FairyMander

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Our team

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Meet Our Client

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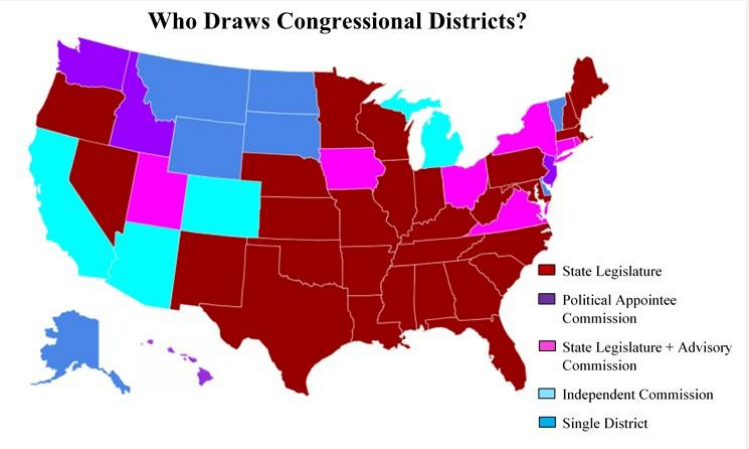
Problem Statement

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



Problem Statement - cont.

Packing

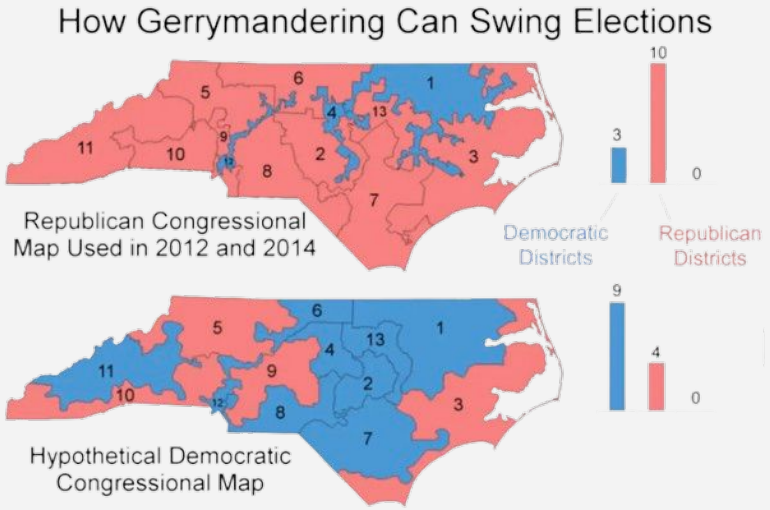
- Packing like-minded voters to as few districts as possible

Cracking

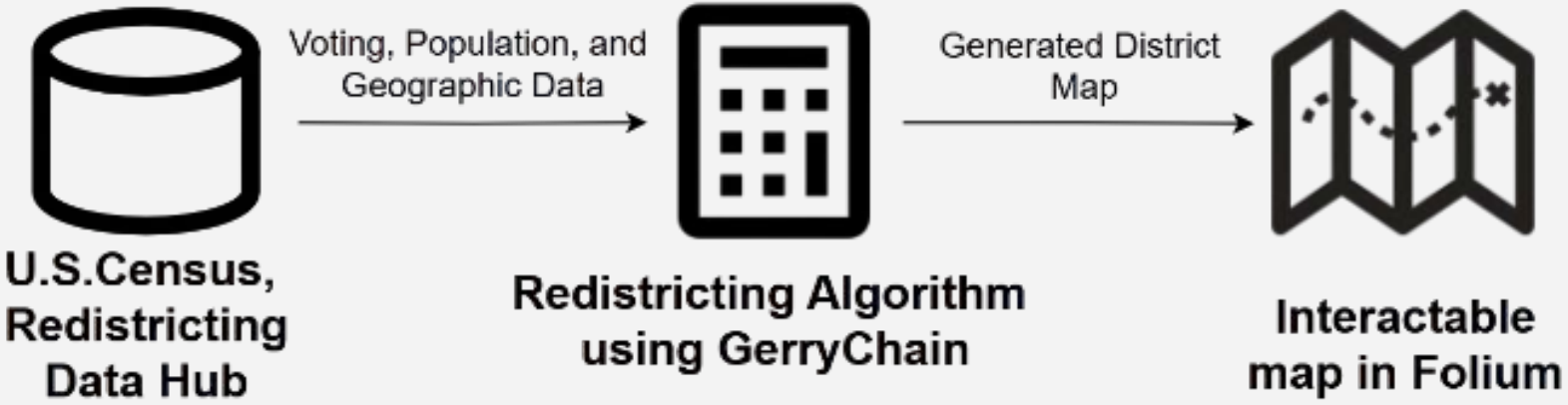
- Splitting like-minded voters across different districts

Underrepresentation

- Taking away the principle of fair representation



Solution Overview



Requirements

Creating Fair Districts

- Using geographic, electoral, and demographic data

Visualize Results

- Display results using interactable district maps

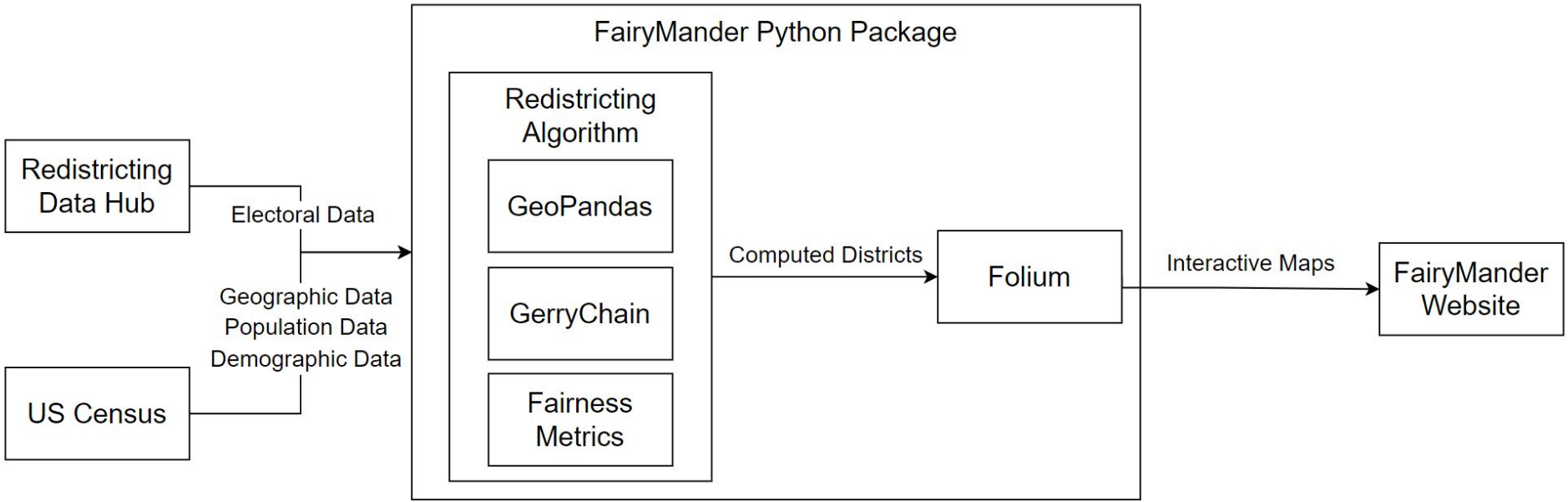
Web Application

- Results are viewable through responsive website

Redistricting Education

- Provide easy to understand insight into redistricting process

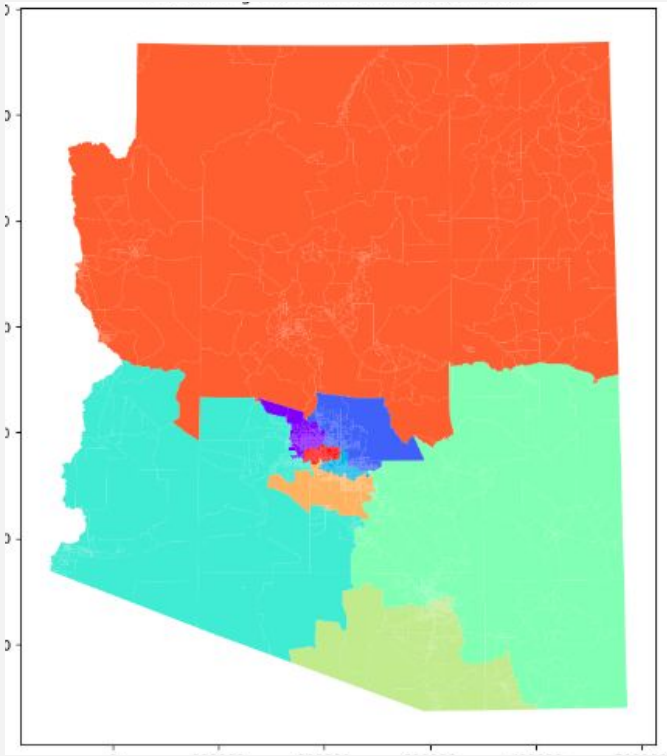
Implementation Overview



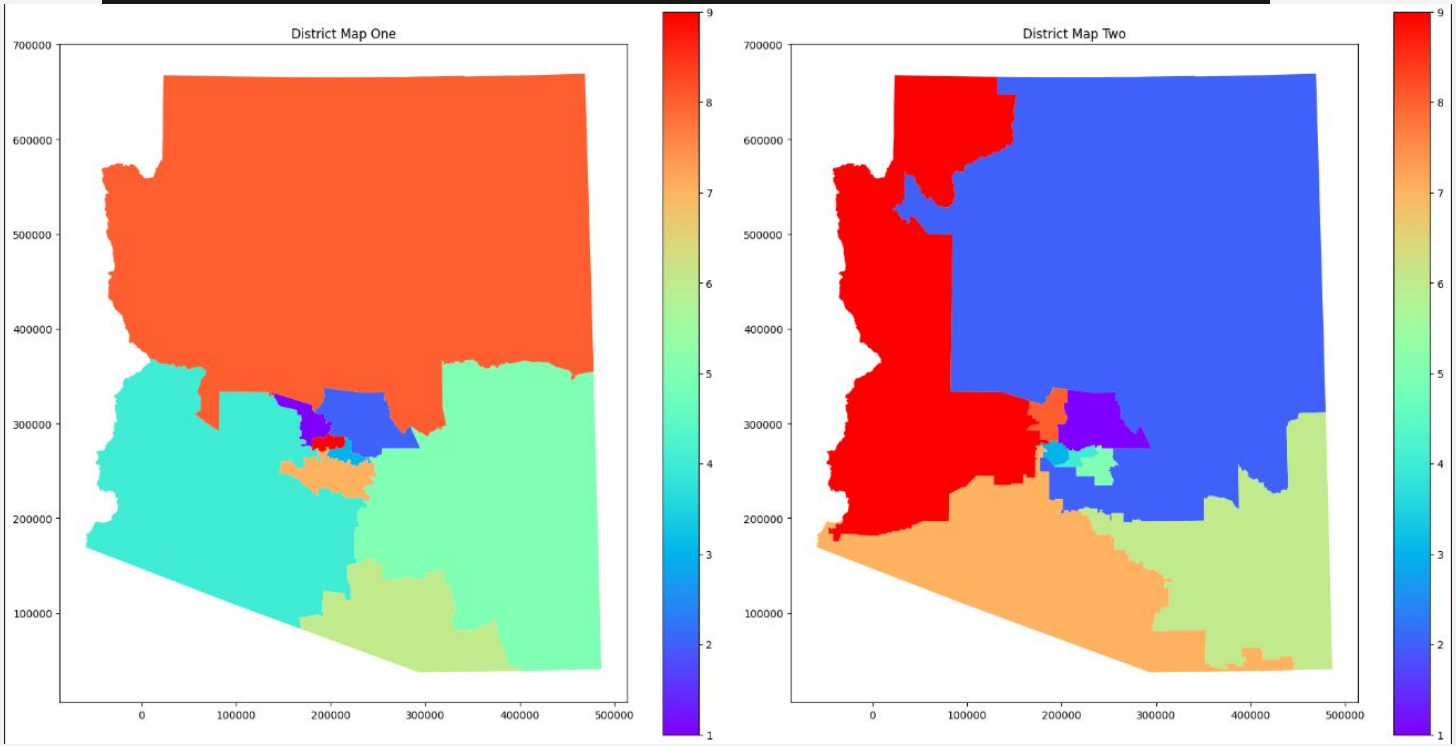
Prototype Review

```
from fairymander.generator import DistrictGenerator

'''
 1st parameter: State to be redistricted
 2nd parameter: Standard deviation
     Note: The smaller the SD is, the closer districts are in population
 3rd parameter: Steps: The number of iterations the algorithm runs to generate
                and explore new districting plans
     Note: A higher step number yields better results. It is not recommended to exceed 10,000 steps.
 4th parameter: Number of maps to display
 5th parameter: Specify which optimization metric you want to use.
                Polsby-popper (tests compactness) or efficiency-gap (tests political competitiveness)
                Enter "compact" for Polsby-popper OR "competitiveness" for efficiency-gap
'''
my_generator = DistrictGenerator("az", 0.005, 5000, 3, "compact")

districts = my_generator.run_and_save(directory="my_districts", file_prefix="az_polsby-popper")
"""
Running this will save as the following file structure, creating the directory if it doesnt exist:

my_districts
    |
    |-testing_az
        |
        |-testing_az-0
        |-testing_az-1
        |-testing_az-2

Where the final "prefix-index" files will have all the .shp related files
"""
```

```
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
```



```python
from fairymander.fairness import full_analysis, compare_maps
from fairymander.data import get_curr_district_file

gdf = get_curr_district_file('az')

compare_maps(districts[1], gdf)
```



```
Running Fairness Comparison Analysis
-------------------------------------
Average Polsby-Popper Score for Map 1: 0.28476192895923813
Average Polsby-Popper Score for Map 2: 0.27683861437532836
Map One has a better Polsby-Popper score

Average Reock Score for Map 1: 0.4291943312766201
Average Reock Score for Map 2: 0.41675277276785283
Map One has a better Reock score

Efficiency Gap for Map 1: 14.889525011666677
Efficiency Gap for Map 2: 18.41246198447224
Map One has a better Efficiency Gap

Mean Median Difference, Map One: 1.5081352514439816
Mean Median Difference, Map Two: 2.316903772649026
Map One has a better Mean Median Difference

Lopsided Margin Score, Map One: 2.7692390725988787
Lopsided Margin Score, Map Two: 8.610124992471825
Map One has a better Lopsided Margin Score
```

```
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
```

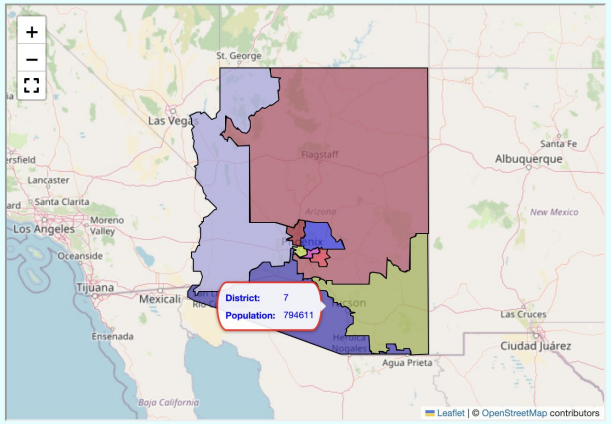
```
Dissimilarity index, Hispanic, for Map One: 0.2515115427627985
Dissimilarity index, African American, for Map One: 0.33408335735723294
Dissimilarity index, East and South Asian, for Map One: 0.15503234229319365
Dissimilarity index, Native American, for Map One: 0.6088585139823699
Dissimilarity index, Other, for Map One: 0.0817961682865351
Dissimilarity index, Hispanic, for Map Two: 0.342405799744813 67
Dissimilarity index, African American, for Map Two: 0.2396280377587448
Dissimilarity index, East and South Asian, for Map Two: 0.14721538817432842
Dissimilarity index, Native American, for Map Two: 0.39041736296724855
Dissimilarity index, Other, for Map Two: 0.3669518858061265
Map One has a better Dissimilarity Index for Hispanic minority population
Map Two has a better Dissimilarity Index for African American minority population
Map Two has a better Dissimilarity Index for East and South Asian minority population
Map Two has a better Dissimilarity Index for Native American minority population
Map One has a better Dissimilarity Index for Other minority population
```

Folium and Website

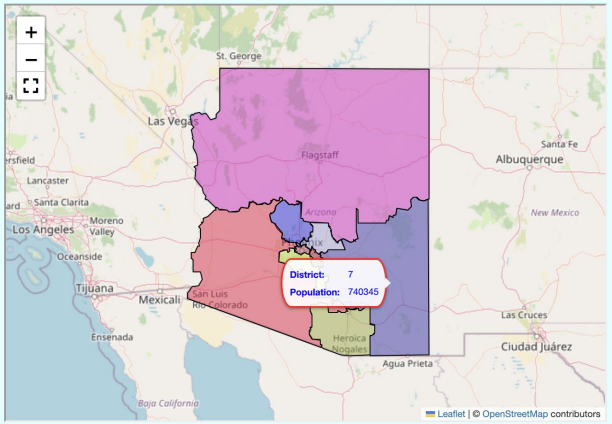
Folium

- Takes Computed Districts file

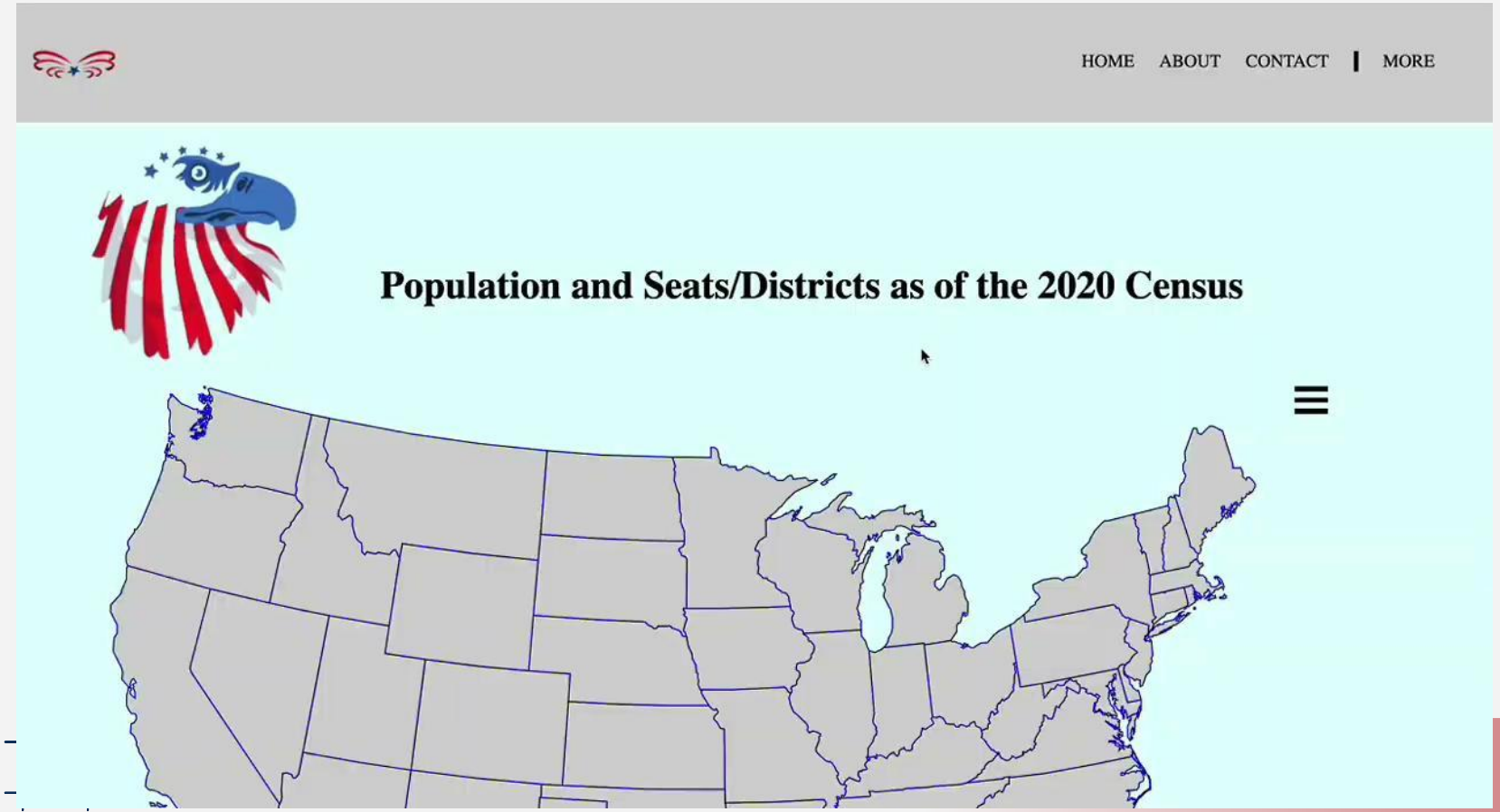
Current Congressional Districts



FairyMandered Districts



Website Cont.



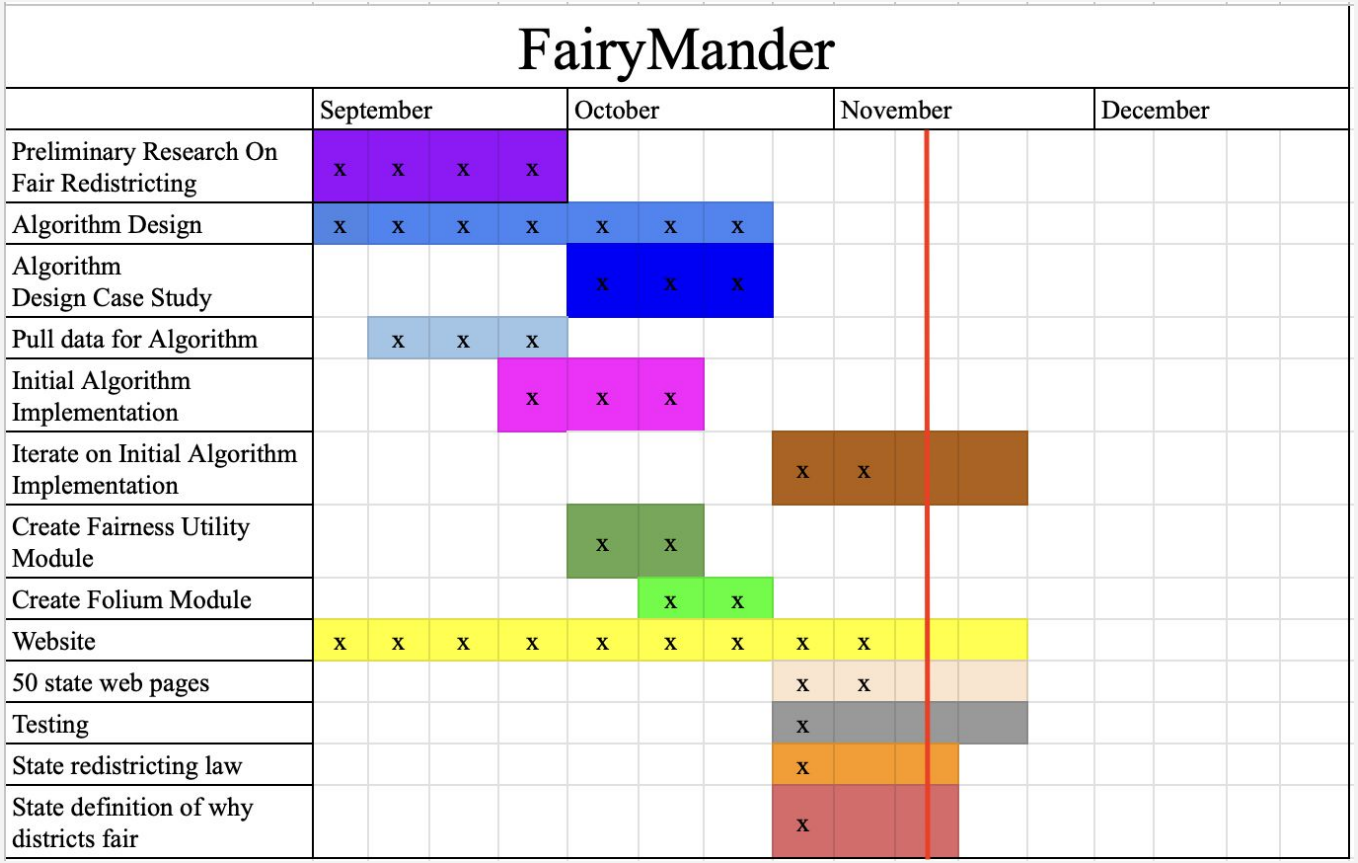
Challenges and Resolutions

- 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

Testing Plan

- Unit Testing
  - Generator, Fairness Metric, Folium Converter, and Data modules
- Integration Testing
  - System for generating, evaluating and visualizing district plan
- Usability Testing
  - Responsiveness and understandability through user acceptance testing

Schedule


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

Conclusion

Problem

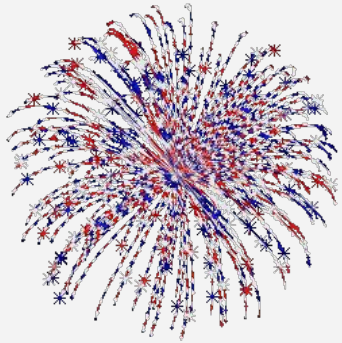
- Gerrymandering poses a serious threat to democracy

Solution

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

Wrapping Up

- Testing and quality assurance



Thank You