



Advancing Computing as a Science & Profession



CCS'19

Proceedings of the 2019 ACM SIGSAC Conference on Computer and Communications Security

Sponsored by:

ACM SIGSAC

General Chairs:

Lorenzo Cavallaro (King's College London, UK)
Johannes Kinder (Bundeswehr University Munich, Germany)

Program Chairs:

XiaoFeng Wang (Indiana University, USA)
Jonathan Katz (George Mason University, USA)



Advancing Computing as a Science & Profession

The Association for Computing Machinery 1601 Broadway, 10th Floor New York, NY 10019-7434

Copyright © 2019 by the Association for Computing Machinery, Inc. (ACM). Permission to make digital or hard copies of portions of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyright for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permission to republish from: permissions@acm.org or Fax +1 (212) 869-0481.

For other copying of articles that carry a code at the bottom of the first or last page, copying is permitted provided that the per-copy fee indicated in the code is paid through www.copyright.com.

ISBN: 978-1-4503-6747-9

Additional copies may be ordered prepaid from:

ACM Order Department PO Box 30777 New York, NY 10087-0777, USA Phone: 1-800-342-6626 (USA and Canada) +1-212-626-0500 (Global) Fax: +1-212-944-1318 E-mail: acmhelp@acm.org

Hours of Operation: 8:30 am - 4:30 pm ET

Printed in the USA

General Chairs' Welcome

It is with great pleasure that we welcome you all to the 2019 edition of the ACM Conference on Computer and Communications Security (CCS). CCS is the flagship annual conference of ACM's Special Interest Group on Security, Audit and Control (SIGSAC), which has been bringing together world-leading academic researchers and practitioners interested in computer security at large since 1993. As in previous years, CCS 2019 features an outstanding program of thought-provoking and cutting-edge research papers. In addition, a record number of 18 workshops provide a forum for in-depth discussions of established and emerging research topics alike.

London is one of the most vibrant metropolises in the world and has something to offer for everyone, whether you are a first-time visitor or a long-time resident. Did you know that London boasts four World Heritage Sites? The Tower of London; Kew Gardens; Westminster Abbey and its surroundings; and the historic settlement in Greenwich. But there is much more! A wide range of world-class museums, most of which are free to visit, restaurants catering to any palate, with cuisines from every corner of the planet, countless cozy pubs and trendy bars, theatres, musicals, and over 20 major universities and about 400,000 students.

CCS would not be possible without you, the community, and the many volunteers working tirelessly to make an event of this scale happen. We would like to thank the authors, who submitted their best work to this conference; the program chairs and the program committee for putting together an excellent program; the steering committee and SIGSAC for providing behind-the-scenes support; and of course the organizing committee who spent many hours on administrative and organizational tasks. Finally, we thank the numerous sponsors of the conference for their generous support.

As a city that prides itself in its diversity and international atmosphere, London is a fitting place to host a conference dedicated to sharing ideas about security and privacy in a diverse and international community. Especially in times of political uncertainty, we should celebrate the free exchange of ideas.

Welcome to London, we hope you will enjoy your stay!

Lorenzo Cavallaro

ACM CCS 2019 General Co-chair King's College London Johannes Kinder

ACM CCS 2019 General Co-chair Bundeswehr University Munich

Program Chairs' Welcome

For the first time in its long history as the ACM's flagship security and privacy conference, CCS this year experimented with a new multi-cycle review model. The model is characterized by two normal submission deadlines (February and May), each with a 2.5-month review cycle. At the end of each cycle, each submitted paper is given a decision of accept, conditional accept (shepherd), reject, or revise. A revised paper can be resubmitted, after the authors have a full month to address reviewers' comments. This new model is designed to facilitate author-reviewer interactions and enhance paper quality.

The February cycle received 220 submissions, with 14 accepted or shepherded and 22 receiving the revision decision. 736 papers were submitted to the May cycle, where 91 papers were accepted or conditionally accepted, and an additional 54 papers were selected to be revised. Altogether, 149 out of 934 submissions were accepted into this year's program, for an acceptance rate of 16.0%. All submissions were reviewed by a program committee of 177 security and privacy experts from around the world, with the vast majority of accepted papers having 4-5 reviews.

The accepted papers cover a wide range of security and privacy topics, from applied cryptography to machine learning to IoT security to hardware security. This diversity showcases the breadth of applied security and privacy research going on nowadays.

To help manage the large number of submissions, 8 area chairs were invited to assist the 2 PC chairs in handling the submissions in their individual areas, guiding the paper-discussion process and helping the chairs select papers. The area chairs were also involved in award paper selection. We thank the area chairs and all other PC members and external reviewers for their contributions to the conference and for their professionalism. We are also grateful to the General Chairs, Lorenzo Cavallaro and Johannes Kinder, for taking care of other organizational issues; to the Proceedings Chairs, Brendan Dolan-Gavitt and Gianluca Stringhini, for working with the publisher to produce the proceedings; and to Xueqiang Wang for managing the submission and paper assignment systems. We also thank all the authors for submitting to CCS.

We hope you enjoy the conference!

XiaoFeng WangIndiana University at Bloomington

Jonathan Katz George Mason University

Table of Contents

C	CCS 2019 Conference Organizationxxii		
A	CM CCS 2019 Sponsors & Supportersxxix		
Se	ession 1A: Attack I		
•	1 Trillion Dollar Refund – How To Spoof PDF Signatures		
•	Practical Decryption exFiltration: Breaking PDF Encryption		
Se	ession 1B: Cryptographic Primitives		
•	Omniring: Scaling Private Payments Without Trusted Setup: Formal Foundations and a Construction of Ring Confidential Transactions with Log-size Proofs		
•	WI Is Not Enough: Zero-Knowledge Contingent (Service) Payments Revisited		
Se	ession 1C: Cloud Security I		
•	A Machine-Checked Proof of Security for AWS Key Management Service		
•	Mitigating Leakage in Secure Cloud-Hosted Data Structures: Volume-Hiding for Multi-Maps via Hashing		
Se	ession 1D: Forensics		
•	The Next 700 Policy Miners: A Universal Method for Building Policy Miners		
•	Towards Continuous Access Control Validation and Forensics		

Se	ession 1E: Privacy I
•	Watching You Watch: The Tracking Ecosystem of Over-the-Top TV Streaming Devices 131 Hooman Mohajeri Moghaddam, Gunes Acar, Ben Burgess, Arunesh Mathur, Danny Yuxing Huang (<i>Princeton University</i>), Nick Feamster (<i>Princeton University & University of Chicago</i>), Edward W. Felten, Prateek Mittal, Arvind Narayanan (<i>Princeton University</i>)
•	Oh, the Places You've Been! User Reactions to Longitudinal Transparency About Third-Party Web Tracking and Inferencing
Se	ession 2A: Side Channels I
•	Page Cache Attacks
•	Hardware-Backed Heist: Extracting ECDSA Keys from Qualcomm's TrustZone
•	VoltJockey: Breaching TrustZone by Software-Controlled Voltage Manipulation over Multi-core Frequencies
•	Principled Unearthing of TCP Side Channel Vulnerabilities
Se	ession 2B: ML Security I
•	Neural Network Inversion in Adversarial Setting via Background Knowledge Alignment 225 Ziqi Yang, Jiyi Zhang, Ee-Chien Chang, Zhenkai Liang (National University of Singapore)
•	Privacy Risks of Securing Machine Learning Models against Adversarial Examples
•	MemGuard: Defending against Black-Box Membership Inference Attacks via Adversarial Examples
•	Procedural Noise Adversarial Examples for Black-Box Attacks on Deep Convolutional Networks
Se	ession 2C: Secure Computing I
•	Efficient Two-Round OT Extension and Silent Non-Interactive Secure Computation
•	Endemic Oblivious Transfer

•	LevioSA: Lightweight Secure Arithmetic Computation
•	Onion Ring ORAM: Efficient Constant Bandwidth Oblivious RAM from (Leveled) TFHE 345 Hao Chen (Microsoft Research), Ilaria Chillotti (KU Leuven), Ling Ren (University of Illinois at Urbana-Champaign)
Se	ession 2D: Encryption (Searchable, Updatable, Homomorphic, etc.)
•	Encrypted Databases: New Volume Attacks against Range Queries
•	Updatable Oblivious Key Management for Storage Systems
•	Efficient Multi-Key Homomorphic Encryption with Packed Ciphertexts
	with Application to Oblivious Neural Network Inference
	Hao Chen, Wei Dai (Microsoft Research), Miran Kim (UT Health Science Center at Houston), Yongsoo Song (Microsoft Research)
•	Traceback for End-to-End Encrypted Messaging
	Nirvan Tyagi (Cornell University), Ian Miers (Cornell Tech & University of Maryland), Thomas Ristenpart (Cornell Tech)
Se	ession 2E: Internet Security
•	SICO: Surgical Interception Attacks by Manipulating BGP Communities
•	Just the Tip of the Iceberg: Internet-Scale Exploitation of Routers for Cryptojacking
•	Network Hygiene, Incentives, and Regulation: Deployment
	of Source Address Validation in the Internet
	Matthew Luckie (University of Waikato), Robert Beverly (Naval Postgraduate School), Ryan Koga, Ken Keys (University of California, San Diego), Joshua A. Kroll (Naval Postgraduate School),
	k claffy (University of California, San Diego)
•	Security Certification in Payment Card Industry: Testbeds, Measurements, and Recommendations
	Sazzadur Rahaman (Virginia Tech), Gang Wang (University of Illinois at Urbana-Champaign), Danfeng (Daphne) Yao (Virginia Tech)
Se	ession 3A: Fuzzing: Methods and Applications
•	Matryoshka: Fuzzing Deeply Nested Branches
•	Intriguer: Field-Level Constraint Solving for Hybrid Fuzzing
•	Learning to Fuzz from Symbolic Execution with Application to Smart Contracts

Session 3B: Blockchain I

•	HyperService: Interoperability and Programmability Across Heterogeneous Blockchains Zhuotao Liu (University of Illinois at Urbana-Champaign & HyperService Consortium), Yangxi Xiang (Beijing University of Posts and Telecommunications), Jian Shi (Case Western Reserve University), Peng Gao (University of California, Berkeley), Haoyu Wang (Beijing University of Posts and Telecommunications Xusheng Xiao (Case Western Reserve University & HyperService Consortium), Bihan Wen (Nanyang Technological University), Yih-Chun Hu (University of Illinois at Urbana-Champaign & HyperService Consortium)	
•	MatRiCT: Efficient, Scalable and Post-Quantum Blockchain Confidential Transactions Protocol	567
	Muhammed F. Esgin (Monash University & Data61, CSIRO), Raymond K. Zhao, Ron Steinfeld, Joseph K. Liu (Monash University), Dongxi Liu (Data61, CSIRO)	
•	Prism: Deconstructing the Blockchain to Approach Physical Limits	585
Se	ession 3C: Secure Computing II	
•	Securely Sampling Biased Coins with Applications to Differential Privacy Jeffrey Champion, abhi shelat, Jonathan Ullman (Northeastern University)	603
•	Stormy: Statistics in Tor by Measuring Securely	615
•	Efficient Publicly Verifiable 2PC over a Blockchain with Applications to Financially-Secure Computations	633
Se	ession 3D: Formal Analysis I	
•	A Formal Treatment of Deterministic Wallets	651
•	5GReasoner: A Property-Directed Security and Privacy Analysis Framework for 5G Cellular Network Protocol	669
•	Verified Verifiers for Verifying Elections	685
Se	ession 3E: Privacy II	
•	Analyzing Subgraph Statistics from Extended Local Views with Decentralized Differential Privacy Haipei Sun (Qatar Computing Research Institute), Xiaokui Xiao (National University of Singapore), Issa Khalil (Qatar Computing Research Institute), Yin Yang (Hamad Bin Khalifa University), Zhan Qin (Zhejiang University), Hui (Wendy) Wang (Stevens Institute of Technology), Ting Yu (Qatar Computing Research Institute)	703
•	How to Accurately and Privately Identify Anomalies	719
•	Differentially Private Nonparametric Hypothesis Testing	737

Se	ession 4A: Side Channels II	
•	ZombieLoad: Cross-Privilege-Boundary Data Sampling	753
•	Fallout: Leaking Data on Meltdown-resistant CPUs	. 769
•	SMoTherSpectre: Exploiting Speculative Execution through Port Contention	785
Se	ession 4B: Blockchain II	
•	Atomic Multi-Channel Updates with Constant Collateral in Bitcoin-Compatible Payment-Channel Networks	. 801
•	Erlay: Efficient Transaction Relay for Bitcoin	. 817
•	Power Adjusting and Bribery Racing: Novel Mining Attacks in the Bitcoin System	. 833
Se	ession 4C: Secure Computing III	
•	A High-Assurance Evaluator for Machine-Checked Secure Multiparty Computation	. 851
•	Practical Fully Secure Three-Party Computation via Sublinear Distributed Zero-Knowledge Proofs	. 869
•	HoneyBadgerMPC and AsynchroMix: Practical Asynchronous MPC and its Application to Anonymous Communication	. 887
Se	ession 4D: Formal Analysis II	
•	Exploiting Symmetries When Proving Equivalence Properties for Security Protocols	. 905
•	Are These Pairing Elements Correct? Automated Verification and Applications	. 923
•	Post-Collusion Security and Distance Bounding	. 941

5	ession 4E: Privacy III
•	Five Years of the Right to be Forgotten
•	(Un)informed Consent: Studying GDPR Consent Notices in the Field
•	Moving Beyond Set-It-And-Forget-It Privacy Settings on Social Media
S	ession 5A: Software Security
•	Binary Control-Flow Trimming
•	Program-mandering: Quantitative Privilege Separation
S	ession 5B: Protocols
•	Flexible Byzantine Fault Tolerance
•	Distributed Vector-OLE: Improved Constructions and Implementation
S	ession 5C: Cloud Security II
•	Houdini's Escape: Breaking the Resource Rein of Linux Control Groups
•	Insecure Until Proven Updated: Analyzing AMD SEV's Remote Attestation
S	ession 5D: SDN Security
•	An In-depth Look Into SDN Topology Discovery Mechanisms: Novel Attacks and Practical Countermeasures
•	Proof-Carrying Network Code

Se	ession 5E: Fingerprinting
•	Triplet Fingerprinting: More Practical and Portable Website Fingerprinting with N-shot Learning
•	DeMiCPU: Device Fingerprinting with Magnetic Signals Radiated by CPU
Se	ession 6A: Biometrics Security
•	Multisketches: Practical Secure Sketches Using Off-the-Shelf Biometric Matching Algorithms
•	28 Blinks Later: Tackling Practical Challenges of Eye Movement Biometrics
•	Velody: Nonlinear Vibration Challenge-Response for Resilient User Authentication
•	The Catcher in the Field: A Fieldprint based Spoofing Detection for Text-Independent Speaker Verification
Se	ession 6B: ML Security II
•	QUOTIENT: Two-Party Secure Neural Network Training and Prediction
•	Quantitative Verification of Neural Networks and Its Security Applications
•	ABS: Scanning Neural Networks for Back-doors by Artificial Brain Stimulation
•	Lifelong Anomaly Detection Through Unlearning
Se	ession 6C: Secure Computing VI
•	Transparency Logs via Append-Only Authenticated Dictionaries
•	Probabilistic Data Structures in Adversarial Environments
•	Make Some ROOM for the Zeros: Data Sparsity in Secure Distributed Machine Learning 1335 Phillipp Schoppmann (Humboldt-Universität zu Berlin), Adrià Gascón (The Alan Turing Institute / University of Warwick), Mariana Raykova (Google), Benny Pinkas (Bar-Ilan University)
•	PIEs: Public Incompressible Encodings for Decentralized Storage

Session 6D: Cyber Thread

•	Log2vec: A Heterogeneous Graph Embedding Based Approach for Detecting Cyber Threats within Enterprise	177
	Fucheng Liu (Institute of Information Engineering, CAS	1///
	& School of Cyber Security, University of Chinese Academy of Sciences),	
	Yu Wen, Dongxue Zhang (Institute of Information Engineering, Chinese Academy of Sciences),	
	Xihe Jiang (Institute of Information Engineering, CAS & School of Cyber Security, University of Chinese Academy of Sciences),	
	Xinyu Xing (The Pennsylvania State University & JD Security Research Center),	
	Dan Meng (Institute of Information Engineering, Chinese Academy of Sciences)	
•	POIROT: Aligning Attack Behavior with Kernel Audit Records for Cyber	
	Threat Hunting	1795
	Sadegh M. Milajerdi (University of Illinois at Chicago), Birhanu Eshete (University of Michigan-Dearborn),	
	Rigel Gjomemo, V.N. Venkatakrishnan (University of Illinois at Chicago)	
•	Effective and Light-Weight Deobfuscation and Semantic-Aware Attack Detection	
	for PowerShell Scripts	1831
	Chunlin Xiong (Zhejiang University), Yan Chen (Northwestern University),	
	Tiantian Zhu (Zhejiang University of Technology), Hai Yang (MagicShield Inc)	
•	MalMax: Multi-Aspect Execution for Automated Dynamic Web Server	
•	Malware Analysis	1849
	Abbas Naderi-Afooshteh, Yonghwi Kwon, Anh Nguyen-Tuong (<i>University of Virginia</i>),	101/
	Ali Razmjoo-Qalaei, Mohammad-Reza Zamiri-Gourabi (ZDResearch), Jack W. Davidson (University of Virginia)	
_		
56	ession 6E: Passwords and Accounts	
•	How to (not) Share a Password: Privacy Preserving Protocols for Finding Heavy	
	Hitters with Adversarial Behavior	1369
	Moni Naor (Weizmann Institute of Science), Benny Pinkas (Bar-Ilan University),	
	Eyal Ronen (Tel Aviv University & KU Leuven)	
•	Protocols for Checking Compromised Credentials	1387
	Lucy Li, Bijeeta Pal (Cornell University), Junade Ali, Nick Sullivan (Cloudflare Inc.), Rahul Chatterjee (University of Wisconsin-Madison & Cornell Tech), Thomas Ristenpart (Cornell Tech)	
•	User Account Access Graphs	1405
•	Detecting Fake Accounts in Online Social Networks at the Time of Registrations	1423
	Dong Yuan, Yuanli Miao (Tsinghua University), Neil Zhenqiang Gong (Duke University), Zheng Yang, Qi Li (Tsinghua University), Dawn Song (University of California, Berkeley),	
	Qian Wang (Wuhan University), Xiao Liang (Tencent)	
Se	ession 7A: Internet of Things	
•	Charting the Attack Surface of Trigger-Action IoT Platforms	1439
	Qi Wang, Pubali Datta (University of Illinois at Urbana-Champaign), Wei Yang (The University of Texas at Dallas,	
	Si Liu, Adam Bates, Carl A. Gunter (University of Illinois at Urbana-Champaign)	
•	Peeves: Physical Event Verification in Smart Homes	1455
	Simon Birnbach, Simon Eberz, Ivan Martinovic (University of Oxford)	
•	Automatic Fingerprinting of Vulnerable BLE IoT Devices with Static UUIDs	
	from Mobile Apps	1469
	Chaoshun Zuo, Haohuang Wen, Zhiqiang Lin, Yinqian Zhang (Ohio State University)	
C	' =D DI I I ' III	
50	ession 7B: Blockchain III	
•	Balance: Dynamic Adjustment of Cryptocurrency Deposits	1485
	Dominik Harz, Lewis Gudgeon, Arthur Gervais, William I Knottenhelt (Imperial College Landon)	

•	TokenScope: Automatically Detecting Inconsistent Behaviors of Cryptocurrency Tokens in Ethereum	1503
	Ting Chen, Yufei Zhang, Zihao Li (University of Electronic Science and Technology of China), Xiapu Luo (The Hong Kong Polytechnic University), Ting Wang (The Pennsylvania State University), Rong Cao, Xiuzhuo Xiao, Xiaosong Zhang (University of Electronic Science and Technology of China)	
•	Tesseract: Real-Time Cryptocurrency Exchange Using Trusted Hardware	1521
Se	ession 7C: Secure Computing V	
•	Efficient MPC via Program Analysis: A Framework for Efficient Optimal Mixing	1539
•	Two-Thirds Honest-Majority MPC for Malicious Adversaries at Almost the Cost of Semi-Honest	1557
	Jun Furukawa (NEC Israel Research Center), Yehuda Lindell (Bar-Ilan University & Unbound Tech)	
•	Fast Actively Secure Five-Party Computation with Security Beyond Abort	1573
S	ession 7D: Formal Analysis III	
•	Signed Cryptographic Program Verification with Typed CryptoLine	1591
•	Machine-Checked Proofs for Cryptographic Standards: Indifferentiability of Sponge and Secure High-Assurance Implementations of SHA-3	1607
•	VeriSketch: Synthesizing Secure Hardware Designs with Timing-Sensitive	
	Information Flow Properties Armaiti Ardeshiricham, Yoshiki Takashima, Sicun Gao, Ryan Kastner (University of California, San Diego)	1623
Se	ession 7E: Privacy-Preserving Techniques	
•	SEEM/ess: Secure End-to-End Encrypted Messaging with /ess Trust Melissa Chase (Microsoft Research), Apoorvaa Deshpande (Brown University), Esha Ghosh (Microsoft Research), Harjasleen Malvai (Cornell University)	1639
•	PrivDPI: Privacy-Preserving Encrypted Traffic Inspection with Reusable Obfuscated Rules Jianting Ning (Fujian Normal University & National University of Singapore), Geong Sen Poh (Trustwave & NUS-Singtel Cyber Security Lab), Jia-Ch'ng Loh, Jason Chia (NUS-Singtel Cyber Security Lab), For Chian Chang (National University of Singapore)	1657
•	Ee-Chien Chang (National University of Singapore) Updatable Anonymous Credentials and Applications to Incentive Systems Johannes Blömer, Jan Bobolz, Denis Diemert, Fabian Eidens (Paderborn University)	1671

K	eynote
•	Hardware-assisted Trusted Execution Environments: Look Back, Look Ahead
Se	ession 8A: Attack II
•	Gollum: Modular and Greybox Exploit Generation for Heap Overflows in Interpreters 1689 Sean Heelan, Tom Melham, Daniel Kroening (<i>University of Oxford</i>)
•	SLAKE: Facilitating Slab Manipulation for Exploiting Vulnerabilities in the Linux Kernel
Se	ession 8B: TEE I
•	SecTEE: A Software-based Approach to Secure Enclave Architecture Using TEE
•	A Tale of Two Worlds: Assessing the Vulnerability of Enclave Shielding Runtimes
Se	ession 8C: Blockchain VI
•	zkay: Specifying and Enforcing Data Privacy in Smart Contracts
•	Privacy Aspects and Subliminal Channels in Zcash
Se	ession 8D: Language Security
•	Where Does It Go? Refining Indirect-Call Targets with Multi-Layer Type Analysis
•	Different is Good: Detecting the Use of Uninitialized Variables through Differential Replay
Se	ession 8E: Web Security
•	HideNoSeek: Camouflaging Malicious JavaScript in Benign ASTs
•	Your Cache Has Fallen: Cache-Poisoned Denial-of-Service Attack
Se	ession 9A: User Study
•	"I don't see why I would ever want to use it": Analyzing the Usability of Popular Smartphone Password Managers
•	Matched and Mismatched SOCs: A Qualitative Study on Security Operations Center Issues
•	A Usability Evaluation of Let's Encrypt and Certbot: Usable Security Done Right

Session 9B: ML Security III

•	Seeing isn't Believing: Towards More Robust Adversarial Attack Against Real World Object Detectors	1989
	Yue Zhao, Hong Zhu, Ruigang Liang, Qintao Shen (Institute of Information Engineering, Chinese Academy of Sciences & University of Chinese Academy of Sciences), Shengzhi Zhang (Metropolitan College, Boston University), Kai Chen (Institute of Information Engineering, Chinese Academy of Sciences	
	& University of Chinese Academy of Sciences)	
•	AdVersarial: Perceptual Ad Blocking meets Adversarial Machine Learning	2005
•	Attacking Graph-based Classification via Manipulating the Graph Structure	2023
•	Latent Backdoor Attacks on Deep Neural Networks	2041
Se	ession 9C: Zero-Knowledge Proofs	
•	Succinct Arguments for Bilinear Group Arithmetic:	
	Practical Structure-Preserving Cryptography Russell W. F. Lai (Friedrich-Alexander University Erlangen-Nuremberg), Giulio Malavolta (Carnegie Mellon University), Viktoria Ronge (Friedrich-Alexander University Erlangen-Nuremberg)	2057
•	LegoSNARK: Modular Design and Composition of Succinct Zero-Knowledge Proofs Matteo Campanelli, Dario Fiore (IMDEA Software Institute), Anaïs Querol (IMDEA Software Institute & Universidad Politécnica de Madrid)	2075
•	Efficient Zero-Knowledge Arguments in the Discrete Log Setting, Revisited	2093
•	Sonic: Zero-Knowledge SNARKs from Linear-Size Universal and Updatable	
	Structured Reference Strings	2111
Se	ession 9D: Signatures	
•	The SPHINCS ⁺ Signature Framework	2129
	Daniel J. Bernstein (<i>University of Illinois at Chicago & Ruhr University Bochum</i>), Andreas Hülsing (<i>Eindhoven University of Technology</i>), Stefan Kölbl (<i>Cybercrypt</i>), Ruben Niederhagen (<i>Fraunhofer SIT, Darmstadt</i>), Joost Rijneveld, Peter Schwabe (<i>Radboud University</i>)	
•	GALACTICS: Gaussian Sampling for Lattice-Based Constant - Time Implementation of Cryptographic Signatures, Revisited	2147
	Gilles Barthe (MPI-SP and IMDEA Software Institute), Sonia Belaïd (CryptoExperts), Thomas Espitau (Sorbonne Université), Pierre-Alain Fouque (Université de Rennes), Mélissa Rossi (Thales, ENS Paris, CNRS, PSL University, INRIA), Mehdi Tibouchi (NTT Corporation)	
•	Seems Legit: Automated Analysis of Subtle Attacks on Protocols that Use Signatures Dennis Jackson (<i>University of Oxford</i>), Cas Cremers (<i>CISPA Helmholtz Center for Information Security</i>), Katriel Cohn-Gordon (<i>Independent Scholar</i>), Ralf Sasse (<i>ETH Zurich</i>)	2165
•	Membership Privacy for Fully Dynamic Group Signatures	2181

Se	ession 9E: Web Censorship and Auditing	
•	Geneva: Evolving Censorship Evasion Strategies	. 2199
•	Conjure: Summoning Proxies from Unused Address Space Sergey Frolov, Jack Wampler (University of Colorado Boulder), Sze Chuen Tan (University of Illinois at Urbana-Champaign), J. Alex Halderman (University of Michigan), Nikita Borisov (University of Illinois at Urbana-Champaign), Eric Wustrow (University of Colorado Boulder)	. 2215
•	You Shall Not Join: A Measurement Study of Cryptocurrency Peer-to-Peer Bootstrapping Techniques Angelique Faye Loe, Elizabeth Anne Quaglia (Royal Holloway, University of London)	. 2231
•	SAMPL: Scalable Auditability of Monitoring Processes using Public Ledgers	. 2249
Se	ession 10A: Cyberphysical Security	
•	Adversarial Sensor Attack on LiDAR-based Perception in Autonomous Driving	. 2267
•	LibreCAN: Automated CAN Message Translator	. 2283
•	Trick or Heat? Manipulating Critical Temperature-Based Control Systems Using Rectification Attacks Yazhou Tu (University of Louisiana at Lafayette), Sara Rampazzi (University of Michigan), Bin Hao (University of Louisiana at Lafayette), Angel Rodriguez, Kevin Fu (University of Michigan), Xiali Hei (University of Louisiana at Lafayette)	. 2301
Se	ession 10B: TEE II	
•	OPERA: Open Remote Attestation for Intel's Secure Enclaves. Guoxing Chen, Yinqian Zhang, Ten-Hwang Lai (Ohio State University)	. 2317
•	Towards Memory Safe Enclave Programming with Rust-SGX	. 2333
•	LightBox: Full-stack Protected Stateful Middlebox at Lightning Speed	. 2351
Se	ession 10C: Secret Sharing	
•	CHURP: Dynamic-Committee Proactive Secret Sharing	. 2369
•	Efficient Verifiable Secret Sharing with Share Recovery in BFT Protocols	. 2387

•	Two-party Private Set Intersection with an Untrusted Third Party
Se	ession 10D: Mobile Security
•	DeepIntent: Deep Icon-Behavior Learning for Detecting Intention-Behavior
	Discrepancy in Mobile Apps
•	The Art and Craft of Fraudulent App Promotion in Google Play
•	CryptoGuard: High Precision Detection of Cryptographic Vulnerabilities
	in Massive-sized Java Projects
Se	ession 10E: Certificates
•	Let's Encrypt: An Automated Certificate Authority to Encrypt the Entire Web
•	You Are Who You Appear to Be: A Longitudinal Study of Domain Impersonation in TLS Certificates
•	Certificate Transparency in the Wild: Exploring the Reliability of Monitors
P	osters
•	POSTER: Detecting Audio Adversarial Example through Audio Modification
•	Poster: Fuzzing IoT Firmware via Multi-stage Message Generation
•	Poster: Snout – An Extensible IoT Pen-Testing Tool
•	POSTER: Traffic Splitting to Counter Website Fingerprinting
•	Poster: Force vs. Nudge – Comparing Users' Pattern Choices on SysPal and TinPal

•	Poster: Framework for Semi-Private Function Evaluation with Application to Secure Insurance Rate Calculation	2541
	Daniel Günther, Ágnes Kiss, Lukas Scheidel, Thomas Schneider (TU Darmstadt)	2011
•	Poster: Deployment-quality and Accessible Solutions for Cryptography Code Development	0545
	Sazzadur Rahaman, Ya Xiao, Sharmin Afrose, Ke Tian, Miles Frantz, Na Meng (Virginia Tech), Barton P. Miller (University of Wisconsin-Madison), Fahad Shaon, Murat Kantarcioglu (University of Texas at Dallas), Danfeng (Daphne) Yao (Virginia Tech)	2343
•	Poster-Medical Protocol Security: DICOM Vulnerability Mining Based	
	on Fuzzing Technology	2549
•	Poster: A Proof-of-Stake (PoS) Blockchain Protocol using Fair and Dynamic	
	Sharding Management Daehwa Rayer Lee, Yunhee Jang (Sungkyunkwan University), Hyoungshick Kim (CSIRO Data61)	2553
•	Poster: Kerberoid: A Practical Android App Decompilation System	
	with Multiple Decompilers Heejun Jang, Beomjin Jin (Sungkyunkwan University), Sangwon Hyun (Myongji University), Hyoungshick Kim (Sungkyunkwan University and CSIRO Data61)	2557
•	Poster: A Reliable and Accountable Privacy-Preserving Federated Learning	
	Framework using the Blockchain	2561
•	Poster: Attacking Malware Classifiers by Crafting Gradient-Attacks	
	that Preserve Functionality	2565
•	Poster: simFIDO – FIDO2 User Authentication with simTPM	2569
•	Poster: pFilter – Retrofitting Legacy Applications for Data Privacy	2573
•	Poster: Towards a Framework for Assessing Vulnerabilities of Brainwave	
	Authentication Systems	2577
•	Poster: Network Message Field Type Recognition	2581
•	Poster: Towards a Data Centric Approach for the Design and Verification	
	of Cryptographic Protocols	2585
•	Poster: ÆGIS: Smart Shielding of Smart Contracts	2589
•	Poster: Nickel to Lego – Using Foolgle to Create Adversarial Examples	<u> </u>
	to Fool Google Cloud Speech-to-Text API	2593
•	Poster: Using Generative Adversarial Networks for Secure Pseudorandom	
	Number Generation	2597

•	Poster: Proofs of Retrievability with Low Server Storage	2601
•	Poster: Data Quality for Security Challenges: Case Studies of Phishing, Malware and Intrusion Detection Datasets	2605
	Rakesh M. Verma, Victor Zeng, Houtan Faridi (<i>University of Houston</i>)	
•	Poster: Finding JavaScript Name Conflicts on the Web	2609
•	Poster: Towards Robust Open-World Detection of Deepfakes	2613
•	Poster: Understanding User's Decision to Interact with Potential Phishing Posts on Facebook using a Vignette Study	2617
•	Poster: Adversarial Examples for Hate Speech Classifiers	2621
•	Poster: Evaluating Security Metrics for Website Fingerprinting	2625
•	Poster: Video Fingerprinting in Tor	2629
•	Poster: A First Look at the Privacy Risks of Voice Assistant Apps Atsuko Natatsuka (Waseda University), Ryo Iijima (Waseda University & NICT), Takuya Watanabe (NTT Secure Platform Laboratories & Waseda University), Mitsuaki Akiyama (NTT Secure Platform Laboratories), Tetsuya Sakai (Waseda University), Tatsuya Mori (Waseda University, NICT & RIKEN AIP)	2633
•	Poster: Directed Hybrid Fuzzing on Binary Code Juhwan Kim, Joobeom Yun (Sejong University)	2637
•	Poster: On the Application of NLP to Discover Relationships between Malicious	
	Network Entities	2641
•	Poster: SDN-based System to Filter Out DRDoS Amplification Traffic in ISP Networks Priyanka Dodia (<i>Qatar Computing Research Institute, HBKU</i>), Yury Zhauniarovich (<i>Perfect Equanimity</i>)	2645
•	Poster: GRANDPA Finality Gadget	2649
•	Poster: Towards Characterizing and Limiting Information Exposure in DNN Layers	2653
•	Poster: Recovering the Input of Neural Networks via Single Shot Side-channel Attacks Lejla Batina (Radboud University), Shivam Bhasin, Dirmanto Jap (Nanyang Technological University, Singapore), Stjepan Picek (Delft University of Technology)	2657
•	Poster: Challenges of Accurately Measuring Churn in P2P Botnets Leon Böck (Technische Universität Darmstadt), Shankar Karuppayah (Technische Universität Darmstadt & Universiti Sains Malaysia), Kory Fong (RBC Research Institute), Max Mühlhäuser (Technische Universität Darmstadt), Emmanouil Vasilomanolakis (Aalborg University)	2661

•	Poster: TCLP: Enforcing Least Privileges to Prevent Containers from Kernel Vulnerabilities Suyeol Lee, Junsik Seo, Jaehyun Nam, Seungwon Shin (Korea Advanced Institute of Science and Technology)	2665
•	Poster: Let History not Repeat Itself (this Time) – Tackling WebAuthn Developer Issues Early On	2669
•	Poster: When Adversary Becomes the Guardian – Towards Side-channel Security With Adversarial Attacks Stjepan Picek (Delft University of Technology), Dirmanto Jap, Shivam Bhasin (Nanyang Technological University)	2673
•	Poster: Towards Automated Quantitative Analysis and Forecasting of Vulnerability Discoveries in Debian GNU/Linux Nikolaos Alexopoulos, Rolf Egert, Tim Grube, Max Mühlhäuser (Technische Universität Darmstadt)	2677
•	Poster: Effective Layers in Coverage Metrics for Deep Neural Networks Leo Hyun Park, Sangjin Oh, Jaeuk Kim, Soochang Chung, Taekyoung Kwon (Yonsei University)	2681
•	Poster: Detecting WebAssembly-based Cryptocurrency Mining	2685
•	Poster: Evaluating Code Coverage for System Call Fuzzers	2689
W	orkshop Summaries	
•	CCSW'19 Workshop Summary – 2019 Cloud Computing Security Workshop	2693
•	CPS-SPC 2019: Fifth Workshop on Cyber-Physical Systems Security and PrivaCy	2695
•	MTD 2019: The 6th ACM Workshop on Moving Target Defense	2697
•	SSR'19: The 5th Conference on Security Standardisation Research Maryam Mehrnezhad (Newcastle University), Thyla van der Merwe (Mozilla), Feng Hao (University of Warwick)	2699
•	TIS'19: Theory of Implementation Security Workshop 2019	2701
•	WAHC'19: 7th Workshop on Encrypted Computing & Applied Homomorphic Cryptograph Michael Brenner (Leibniz Universität Hannover), Tancrède Lepoint (Google), Kurt Rohloff (New Jersey Institute of Technology and Duality Technologies)	2703
•	18th Workshop on Privacy in the Electronic Society (WPES 2019)	2705
•	AlSec'19: 12th ACM Workshop on Artificial Intelligence and Security	2707
•	ASHES 2019 — 3rd Workshop on Attacks and Solutions in Hardware Security	2709
•	1st Workshop on Cyber-Security Arms Race (CYSARM 2019) Thanassis Giannetsos (Technical University of Denmark), Daniele Sgandurra (Royal Holloway, University of London)	2711

•	IoT S&P 2019: 2nd Workshop on the Internet of Things Security and Privacy Peng Liu (Penn State University), Yuqing Zhang (University of Chinese Academy of Sciences, China)	2713
•	PLAS 2019 - ACM SIGSAC Workshop on Programming Languages and Analysis for Security	2715
•	PPML '19: Privacy Preserving Machine Learning	2717
•	3rd International Workshop on Software Protection (SPRO 2019)	2719
Α	uthor Index	2721

CCS 2019 Conference Organization

General Chairs: Lorenzo Cavallaro (King's College London, UK)

Johannes Kinder (Bundeswehr University Munich, Germany)

Program Chairs: XiaoFeng Wang (Indiana University, USA)

Jonathan Katz (George Mason University, USA)

Workshops Chair: Thorsten Holz (Ruhr-University Bochum, Germany)

Poster / Demo Chair: Stefan Brunthaler (Bundeswehr University Munich, Germany)

Panel Chair: Adam Doupé (Arizona State University, USA)

Publication Chairs: Brendan Dolan-Gavitt (New York University, USA)

Gianluca Stringhini (Boston University, USA)

Web Chair: Swen Jacobs (CISPA Helmholtz Center for Information Security, Germany)

Publicity Chairs: Emiliano De Cristofaro (University College London, UK)

Mark Manulis (University of Surrey, UK) Mathias Payer (EPFL, Switzerland)

Sponsorship Chairs: Nick Nikiforakis (Stony Brook University, USA)

Andrew Paverd (Microsoft Research, UK)

Student Travel Grant Chairs: Katharina Krombholz (CISPA Helmholtz Center for Information Security,

Germany)

Elissa Redmiles (University of Maryland, USA) Hassan Takabi (University of North Texas, USA)

Registration Chairs: Jorge Blasco Alis (Royal Holloway University of London, UK)

Daniele Sgandurra (Royal Holloway University of London, UK)

Local Arrangements Chair: Mia Robertson

Volunteer Chair: Dan O'Keeffe (Royal Holloway University of London, UK)

Program Committee: Gail-Joon Ahn (Arizona State University)

Sumayah Alrwais (King Saud University)

Owen Arden (UC Santa Cruz)

Adam Aviv (The George Washington University) Erman Ayday (Case Western Reserve University)

Michael Backes (CISPA Helmholtz Center for Information Security)

Raef Bassily (Ohio State University)

Program Committee (continued): Gilles Barthe (MPI Security and Privacy and IMDEA Software Institute)

Lujo Bauer (CMU)

Mihir Bellare (UCSD)

Karthikeyan Bhargavan (INRIA)

Leyla Bilge (Symantec)

Vincent Bindschaedler (University of Florida)

Jeremiah Blocki (Purdue University)

Rakesh Bobba (Oregon State University)

Sven Bugiel (CISPA Helmholtz Center for Information Security)

Christian Cachin (IBM Research Zürich)

L. Jean Camp (Indiana University)

Yinzhi Cao (Johns Hopkins University)

Alvaro Cardenas (UC Santa Cruz)

David Cash (University of Chicago)

Haibo Chen (Shanghai Jiao Tong University)

Hao Chen (University of California, Davis)

Hao Chen (MIcrosoft Research)

Kai Chen (Institute of Information Engineering, Chinese Academy of

Sciences, China)

Shuo Chen (Microsoft Research)

Yan Chen (Northwestern University)

Yingying Chen (Rutgers University)

Omar Chowdhury (The University of Iowa)

Nicolas Christin (Carnegie Mellon University)

Weidong Cui (Microsoft Research)

Lucas Davi (University of Duisburg-Essen)

Lorenzo De Carli (Worcester Polytechnic Institute)

Emiliano De Cristofaro (UCL)

Soteris Demetriou (Imperial College London)

Wenrui Diao (Shandong University)

Adam Doupe (Arizona State University)

Haixin Duan (360 ESG Institute of Security Research; Institute for

Network Science and Cyberspace, Tsinghua University)

Tudor Dumitras (Univ. Maryland)

Manuel Egele (Boston University)

Ittay Eyal (Technion, Israel)

Sascha Fahl (University of Hannover)

Kassem Fawaz (University of Wisconsin-Madison)

Dario Fiore (IMDEA Software Institute)

Marc Fischlin (TU Darmstadt)

Sara Foresti (Università degli Studi di Milano)

Michael Franz (University of California, Irvine, USA)

Xinyang Ge (Penn State)

Daniel Genkin (University of Michigan)

Rosario Gennaro (City College, CUNY)

Irene Giacomelli (Protocol Labs)

Neil Gong (Duke University)

Guofei Gu (Texas A&M)

Yong Guan (Iowa State University)

Program Committee (continued): Carl Gunter (University of Illinois)

Weili Han (Fudan University)

Carmit Hazay (Bar-Ilan University)

Ryan Henry (University of Calgary)

Michael Hicks (University of Maryland)

Thorsten Holz (Ruhr-University Bochum)

Nick Hopper (University of Minnesota)

Amir Houmansadr (UMass Amherst)

Yan Huang (Indiana University)

Trent Jaeger (Penn State University)

Tibor Jager (Paderborn University)

Rob Jansen (U.S. Naval Research Laboratory)

Somesh Jha (University of Wisconsin)

Shouling Ji (Zhejiang University)

Yier Jin (University of Florida)

Brent ByungHoon Kang (KAIST)

Murat Kantarcioglu (University of Texas at Dallas)

Alexandros Kapravelos (North Carolina State University)

Aniket Kate (Purdue University)

Jonathan Katz (University of Maryland)

Aggelos Kiayias (University of Edinburgh)

Taesoo Kim (Georgia Institute of Technology)

Yongdae Kim (KAIST)

Engin Kirda (Northeastern University)

Ralf Kuesters (University of Stuttgart, Germany)

Bum Jun Kwon (National Security Research Institute)

Ruby Lee (Princeton)

Wenke Lee (Georgia Institute of Technology)

Kirill Levchenko (University of Illinois Urbana-Champaign)

Bo Li (UIUC)

Ninghui Li (Purdue University)

Zhou Li (UC Irvine)

Zhenkai Liang (National University of Singapore)

Xiaojing Liao (Indiana University)

David Lie (Univ. Toronto)

Zhiqiang Lin (Ohio State University)

Peng Liu (Pennsylvania State University)

Yang Liu (Nanyang Technological University)

Wenjing Lou (Virginia Polytechnic Institute and State University)

Kangjie Lu (University of Minnesota)

Vadim Lyubashevsky (IBM Research - Zurich)

Ashwin Machanavajjhala (Duke University)

Matteo Maffei (TU Wien)

Mohammad Mannan (Concordia University)

Damon McCoy (NYU)

Patrick McDaniel (Penn State University)

Ian Miers (Cornell Tech; University of Maryland)

Andrew Miller (University of Illinois at Urbana-Champaign)

Jiang Ming (University of Texas at Arlington)

Program Committee (continued): Ilya Mironov (Google)

Esfandiar Mohammadi (ETH Zurich)

Payman Mohassel (Yahoo Inc)

Muhammad Naveed (USC)

Stefan Nuernberger (CISPA Helmholtz Center i.G.)

Olya Ohrimenko (Microsoft Research) Claudio Orlandi (Aarhus University)

Nicolas Papernot (Penn State)

Kenny Paterson (RHUL/ETH Zurich)

Mathias Payer (EPFL)

Paul Pearce (Georgia Tech; Facebook; International Computer Science

Institute)

Adrian Perrig (ETH)

Frank Piessens (KU Leuven)

Feng Qian (University of Minnesota - Twin Cities)

Zhiyun Qian (UC Riverside)

Mike Reiter (UNC)

William Robertson (Northeastern University)

Mike Rosulek (Oregon State University)

Andrew Ruef (Independent)

Ulrich Rührmair (LMU Munich)

Andrei Sabelfeld (Chalmers University of Technology)

Ahmad-Reza Sadeghi (TU Darmstadt)

Nitesh Saxena (The University of Alabama at Birmingham)

Joshua Schiffman (HP Labs, HP Inc.)

Benedikt Schmidt (Google)

Dominique Schröder (Friedrich-Alexander Universität Erlangen-

Nürnberg)

Abhi Shelat (Northeastern University)

Seungwon Shin (KAIST)

Reza Shokri (National University of Singapore (NUS))

Radu Sion (Stony Brook University)

Adam Smith (Boston University)

Chengyu Song (UC Riverside)

Ben Stock (CISPA Helmholtz Center for Information Security)

Gianluca Stringhini (Boston University)

Kun Sun (George Mason University)

Paul Syverson (U.S. Naval Research Laboratory)

Kunal Talwar (Google Inc)

Yuan Tian (University of Virginia)

Nils Ole Tippenhauer (CISPA Helmholtz-Zentrum i.G.)

Mohit Tiwari (University of Texas - Austin)

Blase Ur (University of Chicago)

Venkat Venkatakrishnan (UIC)

Giovanni Vigna (UC Santa Barbara)

Hayawardh Vijayakumar (Samsung Research America)

Haining Wang (University of Delaware)

Ruoyu "Fish" Wang (Arizona State University)

Wenhao Wang (Institute of Information Engineering, CAS)

XiaoFeng Wang (Indiana University Bloomington)

Program Committee (continued): Xiao Wang (MIT, Boston University)

Rebecca Wright (Rutgers University)

Dinghao Wu (Pennsylvania State University)

Tao Xie (UIUC)

Luyi Xing (Indiana University Bloomington) Xinyu Xing (Pennsylvania State University)

Li Xiong (Emory U)

Wenyuan Xu (Zhejiang University) Min Yang (Fudan University)

Danfeng Yao (Virginia Tech, Dept of Computer Science)

Yuval Yarom (University of Adelaide and Data61)

Arkady Yerukhimovich (George Washington University)

Heng Yin (UC Riverside)

Ting Yu (Oatar Computing Research Institute)

Yu Yu (Shanghai Jiao Tong University)

Chao Zhang (Institute for Network Sciences and Cyberspace of Tsinghua

University)

Danfeng Zhang (Penn State University) Fengwei Zhang (Wayne State University)

Kehuan Zhang (The Chinese University of Hong Kong)

Xiangyu Zhang (Purdue University)

Yang Zhang (CISPA Helmholtz Center for Information Security)

Yingian Zhang (Ohio State) Yupeng Zhang (UC Berkeley)

Jianying Zhou (Singapore University of Technology and Design)

Yajin Zhou (Zhejiang University) Zhe Zhou (Fudan University)

Additional reviewers: Aydin Abadi

Raphael Bost Shashank Agrawal Robert Brotzman Seved Mohammad Mehdi Carlo Brunetta Ahmadpanah Jo Van Bulck Chuadhry Mujeeb Ahmed Quinn Burke Hasan Faik Alan Andrei Bytes Arwa Alrawais Matteo Campanelli

Vivek Arte Jiahao Cao Enrico Bacis Yang Cao

Christian Badertscher Xavier de Carné de Carnavalet

Shi Bai Dario Catalano Berkay Celik Subarno Baneriee Manuel Barbosa Pyrros Chaidos Iulia Bastys Hongyan Chang

Fabrice Benhamouda Bo Chen Hongxu Chen Ian Bobolz Jonathan Bootle Jianjun Chen

Additional reviewers (continued): $Jiongyi\ Chen$

Jiongyi Chen Chiraag Juvekar

Joann Chen Amir-Hossein Karimi

Lingwei Chen Mohammad Kavousi

Sen Chen Junming Ke Yang Chen Miran Kim Yilei Chen Kamil Kluczniak Chris Chao-Chun Cheng Dimitris Kolonelos Haehyun Cho Karel Kubicek Michele Ciampi Rafael Kurek Sandro Coretti-Drayton Russell W. F. Lai Adrien Cosson Thalia Laing Wei Dai Jonathan Lee

Anja Lehmann

Gareth Davies

Nikos Leonardos Hannah Davis Jiangyi Deng Frank Li Zeyu Ding Wenting Li Shuaike Dong Xiaoting Li Xiaoning Du Yanjie Li Benjamin Eriksson Yuekang Li Antonio Faonio Zengpeng Li David Freeman Zhenyuan Li Chaya Ganesh Iulian Liedtke Xing Gao Baojun Liu Essam Ghadafi Songsong Liu Esha Ghosh Xiao Liu Neline van Ginkel Xueging Liu Jian Lou Huijing Gong Benjamin Gregoire Wouter Lueks

Jinyu Gu Shuaicheng Ma Xiaolan Gu Zeyu Mi Le Guan Peihan Miao Chun Guo Mohsen Minaei

HyungSeok HanPedro Moreno-SanchezYufei HanJan Tobias MuehlbergDaniel HedinSasi Kumar Murakonda

Andrew Hirsch Johannes Müller
Grant Ho Mohamed Nabeel
Kyle Hogan Yuhong Nan
Pedram Hosseyni Gregory Neven
Kaiyu Hou Ruth Ng

Hongxin Hu Ngoc Khanh Nguyen

Remy Husson **David Niehues** Yongho Hwang Jianting Ning Joseph Jaeger Luca Nizzardo Xiangkun Jia David Paaßen Yufei Jiang Elena Pagnin Chenglu Jin **Eric Pauley** Lin Jin Gerardo Pelosi Aaron Johnson Krzysztof Pietrzak Additional reviewers (continued): Rupesh Prajapati

Jay Prakash Kobe Vrancken Anais Querol Shengye Wan Ananth Raghunathan Li Wang Daniel Rausch Pei Wang Peter Rindal Shu Wang Michael Rodler Xinda Wang Viktoria Ronge Yuxin Wang Carlos Rubio Zihao Wang Tim Ruffing Gaven Watson Gaëtan Wattiau David Rupprecht

Christine Utz

Leonid Ryzhyk Yibo Wu Ralf Sasse Tim Würtele Patrick Schaumont Jidong Xiao Thomas Schneider Yang Xiao Jonas Schneider-Bensch Yonghui Xiao Andre Schrottenloher Xiaofei Xie Chunlin Xiong Mahmood Sharif Fenghao Xu Vishal Sharma Chen Yan Ryan Sheatsley Chen Shi Wei Yang **Junbum Shin Zheng Yang** Mike Simon Qingqing Ye **David Sommer** Yang Yu

Yongsoo Song Thomas Zacharias

Igors Stepanovs Bin Zhang Aikaterini-Panagiota Stouka Guomin Zhang Raoul Strackx Jinquan Zhang Haipei Sun Ning Zhang Jianhua Sun Qiuchen Zhang Menghan Sun Xian Zhang Sebastian Surminski Yubao Zhang Di Tang Yushi Zhang Stefano Tessaro Lianying Zhao Ziming Zhao Om Thakkar Zirui Zhao Abhradeep Guha Thakurta

Ni Trieu Dionysis Zindros

Ruiyu Zhu

Steering Committee Chair: Somesh Jha (University of Wisconsin-Madison)

David Basin (ETH Zurich)

Trent Jaeger (Pennsylvania State University)

Steering Committee: Carl Landwehr (George Washington University)

Stefan Savage (University of California-San Diego)

Rebecca Wright (Rutgers University)

Sri Aravinda Krishnan Thyagarajan

ACM CCS 2019 Sponsors & Supporters

Sponsor:



Platinum Supporters:







Gold Supporters:













S/MSUNG Research

Silver Supporters:

IBM Research



Bronze Supporters:







