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Lucas Davi
Ahmad-Reza Sadeghi

Building Secure Defenses Against Code-Reuse Attacks



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Building Secure Defenses Against Code Reuse Attacks Springerbriefs In Computer Science

Isaac Noah Evans



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Building Secure Defenses Against Code-Reuse Attacks Lucas Davi,Ahmad-Reza Sadeghi,2015-12-07 This book provides an in depth look at return oriented programming attacks It explores several conventional return oriented programming attacks and analyzes the effectiveness of defense techniques including address space layout randomization ASLR and the control flow restrictions implemented in security watchdogs such as Microsoft EMET Chapters also explain the principle of control flow integrity CFI highlight the benefits of CFI and discuss its current weaknesses Several improved and sophisticated return oriented programming attack techniques such as just in time return oriented programming are presented Building Secure Defenses against Code Reuse Attacks is an excellent reference tool for researchers programmers and professionals working in the security field It provides advanced level students studying computer science with a comprehensive overview and clear understanding of important runtime attacks

Building Secure Defenses Against Code-Reuse Attacks Lucas Davi,Ahmad-Reza Sadeghi,2015 This book provides an in depth look at return oriented programming attacks It explores several conventional return oriented programming attacks and analyzes the effectiveness of defense techniques including address space layout randomization ASLR and the control flow restrictions implemented in security watchdogs such as Microsoft EMET Chapters also explain the principle of control flow integrity CFI highlight the benefits of CFI and discuss its current weaknesses Several improved and sophisticated return oriented programming attack techniques such as just in time return oriented programming are presented Building Secure Defenses against Code Reuse Attacks is an excellent reference tool for researchers programmers and professionals working in the security field It provides advanced level students studying computer science with a comprehensive overview and clear understanding of important runtime attacks

Analysis of Defenses Against Code Reuse Attacks on Modern and New Architectures Isaac Noah Evans,2015 Today the most common avenue for exploitation of computer systems is a control flow attack in which the attacker gains direct or indirect control of the instruction pointer In order to gain remote code execution attackers then exploit legitimate fragments of code in the executable via techniques such as return oriented programming or virtual table overwrites This project aims to answer fundamental questions about the efficacy of control flow integrity CFI a defensive technique which attempts to prevent such attacks by ensuring that every control flow transfer corresponds to the original intent of the program author Although this problem is in general undecidable most programs running on modern operating systems adhere to standard conventions which allow inferences from static analysis to set a specification for allowable runtime behavior 1 By examining extremely large complex real world programs such as web browsers this project will characterize the fundamental limits of CFI techniques We find that it is possible for a program in which CFI is perfectly enforced to be exploited via a novel control flow attacks 2 We examine the potential for hardware support for CFI and other techniques via generalized tagged architectures and explore the tradeoff between the compatibility performance and security

guarantees of hardware assisted policies on tagged architectures

The Continuing Arms Race Per Larsen,Ahmad-Reza Sadeghi,2018-02-23 As human activities moved to the digital domain so did all the well known malicious behaviors including fraud theft and other trickery There is no silver bullet and each security threat calls for a specific answer One specific threat is that applications accept malformed inputs and in many cases it is possible to craft inputs that let an intruder take full control over the target computer system The nature of systems programming languages lies at the heart of the problem Rather than rewriting decades of well tested functionality this book examines ways to live with the programming sins of the past while shoring up security in the most efficient manner possible We explore a range of different options each making significant progress towards securing legacy programs from malicious inputs The solutions explored include enforcement type defenses which excludes certain program executions because they never arise during normal operation Another strand explores the idea of presenting adversaries with a moving target that unpredictably changes its attack surface thanks to randomization We also cover tandem execution ideas where the compromise of one executing clone causes it to diverge from another thus revealing adversarial activities The main purpose of this book is to provide readers with some of the most influential works on run time exploits and defenses We hope that the material in this book will inspire readers and generate new ideas and paradigms

Defeating Code Reuse Attacks with Minimal Tagged Architecture Samuel P. Fingeret,2015 In this thesis we argue that software based defenses to code reuse attacks are fundamentally flawed With code pointer integrity as a case study we show that a secure and efficient software based defense to code reuse attacks is impossible and thus motivate the case for hardware approaches We then propose our tagged architecture system Taxi Tagged C as a practical defense against code reuse attacks which minimally modifies existing hardware components We also propose strong defense policies which aim to guarantee security while minimizing tag memory usage Our Taxi prototype a modified RISC V ISA simulator demonstrates that we can defeat code reuse attacks with high compatibility and low memory overhead

A Systematic Analysis of Defenses Against Code Reuse Attacks Kelly C. Casteel,Massachusetts Institute of Technology. Department of Electrical Engineering and Computer Science,2013 In this thesis we developed a systematic model of the code reuse attack space where facts about attacks and defenses were represented as propositional statements in boolean logic and the possibility of deploying malware was a satisfiability instance We use the model to analyze the space in two ways we analyze the defense configurations of a real world system and we reason about hypothetical defense bypasses We construct attacks based on the hypothetical defense bypasses Next we investigate the control flow graphs enforced by proposed control flow integrity CFI systems We model the behavior of these systems using a graph search We also develop several code reuse payloads that work within the control flow graph enforced by one proposed CFI defense Our findings illustrate that the defenses we investigated are not effective in preventing real world attacks

Adversarial and Uncertain Reasoning for Adaptive Cyber Defense Sushil Jajodia,George Cybenko,Peng Liu,Cliff Wang,Michael Wellman,2019-08-30 Today s cyber

defenses are largely static allowing adversaries to pre plan their attacks In response to this situation researchers have started to investigate various methods that make networked information systems less homogeneous and less predictable by engineering systems that have homogeneous functionalities but randomized manifestations The 10 papers included in this State of the Art Survey present recent advances made by a large team of researchers working on the same US Department of Defense Multidisciplinary University Research Initiative MURI project during 2013 2019 This project has developed a new class of technologies called Adaptive Cyber Defense ACD by building on two active but heretofore separate research areas Adaptation Techniques AT and Adversarial Reasoning AR AT methods introduce diversity and uncertainty into networks applications and hosts AR combines machine learning behavioral science operations research control theory and game theory to address the goal of computing effective strategies in dynamic adversarial environments Taxi Julián Armando González,2015 The rise of code reuse attacks has been devastating for users of languages like C and C++ that lack memory safety We survey existing defenses to understand why none are generally applicable focusing our attention on the Code Pointer Integrity CPI defense We show that while CPI is hard to implement securely on modern architectures it is based on the promising idea of storing metadata on memory We also introduce Taxi Tagged C a set of hardware modifications that aim to prevent code reuse attacks by storing small amounts of memory metadata known as tags in hardware Our reference implementation prevents several classes of code reuse attacks without losing compatibility with the C memory model and provides valuable insight into how tagged architectures can be used to enforce security properties on existing code

Analysis of Return Oriented Programming and Countermeasures Eric K. Soderstrom,2014 Introduction Attackers have relatively success in defeating modern defensive techniques by using an exploitation method known as code reuse This class of exploitation techniques makes use of the lack of memory safety in C which allows an attacker to redirect a program s control flow to pre existing snippets of code Code reuse attacks have historically been a powerful and ubiquitous exploitation technique 2 Even as recently as 2014 there has been an outbreak of these code reuse attacks targeting such applications as Adobe Internet Explorer and Firefox 15 Many defensive countermeasures have been taken by the security community ranging from data execution prevention to varying degrees of code randomization This thesis can roughly be broken into two halves 1 Show how code reuse attacks can leverage timing information in order to break many existing defenses 2 Investigate how control flow integrity can be improved upon as a countermeasure to code reuse attacks Code-Reuse Attacks and Defenses Lucas Vincenzo Davi,2015

Decoding **Building Secure Defenses Against Code Reuse Attacks Springerbriefs In Computer Science**: Revealing the Captivating Potential of Verbal Expression

In an era characterized by interconnectedness and an insatiable thirst for knowledge, the captivating potential of verbal expression has emerged as a formidable force. Its capability to evoke sentiments, stimulate introspection, and incite profound transformations is genuinely awe-inspiring. Within the pages of "**Building Secure Defenses Against Code Reuse Attacks Springerbriefs In Computer Science**," a mesmerizing literary creation penned by a celebrated wordsmith, readers set about an enlightening odyssey, unraveling the intricate significance of language and its enduring impact on our lives. In this appraisal, we shall explore the book's central themes, evaluate its distinctive writing style, and gauge its pervasive influence on the hearts and minds of its readership.

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