

## *preface*

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Have you ever wondered how navigation apps like Google Maps and Apple Maps determine the fastest route from one place to another? Have you been curious about how ride-sharing companies like Uber, Lyft, or DiDi guide their drivers to the best spots to reduce your wait time and their travel distance, making things better for everyone? Or perhaps you've asked yourself how food delivery platforms like Uber Eats suggest food choices for you. Have you considered how last-mile delivery apps map out the fastest routes for parcel deliveries while minimizing empty return trips? Do you ever wonder how emergency responders are dispatched swiftly to incidents? Have you thought about the process behind selecting locations for electric vehicle charging stations? Or how to calculate the optimal price for a product, optimize investment portfolios, allocate resources, or schedule surgeries efficiently? This book dives into the world of artificial intelligence algorithms that tackle these real-world design, planning, and control problems. The book is written for practitioners interested in solving ill-structured search and optimization problems using modern derivative-free algorithms. This book will get you up to speed with the core concepts of search and optimization and endow you with the ability to deal with practical design, planning, and control problems.

This book has been written to take almost anyone with no prior knowledge of search and optimization, and with only an intermediate knowledge of Python and data structures, from never having solved search and optimization problems to being a well-rounded search and optimization practitioner able to

select, implement, and adapt the right solver for the right problem. This book grew out of several courses related to search and optimization that I have taught at different universities and at industry training centers.

The book will take you on a comprehensive journey through a diverse landscape of search and optimization algorithms. It begins with a deep dive into deterministic search algorithms that rigorously explore problem spaces for optimal solutions, utilizing both blind and informed strategies. The journey then progresses to trajectory-based algorithms, where you'll discover the effectiveness of simulated annealing and tabu search in overcoming local optima. As we advance, we'll delve into the domain of evolutionary computing algorithms, observing the prowess of genetic algorithms in tackling complex continuous and discrete optimization problems. This fascinating journey continues with an intriguing look at swarm intelligence algorithms, including particle swarm optimization, ant colony optimization, and the artificial bee colony algorithm. The final leg of our journey introduces machine learning-based methods, utilizing unsupervised, supervised, and reinforcement learning to address complex combinatorial optimization problems.

My 25 years working as an AI and robotics professor in academia and as a technical leader in industry have given me a wealth of experiences to share with you. Throughout this book, numerous examples and in-depth case studies are provided for both novices and experts. These examples and case studies are thoroughly explained and put into practice with cutting-edge Python libraries dedicated to search and optimization.

I hope that this book, which traverses the vast landscape of optimization algorithms, serves as a valuable guide and resource in your journey. Whether you are a novice or an expert, the insights you'll gain from this comprehensive exploration of various algorithms and their application to real-world problems can empower you to make impactful decisions and innovate in various domains. The field of optimization is continuously evolving, and with this book, you are equipped not just to keep pace with its advancements but also to contribute to shaping the future of this dynamic and critical discipline. Let the knowledge you gain here inspire you to tackle new challenges, forge new paths, and realize the immense potential that lies in optimization.