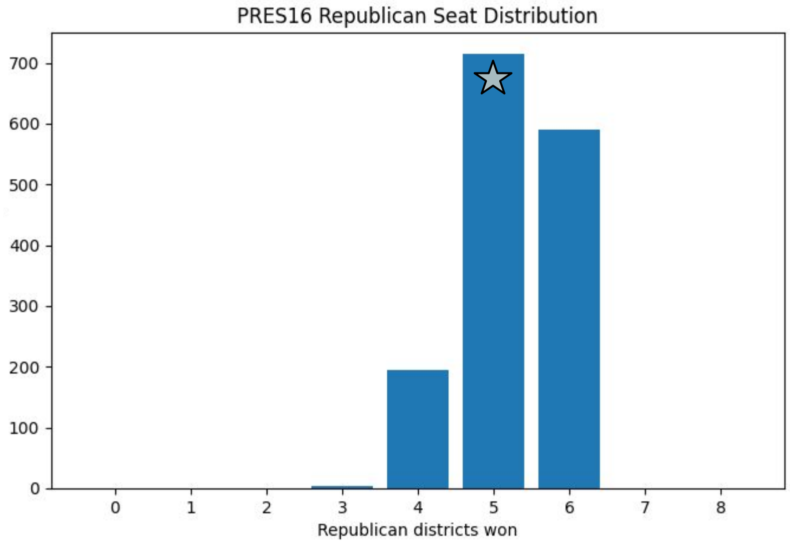
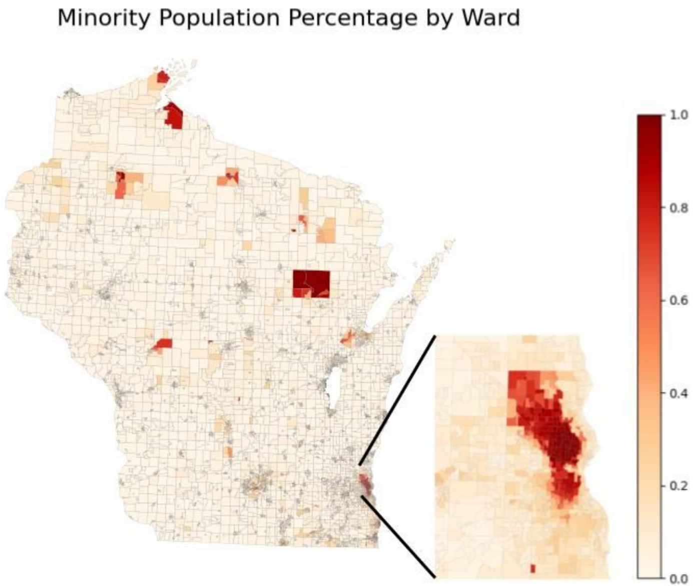




Party		After the 2016 Election
	Democratic Party	3
	Republican Party	**5**

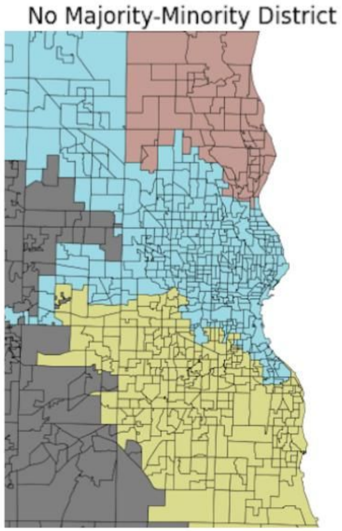
Majority-Minority Districts

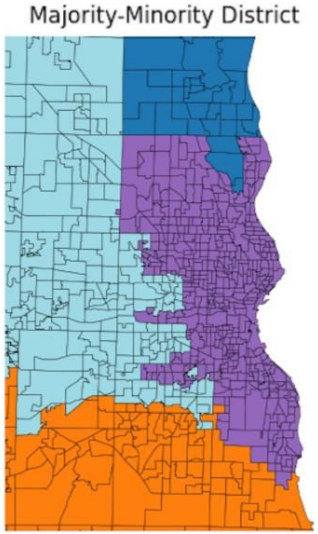
- ➔ The Voting Rights Act says that when possible, a majority-minority district *should* be created
- ➔ Minority population = total population - white population



It is Possible

- ➔ 449/1500 maps had a Majority-Minority district ≈30%
- ➔ At most 1 per map
- ➔ Centered around densely populated areas of Milwaukee





Takeaways

- ➔ District boundaries matter more than you think
- ➔ There is no single “correct” map
- ➔ Algorithms reveal hidden bias

Extensions

- ➔ Assembly districts
- ➔ Newer shapefiles with an updated census
- ➔ More ReCom steps

Thank You