



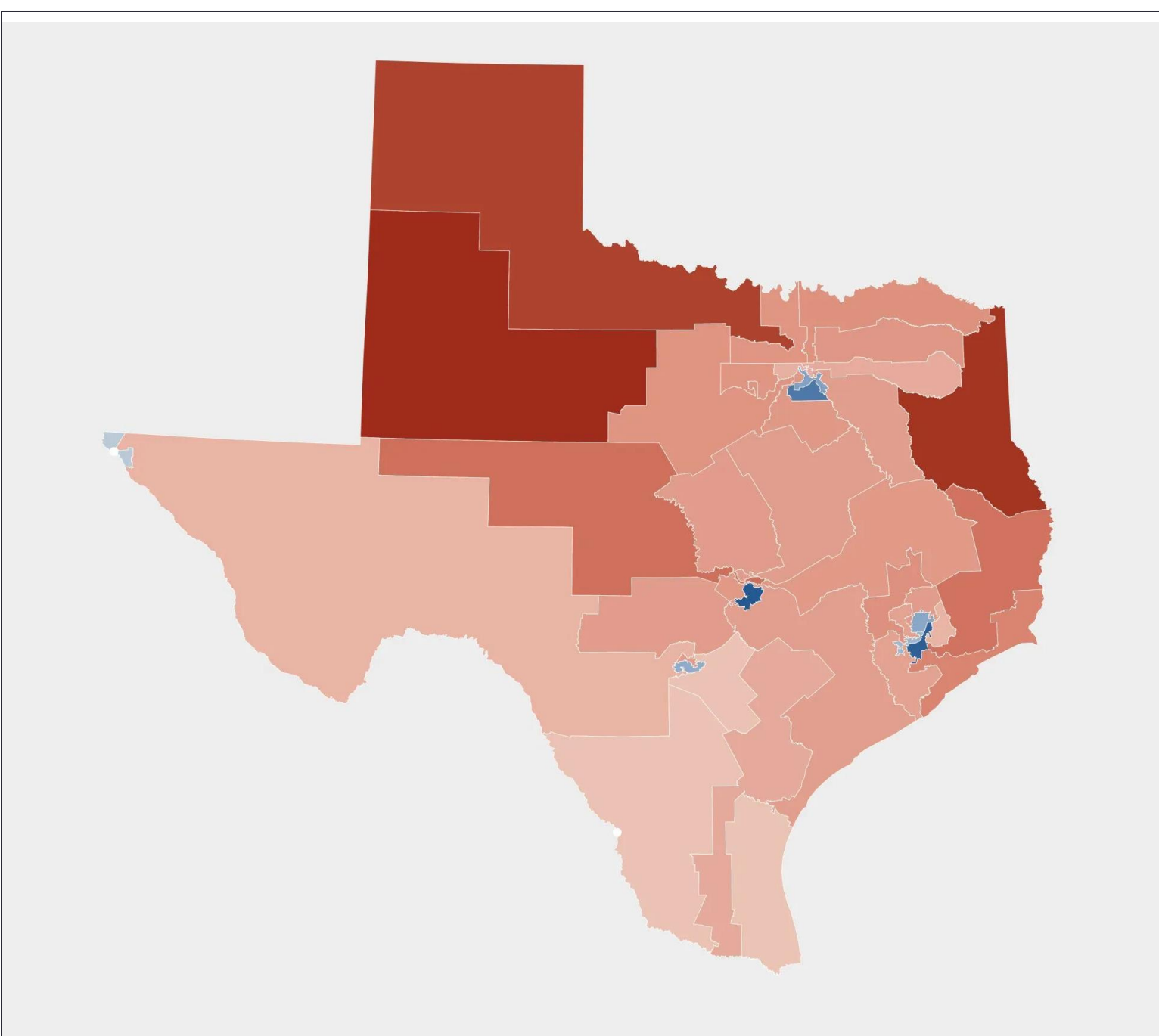
# Algorithmic Redistricting



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## BACKGROUND

- Existing congressional districts are unfair
- District boundaries for the U.S. House of Representatives are often unfair; splitting up communities, disenfranchising minority voters, and failing to reflect the will of the people. This problem is only made worse by partisan gerrymandering, when politicians redraw districts to exacerbate these issues and disproportionately favor their own political party. These gerrymandered districts undermine democracy by delivering elections with a fixed outcome.
- An algorithm can make this better
- Even non-partisan redistricting commissions can have hidden partisan agendas. To generate truly fair districts, an unbiased algorithm may be needed. Our project sought to create such an algorithm that would create compact, competitive districts without favor for one side or the other.
- What variables matter in redistricting?
  - Some characteristics of a congressional district are non-negotiable. Districts must be contiguous, one district must not completely surround another, all areas of the state must be covered by a respective congressional district, and the districts must have as close to equal populations as possible (various courts have set an 0.75% threshold for population variation between districts). Other aspects are more fluid, but Constitutional interpretation, the Voting Rights Act of 1965, and judicial precedent have highlighted district competitiveness, proportionality, minimum splitting of communities, compactness, and minority representation as especially vital to consider.



- A recently proposed congressional map of Texas has oddly-shaped districts and overrepresents Republicans

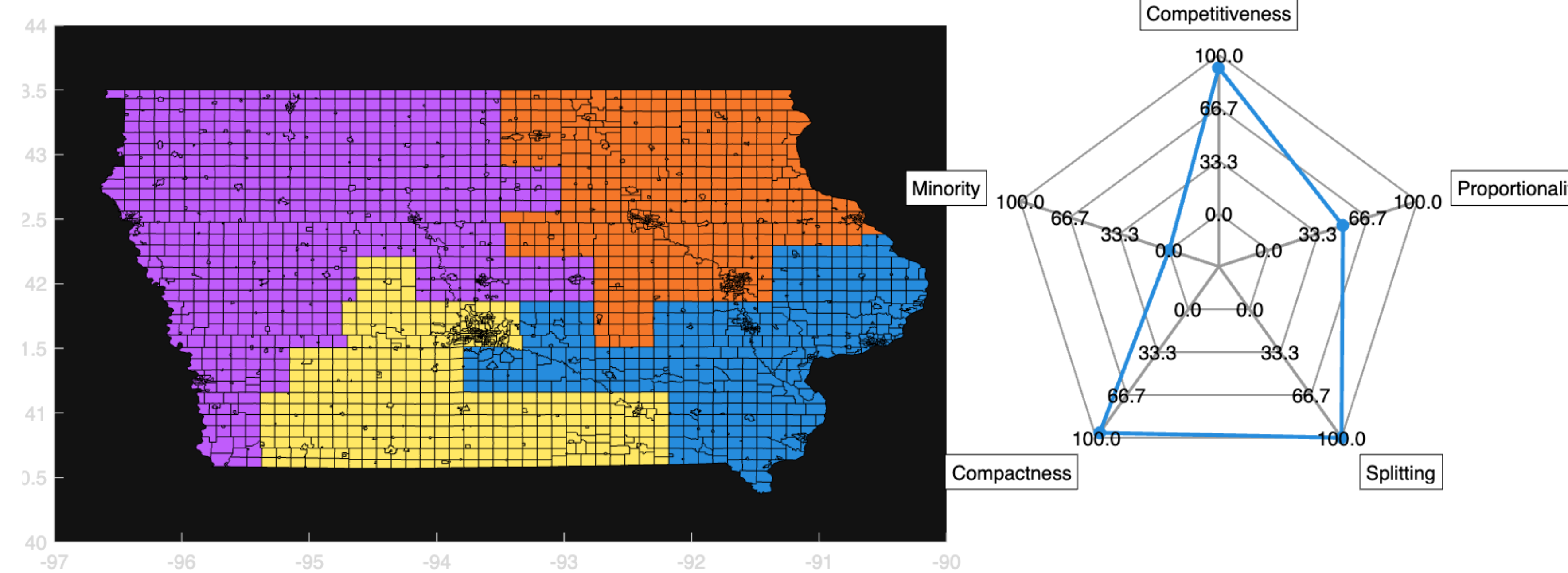
## GOALS

- Observe the disadvantages of the current districts
- Create our own general algorithm that will better optimize the major components of a district
- Apply this algorithm to real U.S. states, ideally creating districts that are more fair overall

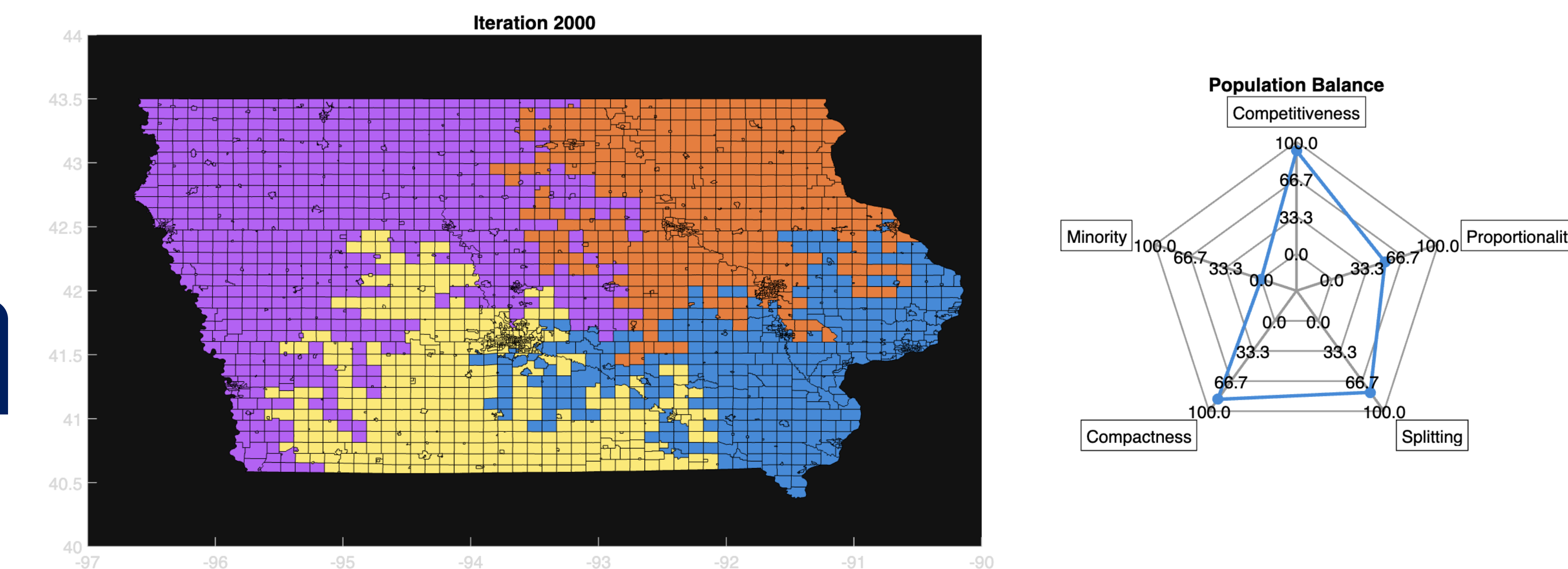
## METHODS

- Markov Chains: We originally looked at many different algorithms and approaches in our initial research of redistricting. We ultimately looked at a number of other studies and research, and we found a repeated mention of Markov Chains, this was the start of us learning what Markov Chains were and how we can utilize them in our own algorithm.
- MATLAB: When we first started our research, we did not know the best coding language to use, that would be the most conducive to our project. We experimented with Python, R and finally landed on MATLAB. This language became the most useful for working with data files such as the U.S. census files, as well as having effective output graphs that were most favorable.

## RESULTS



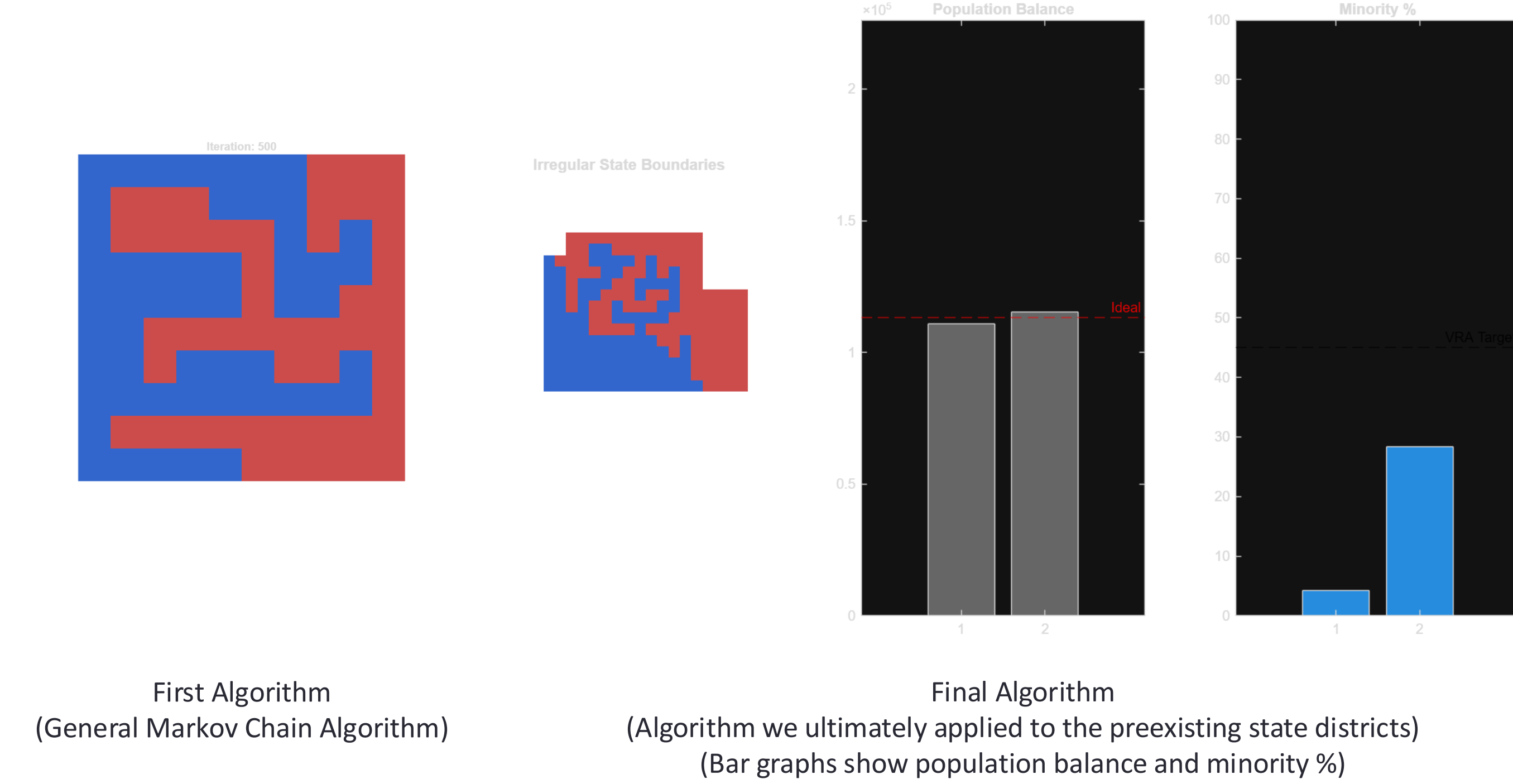
Iowa's existing congressional districts



Iowa after the algorithm

## RESULTS

- The arbitrary state algorithm was very successful
- Creating the arbitrary state and developing an algorithm without the complexity of working directly within a state file worked well
- Adapting this algorithm to real states proved more difficult, and results were mixed. The compactness score was inconsistent, but districts still remained fair overall.
- The mechanisms of the algorithm such as flipping and mapping worked well, but the scoring's impact on the state was less successful
- Testing this on larger states was also difficult, as the computation time increased and overall change to the districts decreased.



## CONCLUSIONS

- A more polished version of this algorithm could be applied to the U.S. house, and possibly other legislatures around the world, to bring greater representation to the people
- Going forward, we would like to improve the scoring criteria of this algorithm to have it more reliably produce improved maps

## REFERENCES

- Data used:
  - Precinct and Congressional District Shapefiles – US Census Bureau
  - Redistricting Data Files – ALARM Project
- MATLAB spider\_plot function – Copyright (c) 2020-2023, Moses, All rights reserved.
- Texas image - Carla Astudillo, the Texas Tribune
- MATLAB Markov Chain Models – MATLAB Help Center
- Redistricting outline – ALARM redist.org