Voting District Generation

Project Teams
- Teams listed on course home page
- All class members are now part of a team

3-student teams will have a use case number target appropriate to the size of the team
Comments on Project Use Case List

- Project not a great fit for use cases since actor driven scenarios create many complex use cases
- List of use cases is a 2-step process
  - Teams develop their list of requested use cases
  - Recommendations of each team will be considered in the generation of a master list of about 40 use cases
- Use cases for project will
  - Provide balanced units of work
  - Allow for final demo grading based on completed use cases
- Use cases will consist of required, preferred, and optional
- Project grading will emphasize required and preferred use cases

Project - Voting District Generation

- Develop a system to generate a state congressional redistricting plan based on user-set parameters
- Parameters include, but are not limited to:
  - Compactness
  - Alignment with county and city boundaries
  - Variation limits in population
  - Alignment with natural boundaries (e.g., highways, rivers, etc.)
  - Adherence to Voting Rights Act
- Shows a comparison with existing district boundaries
- Depicts the results graphically in a Web interface
- Works for a minimum of 3 states
Top Level View of the System

- Consider a state with a defined set of geographically defined districts (each small in size). We refer to these as precincts.
- A higher level district (e.g., congressional district) is composed of some collection of these small districts.
- Determine a suitable allocation of low-level districts to higher level districts.
- The process:
  - ignores political considerations
  - is “good” in some sense
  - Does not violate any constraints

Algorithmic Approach - Part 1

- Create an initial set of congressional districts by
  - In a given step, combine some (not all) pairs of precincts according to the factors set by the user - producing a set of precinct clusters.
  - Repeat until the number of precinct clusters equals the desired number of congressional districts.

Rules for combining clusters might change as the algorithm proceeds.
Algorithmic Approach - Part 2

Starting with the clusters obtained in Part 1

1. Move one precinct into a different higher level district
2. Determine if the move violates any constraints, and if so, move that district back
3. Measure the "goodness" of each district affected by the move. If the move improves overall goodness, keep the move.
4. Repeat steps 2-4 until goodness cannot be further improved

This approach is referred to as "simulated annealing"

What are Some of the Constraints?

- Districts should be contiguous, where possible
- Incumbent representatives should be in separate districts, where possible
- Districts should be aligned on natural boundaries (e.g., rivers and highways) where appropriate
- Districts should not split counties and/or cities
- Majority/minority districts should be allowed (where appropriate)
- Communities of interest should be enclosed in a district (where possible)
- Districts should be compact
What are Some of the “Goodness” Measures?

- Compactness
- Contiguity
- Equal population
- Preservation of existing communities
- Partisan fairness
- Majority/minority

These measures will have weights in your “goodness” calculation

Some measures are quantifiable, other perhaps not

Some weights might be zero

Compactness Measures

- Not a single best measure
- Good description of the measures in Kaufman, King, and Komisarchik
- Multiple measures are needed, with some weighted compactness score
Partisan Fairness Measures

- Multiple measures available
  - Efficiency gap – required
  - Seats – to – votes curve analysis
  - Mean-median difference
  - Others

These measures estimate the presence of political gerrymandering

Some measures will be extracted from previous projects, and provide as an API.

Equal Population

- Higher level districts (e.g., congressional districts) should contain approximately equal populations
- How much variance is allowed?
What Data is Needed for the Constraints and Measures?

- Geospatial boundary data
  - Precincts
  - Existing Congressional districts
  - Cities/counties
  - Natural boundaries (e.g., roads and rivers)
- Election results data
- Voter preference data (e.g., party affiliation)
- Demographic data (e.g., racial, ethnic)

GUI

- Your user interface will be very helpful in understanding system requirements
- Good to begin work on the GUI very soon.

Demo of a previous system in the next class