The International Library of Ethics, Law and Technology

Volume 21

Technologies are developing faster and their impact is bigger than ever before. Synergies emerge between formerly independent technologies that trigger accelerated and unpredicted effects. Alongside these technological advances new ethical ideas and powerful moral ideologies have appeared which force us to consider the application of these emerging technologies. In attempting to navigate utopian and dystopian visions of the future, it becomes clear that technological progress and its moral quandaries call for new policies and legislative responses. Against this backdrop this new book series from Springer provides a forum for interdisciplinary discussion and normative analysis of emerging technologies that are likely to have a significant impact on the environment, society and/or humanity. These will include, but be no means limited to nanotechnology, neurotechnology, information technology, biotechnology, weapons and security technology, energy technology, and space-based technologies.

More information about this series at http://www.springer.com/series/7761

Markus Christen • Bert Gordijn • Michele Loi
Editors

The Ethics of Cybersecurity

Springer Open

Editors
Markus Christen
UZH Digital Society Initiative
Zürich, Switzerland

Bert Gordijn
Dublin City University
Dublin, Ireland

Michele Loi
Digital Society Initiative
University of Zurich
Zürich, Switzerland

ISSN 1875-0044 ISSN 1875-0036 (electronic)
The International Library of Ethics, Law and Technology
ISBN 978-3-030-29052-8 ISBN 978-3-030-29053-5 (eBook)
https://doi.org/10.1007/978-3-030-29053-5

This Springer imprint is published by the registered company Springer Nature Switzerland AG.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Contents

About the Contributors

Alberto Blanco-Justicia is a Postdoctoral Researcher at Universitat Rovira i Virgili. He obtained his MSc in Computer Security in 2013 from Universitat Rovira i Virgili, and his PhD in Computer Engineering and Mathematics of Security from the same university in 2017, with a thesis focused on the reconciliation of privacy, security and functionality in e-commerce applications. His research interests include data privacy, data security and cryptographic protocols. He has been involved in several European and national Spanish research projects, as well as technology transfer contracts.

Markus Christen is a Research Group Leader at the Institute of Biomedical Ethics and History of Medicine and Managing Director of the UZH Digital Society Initiative. He received his MSc in Philosophy, Physics, Mathematics and Biology from the University of Berne, his PhD in Neuroinformatics from the Federal Institute of Technology in Zurich and his Habilitation in Bioethics from the University of Zurich. His research interests include empirical ethics, neuroethics, ICT ethics and data analysis methodologies.

Josep Domingo-Ferrer is the Distinguished Professor of Computer Science and an ICREA-Acadèmia Researcher at Universitat Rovira i Virgili, Tarragona, Catalonia, where he holds the UNESCO Chair in Data Privacy and is the founding director of CYBERCAT-Center for Cybersecurity Research of Catalonia. He received his MSc and PhD degrees in Computer Science from the Autonomous University of Barcelona. He also holds an MSc in Mathematics. His research interests include data privacy, data security, statistical disclosure control and cryptographic protocols, with a focus on the conciliation of privacy, security and functionality. He is an IEEE Fellow, an ACM Distinguished Scientist and an elected member of Academia Europaea.

Gloria González Fuster is a Research Professor in the Faculty of Law and Criminology at the Vrije Universiteit Brussel (VUB). She is Co-Director of the Law, Science, Technology and Society (LSTS) Research Group, and a member of

the Brussels Privacy Hub (BPH); she investigates legal issues related to privacy, personal data protection and security, and teaches 'Data Policies in the European Union' at the Data Law option of the Master of Laws in International and European Law (PILC) of VUB's Institute for European Studies (IES). She studied law at the Universidad Nacional de Educación a Distancia (UNED), journalism in the Faculty of Communication Sciences of the Universidad Autónoma de Barcelona (UAB) (including a stay at the Université Paris VIII) and modern languages and literature at the Université Libre de Bruxelles (ULB).

Bert Gordijn has been a Full Professor and Director of the Institute of Ethics at Dublin City University (Ireland) since 2008. He is a Visiting Professor at Lancaster University (UK), Georgetown University (USA), the National University of Singapore, the Fondation Brocher (Switzerland), Yenepoya University (India) and the University of Otago (New Zealand). He has served on advisory panels and expert committees of the European Chemical Industry Council, the European Patent Organisation, the Irish Department of Health and UNESCO. He is currently the Secretary of the European Society for Philosophy of Medicine and Healthcare and President of the International Association of Education in Ethics.

Florian Grunow is a Security Analyst and currently CEO of ERNW GmbH, Heidelberg, Germany. He holds a Master of Science degree in computer science with a focus on software engineering and a Bachelor of Science degree in medical computer sciences. He is committed to practical security education, both internally at ERNW and by giving public talks.

Dominik Herrmann is a Full Professor of Privacy and Security in Information Systems at University of Bamberg (Germany). Prior to this, he was a Temporary Professor at the University of Siegen between October 2015 and March 2017. He holds a PhD in Computer Science (University of Hamburg, 2014) and a Diploma with Honors in Management Information Systems (University of Regensburg, 2008). He has received a series of awards, including the GI-Dissertationspreis 2014 for the best computer science dissertation in Germany. He was also named a Junior Fellow of the German Computer Science Society for his services to the profession.

Reto Inversini studied Geography at the University of Berne and Information Technology at the University of Applied Sciences in Berne. He worked for Amnesty International as a network and systems engineer and for the Swiss Federal Administration as a security architect. He currently works as a malware analyst and security officer for the Swiss Governmental CERT (GovCERT.ch). He is a part-time lecturer at the University of Applied Sciences in Bern in the domains of network engineering and information security. His focus lies on network intrusion detection and malware analysis. It is important to him that core values of our society such as individual responsibility, democracy, freedom of speech and privacy are preserved while increasing the security of the Internet.

David-Olivier Jaquet-Chiffelle is a Full Professor at the School of Criminal Justice, University of Lausanne, Switzerland. He is the head of the Master programme in forensic science, orientation digital investigation and identification. He accomplished his PhD in Mathematics at the University of Neuchâtel, Switzerland. He spent a post-doc at Harvard University (Boston, USA). He then strengthened his experience in cryptology while working for the Swiss government at the Swiss Federal Section of Cryptology. He has a long experience in projects related to identity, security and privacy. His current research includes cybercrime, security and privacy, and new forms of identities in the information society, as well as authentication, anonymisation and identification processes, especially in the digital world.

Lina Jasmontaite is a PhD candidate at the Vrije Universiteit Brussel. She joined the Law, Science, Technology and Society (LSTS) Research Group in September 2016. Currently, she works on the awareness raising project under the Rights, Equality and Citizenship Programme 2014–2020 titled 'Support Small and Medium Enterprises on the Data Protection Reform II' (STARII). Under the supervision of Professor Gloria González Fuster, she contributed to the Horizon 2020 project titled 'Constructing an Alliance for Value-driven Cybersecurity' (CANVAS). She is also a Contributing Fellow at the Brussels Privacy Hub, where she explores the legal implications of new technologies that are being operationalised in humanitarian practice. Her PhD research concerns primarily the interaction between data breach notification obligations foreseen in the General Data Protection Regulation and the Network and Information Security Directive.

Alexey Kirichenko received his MSc in Mathematics from Leningrad (St. Petersburg) State University, Russia, and completed his PhD in Theoretical Computer Science at Aalto University, Finland. He joined F-Secure in 1997 and was for a long time leading the development of the company's cryptographic modules and authorisation infrastructure. Since 2007, he has been working as Research Collaboration Manager, coordinating F-Secure's participation in European and Finnish national research collaboration projects. He represents F-Secure in WG6 of European Cyber Security Organisation (ECSO) and significantly contributed in the ECSO SRIA preparation. Prior to joining F-Secure, he worked in the Computer Graphics area at Altsys Corp., and prior to this he lectured in mathematical courses at St. Petersburg Electro-Technical University. He is actively involved in training the Finnish national team for the International Mathematical Olympiad.

Nadine Kleine studied sociology and political science at the University of Potsdam, Germany, as well as cultural sciences with a focus on technology at the BTU Cottbus-Senftenberg, Germany. She was a Research Associate at the Institute for Social Research and Technology Assessment (IST), Regensburg University of Applied Studies, where she worked on the H2020 project "Constructing an Alliance for Value-driven Cybersecurity" (CANVAS) concerning issues of cyber security and ethics in healthcare. Currently, she researches worker's autonomy and

acceptance of digital technologies in the work environment as a member of the doctoral research group "Trust and Acceptance in Augmented and Virtual Working Environments" (va-eva) and is involved in the project "Teamwork 4.0" at the Department of Economic and Industrial Sociology, both at the University of Osnabrueck.

David Koeppe studied economics at the Free University of Berlin (Diplom-Kaufmann) and has worked in various positions in hospitals since 1995. As Privacy Officer of the Vivantes Group (Netzwerk für Gesundheit GmbH), he is intensively involved with all facets of data protection in the health care sector. Within the framework of the society 'Gesellschaft für Datenschutz und Datensicherheit e.V.' (Society for Data Protection and Data Security), he is leading the working group 'Data Protection and Data Security in Health and Social Services' and the regional experience exchange group in Berlin. He is the co-editor of the *Handbuch Datenschutz und Datensicherheit im Gesundheits und Sozialwesen* (Datakontext, 2016) and co-author of a number of published data protection tools.

Michele Loi (PhD, Luiss Guido Carli) is an applied philosopher working at the intersection between digital ethics and bioethics. Besides researching the ethics of cybersecurity, he is also interested in fairness and transparency in machine learning and in the regulation access and use to big data in health. Currently, he is affiliated as Postdoctoral Researcher with the Digital Ethics Lab, Digital Society Initiative and with the Institute of Biomedical Ethics and the History of Medicine (both University of Zurich). His research on the ethics of cybersecurity has been funded by the CANVAS project, the same H2020 project funding the project of this book.

George Lucas is retired as Distinguished Chair of Ethics at the US Naval Academy (Annapolis, Maryland). He is a Senior Fellow at the Stockdale Center for Leadership and Ethics at US Naval Academy. His most recent book is *Ethics and Military Strategy in the 21st-Century: Moving Beyond Clausewitz* (Routledge, 2019).

Paul Meyer is Fellow in International Security and Adjunct Professor of International Studies at Simon Fraser University and a Senior Fellow with The Simons Foundation in Vancouver, Canada. He is also a Senior Advisor with ICT4Peace, an NGO devoted to preserving a peaceful cyberspace. Previously, he had a 35-year career with the Canadian Foreign Service, including serving as Canada's Ambassador to the United Nations and to the Conference on Disarmament in Geneva (2003–2007). He writes on issues of nuclear non-proliferation and disarmament, space security and the diplomacy of international cyber security.

Seumas Miller holds research positions at Charles Sturt University, Technical University Delft and the University of Oxford. He is the author or co-author of 20 books, including *Social Action* (CUP, 2001), *Moral Foundations of Social Institutions* (CUP, 2010), *Terrorism and Counter-terrorism* (Blackwell, 2009), *Shooting to Kill: The Ethics of Police and Military Use of Lethal Force* (OUP, 2016)

and *Institutional Corruption* (CUP, 2017), and of over 200 academic articles. He is currently working on a co-authored book on the ethics of cybersecurity with a computer scientist, Terry Bossomaier.

Gwenyth Morgan is a PhD candidate at the ADAPT Centre for Digital Content Technologies and at the Institute of Ethics in All Hallows Drumcondra. She is conducting her research on the topic of ethically appropriate business responses to ransomware attacks and data breaches. Her work encompasses ethics and cybersecurity, ranging from ethical issues in cybersecurity relating to dataveillance, hacking back and the use of AI, to the dynamic and ambiguous relationship between businesses and security researchers, i.e., white hats, grey hats and black hats. She aims to open up the field of ethics and cybersecurity research in such a way that business ethics theories such as stakeholder theory can be used to practically establish how businesses can ethically manage and respond to issues that arise in cybersecurity. She teaches bachelor's and master's students at the Dublin City University on the topics of applied ethics, ethics of technology and health care ethics.

Henning Pridöhl is a Research and Teaching Assistant in the Privacy and Security in Information Systems Group at University of Bamberg. Prior to this, he was a Research Assistant in the Security in Distributed Systems Group at University of Hamburg. He holds an MSc in Computer Science from the University of Hamburg, where he graduated in 2016. He enjoys playing Capture The Flag security competitions and mentors young hackers in programming and IT security.

Eva Schlehahn is a Senior Legal Researcher and Consultant employed at Unabhängiges Landeszentrum für Datenschutz (ULD) in the German federal state of Schleswig-Holstein. Her work focuses on the requirements of the European General Data Protection Regulation (GDPR) and Privacy Enhancing Technologies (PETs). Since 2010, she has been working in various EC-funded FP7 and H2020 R&D projects focused on a multitude of data protection relevant topics. In her work, she has obtained a variety of know-how and experience related to topics such as cloud computing, identity and consent management, accessibility, UI design and usability, IT security, data privacy vocabularies and ontologies, data policy enforcement, surveillance technologies, requirements analysis and conceptualisation. Her research interests include interdisciplinary requirements analysis, balancing and evaluation, specifically considering Privacy by Design solutions.

Salome Stevens is a Teaching and Research Fellow at the Department of Criminal Law of the University of Zurich. She is pursuing her PhD on the subject of cybersecurity. Before joining the university, she worked as a Legal and Political Advisor for the Federal Department of Foreign Affairs and the Police Force, as well as for the private sector and the United Nations. She also supported several NGOs in their mandate to prevent international crime and fight impunity. Throughout her professional development, she has lived in Switzerland, Italy, Israel and the United Arab Emirates.

Ibo van de Poel is Anthoni van Leeuwenhoek Professor in Ethics and Technology and head of the Department of Values, Technology and Innovation at the Faculty of Technology, Policy and Management at the Technical University Delft in the Netherlands. He has published on engineering ethics, the moral acceptability of technological risks, design for values, responsible innovation, moral responsibility in research networks, ethics of newly emerging technologies and the idea of new technology as a social experiment. He has recently received an ERC Advanced grant for 'Design for changing values: a theory of value change in sociotechnical systems'.

Eleonora Viganò is a Postdoctoral Researcher at the Institute of Biomedical Ethics and History of Medicine and at the Digital Society Initiative of the University of Zurich. Her research is funded by the Cogito Foundation and the CANVAS project. She is a Moral Philosopher with a strong interest in the neuroscience of ethics. Her research interests include intrapersonal conflicts of values, the morality of prudence, and the implications for ethics of the neuroscientific discoveries on decision making. She has recently started working on ethical trade-offs in cybersecurity and on trust and transparency in machine learning algorithms.

Karsten Weber studied philosophy, informatics and sociology at University Karlsruhe (TH), Germany, and from 1996 to 1999 worked there as a Junior Researcher. After his doctorate in 1999, from 1999 to 2008 he was a Senior Researcher at European University Viadrina in Frankfurt (Oder), Germany. From 2006 to 2012, he worked as a Professor of Philosophy at University Opole, Poland. Since 2007, he has held an honorary professorship for Culture and Technology at BTU Cottbus-Senftenberg, Germany. At TU Berlin from 2008 to 2009, he was a Professor for Information Ethics and Data Protection and from 2009 to 2011 Professor for Computer Science and Society. From 2011 to 2016, he was Chair for General Science of Technology at BTU Cottbus-Senftenberg. Since 2013, Prof. Weber has taught technology assessment at OTH Regensburg, Germany and is co-head of the Institute for Social Research and Technology Assessment (IST) and one of the three directors of the Regensburg Center of Health Sciences and Technology (RCHST).

Emad Yaghmaei is a Senior Researcher at the Faculty of Technology, Policy and Management at the Technical University Delft. His research interests include the innovation management issues arising from the intersections of science, technology and society. The emphasis of his research and consulting is on innovation and technology management of emerging technologies such as ICT, the Internet of Things, nanotechnology and so on to identify and work on the social impacts of these technologies. He has been working on monitoring industry business innovation across non-financial values. He is currently focusing on Responsible Research and Innovation (RRI) principles in an industrial context to demonstrate how industry can work productively together with societal actors and integrate methodologies of RRI into research and innovation processes.

Acronyms and Abbreviations

ACM	Association for Computing Machinery
AI	Artificial Intelligence
APT	Advanced Persistent Threat
ASLR	Address Space Layout Randomization
AV	Anti Virus
C&C	Command and Control
CA	Certification Authority
CANVAS	Constructing an Alliance for Value-driven Cybersecurity
CCC	Convention on Cyber Crime
CENELEC	European Committee for Electrotechnical Standardization
CERT	Computer Emergency Response Team
CFI	Control-Flow Integrity
CFSP	Common Foreign and Security Policy
CJEU	Court of Justice of the European Union
CNIL	Commission Nationale de l'Informatique et des Libertés
CoE	Council of Europe
DDoS	Distributed Denial of Service
DEP	Data Execution Prevention
DNS	Domain Name System
DPI	Deep Packet Inspection
DPIA	Data Protection Impact Assessment
EC	European Commission
ECHR	European Convention of Human Rights
ECSO	European Cyber Security Organisation
ECHR	European Court of Human Rights
EDPS	European Data Protection Supervisor
EFF	Electronic Frontier Foundation
eHC	electronic Health Card
ENISA	European Network and Information Security Agency
EU	European Union
FRS	Face Recognition System

GAFAM	Google, Apple, Facebook, Amazon and Microsoft
GDPR	General Data Protection Regulation
GGE	Group of Governmental Experts
HTTP	Hypertext Transfer Protocol
ICRC	International Committee of the Red Cross
ICT	Information and Communication Technology
IMD	Implantable Medical Device
IoT	Internet of Things
ISACA	Information Systems Audit and Control Association
ISO	International Organization for Standardization
ISP	Internet Service Providers
ITU	International Telecommunication Union
LEA	Law Enforcement Agency
MAC	Message Authentication Code
MDR	Medical Device Regulation
MitM	Man in the Middle
NATO	North Atlantic Treaty Organization
NER	Named Entity Recognition
NIDS	Network Intrusion Detection Systems
NIS	Network and Information Security
NSA	National Security Agency (USA)
OJ	Official Journal of the European Communities
OSCE	Organization for Security and Cooperation in Europe
PGP	Pretty Good Privacy
PPDM	Privacy-Preserving Data Mining
QC	Quantum Computing
ROP	Return-Oriented Programming
SDC	Statistical Disclosure Control
SDM	Standard Data Protection Model
SME	Small and Medium Enterprises
SOST	Surveillance-Oriented Security Technology
SQL	Structured Query Language
TAO	Tailored Access Operations
T-CY	Cybercrime Convention Committee
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
TLS	Transport Layer Security

List of Figures

List of Tables