Synthesis Lectures on
Learning, Networks, and Algorithms

SYNTHESIS
COLLECTION OF TECHNOLOGY

James Hughes · Sheridan Houghten ·
Michael Dubé · Daniel Ashlock ·
Joseph Alexander Brown · Wendy Ashlock ·
Matthew Stoodley

AI Versus Epidemics

Springer

Synthesis Lectures on Learning, Networks, and Algorithms

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The series publishes short books on the design, analysis, and management of complex networked systems using tools from control, communications, learning, optimization, and stochastic analysis. Each Lecture is a self-contained presentation of one topic by a leading expert. The topics include learning, networks, and algorithms, and cover a broad spectrum of applications to networked systems including communication networks, data-center networks, social, and transportation networks.

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Preface

At the beginning of the COVID-19 pandemic, the authors of this book formed a research group that met weekly to discuss how we could apply our research to the public health emergency. The group includes mathematicians, computer scientists, and bioinformaticians. We have expertise in computational intelligence including evolutionary algorithms, genetic programming, and agent-based modelling and in combinatorial graph theory. We all worked though the pandemic, moving our minds from our normal diverse tasks. We were compelled by the moment to work on this problem. Given the severity of the problem, we felt a responsibility to use and develop technologies to enable and inform the most effective and least disruptive solutions. Besides doing this research, we took on our roles as educators, many of us speaking locally on vaccine deployment and public health topics.

Our first idea was that when (and if) vaccines were developed they were likely to be in short supply. So, we started by developing a "smart" system for vaccine deployment that would minimize the spread of the virus with the fewest possible vaccines. The system would be based on an agent-based model of the spread of the epidemic in combinatorial graphs representing contact networks. Along the way, we developed techniques for creating models of contact networks from the public data released on the number of cases each day and also techniques for visualizing and interpreting results on very large graphs.

In the event that vaccines were developed, our communities chose to use a much simpler algorithm for deployment—give the vaccine first to the people most at risk. This was a reasonable decision, and we do not fault the hard-working public health decision makers. Our hope is that the tools in this book will help with making plans for the next epidemic, possibly limiting the need for lockdowns or allowing for smarter lockdowns. The tools developed are also useful for solving other problems. For people working on those problems, we hope that this book provides a helpful example of how our techniques can be applied.

We sadly lost Daniel Ashlock while this book was being written. His last public lecture in 2021 was talking about the Russian Sputnik V vaccine at a meeting of a

Western-focused university in Kazan, debunking the various claims about 5G networks, government tracking, and sterilization. He was responsible for a number of people "on the fence" getting inoculated, including a few who would later be diagnosed with COVID and survive. Till the end he was selfless and trying to save lives, even as his own was nearing the end. This book has been completed in his memory and in the hope that his work will continue to inspire students to use their knowledge to help others.

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