Redistricting technology through the ages

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CENTER FOR DEMOCRACY & TECHNOLOGY

The modern era of redistricting, 1971–

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- pre-computer age **1971–1990**

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- PC age **1991–2010**

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The modern era of redistricting, 1971–

- pre-computer* age **1971–1990**
- PC age **1991–2010**
- Internet age **2011–**

*(mostly)

Census tabulation

1790–1870

Source: U.S. Census Bureau

Census tabulation

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“Clerks who made tally marks or added columns of figures with a pen or a pencil.”

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Census tabulation

1790–1870

“Clerks who made tally marks or added columns of figures with a pen or a pencil.”

1880

“A tabulating machine: a wooden box in which a roll of paper was threaded past an opening where a clerk marked the tallies in various columns and then added up the marks.”

Source: U.S. Census Bureau

Census tabulation

1890–1940

Hollerith machine

Source: Computer History Museum

Census tabulation

1951

UNIVAC I computer

Source: U.S. Census Bureau

1971: Very little computerization

- Perhaps only CA, DE, IA, GA, WA use computers.
- Census small geographies were not very useful.

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1975: PL94-171

- 1975: Congress passes PL94-171 to allow states to work with the Census on geographies. NCSL plays key role in getting it passed.

1981

- Census data not perfect, but much better than 1971.
- Even for the states that did use computers, incredibly labor-intensive process.

Let’s draw some districts!

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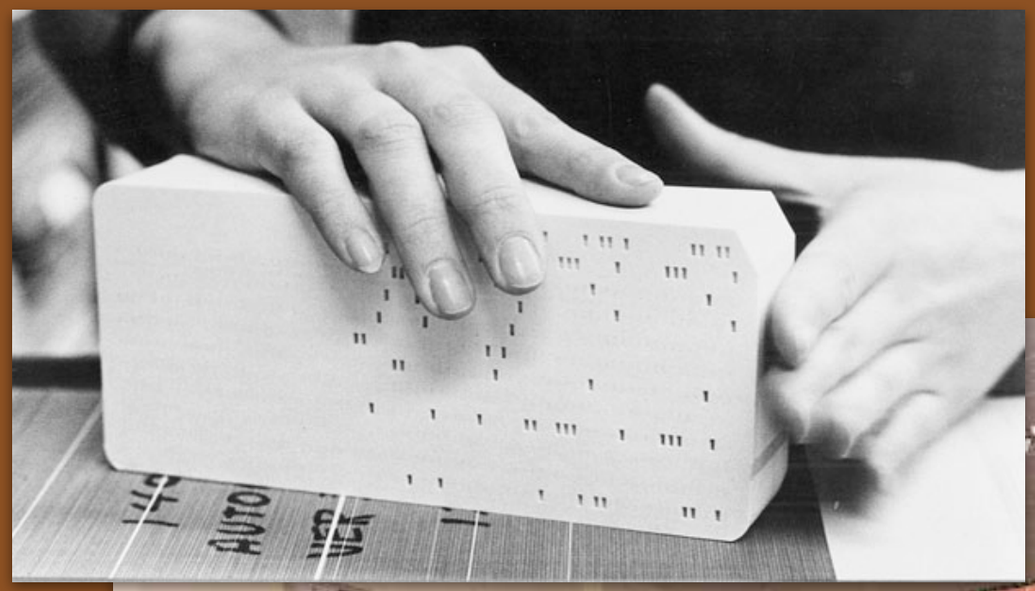

Step 1. Receive data from the Census

Tract	POP	CVAP	BVAP
1	6118	4894	1835
2	3324	2659	997
3	589	471	177
4	8251	6601	2475
5	9749	7799	2925
6	4319	3455	1296
7	1155	924	347
8	6355	5084	1907
...	...	...	...

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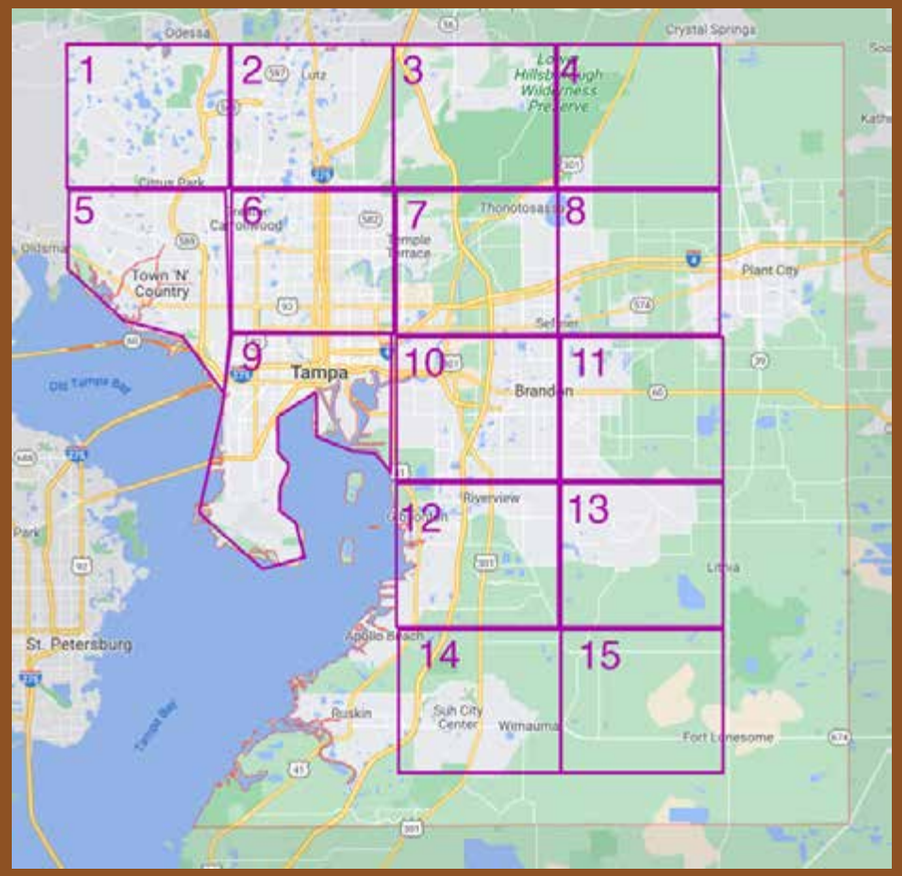
Step 2. Print out a really big map.



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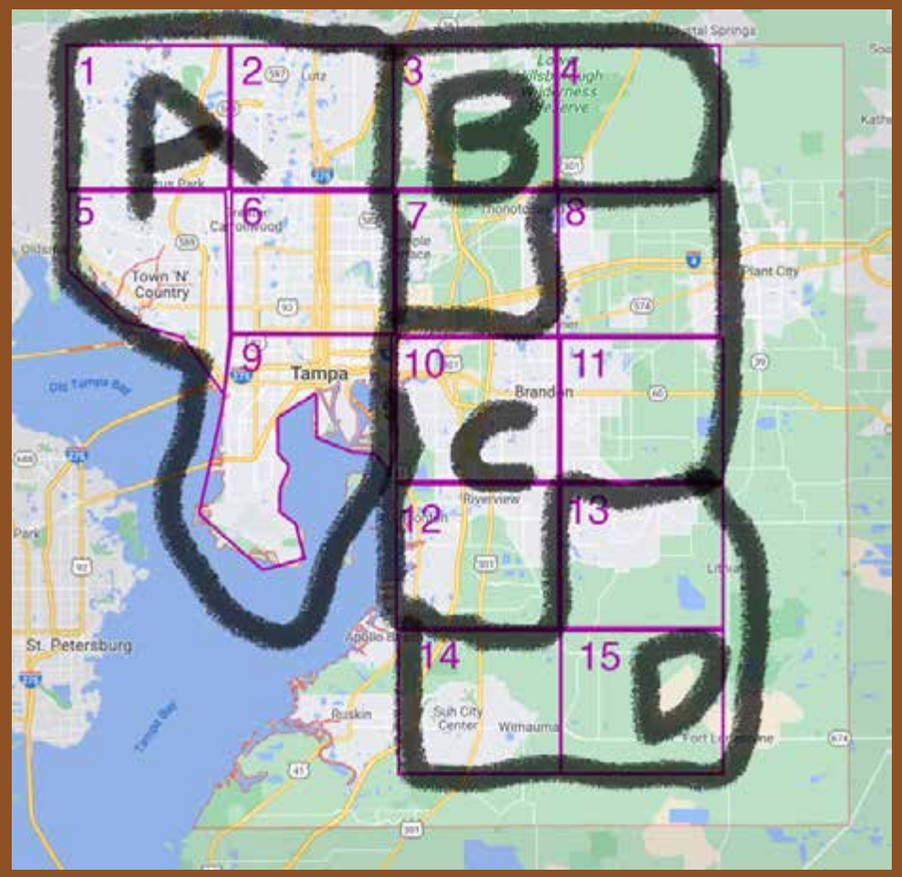
Step 3. Crawl around on your hands and knees with dry erase markers, drawing districts on acetate.



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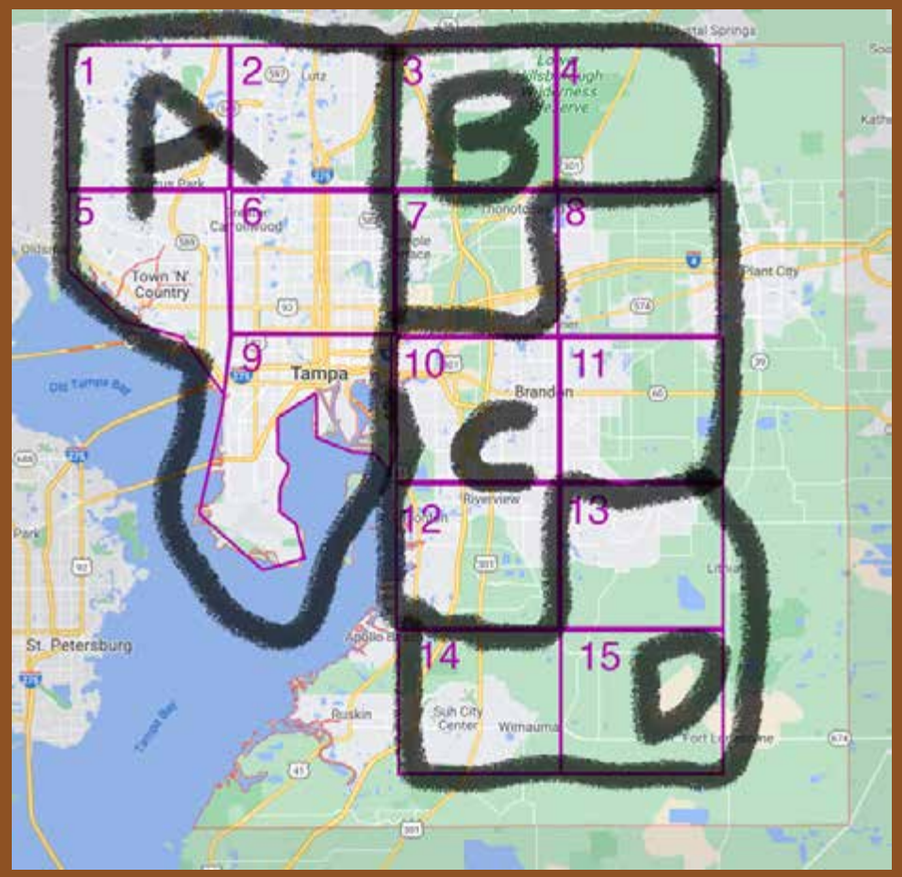

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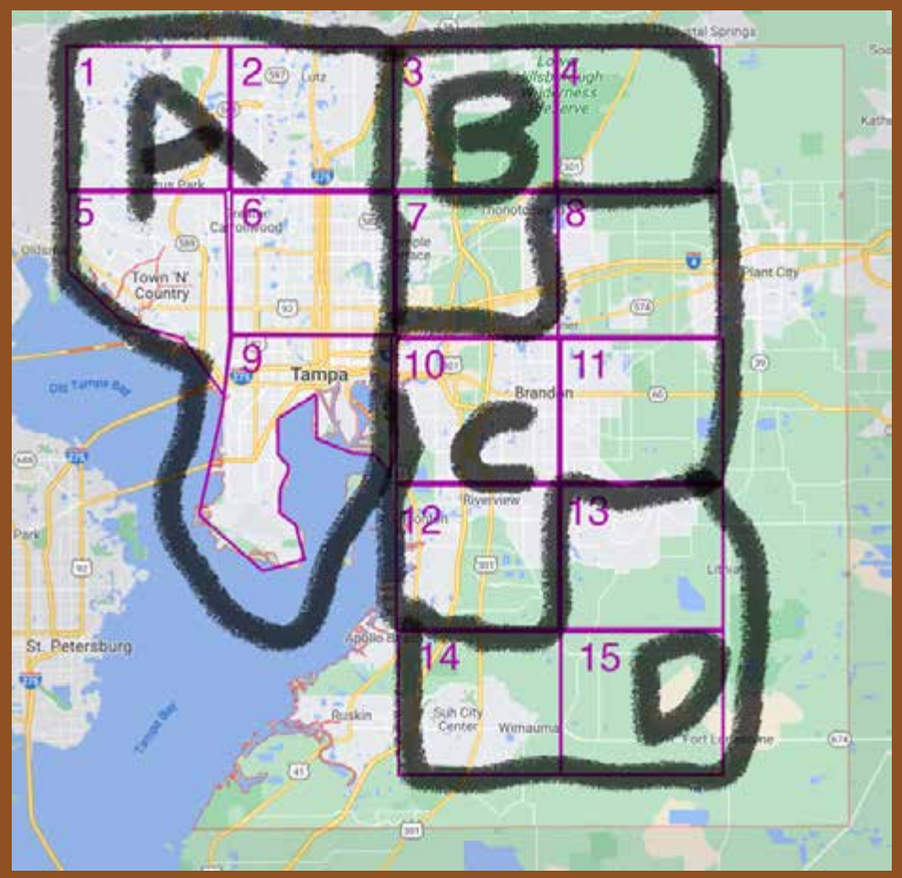

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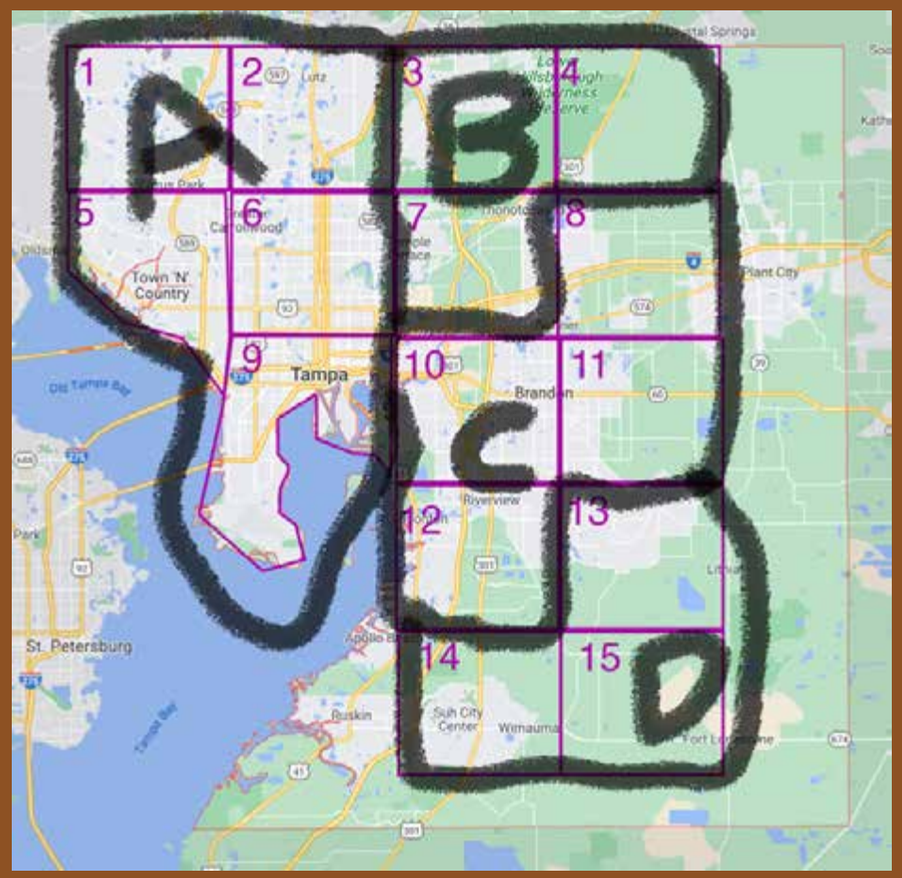

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Step 6. Pick up your report.

District	POP	CVAP	BVAP
A	**25,910**	20,728	7,773
B	**1,410**	1,128	423
C	**2,909**	2,327	873
D	**32,809**	26,247	9,843

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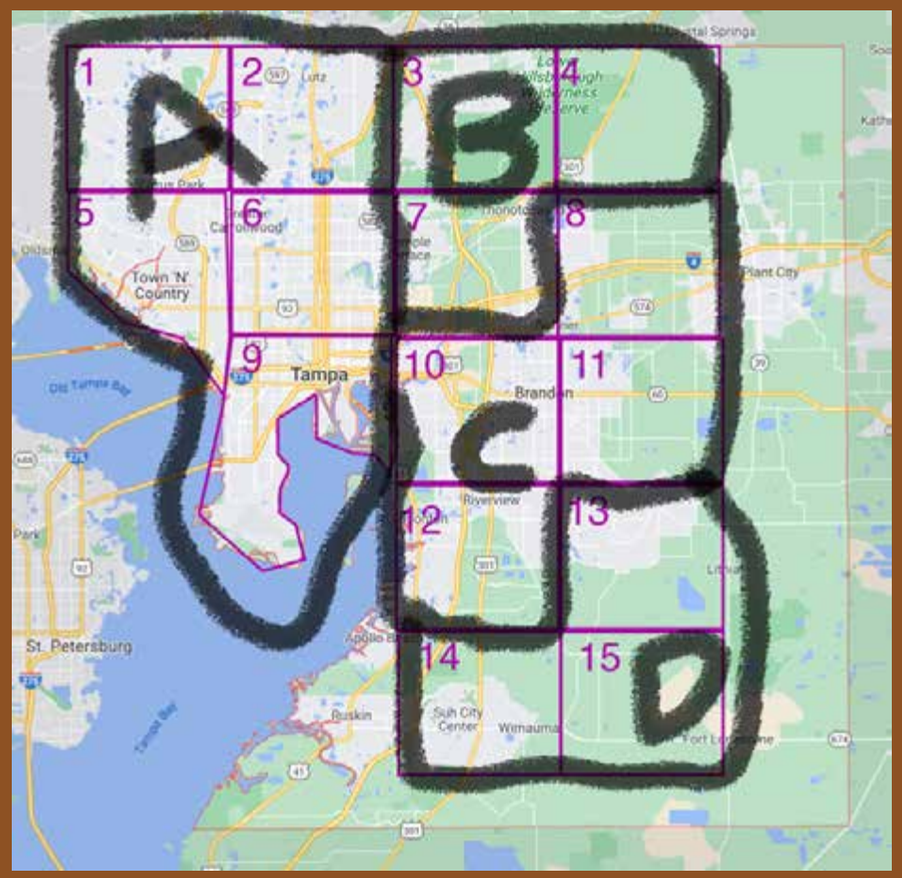

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Step 7. Did you achieve your objectives? No? Go back to step 2.

1981

Source: KXAS-TV

1981

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1981

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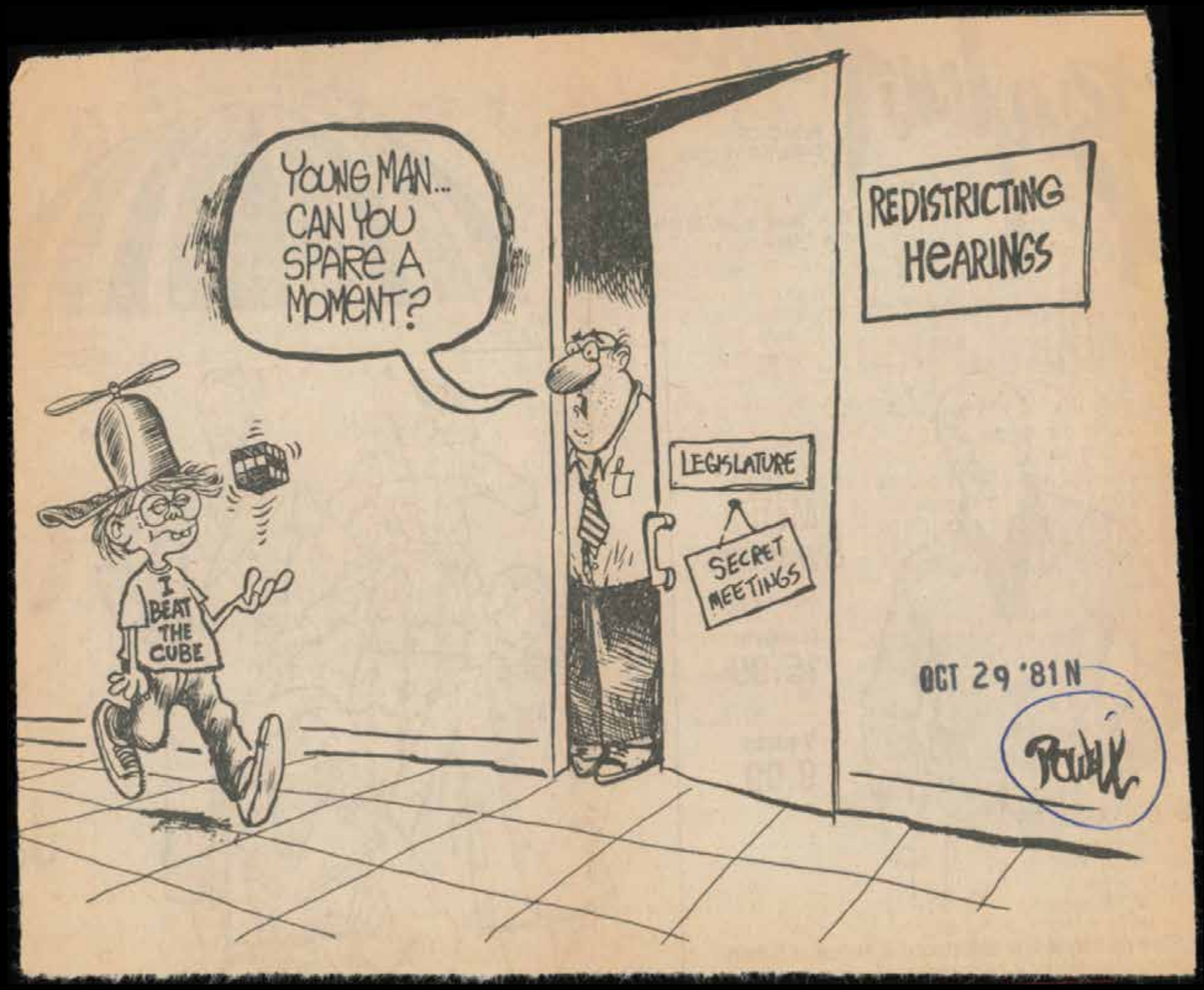
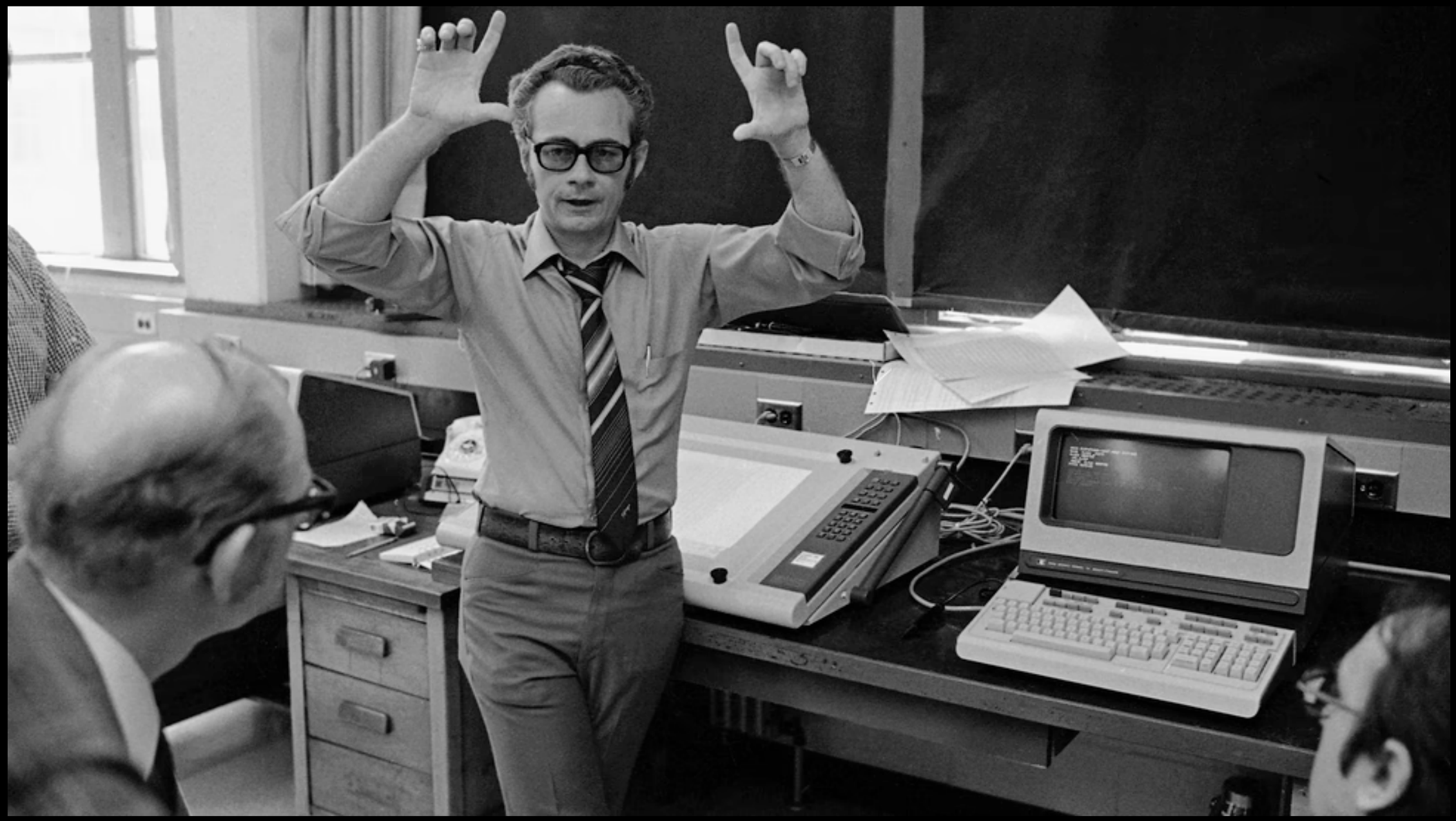
1981



Source: UNC Library

1981



Source: Gary Stewart / AP

1991: The culmination of some mid-80s revolutions

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  - … in the law: Gingles factors

THE NEWSWEEKLY OF INFORMATION SYSTEMS MANAGEMENT
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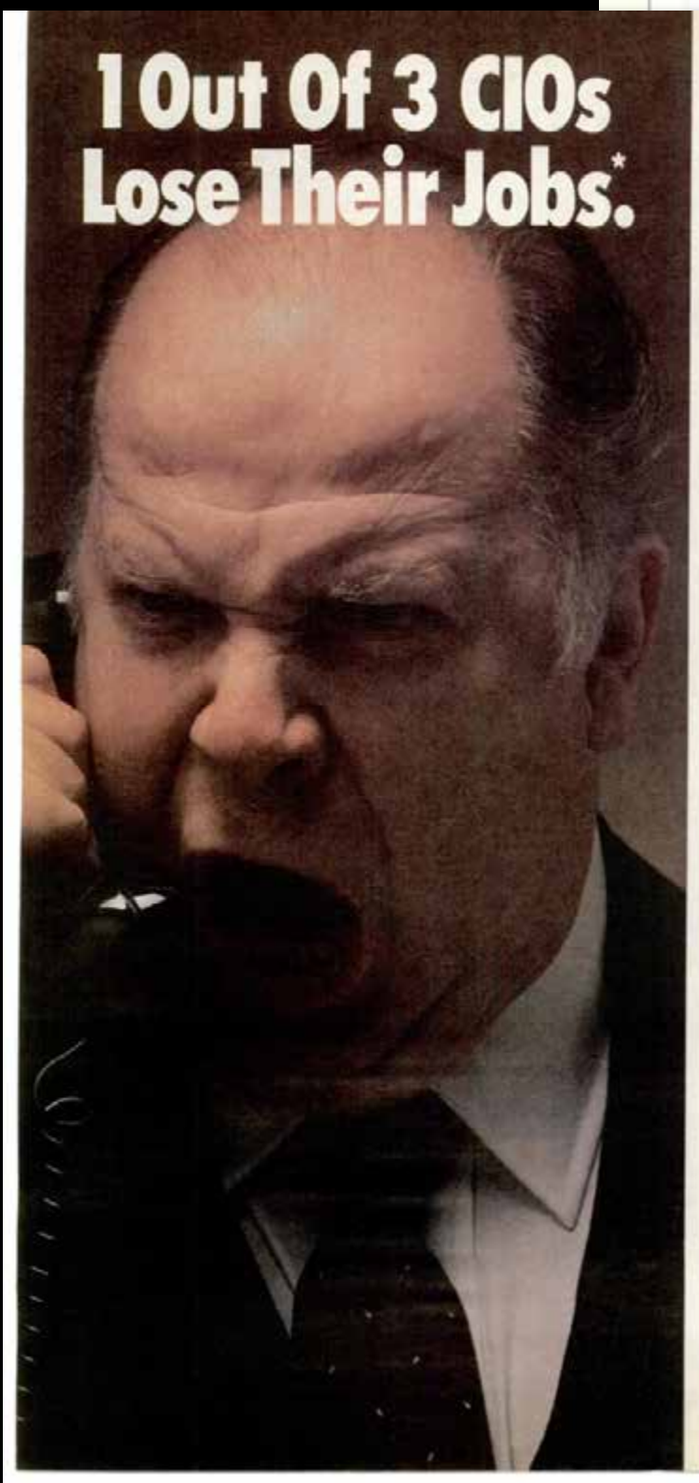

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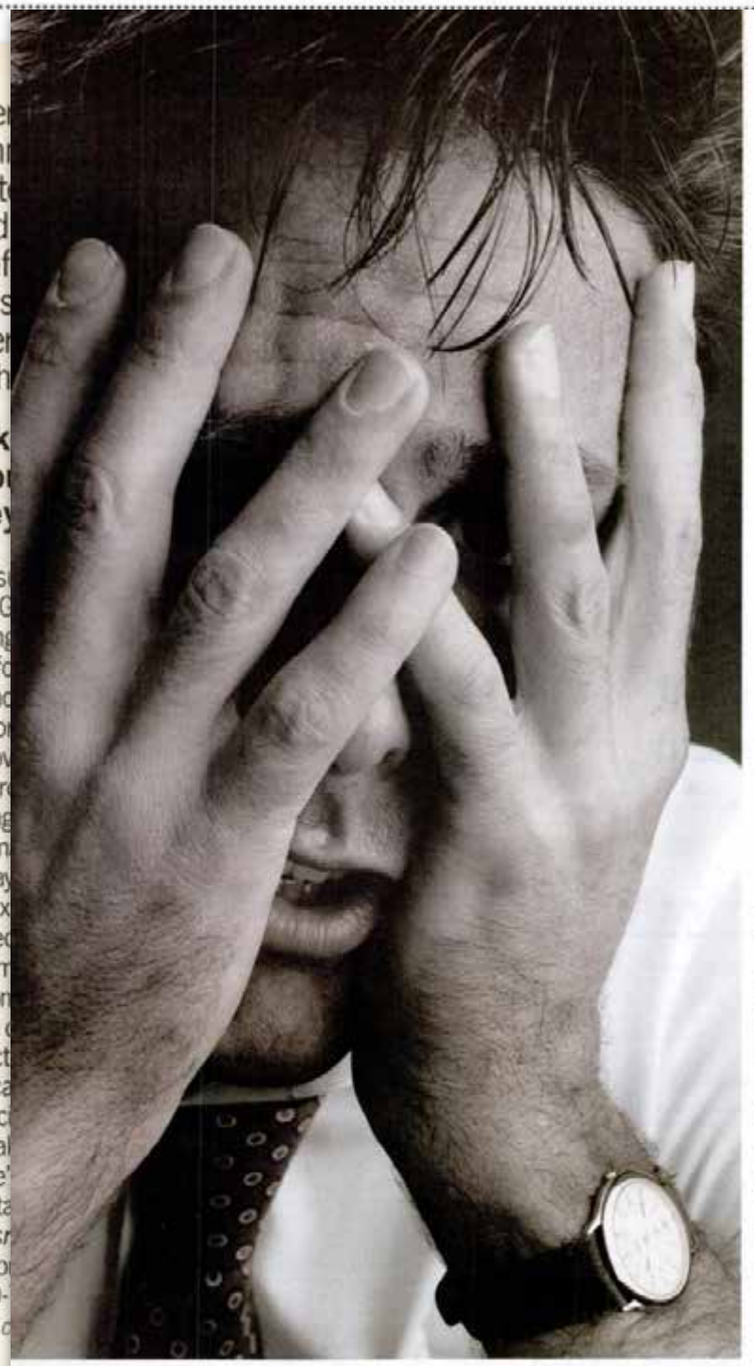

Okay.

You're using dBASE. You're trying to develop a payroll application for the entire company, and you've just hit the wall. So the first thing you do is try a few workarounds, then some more. And ignore the fact that you don't have any decent back-up and recovery, data integrity, database security or multi-user concurrency.

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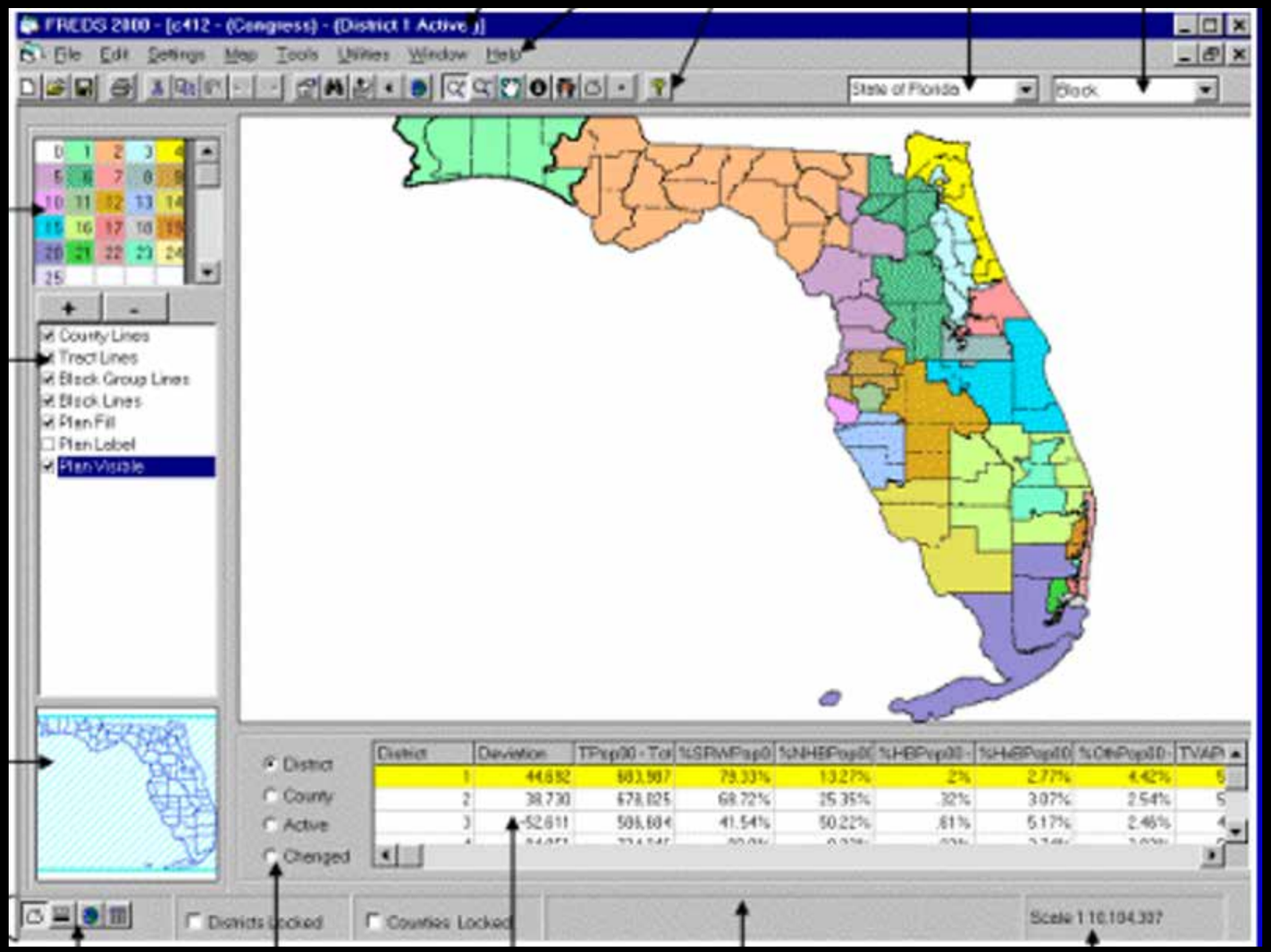
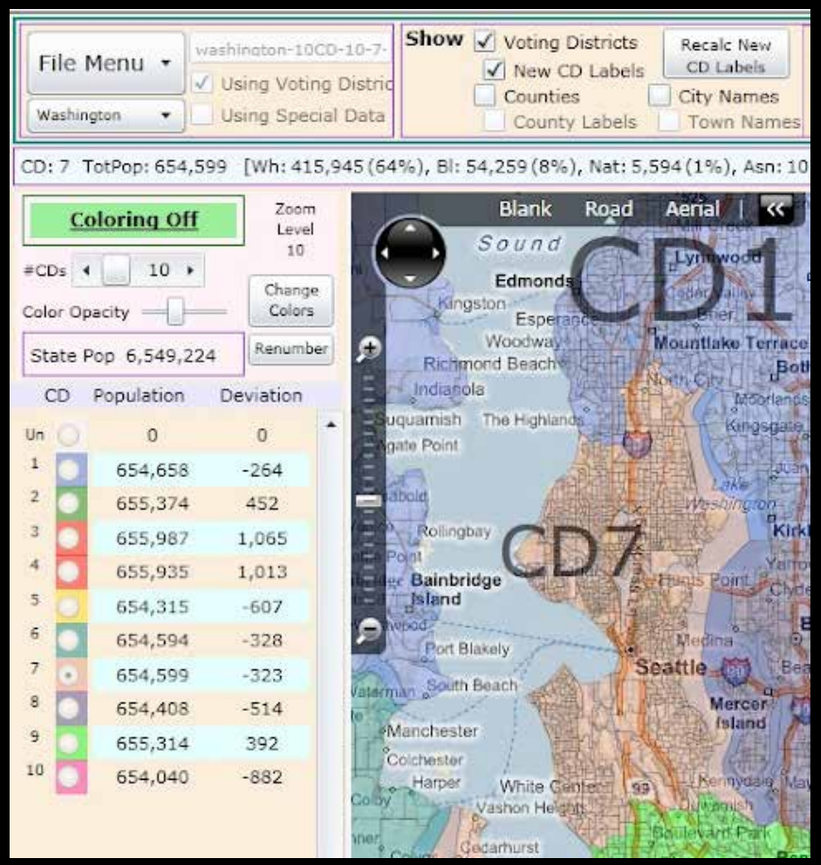
2001

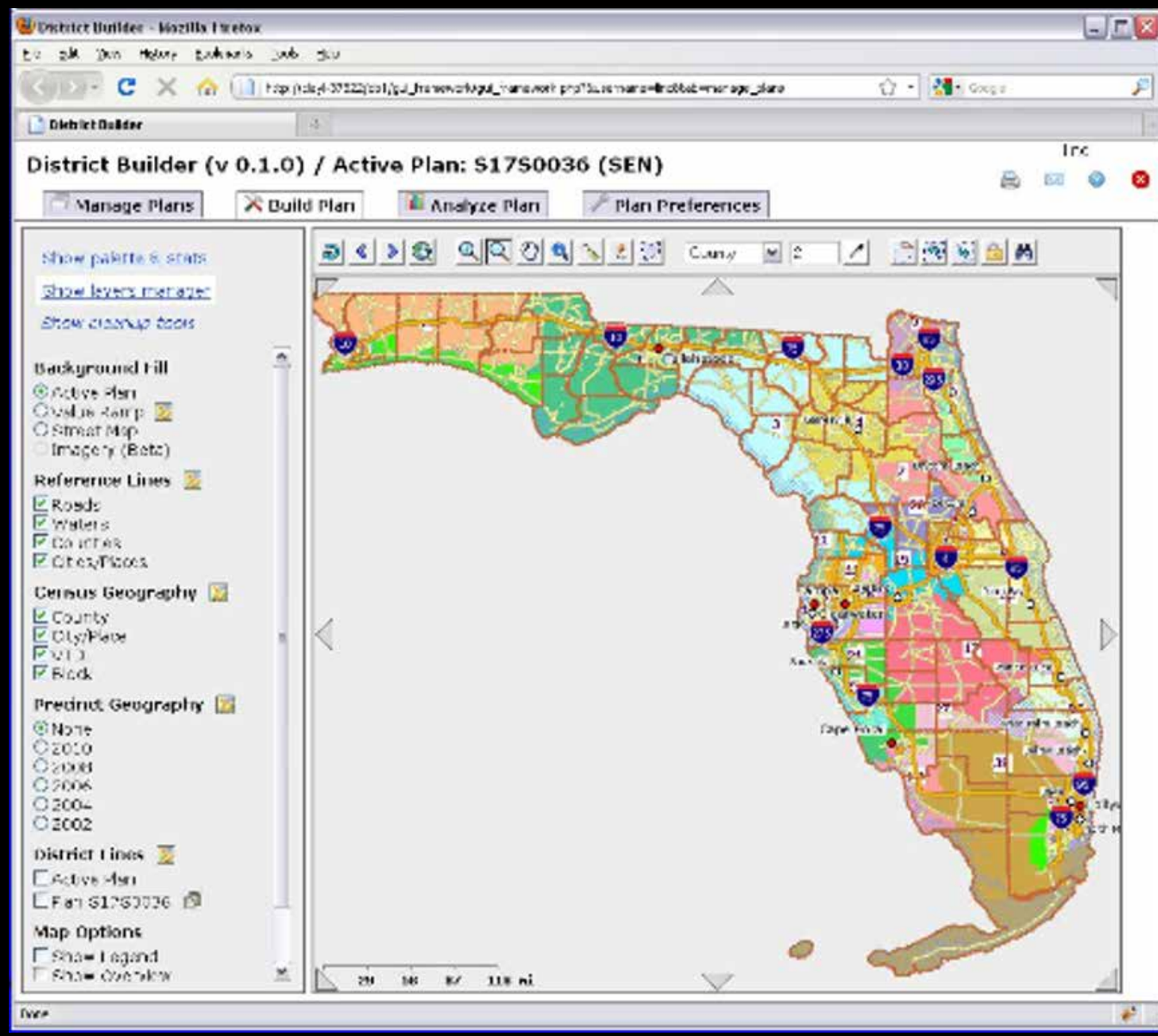
- Commercial off-the-shelf software available: CityGate, Maptitude
- Can be run off of laptops
- Uses of the Internet are rudimentary
- Some legislatures still building their own software



2011: The Internet age

- Free Internet redistricting software: Dave's Redistricting App, DistrictBuilder
- Public workstations
- Increased access
- Great data journalism





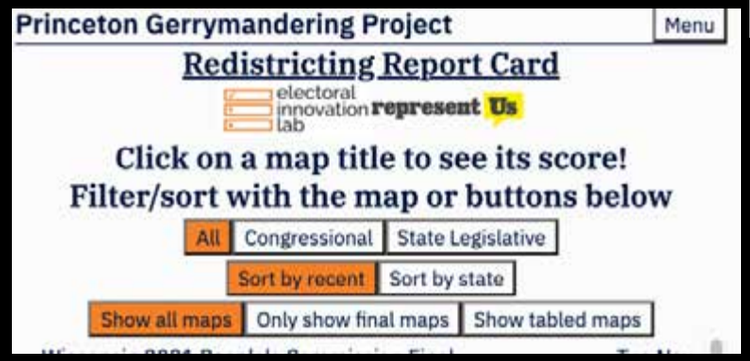
2021

- Proliferation of free online tools

DistrictR

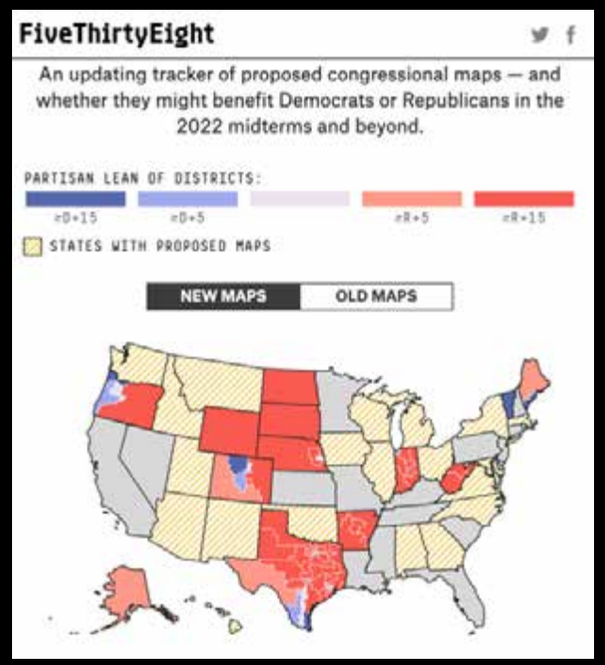
representable

DistrictBuilder



DRA2020

PlanScore
A PROJECT OF CAMPAIGN LEGAL CENTER



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- Proliferation of free online tools
- States seeing unprecedented interest in redistricting

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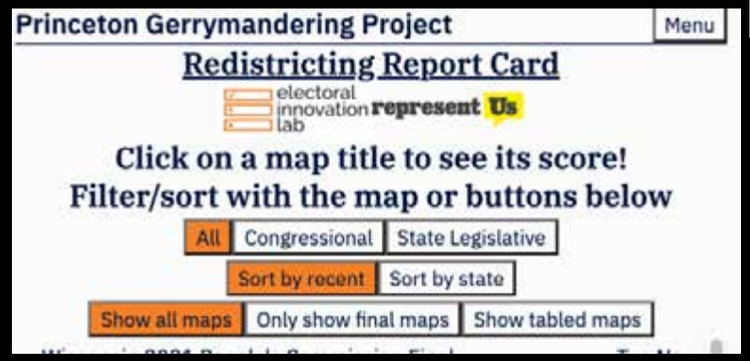

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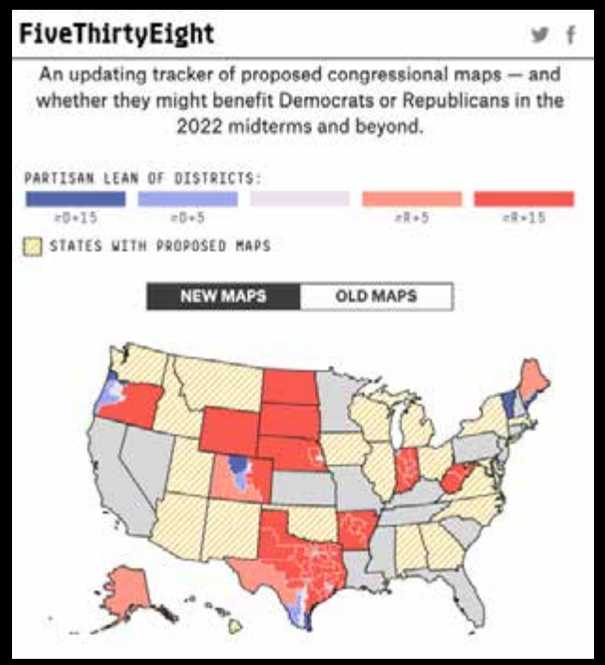

2021

- Proliferation of free online tools
- States seeing unprecedented interest in redistricting
- Legislatures, commissions, soliciting public input

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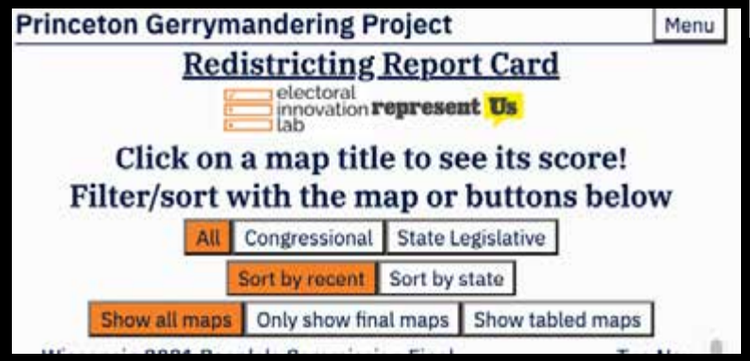

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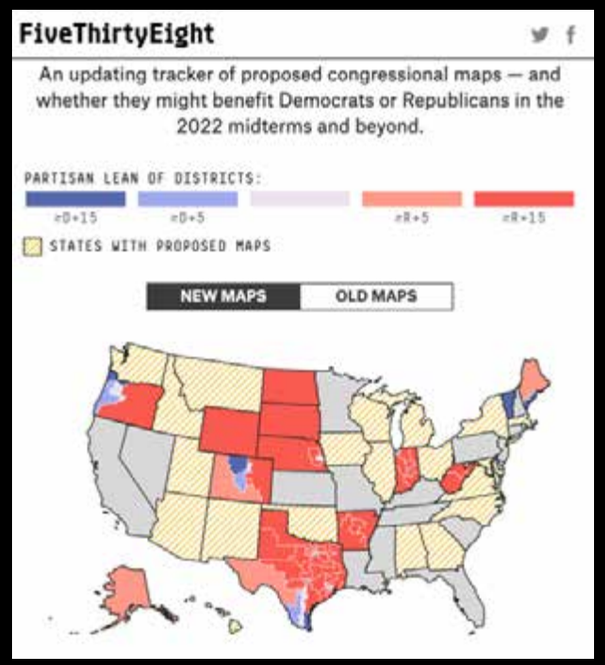
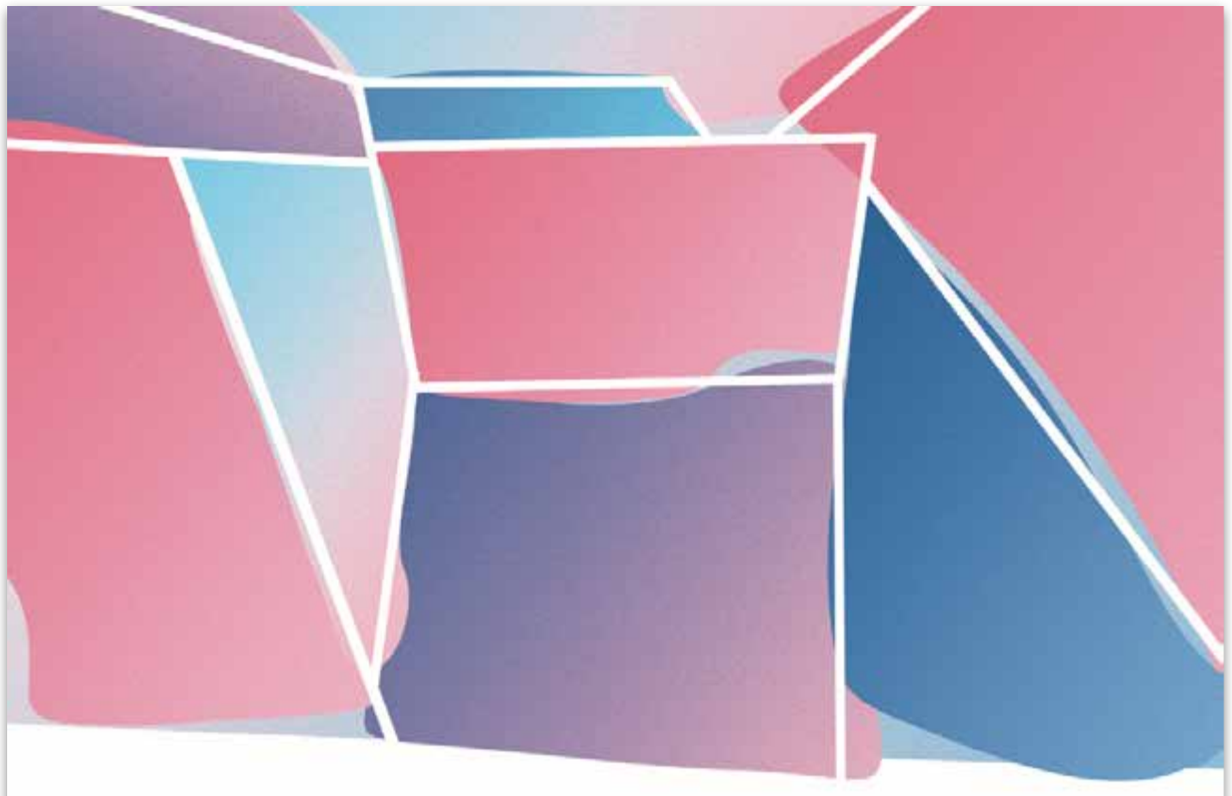


Beyond 2021

- Anyone can draw a map now.
- Soliciting public input is great, but how are legislatures supposed to make sense of all this public input?



Split Decisions

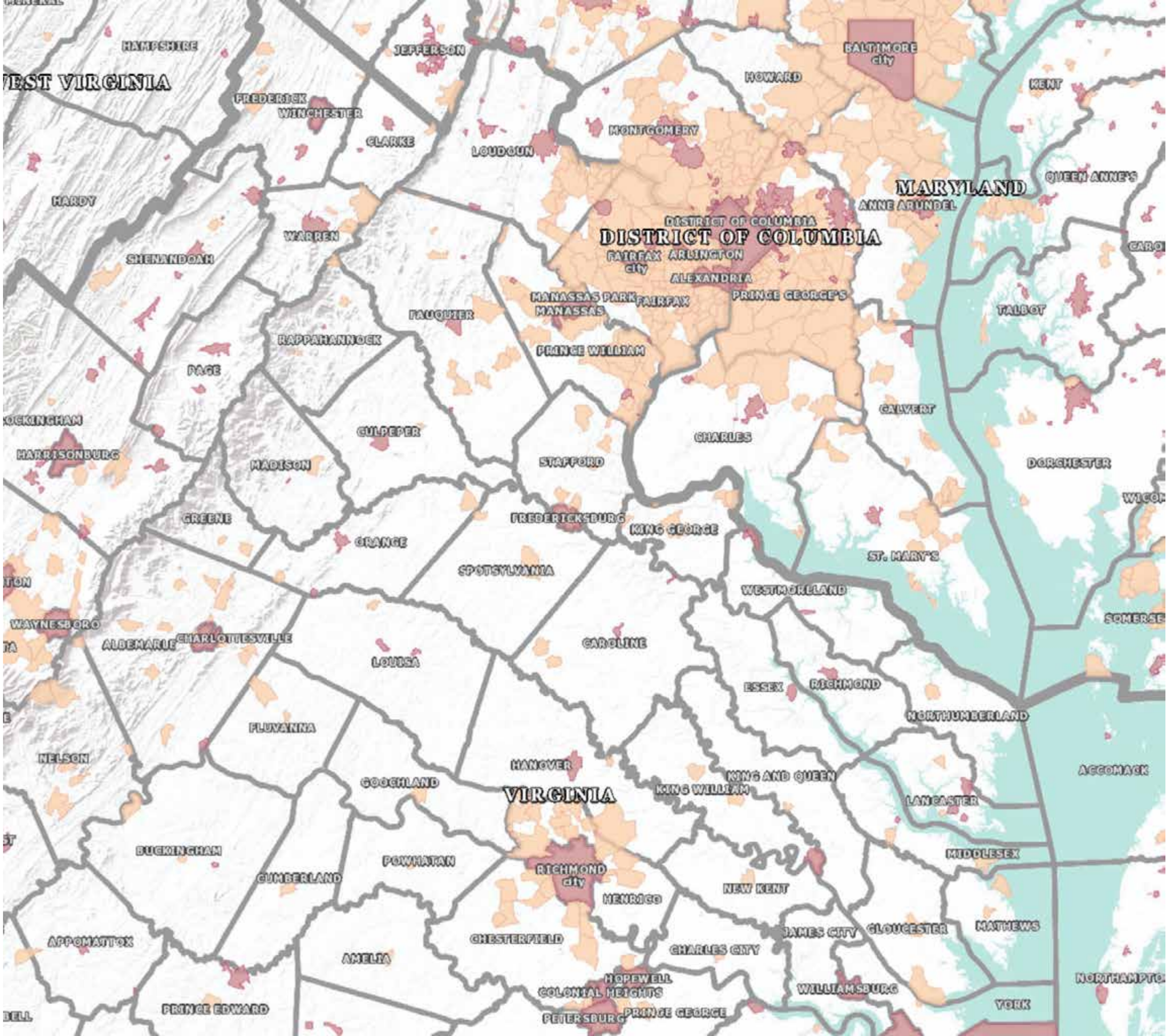
Guidance for Measuring Locality Preservation in District Maps

CENTER FOR DEMOCRACY & TECHNOLOGY

November 2021

What's a locality?

- Counties
- Communities of interest (COIs)
- Cities, towns, municipalities (Census term: "incorporated places")
- Unincorporated communities (Census term: "census-designated places"
- American Indian reservations and associated statistical areas
- …


HAMPSHIRE
JEFFERSON
BALTIMORE city
HOWARD
KENT
WEST VIRGINIA
FREDERICK
WINCHESTER
CLARKE
LOUDOUN
MONTGOMERY
QUEEN ANNE'S
MARYLAND
HARDY
ANNE ARUNDEL
DISTRICT OF COLUMBIA
DISTRICT OF COLUMBIA
WARREN
FAIRFAX
ARLINGTON
city
SHENANDOAH
ALEXANDRIA
MANASSAS PARK
FAIRFAX
PRINCE GEORGE'S
MANASSAS
FAUQUIER
TALBOT
RAPPAHANNOCK
PRINCE WILLIAM
PAGE
CALVERT
ROCKINGHAM
CULPEPER
CHARLES
HARRISONBURG
STAFFORD
MADISON
DORCHESTER
GREENE
FREDERICKSBURG
KING GEORGE
ORANGE
ST. MARY'S
SPOTSYLVANIA
WESTMORELAND
WAYNESBORO
CHARLOTTESVILLE
ALBEMARLE
CAROLINE
LOUISA
ESSEX
RICHMOND
FLUVANNA
NORTHUMBERLAND
NELSON
HANOVER
KING AND QUEEN
ACCOMACK
GOOCHLAND
VIRGINIA
KING WILLIAM
LANCASTER
BUCKINGHAM
MIDDLESEX
POWHATAN
RICHMOND city
CUMBERLAND
NEW KENT
HENRICO
APPOMATTOX
JAMES CITY
GLOUCESTER
MATHEWS
CHESTERFIELD
CHARLES CITY
AMELIA
HOPEWELL
COLONIAL HEIGHTS
WILLIAMSBURG
YORK
PRINCE EDWARD
PETERSBURG
PRINCE GEORGE

Why keep localities whole?

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- Preserve political power

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- Empower communities

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- Inform voters

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- Preserve political power
- Empower communities
- Inform voters
- Simplify election administration

Statutory requirements

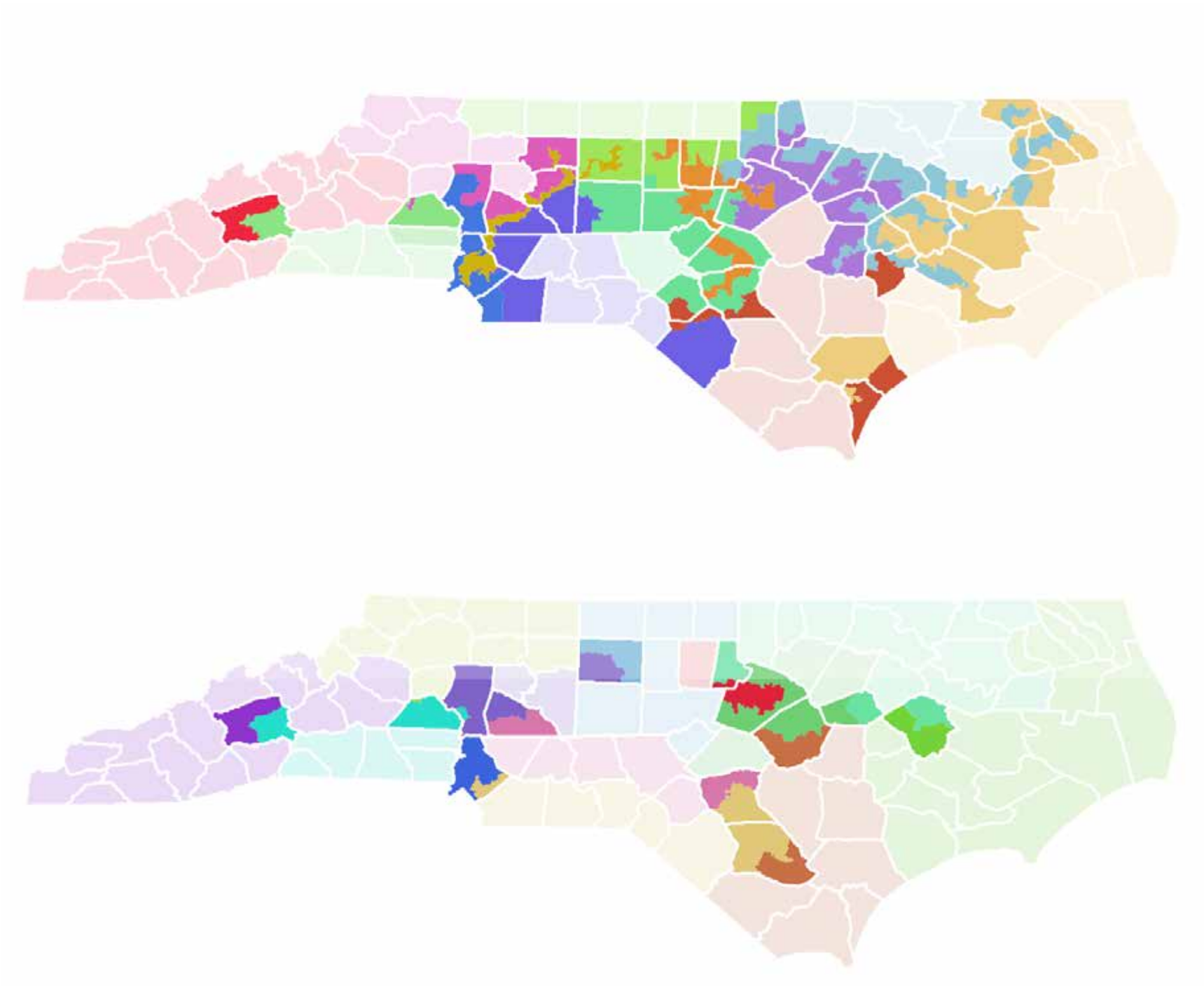
- Detailed rules (OH):

  …of the eighty-eight counties in this state, sixty-five counties shall be contained entirely within a district, eighteen counties may be split not more than once, and five counties may be split not more than twice. The authority drawing the districts may determine which counties may be split…No two congressional districts shall share portions of the territory of more than one county, except for a county whose population exceeds four hundred thousand…

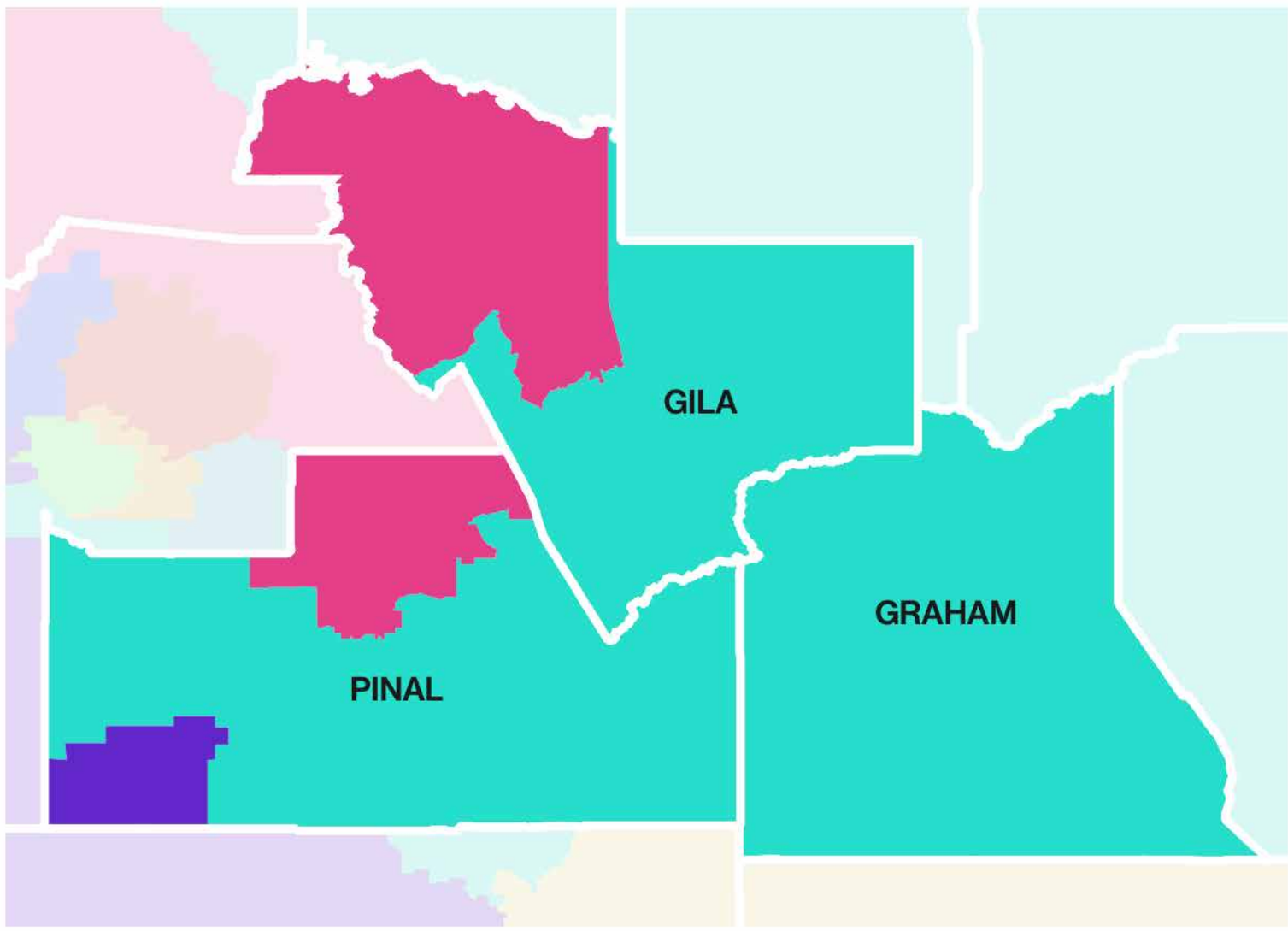
- Ambiguous rules (ID):

  …[t]o the maximum extent possible, districts shall preserve traditional neighborhoods and local communities of interest.

One way to measure split localities: Just count them



Another way:
Count the pieces



What’s wrong with just counting splits or pieces?

What's wrong with just counting splits or pieces?

- They don't take into account where *people* are. People need representation, not land.

- A 99/1 split counts the same as a 50/50 split.

- Splitting a low-population locality counts the same as splitting a high-population locality.

A better way:
Population-based metrics

- Effective splits
- Conditional entropy
- Square root entropy
- Split pairs

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Population-based metrics

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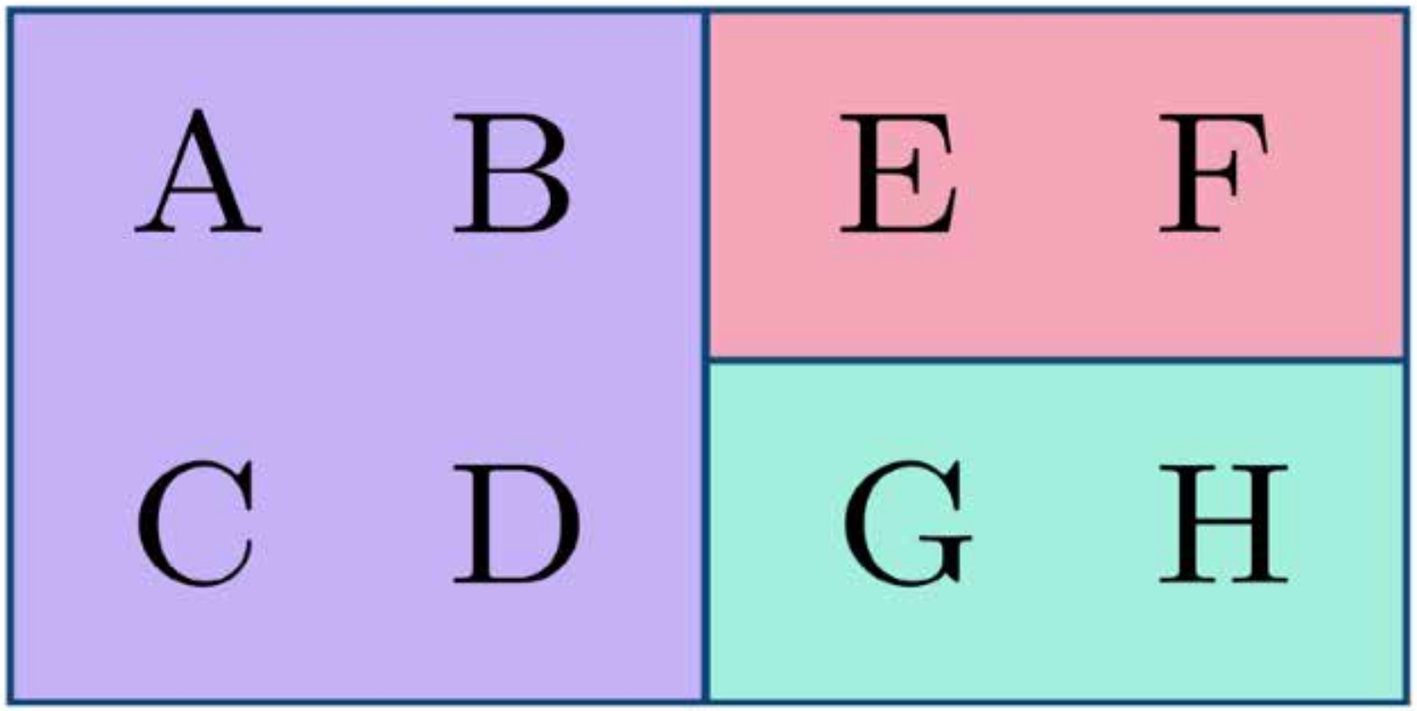
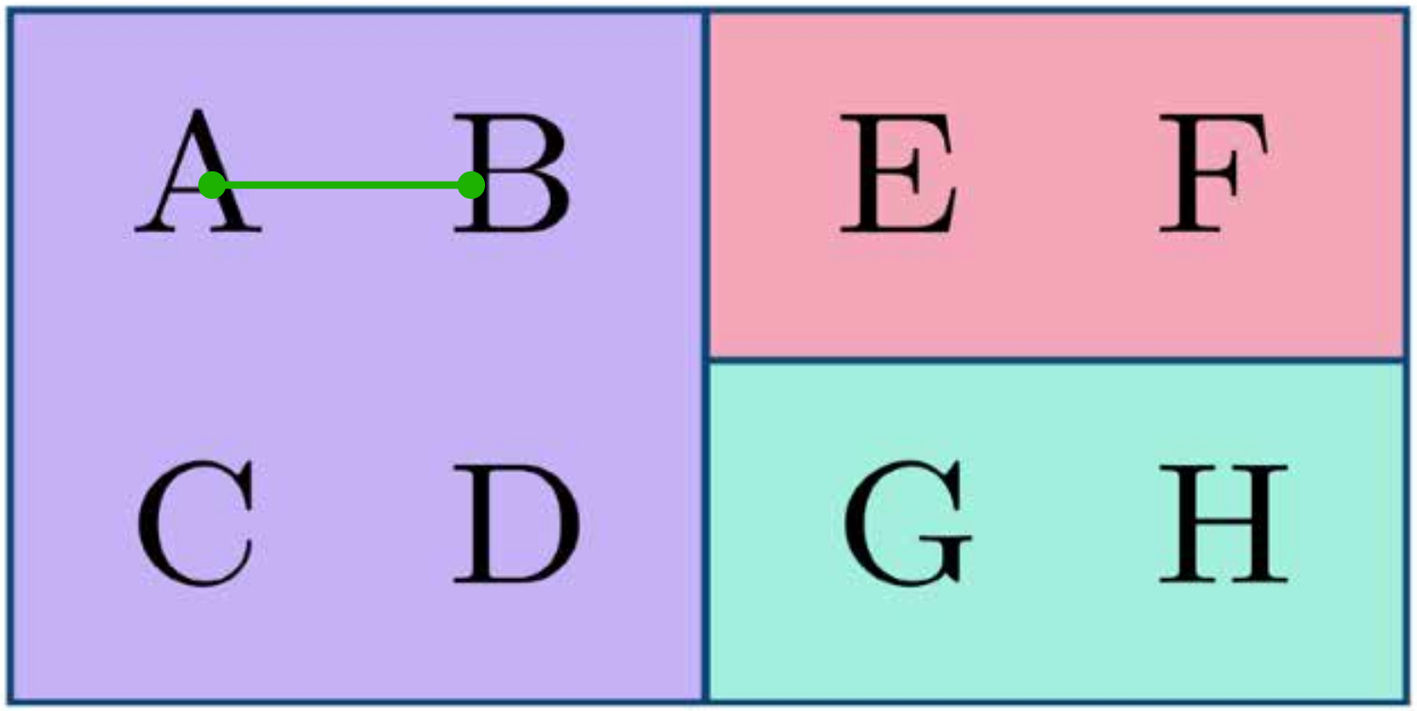
“Split pairs” metric



28 pairs of people

“Split pairs” metric



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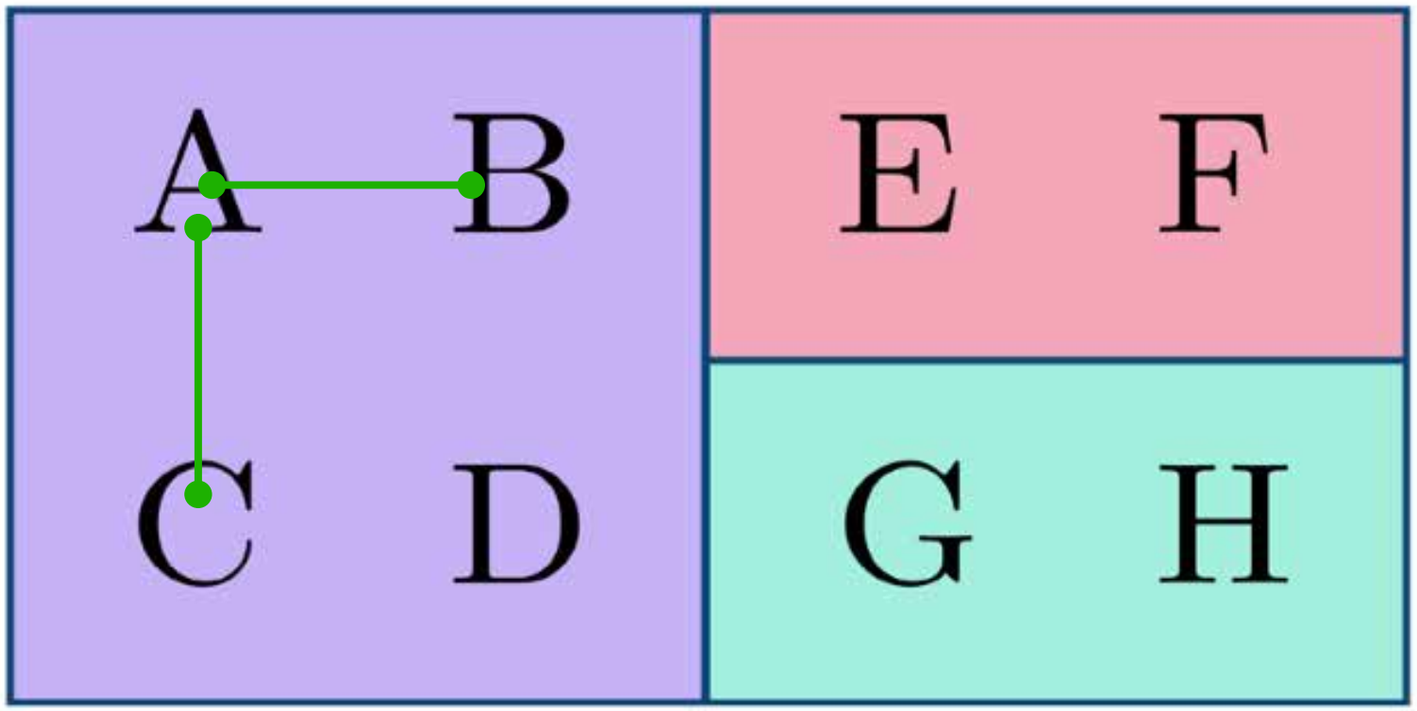
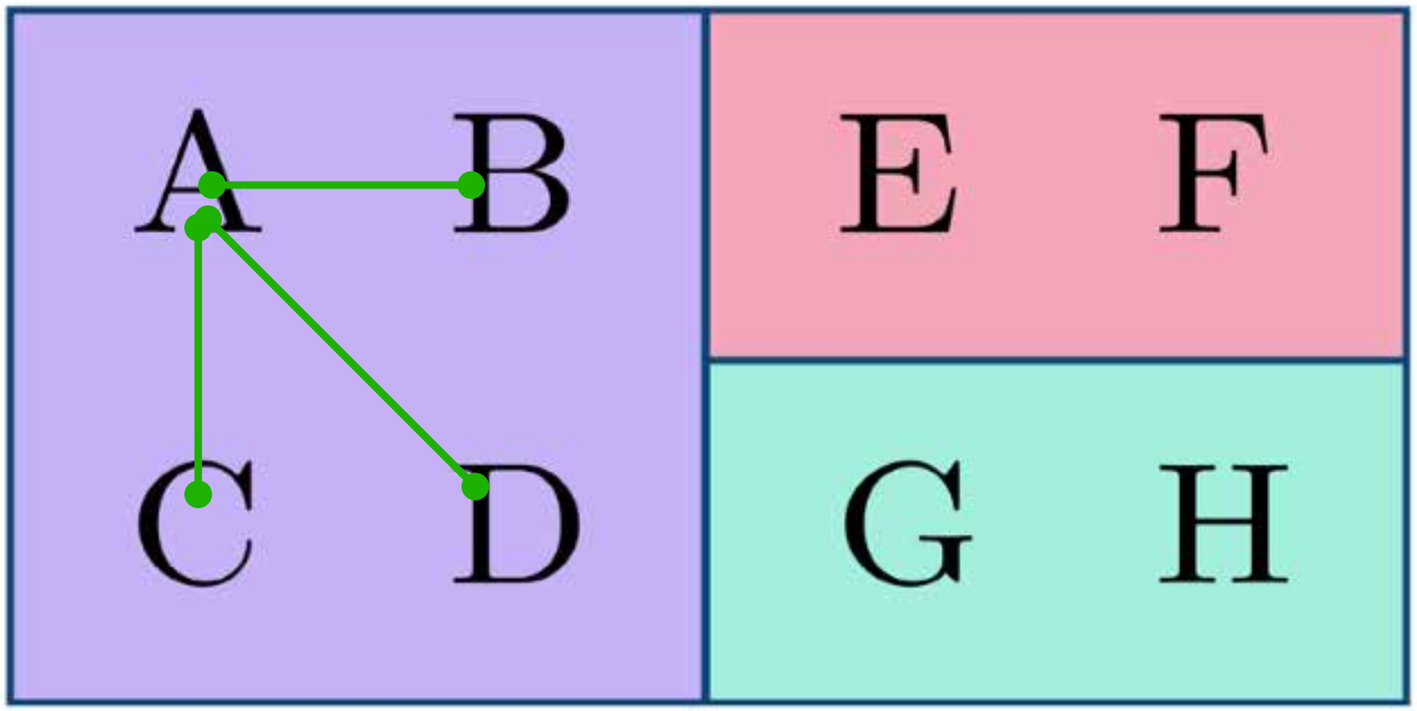


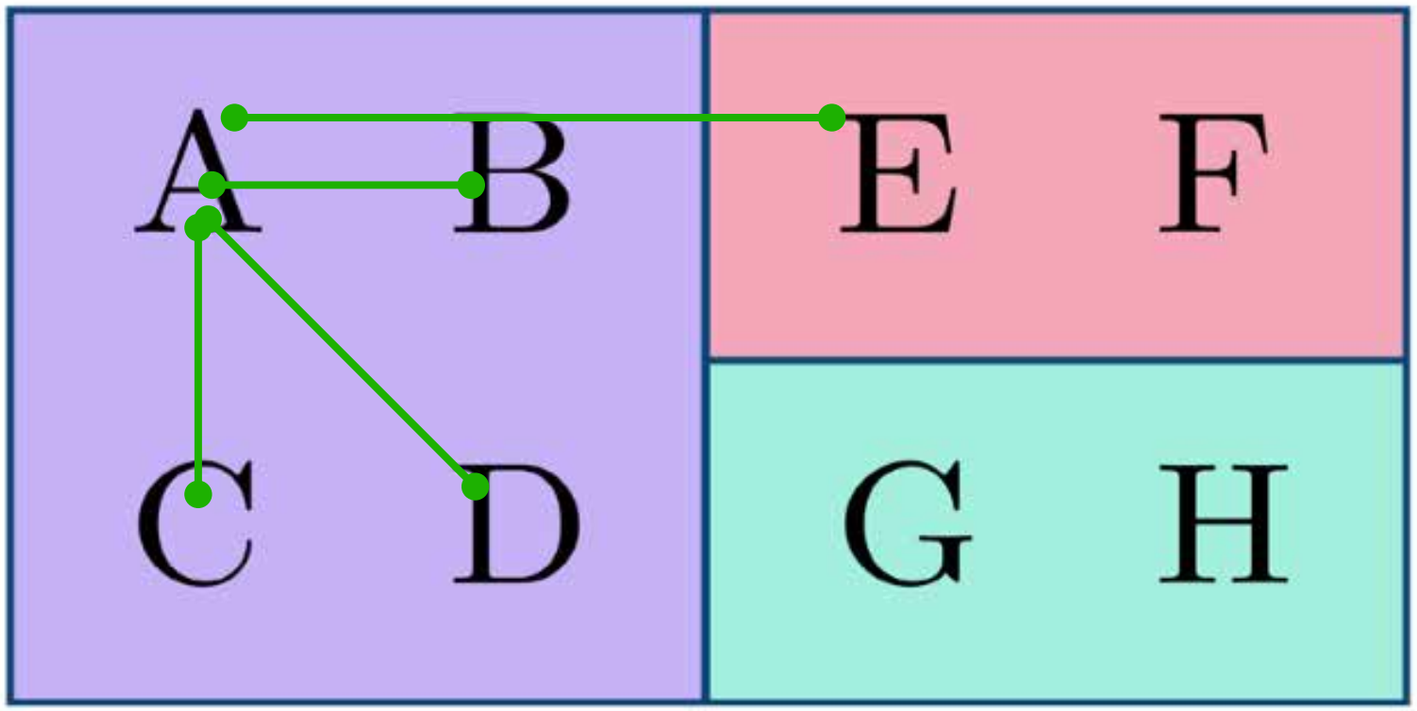
28 pairs of people

“Split pairs” metric



28 pairs of people

“Split pairs” metric



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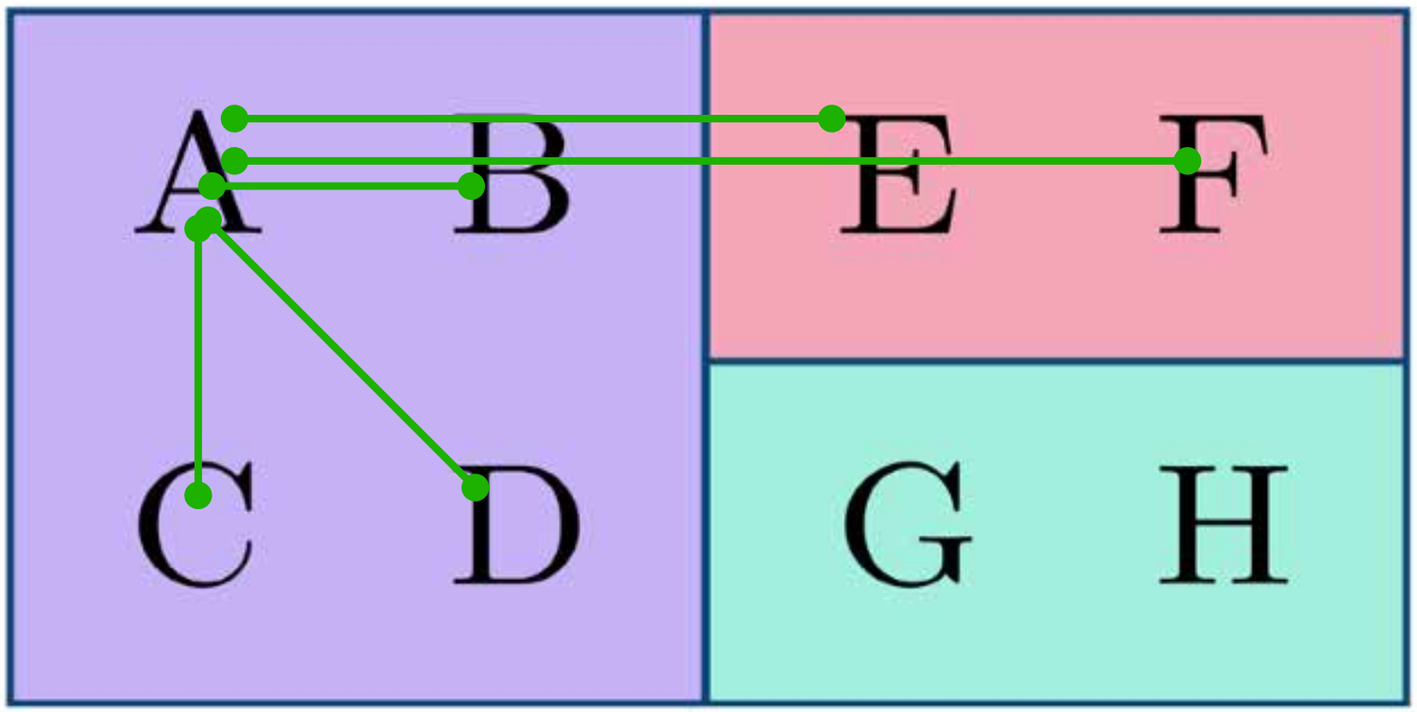

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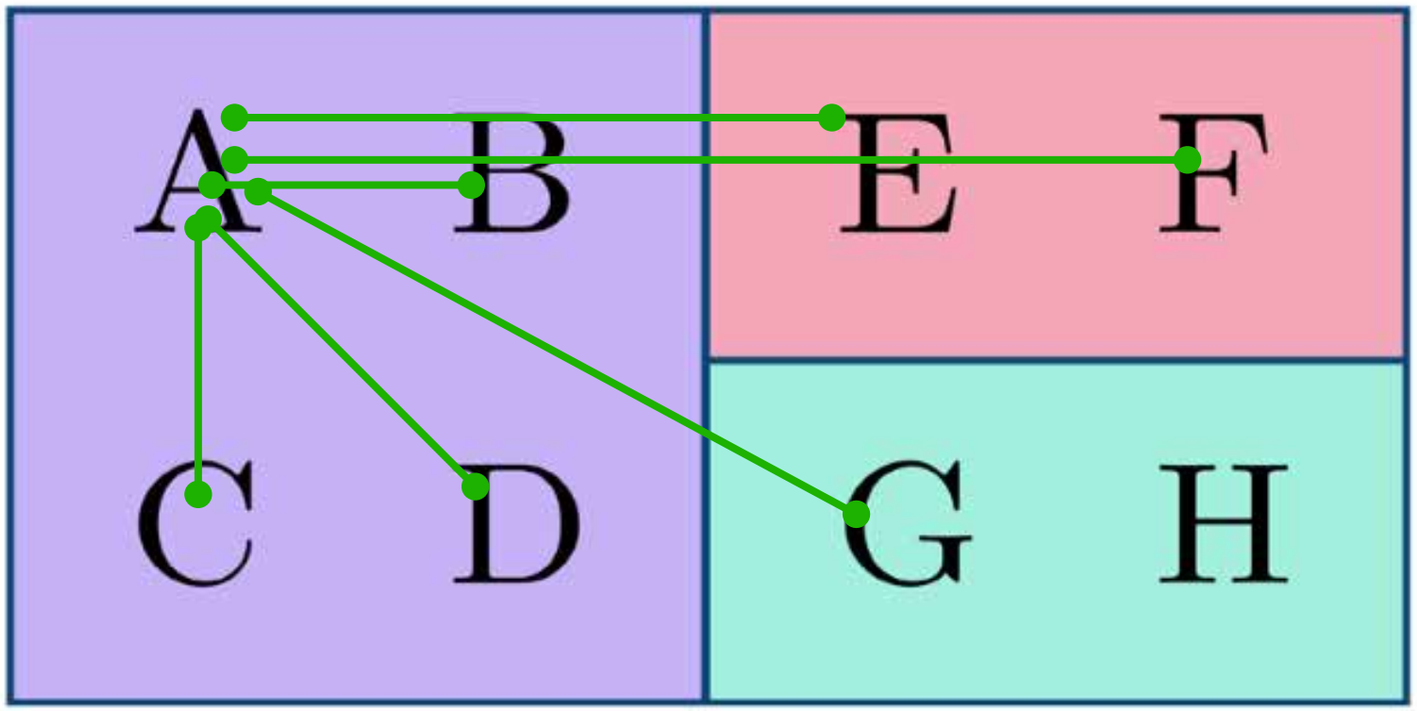

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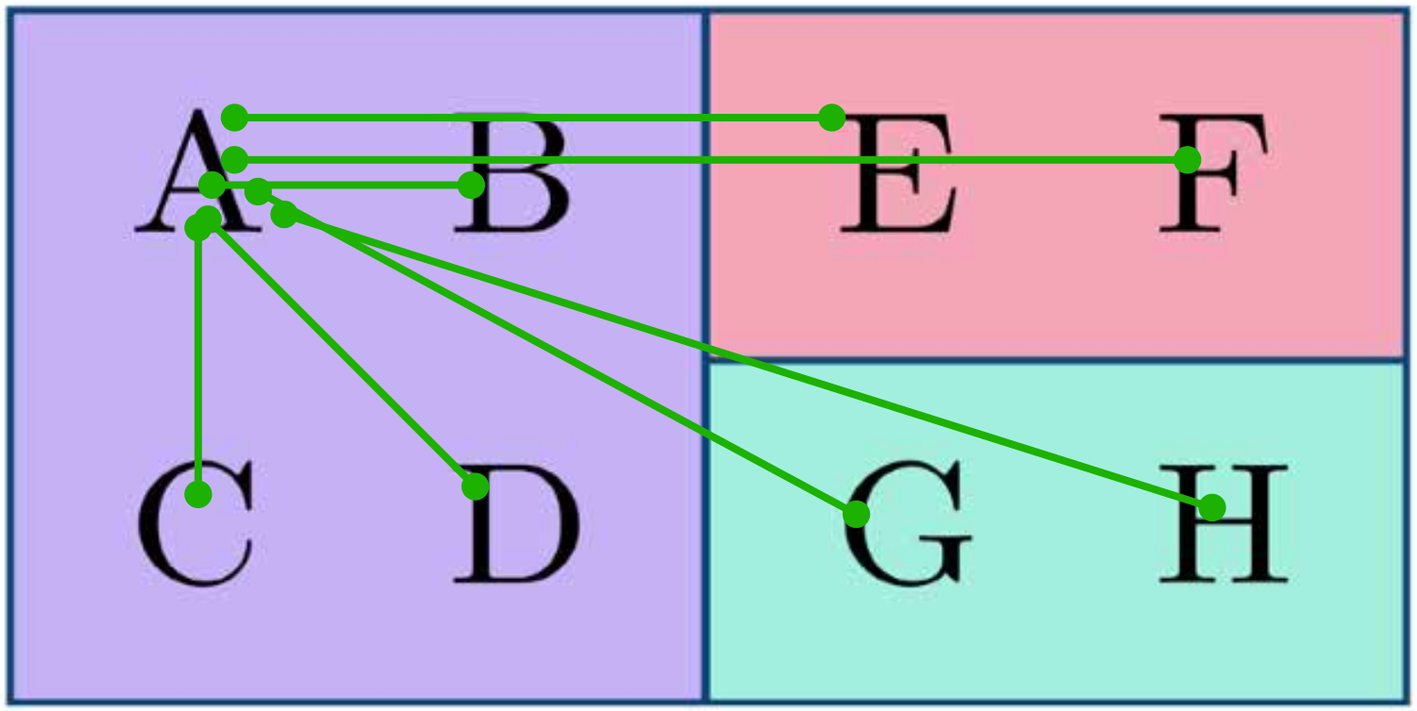

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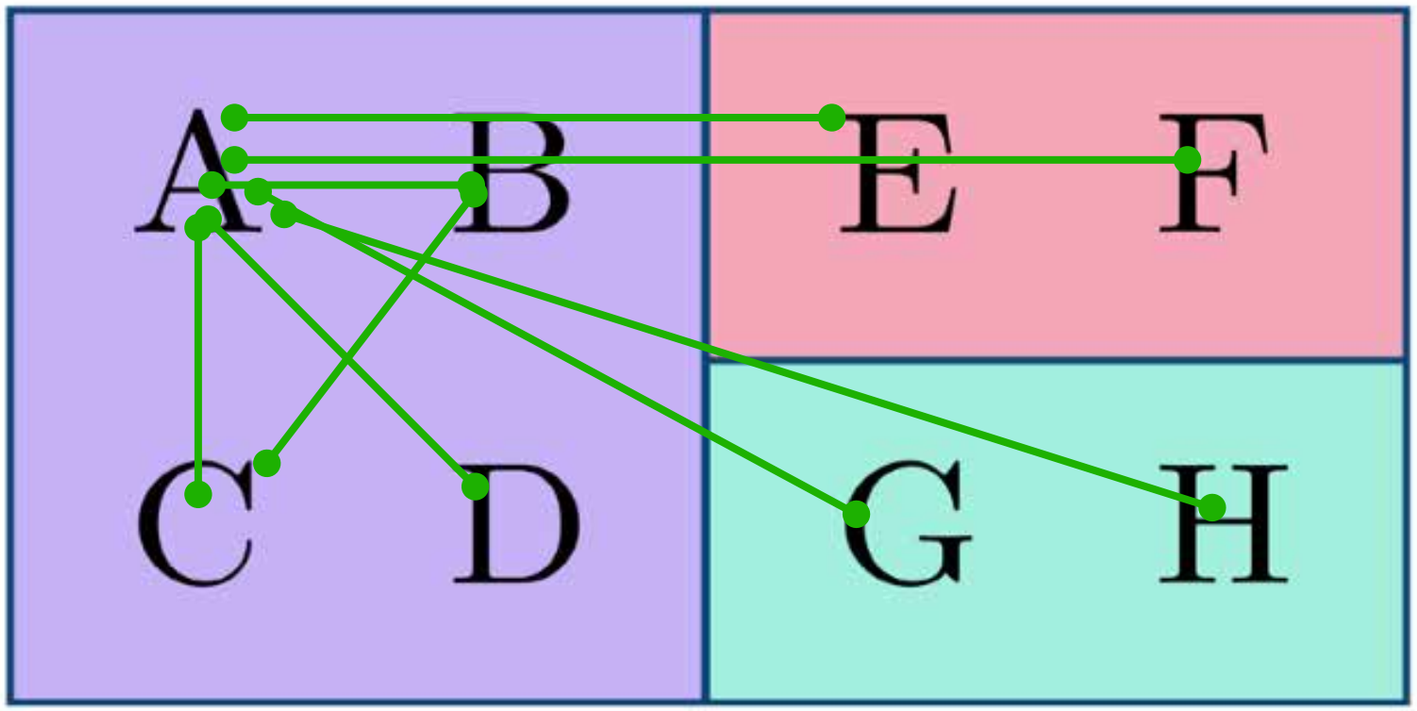

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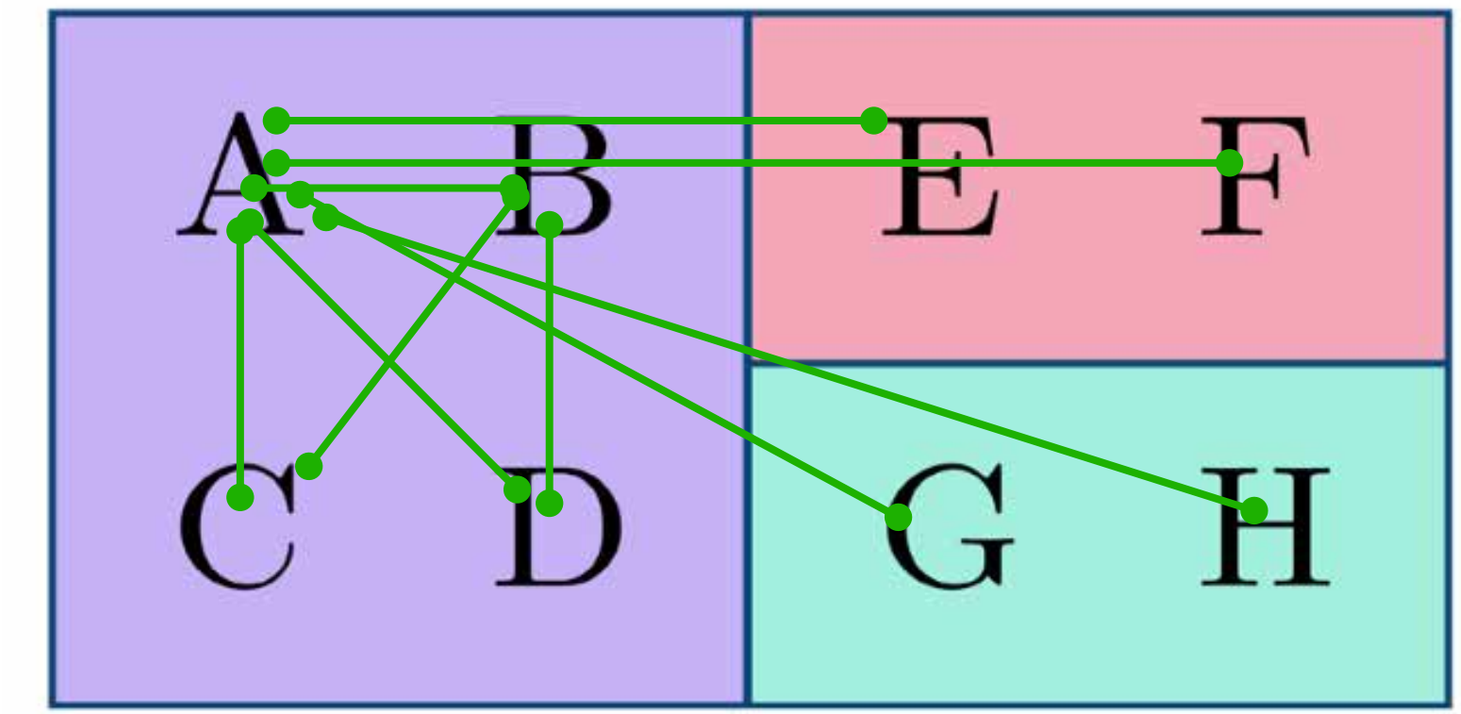

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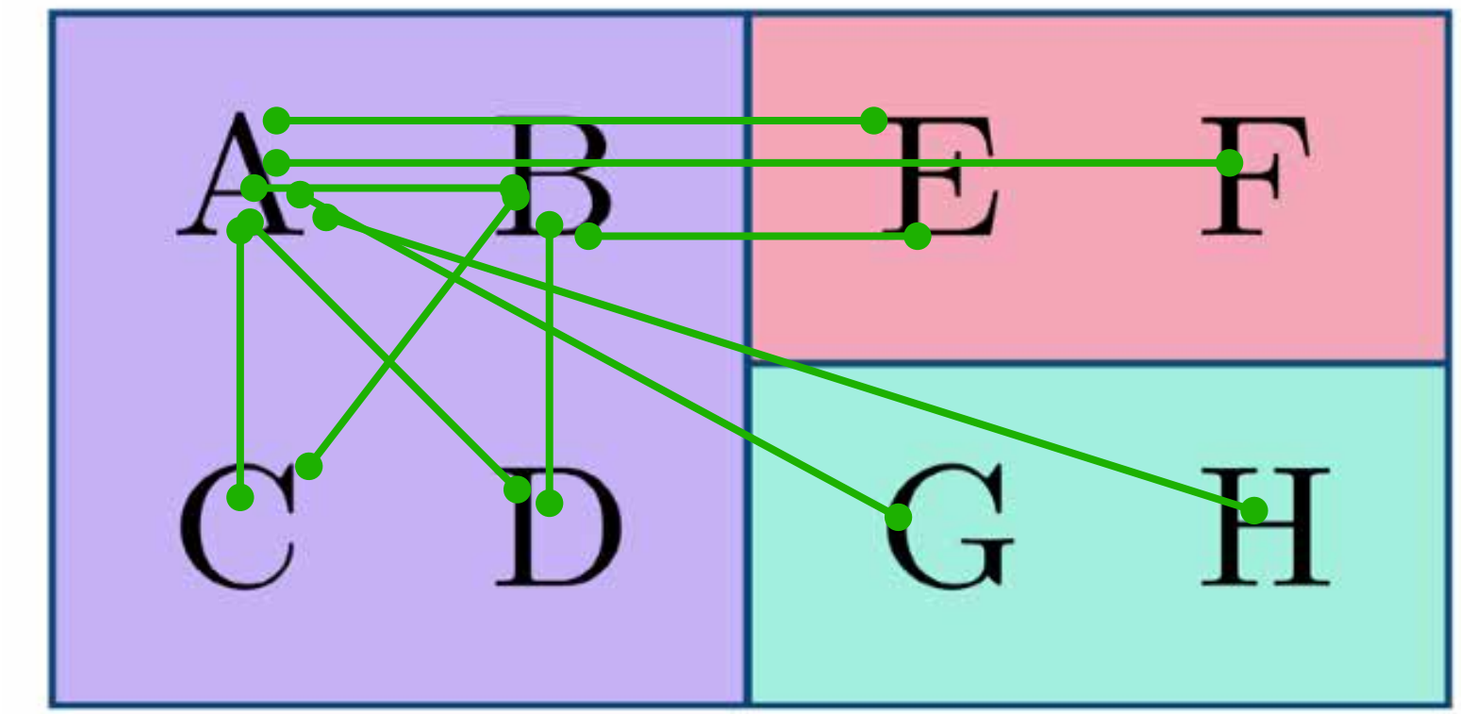
“Split pairs” metric



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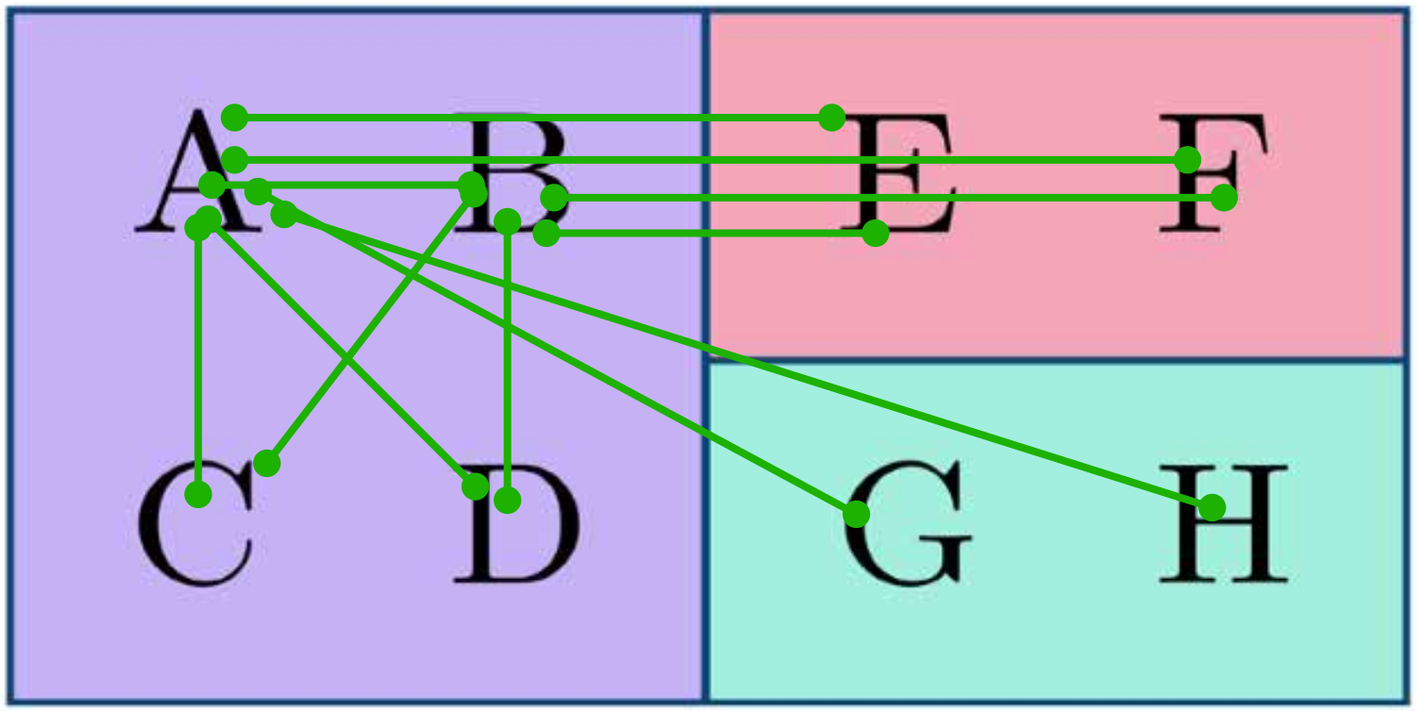

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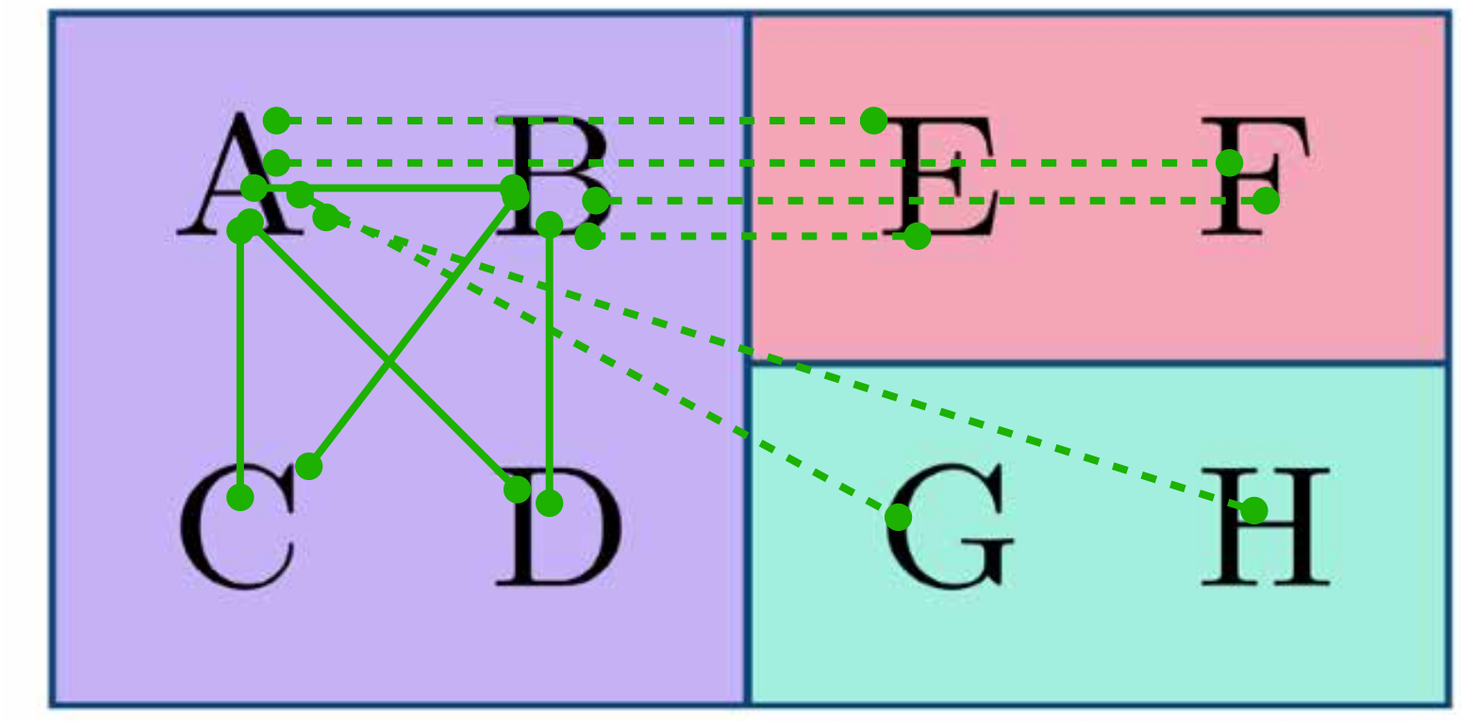
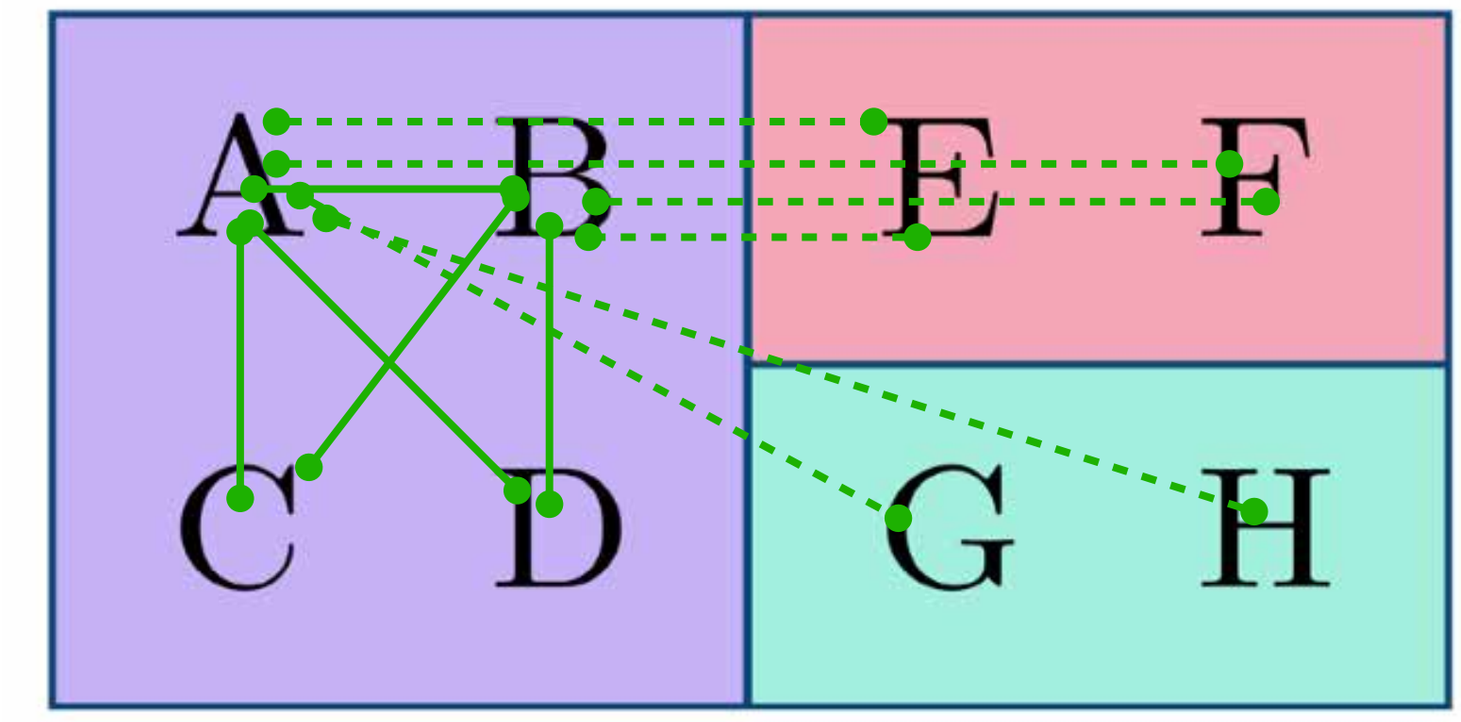


20/28 pairs of people are split, for a score of 20/28=0.71

“Split pairs” metric



20/28 pairs of people are split, for a score of 20/28=0.71

A random person does not remember his congressional district, so he picks a person randomly from his locality and asks what that person’s district is. Then he guesses that he lives in the same district. What is the probability of guessing wrong? The split pairs metric.

Where to try these metrics?

- Currently:
  - Princeton Gerrymandering Project report card
  - Representable

Redistricting Report Card

electoral innovation lab | represent Us

Select a map to view its report card and metric dashboard

Florida 2021 Draft Staff Congressional Map H000C8001

Learn more about the Florida redistricting process

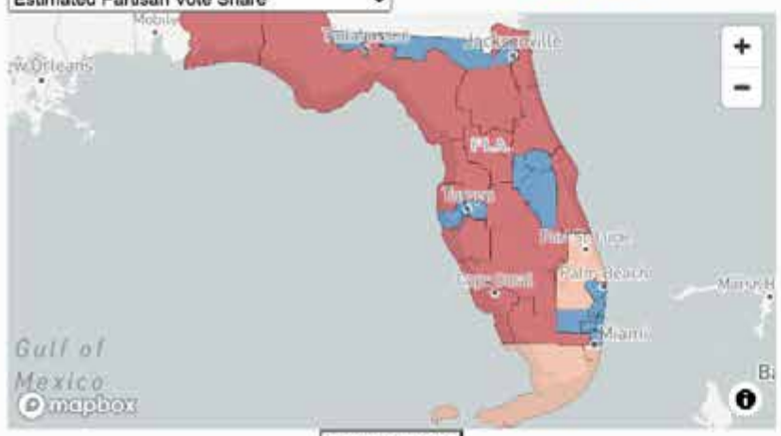
View Communities of Interest on Representable|Learn more

Florida 2021 Draft Staff Congressional Map H000C8001

Select VAP on Tooltip: BVAP

Map color scale: R D

Estimated Partisan Vote Share



Show counties

Link to plan source | Download Map Data |Download Score Data

Show additional details

Overall Grade	F

Partisan Fairness

F — Significant Republican advantage.

Competitiveness

C — Similarly competitive relative to other maps that could have been drawn

Geographic Features

C — Compact districts, typical number of county splits

A: *Good for the category*
B: *Better than average for the category, but bias still exists*
C: *Average for the category, could be better, but also could be worse*
F: *Poor for the category, could be much better*

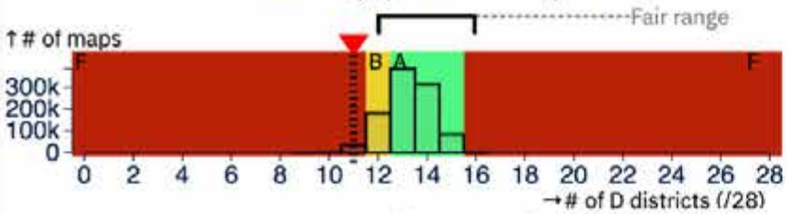
Metrics

Partisan Fairness — F

Advantage: Republican

Frequency of Democratic wins **out of 28 districts**

Powered by up to 1 million maps



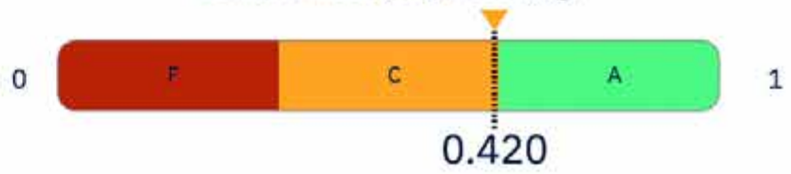
Competitiveness

Additional metrics

Packed Wins	Mean-Median	Partisan Bias
2.3% favoring R	+3% R	+7.1% R

Geographic Features — C

Compactness (Avg. Reock)



County Splits

Additional metrics

Min. Reock	Avg. Polsby-Popper	Min. Polsby-Popper	Split Pairs
0.115	0.276	0.084	0.399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wtadler Update README.md 0c4d485 24 days ago 71 commits

clean_data	fix census population variable, re-upload classifications	3 months ago
geoprocessing	fix census population variable, re-upload classifications	3 months ago
.gitignore	add symmetric splitting scores to geo metrics, update analysis noteb...	2 months ago
CITATION.cff	Create CITATION.cff	4 months ago
README.md	Update README.md	24 days ago
block_equivalency_file.py	allow user to input FIPS, state name, or fuzzy statename	3 months ago
metrics.py	add symmetric splitting scores to geo metrics, update analysis noteb...	2 months ago
splitting_metric_comparisons.ipynb	add symmetric splitting scores to geo metrics, update analysis noteb...	2 months ago

README.md

Metrics of locality splitting/preservation in district maps

pypi package 0.2.1

Description

This code accompanies the Center for Democracy & Technology report, Split Decisions: Guidance for Measuring Locality Preservation in District Maps, by Jacob Wachspress and William T. Adler.

This repository contains Python code that implements a number of metrics for quantifying locality (e.g. county, community of interest) splitting in districting plans. The metrics implemented are:

- Geography-based
  - Number of localities split
  - Number of locality-district intersections
- Population-based
  - Effective splits[1]
  - Conditional entropy[2]
  - Square root entropy[3]
  - Split pairs[4]

Thanks!