Preface

This unusual book was originally conceived as the proceedings of an unusual conference. In 2016-2017, a kitchen-table collective of mathematicians formed the Metric Geometry and Gerrymandering Group, and in July 2017 we planned a Geometry of Redistricting Workshop at Tufts University. Speakers came from many fields and vocations—scholars, technologists, organizers, and litigators—and the conference drew so much interest that we had to hold it at a theater off campus. More than four years later, the collective is now a Lab, and the Lab is engaged in the decennial redistricting in some way in over a dozen states. Meanwhile, the conference proceedings evolved into the ambitious boundary-flouting volume you see here.

What is "political geometry"? For starters, it's a riff on "political geography," an established academic discipline that looks at the spatial dimensions of elections and governance. Where there's space, there's shape, and mathematicians might have something useful to say. And it's not just math, geography, and political science: there's software, graph algorithms, policy, civil rights, history, political philosophy, and of course law in the mix. This book was designed to serve up a multi-disciplinary buffet, with both traditional fare and fresh fusions.

WHAT'S IN THIS BOOK

We've divided this book into five broad parts, coarsely chunked by domain but with lots of overlaps and cross-talk: Political Thought, Law, Geography, Math and Computer Science, and "On the Ground." Each chapter is written by a different author, or set of authors, drawing from a huge variety of backgrounds and perspectives. We've added smaller "Explainers" in a few key places that treat important topics in a stand-alone fashion. (They are marked with colored strips on the page corners so they're easy to flip to.) We've also sprinkled interviews with a range of practitioners and theorists throughout.

OK, BUT REALLY, WHAT'S IN THIS BOOK

We start the book off with an introduction and overview from *Moon Duchin* (Chapter 0). She'll cover some of the basics: Can you use shape to define a gerrymander? What about judging from results themselves, where representation is out of whack

with the vote balance? If not either of those, what can you do? This chapter surveys the lay of the land in data-driven redistricting.

Chapter 1, "Explainer: Compactness by the numbers," builds on the Introduction, defining scores commonly used to judge the shape of a plan and identifying some of their basic shortcomings.

Then we're off to the Parts:

POLITICAL THOUGHT

Traditionally, the identification of gerrymandering has been the province of political science.

In Chapter 2, "Measuring partisan fairness," *Mira Bernstein* and *Olivia Walch* provide a mathematical view on some metrics of fairness from the political science literature.

But what do we even mean by fairness? In Chapter 3, "Concepts of Representation," we interview four political thinkers—philosophers Elizabeth Anderson, Ryan Muldoon, and Brian Kogelmann and political scientist Claudine Gay—on what fairness in representation looks like.

In Chapter 4, "Redistricting: Math, systems, or people?", *Keith Gåddie* gives a high-level take on "the redistricting problem" from his perspective as a political scientist and veteran redistricting expert.

Chapter 5, "Political geography and representation," goes in-depth on a particular conundrum raised throughout this Part: We know that geography matters in elections, but how? Here, *Jonathan Rodden*, a political scientist who specializes in political economics and geography, teams up with data scientist *Thomas Weighill* to take a look at how political geography is reflected in districting outcomes, particularly addressing questions of size and scale.

LAW

Then we turn to the law.

In Chapter 6, "Explainer: A brief introduction to the VRA," *Arusha Gordon* and *Doug Spencer* provide the reader with key background on the Voting Rights Act and its relevance to redistricting.

Leading voting rights scholar *Ellen Katz* jumps off from there in Chapter 7, "Race and Redistricting," where she surveys the law of racial gerrymandering with a detailed look at the intertwining roles of Congress and the Courts.

Chapter 8, "Law, computing and redistricting in the 1960s," brings a historian's perspective to the book. In it, *Alma Steingart* looks back to the moment that the U.S. Supreme Court introduced its One Person, One Vote standard, which made computing a permanent part of the redistricting scene.

Finally, in Chapter 9, "The law of gerrymandering" *Guy-Uriel Charles*, an expert in race and constitutional law, and *Doug Spencer*, who teaches both law and policy, examine the parallels between racial and partisan gerrymandering law.

GEOGRAPHY

As a discipline, geography spans from philosophy of place to technologies of space.

Chris Fowler is a geographer who studies cities, planning, and neighborhood change. In Chapter 10, "Race, space, and the geography of representation," he reminds us not to take demographic distributions for granted, but to put them in historical and social context.

In Chapter 11, "The elusive geographies of communities," *Garrett Dash Nelson*, a historical geographer and the curator of maps at the Boston Public Library, takes a close look at community and regionalization.

Chapter 12, "Explainer: Communities of interest," *Heather Rosenfeld* teams up with Moon for a practical primer on what constitutes a "COI" where redistricting is concerned.

In Chapter 13, "Geography as data," geographer and data scientist *Ruth Buck* comes together with *Lee Hachadoorian*, whose work uses geospatial technology in urban and demographic analysis, to give us a close look at geo-electoral data and the software that wrangles it.

MATH AND COMPUTER SCIENCE

To a mathematician, the redistricting problem can feel like a playground where any idea from math might find fruitful application.

In Chapter 14, "Three applications of entropy," *Larry Guth, Ari Nieh*, and *Thomas Weighill* test this out by taking the math/physics idea of entropy and seeing where it fits. They end up describing three use cases: 1) how different are two plans? 2) how much does a map split counties? 3) how segregated is a city?

Of course, entropy isn't the only hammer in the toolkit. In Chapter 15, "Explainer: Measuring clustering and segregation," *Moon Duchin* and *James Murphy* tackle metrics of spatial patterning in a completely different way, examining a construct that geographers call "Moran's I."

In Chapter 16, "Redistricting algorithms," computer scientists *Amariah Becker* and *Justin Solomon* give a big, big picture overview of how computing can bear on the redistricting story. It's notoriously hard to compare algorithmic strategies against each other because implementation can be very finicky, and the goals of different researchers don't line up perfectly in the first place. But they go for it anyway, and it makes for some very illuminating comparisons.

Next comes Chapter 17, "Random walks," by mathematicians *Daryl DeFord* and *Moon Duchin*. This chapter looks at one of those algorithmic strategies, Markov chain sampling, in closer detail.

ON THE GROUND

We close with the voices of practitioners.

Megan Gall, *Karin Mac Donald*, and *Fred McBride* all have political science training but now work hands-on with maps and data in the field. In Chapter 18, "Making maps," they talk about their experiences drawing in the real world.

Nate Persily is a law professor who has frequently been appointed by courts to draw the lines when the primary parties can't agree. In Chapter 19, we interview him about his experiences.

The longer we spend in the redistricting world, the more our focus moves from flagging the rulebreakers to upgrading the rules. Chapter 20, "Explainer: Ranked choice voting" acts as a primer on one policy change that may be able to do just that.

Next is a redistricting story very close to MGGG's home in Boston—in Chapter 21, *Iván Espinoza-Madrigal* and *Oren Sellstrom* tell us about the voting rights suit that they filed on behalf of plaintiffs in Lowell, Massachusetts—the first to base a voting rights claim on a coalition between Asian and Latino voters. As we write, the lines are being drawn (by Nate Persily!) for a brand new city council structure.

After that is Chapter 22, "Explainer: Race vs. Party," a brief look at how race and party preference intertwine in voting patterns, and how this has played out in several recent cases.

We close with Chapter 23, "The state of play in voting rights," from *Kristen Clarke*, who has held many civil rights law positions across government and nonprofit organizations, and *Arusha Gordon*, an attorney who is her former colleague at the Lawyers' Committee for Civil Rights Under Law (LCCR). They leave us with a wide-angle view of where voting rights stand today, and point to possible locations of battlefields to come.

Who's the audience for this book? Great question.

We have tried to frame the book to be simultaneously engaging to community organizers, math-curious high school students, philosophers, programmers, and election lawyers. We hope it's suitable to assign in a political science class and to ground a data science curriculum. Not every chapter is written at the same level, and they're certainly not written in the same voice. We think this keeps it true to its interdisciplinary conference roots: a symposium of sorts, bringing a lot of different people together to share tools and ideas. There are illustrations (many by Olivia) throughout the book, which provides one kind of throughline. There are also sidebars, often written in the voice of the editors, that can be skipped without cost to the exposition but should provide more depth or color in strategic places.

For readers, we hope there is something for every taste. You will get the most out of this buffet by giving all the dishes a try. The authors have made a real effort to make their flavors accessible but complex.

Online Pre-print

Code-heavy chapters have a corresponding GitHub repo (github.com/political-geometry). We hope that both the code and the book overall can be public resources in the long and wild mapping wars that are already underway.

EDITORS' ACKNOWLEDGMENTS

MD: I wandered into my current obsession with redistricting through teaching a class on abstract voting theory (Mathematics of Social Choice), primed by two happy coincidences. One, I had attended a session of the American Political Science Association a few years earlier and I chanced on a talk that introduced me to the idea of "compactness." Two, one of my closest and oldest friends, Kristen Clarke, is a prominent civil rights attorney, who was just telling me that voting rights litigation was in need of a new generation of experts. So I had election systems, district shape, and civil rights on my mind. I teamed up with two multi-talented, multi-curious mathematician friends, Ari Nieh and Mira Bernstein, and the *Metric Geometry and Gerrymandering Group* was born. We recruited the brilliant and demonically productive computer scientist Justin Solomon (who'd read about us on Reddit!) not long after. I thank Kristen, Mira, Ari, and Justin first for the life-changing inspiration and collaboration.

Five years later, this is my main research focus, and I run a Lab that is deeply engaged in public mapping, plan evaluation, and scholarship in data science for civil rights. And while this book was in press, Kristen became the brand new Assistant Attorney General of the United States—the top civil rights attorney in the land!

Kristen and Moon in 2017 at the first MGGG workshop

MD also thanks: Daryl DeFord, Jordan Ellenberg, Aidan Kestigian, Thomas Weighill, Sam Gutekunst, John Powers, Sarah Cannon, Max Hully, Ruth Buck, Parker Rule,

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