

Using Algorithmic Redistricting to Combat Gerrymandering

Daniel P. Szabo Jin-Yi Cai

University of Wisconsin Madison
dszabo2@wisc.edu

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Overview

1 Gerrymandering

- Introduction

2 Algorithmic Redistricting

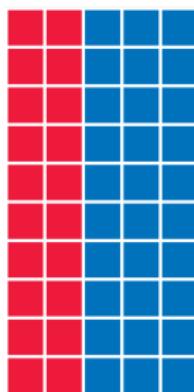
- Existing Methods
- Problems

3 Our algorithm

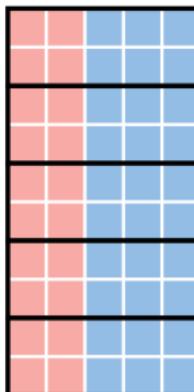
What is gerrymandering?

Definition

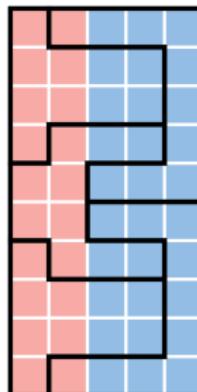
Gerrymandering is the act of drawing voting district boundaries to gain a partisan advantage.



50 PRECINCTS
60% BLUE
40% RED



5 DISTRICTS
5 BLUE
0 RED
BLUE WINS



5 DISTRICTS
3 RED
2 BLUE
RED WINS

Detecting gerrymandering

Goal

Detect gerrymandering in an *automated* and *unbiased* way.

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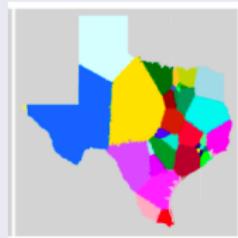
Solution

Take a *random* sample of redistricting plans, evaluate some metrics, and see if proposed plan is an outlier.

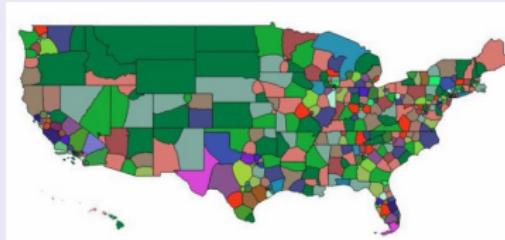
Existing Methods

Geometric Methods

- Modifying Voronoi diagrams [Young et al].



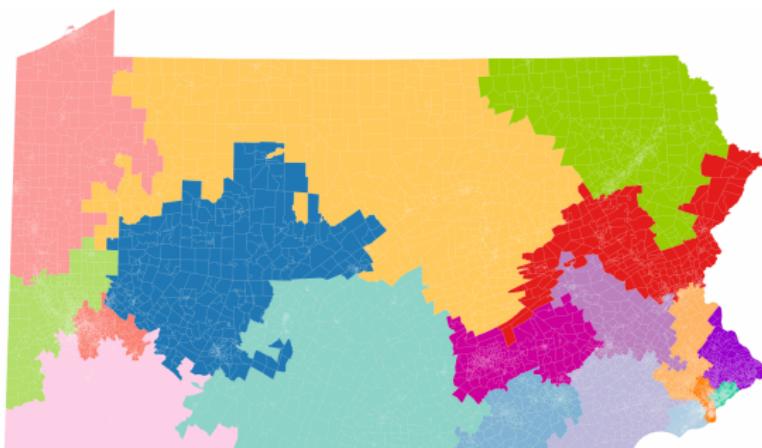
- Divide and conquer arcs [Levin et al].



Existing Methods

MCMC methods

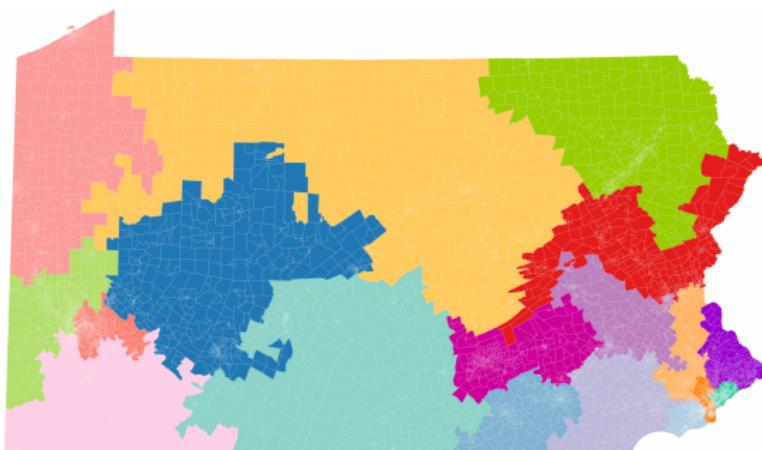
MGGG's GerryChain algorithm [DeFord et al].



Existing Methods

MCMC methods

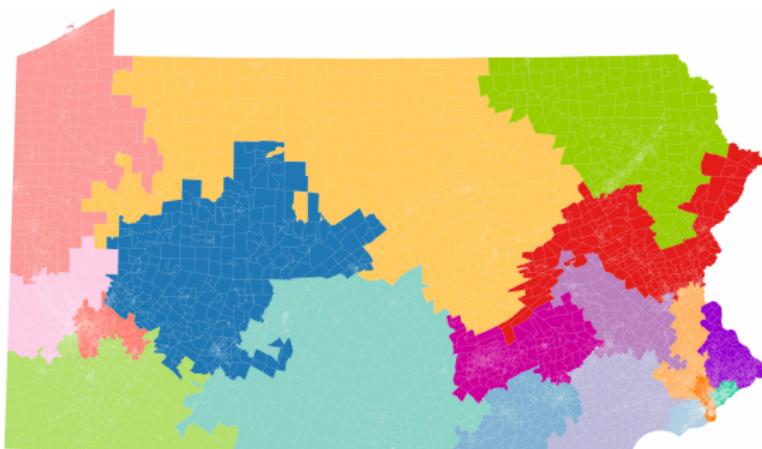
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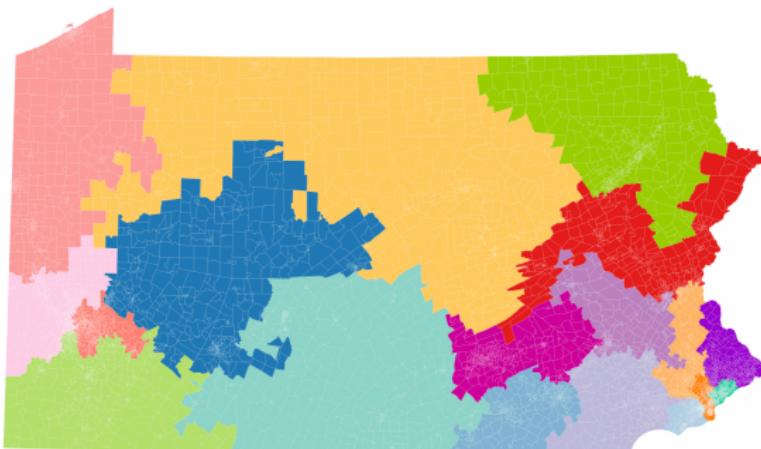
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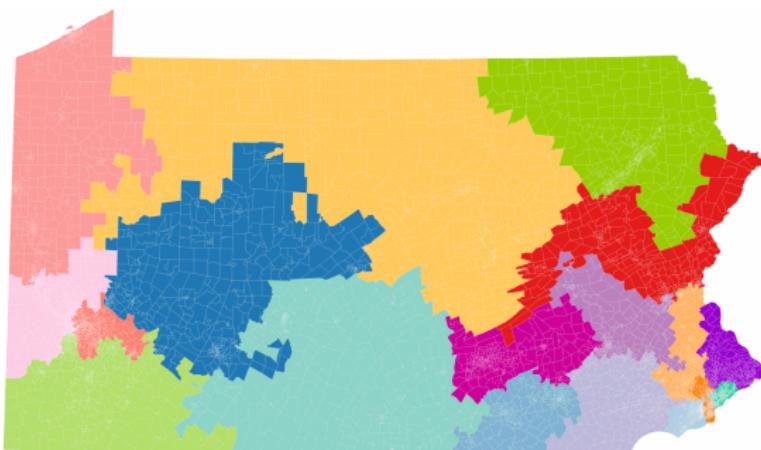
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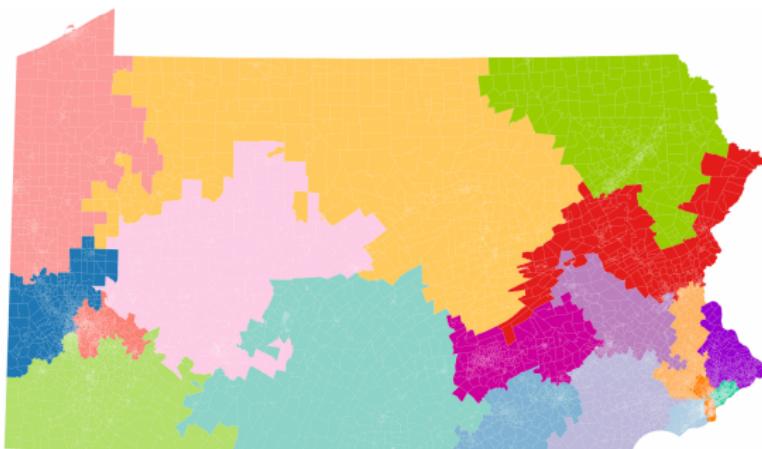
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Existing Methods

MCMC methods

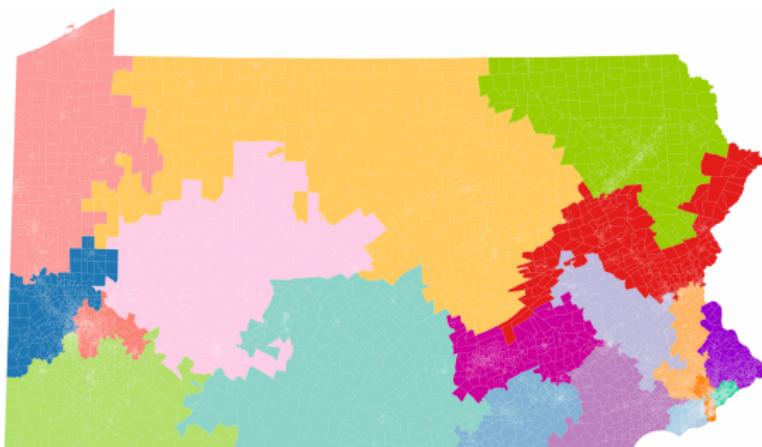
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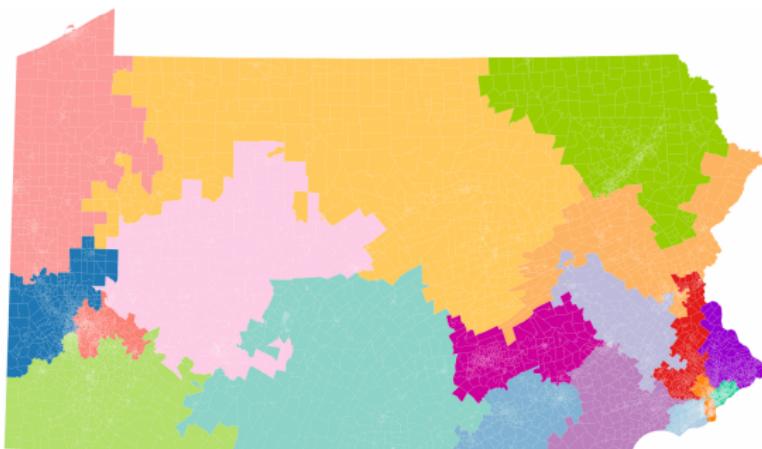
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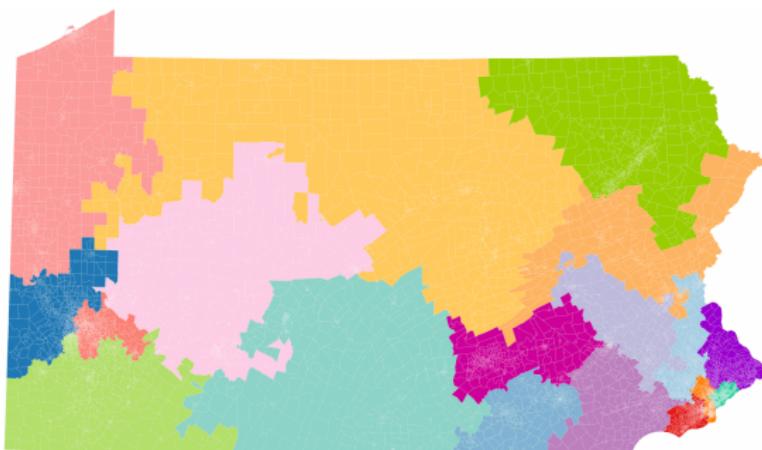
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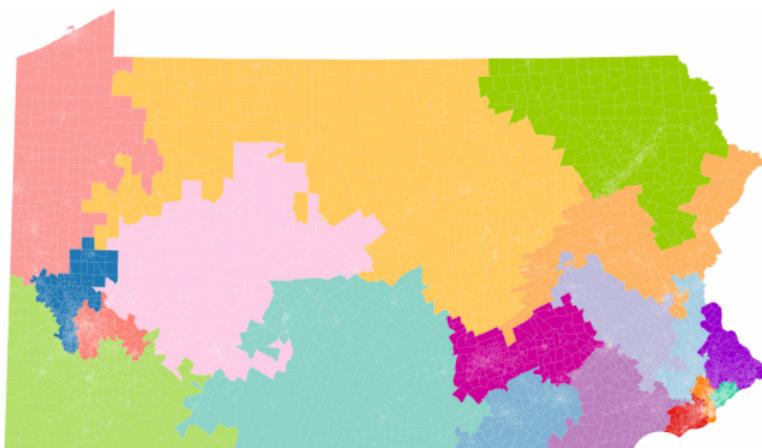
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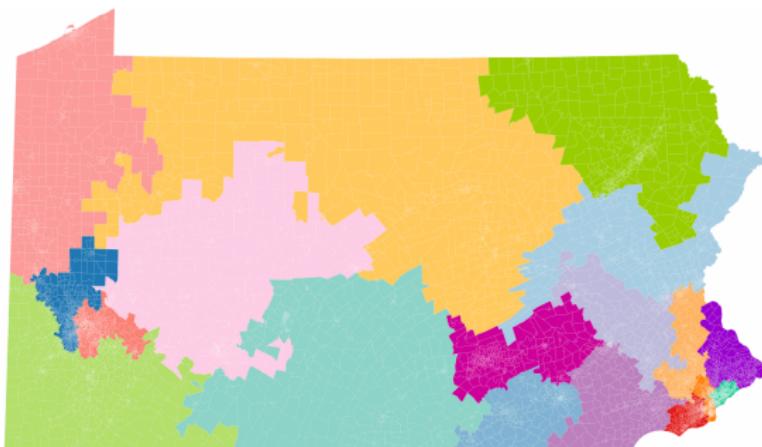
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Existing Methods

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Issues with existing methods

- It is NP-hard to uniformly sample graph partitions [Najt et al].
- Markov chain algorithms are provably slow mixing [Frieze et al].
- Space of all possible plans is **enormous**:
6180023889385196653018131 plans for Manitowoc county alone.

Our solution

We give a subexponential ($O(2^{\sqrt{n}})$) time algorithm to sample connected graph partitions uniformly at random.



References

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