

Preface

This book is about elite types of thought processes and architectures for big data and modeling that can enable smart and real-time decisions. Today's world is abundant with data and models; many new problems are formulated and solved everyday; many artificial-intelligence, mathematical, and statistical models exist, but there is a lack of scholarly work to demonstrate how to bring these data, models, and opportunities together to produce value for organizations. This book does exactly that and is written in a style designed to bridge management and computational scientists.

This is a book about Computational Red Teaming (CRT): a computational machine that can shadow the operations of any system. The Shadow CRT Machine can think together with, or on behalf of, the system by asking “what-if” questions, assessing threats and risks, challenging the system, environment, and competitors, and using its well-engineered predictive models and computational thinking tools to make the right decision at the right time.

Red Teaming (RT) is traditionally a decision-aiding art used by the military to role play an adversary, play the devil's advocate against one's own concepts, plans, strategies, or systems to “test and evaluate” them to improve decision making. This book has been written to distill general principles from RT, and generalize and transform RT, the art, into CRT, the science. The discussion will depart from the military context to demonstrate the utility and applicability of CRT to individuals and organizations. CRT transforms the classical “test-and-evaluation” process to a continuous and proactive “test-and-redesign” process.

CRT means systemic and scientific RT. The word “computational” emphasizes the necessity for systemic and computable steps that can be executed by humans and computers alike, and allows for an evidence-based decision-making process that can be traced to causes. Many tools discussed in this book can be employed by using pencil and paper, and can equally be scaled up to big data and big models that exceed human cognitive processing and classical computer abilities. With the advances that have been made in fields such as computational intelligence, data analytics, optimization, simulation, systems thinking, and computational sciences, today, we have the tools to implement CRT in silico.

Analytics is the science for transforming data to decisions. CRT uses risk analytics, where risk is the focal point of the decision-making process, and challenge analytics, where actions and counteractions are designed just across the system performance boundary, to test and redesign the right decisions for an organization. CRT creates opportunities for individuals, organizations, and governments by grounding RT in system and decision sciences, and by identifying the architectures required to transform data into decisions.

Risk analytics and challenge analytics, jointly, create the CRT world of this book. The part of the world that treats risk analytics examines what risk is, and demonstrates how evidence-based decisions must always be driven by risk thinking. The part of the world treating challenge analytics structures the concept of what a challenge is, discusses how to systematically and autonomously design and discover challenges, and how to challenge an individual, organization, or even a computer algorithm.

Over six chapters, CRT will be presented. Chapter 1 brings the reader inside the classical world of RT. It explains the philosophy of this art, and presents a story to demonstrate that the art of RT can benefit each individual, not only large organizations. The steps for implementing an RT exercise are explained, and the characteristics of a successful RT exercise and the ethics of RT are discussed.

The book then sweeps into the two building blocks of risk analytics and challenge analytics that form the scientific principles for CRT, the science. Chapter 2 uses a systems approach to establish the basis for risk thinking and challenge design. Materials in the chapter cross the boundaries of uncertainty and risk, intentional and deliberate actions, and deliberate challenges to the systems approach, skills and competency to shape and influence performance.

Chapter 3 presents the big-data-to-decisions CRT. The chapter introduces and brings together the architectures and building blocks used to design and develop the computational environment that supports CRT. This chapter presents a gentle introduction to experimentation, optimization, simulation, data mining, and big data before presenting how these technologies need to blend to offer CRT architectures.

The CRT science relies on efficient tools to understand the future, and allows an effective understanding of how to analyze “messy spaces,” as well as discover the right methods to deconstruct complex organizations and the intermingled physical, cyber, cognitive, and social domains (PC2SD). Beginning by offering scenarios to prompt thoughts about the future and concluding with control mechanisms for networks and generation of effects, Chap. 4 complements the computational tools presented in Chap. 3 with the necessary system-thinking ingredients to transform computational models into effective strategic tools. This chapter discusses planning scenarios, and the complexity arising from the interaction of effects in the PC2SD. It presents two models to manage this complexity: a model to transform complex organizations into simple building blocks for analysis, and a model discussing the operations required to analyze and generate effects in complex networked systems, that form the basis for a thinking model suitable to design and form cyber-security operations and complex social-engineering strategies.

Chapter 5 complements the materials by presenting three case studies of increasing complexity. These are adopted from the author's research. The purpose of these case studies is to provide examples to guide the reader in adopting the lessons gleaned from this book. The cases are discussed in plain language and provide an overview of the logic beneath each case: what was done and how. The first case study demonstrates the use of CRT to challenge and evaluate well-designed algorithms for aircraft-conflict detection. The second case study presents a game used to challenge a human. The third case study presents a large-scale experiment that combines many elements of this book. This experiment is aimed at designing a Cognitive-Cyber Symbiosis (CoCyS; pronounced "cookies") environment for air-traffic controllers in safety-critical domains. CoCyS is introduced, in addition to the CRT exercise.

The last chapter (Chap. 6) concludes the book and offers some reflections and ideas for future work on CRT.

The reader is encouraged to read the book in chapter order. Regardless of whether the readers find the information too easy or too difficult, they are advised to keep reading to the end. When the last chapter is reached, the ideas will be connected despite some concepts may still seem to be confusing. However, by the end of the book, the reader is expected to know what CRT is all about to the extent that the book can be read again (and again) to digest some of the most difficult concepts encountered.

Last, but not least, the author is eager to hear comments, good or otherwise, from the readers. Please forward any comments to the author's email address at hussein.abbass@gmail.com. The author asks the reader to red team this book; only then will the reader's own journey toward CRT begin.

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