FairyMander

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Our team

Izaac Molina

Team Lead

Dylan Franco

Architect

Jeysen Angous

Release Manager

Sophia Ingram

Customer Communicator

Ceanna Jarrett

Recorder

Meet Our Client
Dr. Bridget Bero, P.E.

Professor at Northern Arizona University
Associate Chair for CENE Programs

Dept. of Construction Management, Civil and

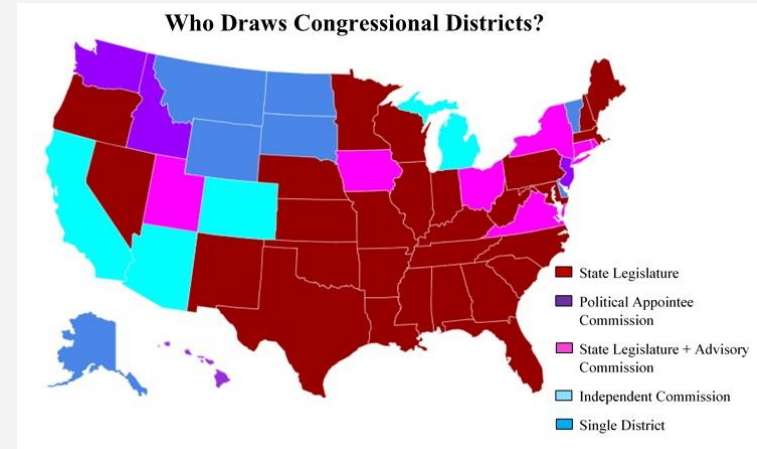Environmental Engineering

Problem Statement

Congressional districts are redrawn every ten years

- 39 states redistricting process is controlled by legislature

- Districts are Gerrymandered

Each district elects a state representative

- Representatives are members of Congress

- Congress creates and changes laws

Who Draws Congressional Districts?

- State Legislature
- Political Appointee Commission
- State Legislature + Advisory Commission
- Independent Commission
- Single District

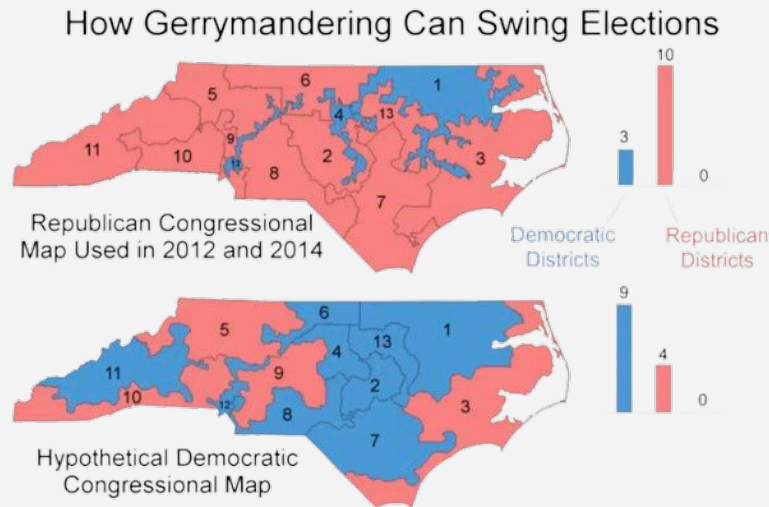# Problem Statement – cont.

Packing

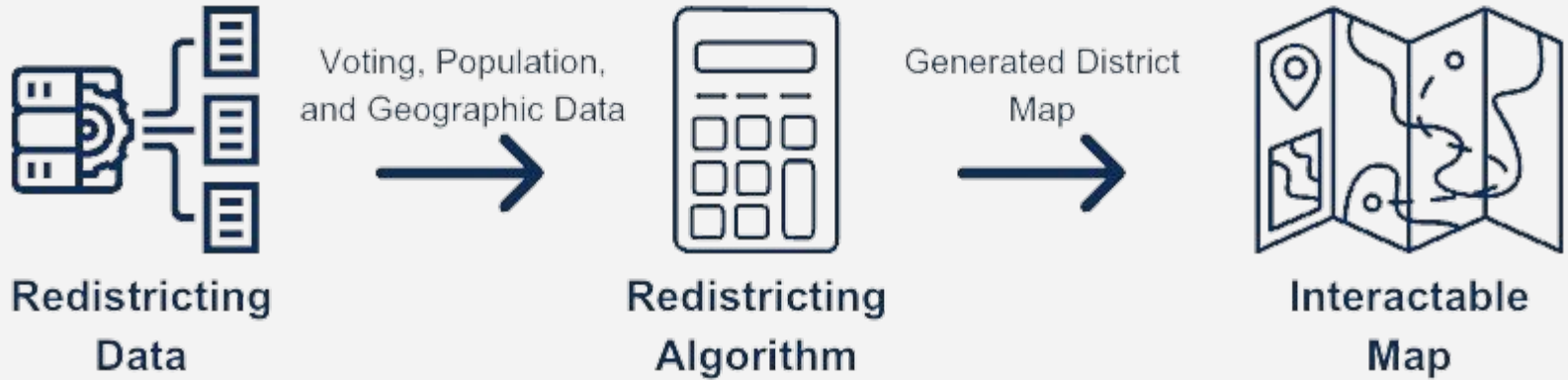- Packing like-minded voters to as few districts as possible

Cracking

- Splitting like-minded voters across different districts

Underrepresentation

- Taking away the principle of fair representation

How Gerrymandering Can Swing Elections

Republican Congressional Map Used in 2012 and 2014

Democratic Districts

Republican Districts

Hypothetical Democratic Congressional Map

Solution Overview

Redistricting Data → Voting, Population, and Geographic Data → Redistricting Algorithm → Generated District Map → Interactable Map

Similar Products

Free

DistrictBuilder

DistrictR

DRA2020

+ + +

SaS

Maptitude
For Redistricting

$420	$695	$995	$9,995
Subscribe	Subscribe	Buy	Subscribe
Free Trial	Free Trial	Free Trial	Free Trial

ArcGIS
$4,950/yr

iRedistrict

?

Requirements

Creating Fair Districts

- Using geographic, electoral, and demographic data

Visualize Results

- Display results using interactable district maps

Web Application

- Results are viewable through responsive website

Redistricting Education

- Provide easy to understand insight into redistricting process

Fairness Metrics

Compactness

- Reock Score, Polsby-Popper

Political Competitiveness

- Efficiency Gap, Mean-Median, Lopsided Margin Test

Minority Representation

- Dissimilarity Index

Implementation - Data

U.S. Census

- Geographic, Demographic, Population Data

Redistricting Data Hub

- Electoral Data

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Implementation - Python Package

Geopandas

- Stores and performs operations on geographic data

GerryChain

- Implements common redistricting algorithms on given geographies

Fairness

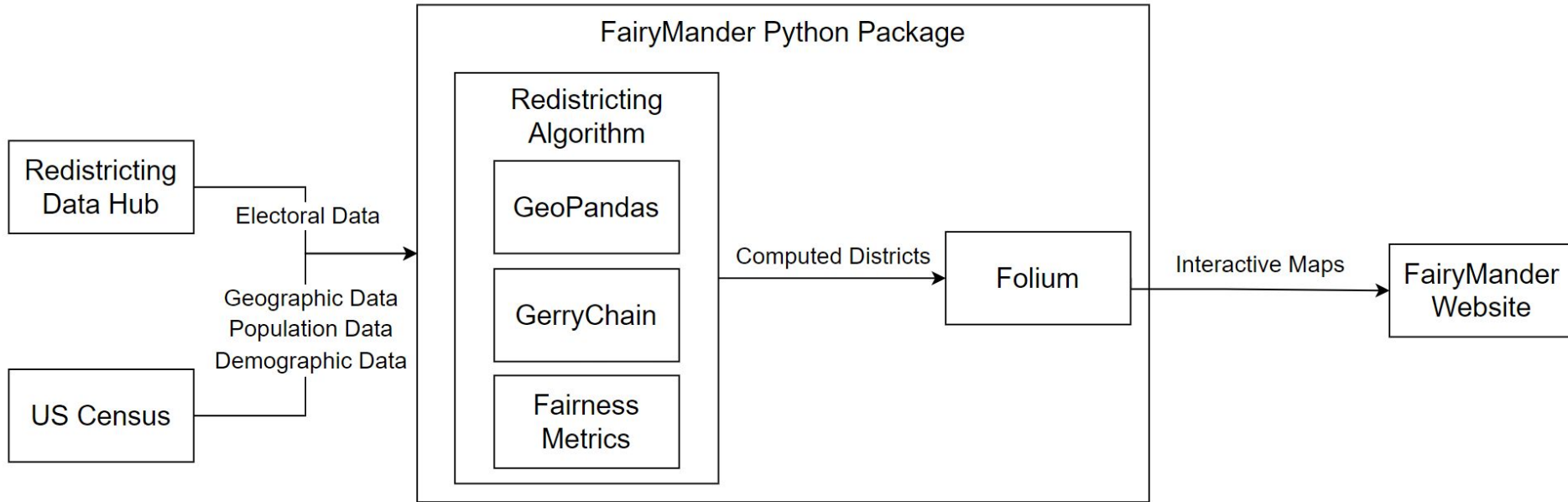- Custom module for evaluating district plan fairness

Folium

- Converts district plans to interactive maps

Implementation Overview

Prototype Review

```python
from fairymander.generator import DistrictGenerator

my_generator = DistrictGenerator("az", 0.002, 4000, 3, "compact")



districts = my_generator.run_and_save(directory="my_districts", file_prefix="az-comp")
```

```
Finished step 40/100

getting state GeoDataFrame
Sucessfully loaded state GeoDataFrame
getting state partition
generating map
Map with Polsby-Popper metric 0.26483196134459003 found:
Population in each district:
District
0    739605
1    744164
2    739529
3    745539
4    742205
5    744500
6    739235
7    745440
8    740875
```
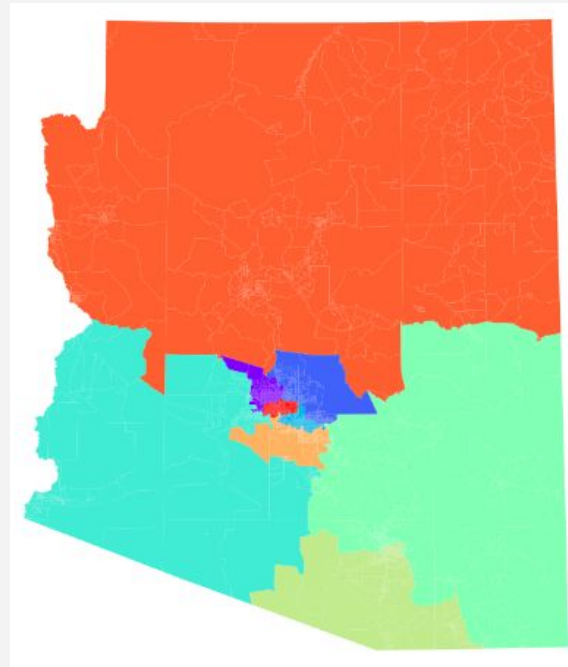
```
from fairymander.data import get_curr_district_file

gdf = get_curr_district_file('az')
print(gdf)
compare_maps(districts[2], gdf)
```

```
Comparison Summary
-------------------
Map One is better in 7 metrics:
Polsby-Popper, Reock, Efficiency Gap, Mean Median Difference, Lopsided Margin, Dissimilarity Index: Hispanic, Dissimilarity Index: Other

Map Two is better in 3 metrics:
Dissimilarity Index: African American, Dissimilarity Index: East and South Asian, Dissimilarity Index: Native American

There were no ties.

Overall, Map One has better metrics
```
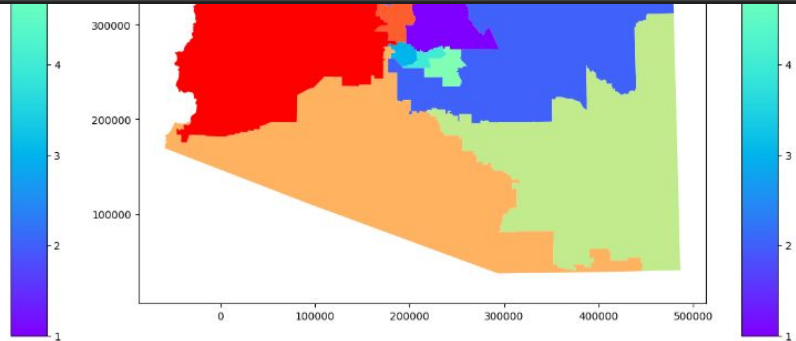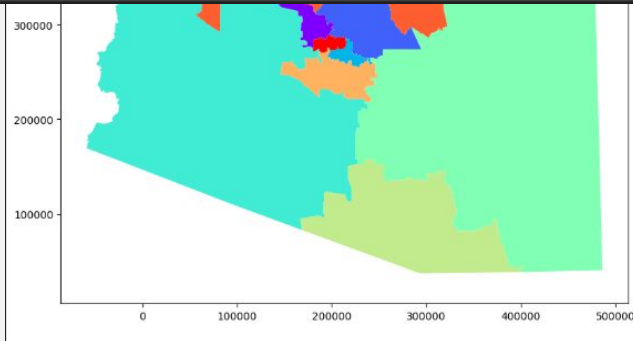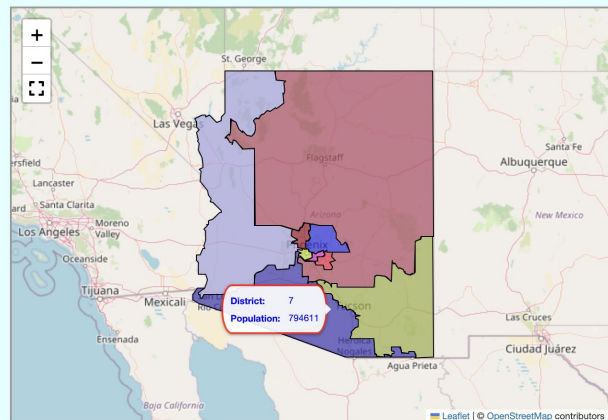
Folium and Website
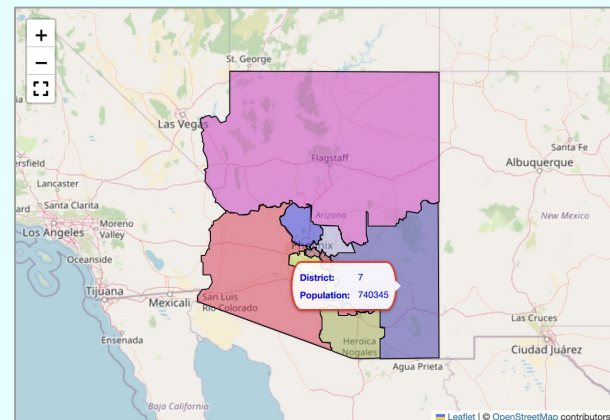
Folium

- Takes Computed Districts

Current Congressional Districts

FairyMandered Districts

Website Cont.

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Population and Seats/Districts as of the 2020 Census

Challenges and Resolutions

Algorithm Design - Acceptance

- Excess criteria: Low acceptance rate
- Minimal criteria: Low quality maps

Representing "Fairness"

- No composite score

Islands

- Connected island nodes to non-island nodes
- Hawaii

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Schedule

FairyMander

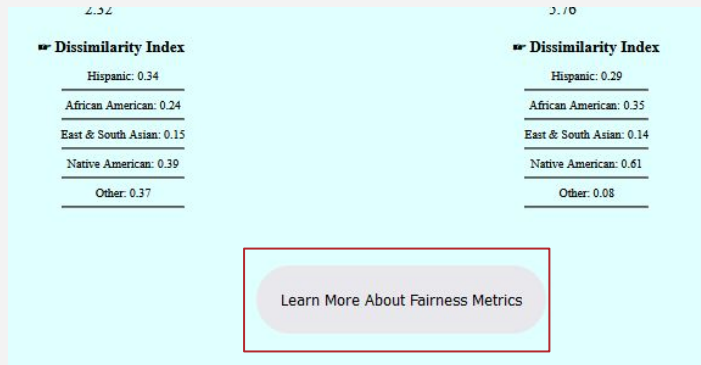|	September				October			November				December			
Preliminary Research On Fair Redistricting	x	x	x	x												
Algorithm Design	x	x	x	x	x	x	x									
Algorithm Design Case Study					x	x	x									
Pull data for Algorithm		x	x	x												
Initial Algorithm Implementation				x	x	x										
Iterate on Initial Algorithm Implementation								x	x	x	x					
Create Fairness Utility Module					x	x										
Create Folium Module						x	x									
Website	x	x	x	x	x	x	x	x	x	x	x	x				
50 state web pages								x	x	x	x	x				
Testing								x	x	x	x					
State redistricting law								x	x	x						
State definition of why districts fair								x	x	x						

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Testing Plan

Unit and Integration Testing

- 47 unit tests
- 8 integration tests

Usability Testing

- User Acceptance Testing
- Improved Fairness Metric Presentation

pytest

2.32

☞ Dissimilarity Index

Hispanic: 0.34

African American: 0.24

East & South Asian: 0.15

Native American: 0.39

Other: 0.37

5.76

☞ Dissimilarity Index

Hispanic: 0.29

African American: 0.35

East & South Asian: 0.14

Native American: 0.61

Other: 0.08

Learn More About Fairness Metrics

Future Work

Implement State Specifics

- State Redistricting Laws
- Groups of Interest

Dynamic data upload

- Data based on most recent census (2020) and election (2022)
- More robust data module for pulling relevant data

Conclusion

Problem

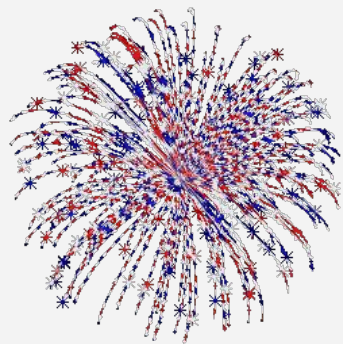- Gerrymandering poses a serious threat to democracy

Solution

- We have developed a geospatial redistricting algorithm, presented using a web application.

Impact

- We are confident in this project's accuracy and educational effectiveness.

Thank You

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