All Politics is Local:

Redistricting via Local Fairness

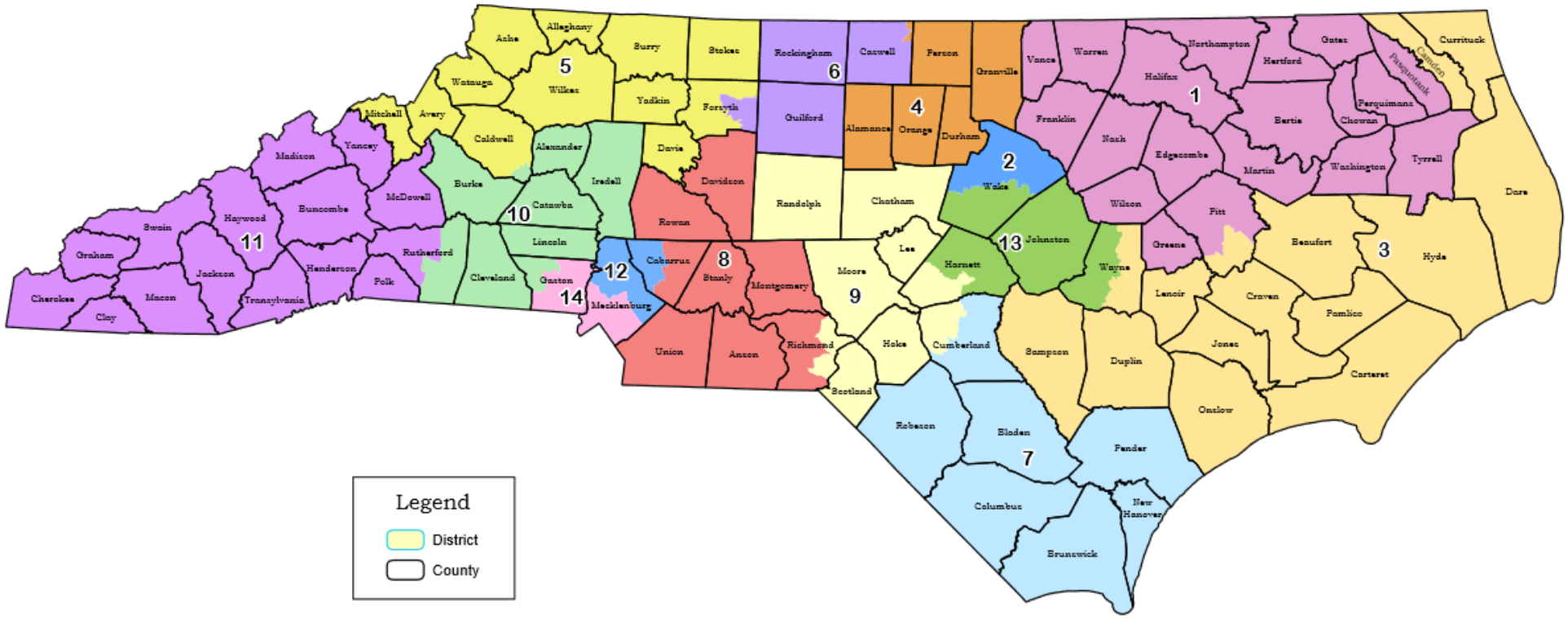
Shao-Heng Ko, **Erin Taylor**, Pankaj K. Agarwal, Kamesh Munagala
Duke University

Background

- Every state in the US is partitioned into (one or more) districts,
  each district elects one representative

Background

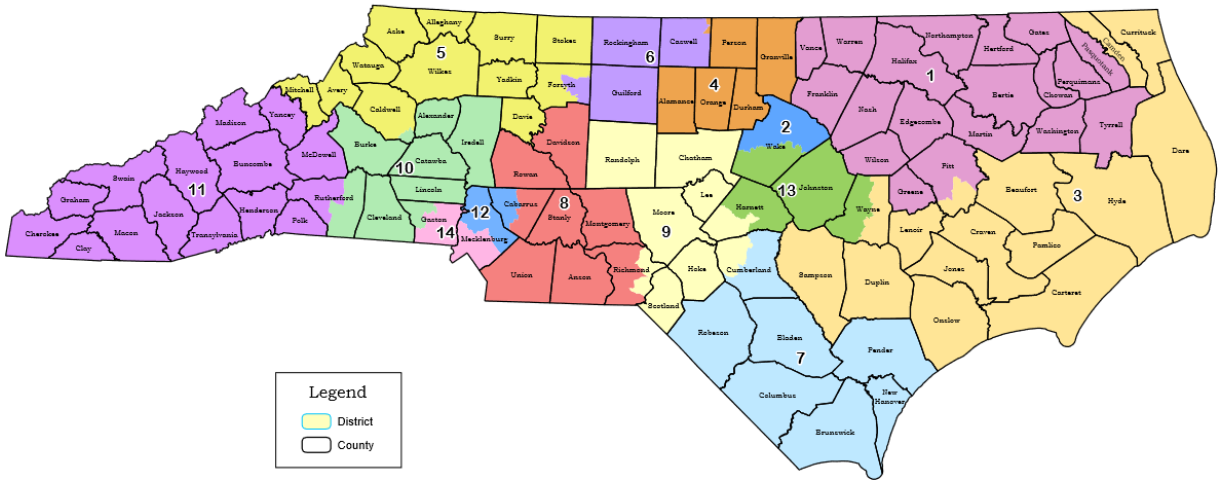
- Every state in the US is partitioned into (one or more) districts,
  each district elects one representative



Background

- Every state in the US is partitioned into (one or more) districts,
  each district elects one representative

How should we redistrict?



How should we redistrict?

Necessary:

- Districts should be connected, partition the state
- Population balanced (up to a small 1-2% factor)

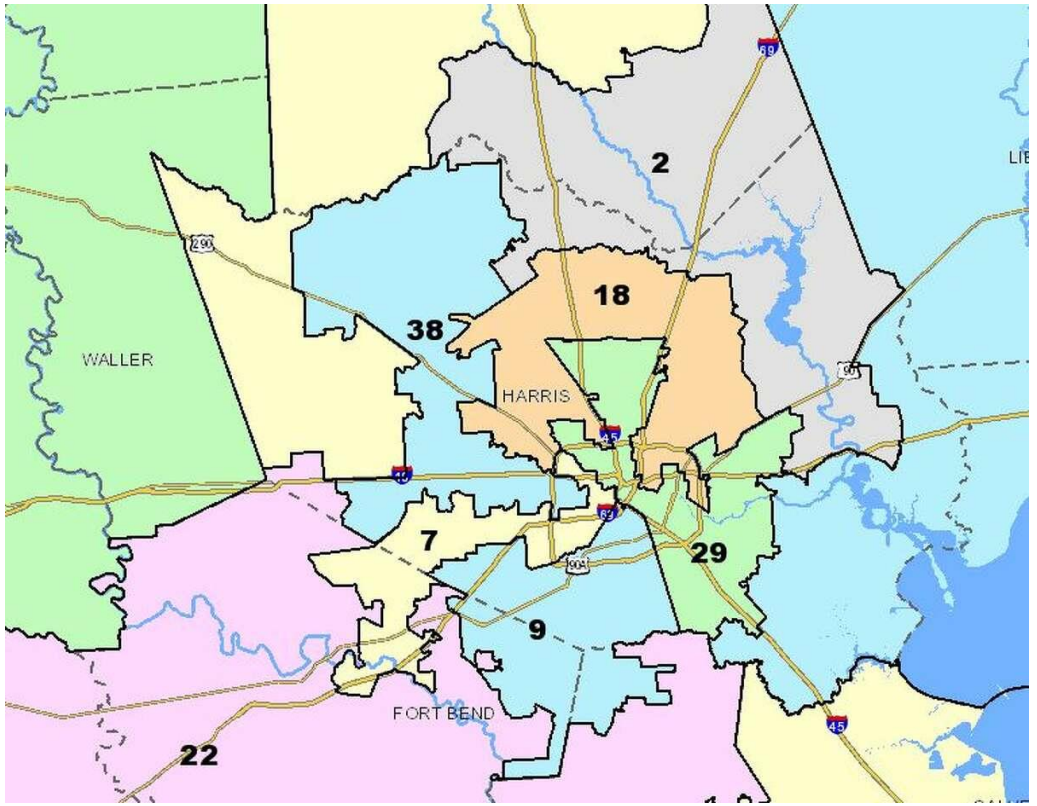
How should we redistrict?

<u>Necessary:</u>

- Districts should be connected, partition the state
- Population balanced (up to a small 1-2% factor)

<u>Desirable global properties</u>

- Proportional seat shares
- Competition within districts
- Compactness
  (districts should have nice boundaries)



How should we redistrict?

<u>Desirable global properties</u>

- Proportional seat shares
- Competition within districts
- Compactness

But what about local concerns?

Ex: Voters in a coastal region may be mis-represented due to global properties receiving priority.

How should we redistrict?

But what about local concerns?

Ex: Voters in a coastal region may be mis-represented due to global properties receiving priority.

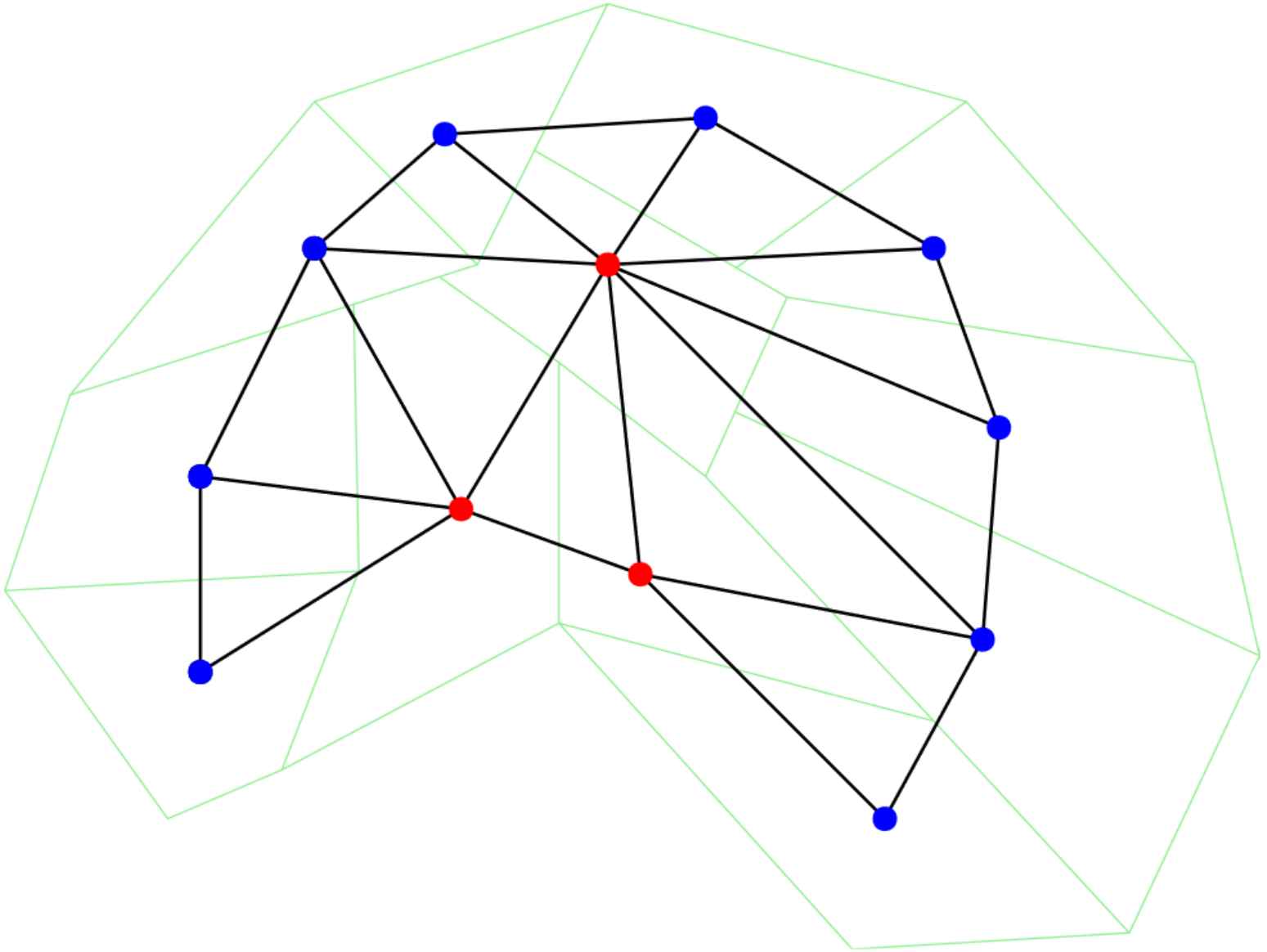
Intuition: Local Fairness (cooperative game theory)
If a subset of unsatisfied voters could draw a **new** district D,
such that their party is the majority in D,
then the current districting is **unfair**.

Intuition: Local Fairness (cooperative game theory)

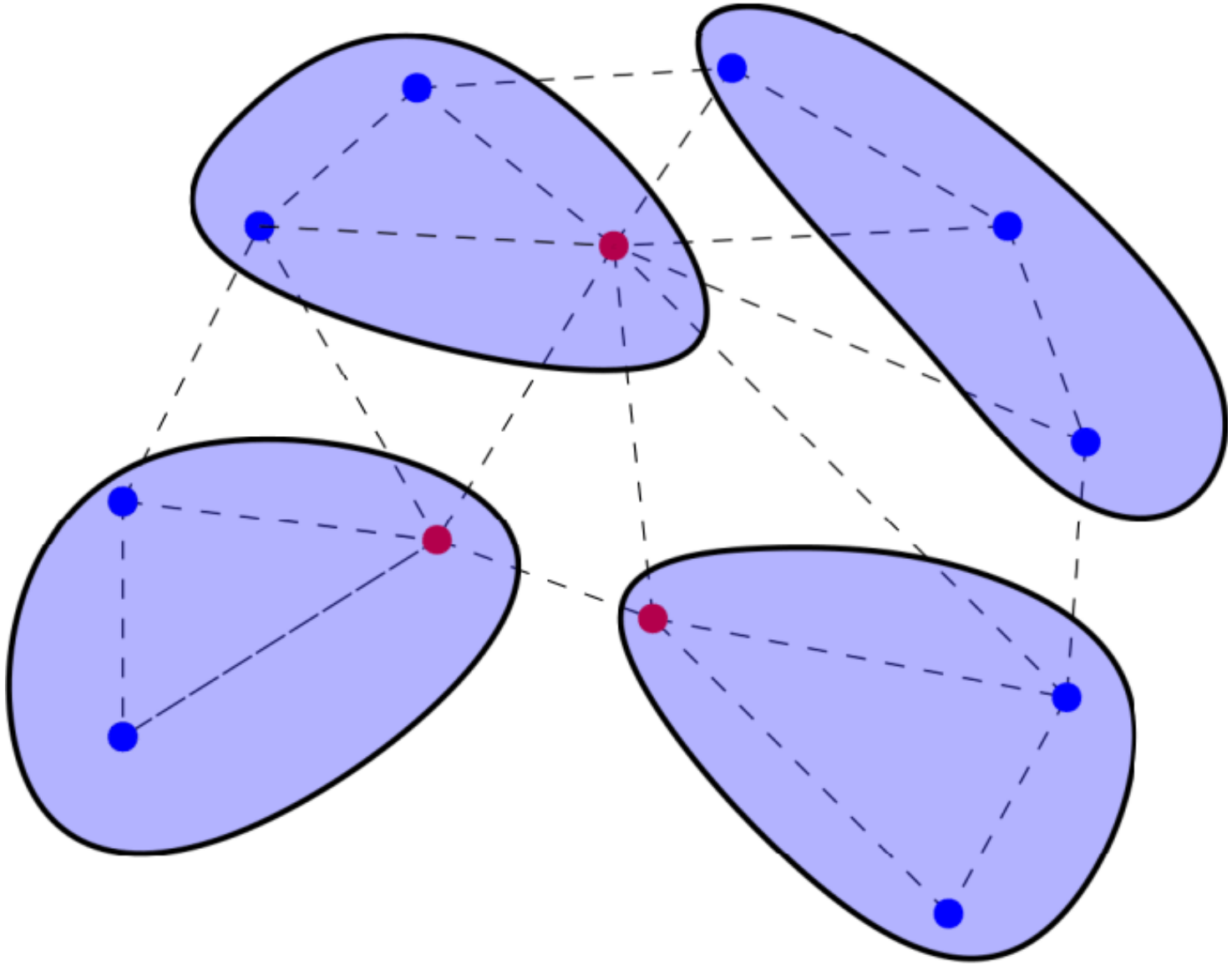
If a subset of unsatisfied voters could draw a new district D,
such that their party is the majority in D,
then the current districting is unfair.

- Captures notion of "justified complaints"
- Interpretable by humans

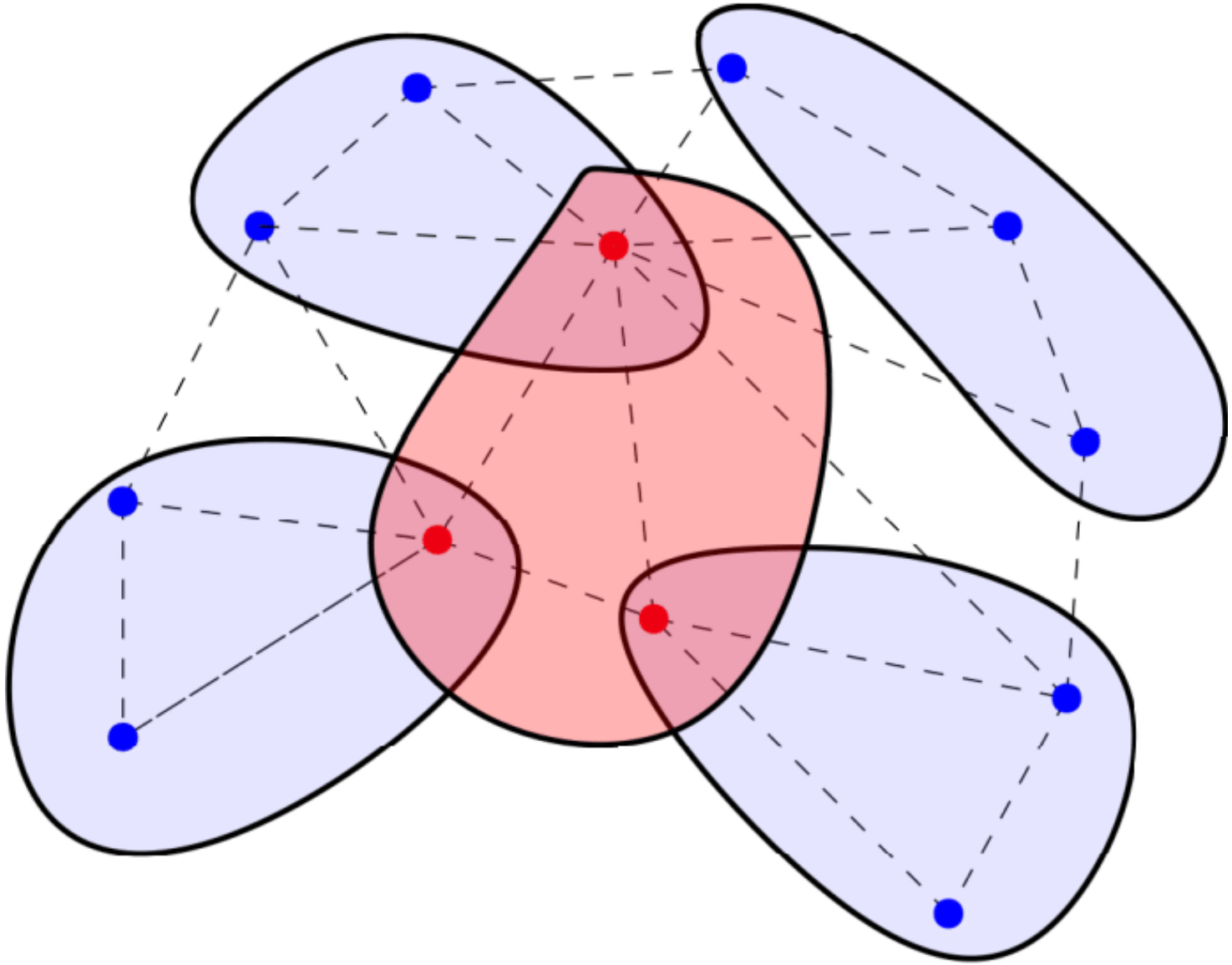
One point represents one voter, either red or blue



Districting into 4 blue districts.



Red voters show the districting is locally unfair.



Local Fairness

If a subset of unsatisfied voters could draw a new district D,
such that their party is the majority in D,
then the current districting is unfair.

- Captures notion of "justified complaints"
- Interpretable by humans

Questions

1. How can we test (audit) if a given plan is fair?
2. Are locally fair plans achievable in real redistricting tasks?
   If so, do they also have desired global properties?

Questions

1. How can we test (audit) if a given plan is fair?
2. Are locally fair plans achievable in real redistricting tasks?
   If so, do they also have desired global properties?

Our contributions

1. Yes, 2 algorithms: ensemble-based, dynamic program.
   Moreover, auditing problem is NP-complete.
2. According to our experiments, yes and yes!

(See paper for details.)