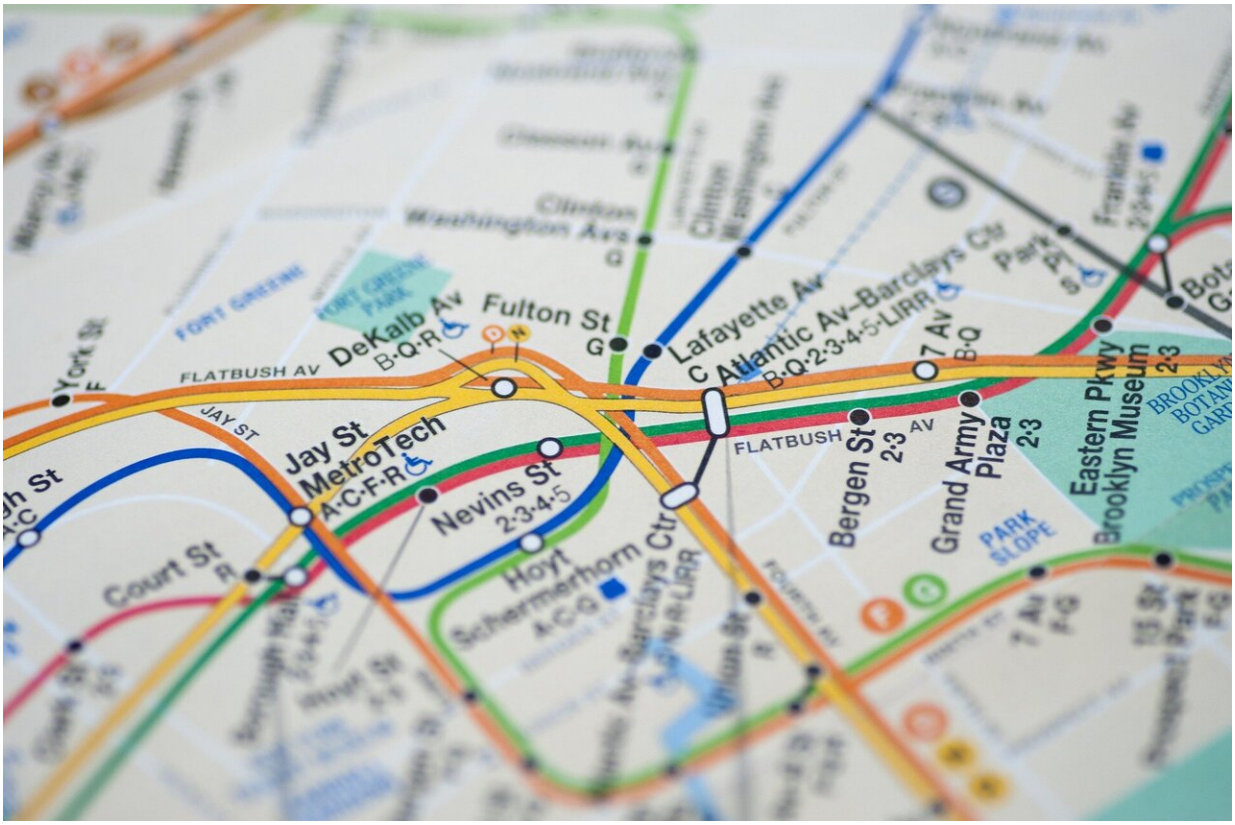
'Fairmandering' draws fair districts using data science

November 25 2020, by Melanie Lefkowitz



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It's almost impossible for humans to draw unbiased maps, even when they're trying.

A new mathematical method developed by Cornell researchers can inject fairness into the fraught process of political redistricting—and proves that it takes more than good intent to create a fair and representative district.

The two-step method, described in the paper, "Fairmandering: A Column Generation Heuristic for Fairness Optimized Political Districting," first creates billions of potential electoral maps for each state, and then algorithmically identifies a range of possibilities meeting the desired criteria for fairness.

"Fairmandering" won the INFORMS Undergraduate Operations Research Prize, awarded to the best undergraduate paper, at the Nov. 8-11 INFORMS Annual Meeting, the leading meeting of operations research and analytics professionals. First author is Wes Gurnee '20, now a software engineer at Google.

The American congressional district system empowers politicians to manipulate district boundaries in order to influence election results. Districts may be drawn by the party in power to include large numbers of people in their party, a process known as gerrymandering, swaying the outcome of elections and determining political control at the local and national level.

It's an urgent issue—especially as states prepare for the decennial redistricting next year, based on the results of the 2020 census.

"Advances in data science have helped the parties get better and better at designing districts to keep political control," said co-author David Shmoys, the Laibe/Acheson Professor of Business Management and Leadership Studies in the School of Operations Research and Information Engineering. "We wanted to offer a completely different perspective that goes to the core of what it means to do a fair districting,

and to put algorithmic tools in policymakers' hands that allow them to do the right thing."

In the research, the largest-ever study of legal congressional district maps, Gurnee and Shmoys sought to create election maps with fair outcomes—those that accurately reflect a state's political leanings, create enough competitive races to ensure accountability and treat each party symmetrically.

Past research has sought to use computational methods to draw unbiased districts. But these efforts have ignored political and demographic factors, assuming that so-called "compact" districts—those constructed in regular shapes based on location—would be fair.

But even then, the researchers found, the demographic and political composition of the district is likely not representative of the political leanings of the entire state.

"Historically, there has been this belief that a map drawn randomly, with no political bias or partisan data, is inherently fair," Gurnee said. "While it's true that these maps are blind to partisan bias, they're not free from partisan bias."

Rather than making reasonably shaped districts the goal, the researchers built in shape as one factor of their model, which can rapidly generate billions of possible electoral maps for each state.

"You need a rich enough set of ways to put the puzzle together so that you have a diversity of possible outcomes," Shmoys said, "but you also need it to be expressive enough to give you the range of fairness outcomes that you want."

Once they've generated the maps, the researchers used the tools of

integer programming—a mathematical modeling framework for which recent advances allowed them to solve a very large-scale problem—to evaluate the maps for fairness.

Though the researchers chose a balanced representation of political affiliation as their definition of fairness in the study, other demographic factors could be considered. The model could also apply to state and local representative maps, in addition to congressional districts.

Gurnee has started an organization called Fairmandering to advance the principles of the research.

"It's not the geographic shape of the district that's important—it's really thinking about more holistic principles of what it means to do a fair districting," Shmoys said. "We're hoping this will really impact the conversation that's going to be taking place state by state over the next year and a half, both at the congressional level and the state legislative level."

Provided by Cornell University

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