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Analysis Techniques for Information Security

Anupam Datta
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*SYNTHESIS LECTURES ON
INFORMATION SECURITY, PRIVACY, AND TRUST*

Ravi Sandhu, *Series Editor*

Analysis Techniques For Information Security Somesh Jha

Sourya Joyee De, Daniel Le Métayer



Analysis Techniques For Information Security Somesh Jha:

Analysis Techniques for Information Security Anupam Datta,Somesh Jha,Ninghui Li,David Melski,Thomas Reps,2022-05-31 Increasingly our critical infrastructures are reliant on computers We see examples of such infrastructures in several domains including medical power telecommunications and finance Although automation has advantages increased reliance on computers exposes our critical infrastructures to a wider variety and higher likelihood of accidental failures and malicious attacks Disruption of services caused by such undesired events can have catastrophic effects such as disruption of essential services and huge financial losses The increased reliance of critical services on our cyberinfrastructure and the dire consequences of security breaches have highlighted the importance of information security Authorization security protocols and software security are three central areas in security in which there have been significant advances in developing systematic foundations and analysis methods that work for practical systems This book provides an introduction to this work covering representative approaches illustrated by examples and providing pointers to additional work in the area Table of Contents Introduction Foundations Detecting Buffer Overruns Using Static Analysis Analyzing Security Policies Analyzing Security Protocols *Analysis Techniques for Information Security* Anupam Datta,Somesh Jha,Ninghui Li,David

Melski,2010-11-11 Increasingly our critical infrastructures are reliant on computers We see examples of such infrastructures in several domains including medical power telecommunications and finance Although automation has advantages increased reliance on computers exposes our critical infrastructures to a wider variety and higher likelihood of accidental failures and malicious attacks Disruption of services caused by such undesired events can have catastrophic effects such as disruption of essential services and huge financial losses The increased reliance of critical services on our cyberinfrastructure and the dire consequences of security breaches have highlighted the importance of information security Authorization security protocols and software security are three central areas in security in which there have been significant advances in developing systematic foundations and analysis methods that work for practical systems This book provides an introduction to this work covering representative approaches illustrated by examples and providing pointers to additional work in the area Table of Contents Introduction Foundations Detecting Buffer Overruns Using Static Analysis Analyzing Security Policies Analyzing Security Protocols **Enhancing Information Security and Privacy by Combining Biometrics with Cryptography**

Sanjay Kanade,Dijana Petrovska-Delacretaz,Bernadette Dorizzi,2022-05-31 This book deals with crypto biometrics a relatively new and multi disciplinary area of research started in 1998 Combining biometrics and cryptography provides multiple advantages such as revocability template diversity better verification accuracy and generation of cryptographically usable keys that are strongly linked to the user identity In this text a thorough review of the subject is provided and then some of the main categories are illustrated with recently proposed systems by the authors Beginning with the basics this text deals with various aspects of crypto biometrics including review cancelable biometrics cryptographic key generation from

biometrics and crypto biometric key sharing protocols Because of the thorough treatment of the topic this text will be highly beneficial to researchers and industry professionals in information security and privacy

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Cyber-Physical Security and Privacy in the Electric Smart Grid Bruce McMillin, Thomas Roth, 2022-06-01 This book focuses on the combined cyber and physical security issues in advanced electric smart grids Existing standards are compared with classical results and the security and privacy principles of current practice are illustrated The book paints a way for future development of advanced smart grids that operated in a peer to peer fashion thus requiring a different security model Future defenses are proposed that include information flow analysis and attestation systems that rely on fundamental physical properties of the smart grid system

Introduction to Secure Outsourcing Computation Xiaofeng Chen, 2022-05-31 With the rapid development of cloud computing the enterprises and individuals can outsource their sensitive data into the cloud server where they can enjoy high quality data storage and computing services in a ubiquitous manner This is known as the outsourcing computation paradigm Recently the problem for securely outsourcing various expensive computations or storage has attracted considerable attention in the academic community In this book we focus on the latest technologies and applications of secure outsourcing computations Specially we introduce the state of the art research for secure outsourcing some specific functions such as scientific computations cryptographic basic operations and verifiable large database with update The constructions for specific functions use various design tricks and thus result in very efficient protocols for real world applications The topic of outsourcing computation is a hot research issue nowadays Thus this book will be beneficial to academic researchers in the field of cloud computing and big data security

Privacy Risk Analysis Sourya Joyee De, Daniel Le Métayer, 2022-05-31 Privacy Risk Analysis fills a gap in the existing literature by providing an introduction to the basic notions requirements and main steps of conducting a privacy risk analysis The deployment of new information technologies can lead to significant privacy risks and a privacy impact assessment should be conducted before designing a product or system that processes personal data However if existing privacy impact assessment frameworks and guidelines provide a good deal of details on organizational aspects including budget allocation resource allocation stakeholder consultation etc they are much vaguer on the technical part in particular on the actual risk assessment task For privacy impact assessments to keep up their promises and really play a decisive role in enhancing privacy protection they should be more precise with regard to these technical aspects This book is an excellent resource for anyone developing and or currently running a risk analysis as it defines the notions of personal data stakeholders risk sources feared events and privacy harms all while showing how these notions are used in the risk analysis process It includes a running smart grids example to illustrate all the notions discussed in the book

Database Anonymization Josep Domingo-Ferrer, David Sánchez, Jordi Soria-Comas, 2022-05-31 The current social and economic context increasingly demands open data to improve

scientific research and decision making However when published data refer to individual respondents disclosure risk limitation techniques must be implemented to anonymize the data and guarantee by design the fundamental right to privacy of the subjects the data refer to Disclosure risk limitation has a long record in the statistical and computer science research communities who have developed a variety of privacy preserving solutions for data releases This Synthesis Lecture provides a comprehensive overview of the fundamentals of privacy in data releases focusing on the computer science perspective Specifically we detail the privacy models anonymization methods and utility and risk metrics that have been proposed so far in the literature Besides as a more advanced topic we identify and discuss in detail connections between several privacy models i e how to accumulate the privacy guarantees they offer to achieve more robust protection and when such guarantees are equivalent or complementary we also explore the links between anonymization methods and privacy models how anonymization methods can be used to enforce privacy models and thereby offer ex ante privacy guarantees These latter topics are relevant to researchers and advanced practitioners who will gain a deeper understanding on the available data anonymization solutions and the privacy guarantees they can offer

Private Information Retrieval Xun Yi, Russell Paulet, Elisa Bertino, 2022-05-31 This book deals with Private Information Retrieval PIR a technique allowing a user to retrieve an element from a server in possession of a database without revealing to the server which element is retrieved PIR has been widely applied to protect the privacy of the user in querying a service provider on the Internet For example by PIR one can query a location based service provider about the nearest car park without revealing his location to the server The first PIR approach was introduced by Chor Goldreich Kushilevitz and Sudan in 1995 in a multi server setting where the user retrieves information from multiple database servers each of which has a copy of the same database To ensure user privacy in the multi server setting the servers must be trusted not to collude In 1997 Kushilevitz and Ostrovsky constructed the first single database PIR Since then many efficient PIR solutions have been discovered Beginning with a thorough survey of single database PIR techniques this text focuses on the latest technologies and applications in the field of PIR The main categories are illustrated with recently proposed PIR based solutions by the authors Because of the latest treatment of the topic this text will be highly beneficial to researchers and industry professionals in information security and privacy

Digital Forensic Science Vassil Roussev, 2022-05-31 Digital forensic science or digital forensics is the application of scientific tools and methods to identify collect and analyze digital data artifacts in support of legal proceedings From a more technical perspective it is the process of reconstructing the relevant sequence of events that have led to the currently observable state of a target IT system or digital artifacts Over the last three decades the importance of digital evidence has grown in lockstep with the fast societal adoption of information technology which has resulted in the continuous accumulation of data at an exponential rate Simultaneously there has been a rapid growth in network connectivity and the complexity of IT systems leading to more complex behavior that needs to be investigated The goal of this book is to provide a systematic technical

overview of digital forensic techniques primarily from the point of view of computer science This allows us to put the field in the broader perspective of a host of related areas and gain better insight into the computational challenges facing forensics as well as draw inspiration for addressing them This is needed as some of the challenges faced by digital forensics such as cloud computing require qualitatively different approaches the sheer volume of data to be examined also requires new means of processing it

Usable Security Simson Garfinkel, Heather Richter Lipford, 2022-06-01 There has been roughly 15 years of research into approaches for aligning research in Human Computer Interaction with computer Security more colloquially known as usable security Although usability and security were once thought to be inherently antagonistic today there is wide consensus that systems that are not usable will inevitably suffer security failures when they are deployed into the real world Only by simultaneously addressing both usability and security concerns will we be able to build systems that are truly secure This book presents the historical context of the work to date on usable security and privacy creates a taxonomy for organizing that work outlines current research objectives presents lessons learned and makes suggestions for future research

Anomaly Detection as a Service Danfeng (Daphne) Yao, Xiaokui Shu, Long Cheng, Salvatore J. Stolfo, 2022-06-01 Anomaly detection has been a long standing security approach with versatile applications ranging from securing server programs in critical environments to detecting insider threats in enterprises to anti abuse detection for online social networks Despite the seemingly diverse application domains anomaly detection solutions share similar technical challenges such as how to accurately recognize various normal patterns how to reduce false alarms how to adapt to concept drifts and how to minimize performance impact They also share similar detection approaches and evaluation methods such as feature extraction dimension reduction and experimental evaluation The main purpose of this book is to help advance the real world adoption and deployment anomaly detection technologies by systematizing the body of existing knowledge on anomaly detection This book is focused on data driven anomaly detection for software systems and networks against advanced exploits and attacks but also touches on a number of applications including fraud detection and insider threats We explain the key technical components in anomaly detection workflows give in depth description of the state of the art data driven anomaly based security solutions and more importantly point out promising new research directions This book emphasizes on the need and challenges for deploying service oriented anomaly detection in practice where clients can outsource the detection to dedicated security providers and enjoy the protection without tending to the intricate details

Privacy Risk Analysis of Online Social Networks Sourya Joyee De, Abdessamad Imine, 2022-06-01 The social benefit derived from Online Social Networks OSNs can lure users to reveal unprecedented volumes of personal data to an online audience that is much less trustworthy than their offline social circle Even if a user hides his personal data from some users and shares with others privacy settings of OSNs may be bypassed thus leading to various privacy harms such as identity theft stalking or discrimination Therefore users need to be assisted in understanding the privacy risks of their OSN profiles as well as

managing their privacy settings so as to keep such risks in check while still deriving the benefits of social network participation This book presents to its readers how privacy risk analysis concepts such as privacy harms and risk sources can be used to develop mechanisms for privacy scoring of user profiles and for supporting users in privacy settings management in the context of OSNs Privacy scoring helps detect and minimize the risks due to the dissemination and use of personal data The book also discusses many open problems in this area to encourage further research

Hardware Malware Edgar Weippl,Christian Krieg,Adrian Dabrowski,Katharina Krombholz,Heidelinde Hobel,2022-05-31 In our digital world integrated circuits are present in nearly every moment of our daily life Even when using the coffee machine in the morning or driving our car to work we interact with integrated circuits The increasing spread of information technology in virtually all areas of life in the industrialized world offers a broad range of attack vectors So far mainly software based attacks have been considered and investigated while hardware based attacks have attracted comparatively little interest The design and production process of integrated circuits is mostly decentralized due to financial and logistical reasons Therefore a high level of trust has to be established between the parties involved in the hardware development lifecycle During the complex production chain malicious attackers can insert non specified functionality by exploiting untrusted processes and backdoors This work deals with the ways in which such hidden non specified functionality can be introduced into hardware systems After briefly outlining the development and production process of hardware systems we systematically describe a new type of threat the hardware Trojan We provide a historical overview of the development of research activities in this field to show the growing interest of international research in this topic Current work is considered in more detail We discuss the components that make up a hardware Trojan as well as the parameters that are relevant for an attack Furthermore we describe current approaches for detecting localizing and avoiding hardware Trojans to combat them effectively Moreover this work develops a comprehensive taxonomy of countermeasures and explains in detail how specific problems are solved In a final step we provide an overview of related work and offer an outlook on further research in this field

Automated Software Diversity Per Larsen,Stefan Brunthaler,Lucas Davi,Ahmad-Reza Sadeghi,Michael Franz,2022-05-31 Whereas user facing applications are often written in modern languages the firmware operating system support libraries and virtual machines that underpin just about any modern computer system are still written in low level languages that value flexibility and performance over convenience and safety Programming errors in low level code are often exploitable and can in the worst case give adversaries unfettered access to the compromised host system This book provides an introduction to and overview of automatic software diversity techniques that in one way or another use randomization to greatly increase the difficulty of exploiting the vast amounts of low level code in existence Diversity based defenses are motivated by the observation that a single attack will fail against multiple targets with unique attack surfaces We introduce the many often complementary ways that one can diversify attack surfaces and provide an accessible guide to more than two decades worth of research on the

topic We also discuss techniques used in conjunction with diversity to prevent accidental disclosure of randomized program aspects and present an in depth case study of one of our own diversification solutions

Mobile Platform Security

N. Asokan, Lucas Davi, Alexandra Dmitrienko, Stephan Heuser, Kari Kostianen, Elena Reshetova, Ahmad-Reza Sadeghi, 2022-05-31

Recently mobile security has garnered considerable interest in both the research community and industry due to the popularity of smartphones The current smartphone platforms are open systems that allow application development also for malicious parties To protect the mobile device its user and other mobile ecosystem stakeholders such as network operators application execution is controlled by a platform security architecture This book explores how such mobile platform security architectures work We present a generic model for mobile platform security architectures the model illustrates commonly used security mechanisms and techniques in mobile devices and allows a systematic comparison of different platforms We analyze several mobile platforms using the model In addition this book explains hardware security mechanisms typically present in a mobile device We also discuss enterprise security extensions for mobile platforms and survey recent research in the area of mobile platform security The objective of this book is to provide a comprehensive overview of the current status of mobile platform security for students researchers and practitioners

Differential Privacy

Ninghui Li, Min Lyu, Dong Su, Weining Yang, 2022-05-31 Over the last decade differential privacy DP has emerged as the de facto standard privacy notion for research in privacy preserving data analysis and publishing The DP notion offers strong privacy guarantee and has been applied to many data analysis tasks This Synthesis Lecture is the first of two volumes on differential privacy This lecture differs from the existing books and surveys on differential privacy in that we take an approach balancing theory and practice We focus on empirical accuracy performances of algorithms rather than asymptotic accuracy guarantees At the same time we try to explain why these algorithms have those empirical accuracy performances We also take a balanced approach regarding the semantic meanings of differential privacy explaining both its strong guarantees and its limitations We start by inspecting the definition and basic properties of DP and the main primitives for achieving DP Then we give a detailed discussion on the the semantic privacy guarantee provided by DP and the caveats when applying DP Next we review the state of the art mechanisms for publishing histograms for low dimensional datasets mechanisms for conducting machine learning tasks such as classification regression and clustering and mechanisms for publishing information to answer marginal queries for high dimensional datasets Finally we explain the sparse vector technique including the many errors that have been made in the literature using it The planned Volume 2 will cover usage of DP in other settings including high dimensional datasets graph datasets local setting location privacy and so on We will also discuss various relaxations of DP

Blocks and Chains

Aljosha Judmayer, Nicholas Stifter, Katharina Krombholz, Edgar Weippl, 2022-06-01 The new field of cryptographic currencies and consensus ledgers commonly referred to as blockchains is receiving increasing interest from various different communities These communities are very diverse and amongst others include technical enthusiasts activist groups

researchers from various disciplines start ups large enterprises public authorities banks financial regulators business men investors and also criminals The scientific community adapted relatively slowly to this emerging and fast moving field of cryptographic currencies and consensus ledgers This was one reason that for quite a while the only resources available have been the Bitcoin source code blog and forum posts mailing lists and other online publications Also the original Bitcoin paper which initiated the hype was published online without any prior peer review Following the original publication spirit of the Bitcoin paper a lot of innovation in this field has repeatedly come from the community itself in the form of online publications and online conversations instead of established peer reviewed scientific publishing On the one side this spirit of fast free software development combined with the business aspects of cryptographic currencies as well as the interests of today's time to market focused industry produced a flood of publications whitepapers and prototypes On the other side this has led to deficits in systematization and a gap between practice and the theoretical understanding of this new field This book aims to further close this gap and presents a well structured overview of this broad field from a technical viewpoint The archetype for modern cryptographic currencies and consensus ledgers is Bitcoin and its underlying Nakamoto consensus Therefore we describe the inner workings of this protocol in great detail and discuss its relations to other derived systems

Security and Trust in Online Social Networks Barbara Carminati,Elena Ferrari,Marco Viviani,2022-05-31 The enormous success and diffusion that online social networks OSNs are encountering nowadays is vastly apparent Users social interactions now occur using online social media as communication channels personal information and activities are easily exchanged both for recreational and business purposes in order to obtain social or economic advantages In this scenario OSNs are considered critical applications with respect to the security of users and their resources for their characteristics alone the large amount of personal information they manage big economic upturn connected to their commercial use strict interconnection among users and resources characterizing them as well as user attitude to easily share private data and activities with strangers In this book we discuss three main research topics connected to security in online social networks i trust management because trust can be intended as a measure of the perception of security in terms of risks benefits that users in an OSN have with respect to other unknown little known parties ii controlled information sharing because in OSNs where personal information is not only connected to user profiles but spans across users social activities and interactions users must be provided with the possibility to directly control information flows and iii identity management because OSNs are subjected more and more to malicious attacks that with respect to traditional ones have the advantage of being more effective by leveraging the social network as a new medium for reaching victims For each of these research topics in this book we provide both theoretical concepts as well as an overview of the main solutions that commercial non commercial actors have proposed over the years We also discuss some of the most promising research directions in these fields

Physically Unclonable Functions (PUFs) Christian Wachsmann,Ahmad-Reza Sadeghi,2022-05-31 Today embedded systems are used in many security critical

applications from access control electronic tickets sensors and smart devices e g wearables to automotive applications and critical infrastructures These systems are increasingly used to produce and process both security critical and privacy sensitive data which bear many security and privacy risks Establishing trust in the underlying devices and making them resistant to software and hardware attacks is a fundamental requirement in many applications and a challenging yet unsolved task Solutions solely based on software can never ensure their own integrity and trustworthiness while resource constraints and economic factors often prevent the integration of sophisticated security hardware and cryptographic co processors In this context Physically Unclonable Functions PUFs are an emerging and promising technology to establish trust in embedded systems with minimal hardware requirements This book explores the design of trusted embedded systems based on PUFs Specifically it focuses on the integration of PUFs into secure and efficient cryptographic protocols that are suitable for a variety of embedded systems It exemplarily discusses how PUFs can be integrated into lightweight device authentication and attestation schemes which are popular and highly relevant applications of PUFs in practice For the integration of PUFs into secure cryptographic systems it is essential to have a clear view of their properties This book gives an overview of different approaches to evaluate the properties of PUF implementations and presents the results of a large scale security analysis of different PUF types implemented in application specific integrated circuits ASICs To analyze the security of PUF based schemes as is common in modern cryptography it is necessary to have a security framework for PUFs and PUF based systems In this book we give a flavor of the formal modeling of PUFs that is in its beginning and that is still undergoing further refinement in current research The objective of this book is to provide a comprehensive overview of the current state of secure PUF based cryptographic system design and the related challenges and limitations

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Reversible Digital Watermarking Ruchira Naskar, Rajat Subhra Chakraborty, 2022-06-01 Digital Watermarking is the art and science of embedding information in existing digital content for Digital Rights Management DRM and authentication Reversible watermarking is a class of fragile digital watermarking that not only authenticates multimedia data content but also helps to maintain perfect integrity of the original multimedia cover data In non reversible watermarking schemes after embedding and extraction of the watermark the cover data undergoes some distortions although perceptually negligible in most cases In contrast in reversible watermarking zero distortion of the cover data is achieved that is the cover data is guaranteed to be restored bit by bit Such a feature is desirable when highly sensitive data is watermarked e g in military medical and legal imaging applications This work deals with development analysis and evaluation of state of the art reversible watermarking techniques for digital images In this work we establish the motivation for research on reversible watermarking using a couple of case studies with

medical and military images We present a detailed review of the state of the art research in this field We investigate the various subclasses of reversible watermarking algorithms their operating principles and computational complexities Along with this to give the readers an idea about the detailed working of a reversible watermarking scheme we present a prediction based reversible watermarking technique recently published by us We discuss the major issues and challenges behind implementation of reversible watermarking techniques and recently proposed solutions for them Finally we provide an overview of some open problems and scope of work for future researchers in this area

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Analysis Techniques For Information Security Somesh Jha Introduction

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