

Editor-in-Chief

Kai Rannenber, Goethe University Frankfurt, Germany

Editorial Board

TC 1 – Foundations of Computer Science

Jacques Sakarovitch, Télécom ParisTech, France

TC 2 – Software: Theory and Practice

Michael Goedicke, University of Duisburg-Essen, Germany

TC 3 – Education

Arthur Tatnall, Victoria University, Melbourne, Australia

TC 5 – Information Technology Applications

Erich J. Neuhold, University of Vienna, Austria

TC 6 – Communication Systems

Aiko Pras, University of Twente, Enschede, The Netherlands

TC 7 – System Modeling and Optimization

Fredi Tröltzsch, TU Berlin, Germany

TC 8 – Information Systems

Jan Pries-Heje, Roskilde University, Denmark

TC 9 – ICT and Society

Diane Whitehouse, The Castlegate Consultancy, Malton, UK

TC 10 – Computer Systems Technology

Ricardo Reis, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

TC 11 – Security and Privacy Protection in Information Processing Systems

Steven Furnell, Plymouth University, UK

TC 12 – Artificial Intelligence

Ulrich Furbach, University of Koblenz-Landau, Germany

TC 13 – Human-Computer Interaction

Marco Winckler, University Paul Sabatier, Toulouse, France

TC 14 – Entertainment Computing

Matthias Rauterberg, Eindhoven University of Technology, The Netherlands

IFIP – The International Federation for Information Processing

IFIP was founded in 1960 under the auspices of UNESCO, following the first World Computer Congress held in Paris the previous year. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.

More information about this series at <http://www.springer.com/series/6102>

Matt Bishop · Lynn Fitcher
Natalia Miloslavskaya
Marianthi Theodoridou (Eds.)


Information Security Education for a Global Digital Society


10th IFIP WG 11.8 World Conference, WISE 10
Rome, Italy, May 29–31, 2017
Proceedings

Editors

Matt Bishop 
University of California, Davis
Davis, CA
USA

Lynn Fletcher
Nelson Mandela Metropolitan University
Port Elizabeth
South Africa

Natalia Miloslavskaya 
National Research Nuclear University
MEPhI
Moscow
Russia

Marianthi Theodoridou 
European Commission
Joint Research Centre
Ispra
Italy

ISSN 1868-4238

ISSN 1868-422X (electronic)

IFIP Advances in Information and Communication Technology

ISBN 978-3-319-58552-9

ISBN 978-3-319-58553-6 (eBook)

DOI 10.1007/978-3-319-58553-6

Library of Congress Control Number: 2017939724

© IFIP International Federation for Information Processing 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by Springer Nature

The registered company is Springer International Publishing AG

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume contains the papers presented at the 10th World Conference on Information Security Education (WISE10) held during May 29–31, 2017 in Rome, in conjunction with the 32nd International Conference on ICT Systems Security and Privacy Protection (IFIP SEC 2017). WISE10 was organized by the IFIP Working Group 11.8, which is an international group of people from academia, government, and private organizations who volunteer their time and effort to increase knowledge in the very broad field of information security through education. WG11.8 has worked to increase information assurance education and awareness for almost two decades. This year, WG11.8 organized the 10th conference of a successful series, which is an important milestone for the working group. The theme for this year’s WISE conference was “Information Security Education for a Global Digital Society.”

This year’s conference received 32 submissions from around the world. Each submission was reviewed by at least three Program Committee members. The committee decided to accept 14 full papers and one workshop proposal. The acceptance rate for the papers is thus 45%.

This conference took place thanks to the support and commitment of many individuals. First, we would like to thank all TC-11 members for continually giving us the opportunity to serve the working group and organize the WISE conferences. Our sincere appreciation also goes to the members of the Program Committee, to the external reviewers, and to the authors who trusted us with their intellectual work. We would like to thank our colleague Diana Burley for proposing and co-organizing the workshop on “Workshop on the Joint Task Force Cybersecurity Curricular Guidelines.” We are grateful for the local organizers and hosts, especially the WISE10 Logistics Chair, Erik Moore. Finally, we would like to thank the IFIP SEC 2017 General Chairs, Sara Foresti and Luigi V. Mancini, for enabling this continuous collaboration with the IFIP SEC conference series.

As for the preparation of this volume, we sincerely thank Erika Siebert-Cole and our publisher Springer for their assistance. Moreover, we acknowledge the EasyChair conference management system, which was used both for managing the conference and creating this volume.

March 2017

Matt Bishop
Lynn Fletcher
Natalia Miloslavskaya
Marianthi Theodoridou

Organization

Program Committee

Matt Bishop	University of California at Davis, USA
Reinhardt Botha	Nelson Mandela Metropolitan University, South Africa
William Caelli	IISEC Pty Ltd, Australia
Melissa Dark	Purdue University, USA
Lynette Drevin	North-West University, South Africa
Steve Furnell	Plymouth University, UK
Lynn Fitcher	Nelson Mandela Metropolitan University, South Africa
Ram Herkanaidu	Plymouth University, UK
Erland Jonsson	Chalmers University of Technology, Sweden
Audun Josang	University of Oslo, Norway
Suresh Kalathur	Boston University, USA
Christos Kalloniatis	University of the Aegean, Greece
Vasilis Katos	Bournemouth University, UK
Sokratis Katsikas	Center for Cyber and Information Security, NTNU, Norway
Elmarie Kritzinger	University of South Africa, South Africa
Hennie Kruger	North-West University, South Africa
Costas Lambrinoudakis	University of Piraeus, Greece
Javier Lopez	University of Malaga, Spain
Leonardo Martucci	Karlstad University, Sweden
Vashek Matyas	Masaryk University, Czech Republic
Natalia Miloslavskaya	National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia
Erik Moore	Regis University, USA
Kara Nance	Virginia Polytechnic Institute and State University, USA
Jacques Ophoff	University of Cape Town, South Africa
Günther Pernul	Universität Regensburg, Germany
Carlos Rieder	isec ag, Switzerland
Jill Slay	University of New South Wales, Australia
Rumen Stainov	Fulda University of Applied Science, Germany
Tye Stallard	University of California, USA
Marianthi Theocharidou	European Commission, Joint Research Centre
Kerry-Lynn Thomson	Nelson Mandela Metropolitan University, South Africa
Alexander Tolstoy	National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia
Sven Uebelacker	Hamburg University of Technology and University of Cambridge, Germany/UK
Ismini Vasileiou	Plymouth University, UK

Rossouw Von Solms	Nelson Mandela Metropolitan University, South Africa
Edgar Weippl	SBA Research, Austria
Louise Yngstrom	Stockholms universitet och KTH i Kista, Sweden

Additional Reviewers

Ali, Raian
Hassan, Sabri
Nisioti, Antonia
Richthammer, Christian
Rostami, Shahin
Stallard, Tye

Workshop on the Joint Task Force Cybersecurity Curricular Guidelines (Workshop Proposal)

Matt Bishop¹, Diana Burley², and Lynn Fletcher³

¹ University of California at Davis, Davis, USA
mabishop@ucdavis.edu

² The George Washington University, Washington, D.C., USA
dburley@gwu.edu

³ Nelson Mandela Metropolitan University, Port Elizabeth, South Africa
Lynn.Fletcher@nmmu.ac.za

Abstract. The goal of the Joint Task Force on Cybersecurity Education is to develop comprehensive curricular guidance in cybersecurity that will support future program development and associated educational efforts. This workshop is to present the current draft of the proposed guidelines and obtain feedback that can be incorporated into the next version.

In 2016, the professional computing societies ACM, IEEE-CS, AIS SIGSEC, and IFIP WG 11.8 assembled a Joint Task Force on Cybersecurity Education.¹ The goal of this working group is to develop cybersecurity curricular guidelines for programs that emphasize different areas of specialization. The intent is that these guidelines can drive curricula, with each curriculum being tailored for the specific discipline and goals while ensuring that professionals (or prospective professionals) obtain the knowledge and skills they need.

The model consists of four parts: knowledge areas, cross-cutting concepts that span, or underlie, the knowledge areas; disciplinary lenses that provide the views of the knowledge areas and cross-cutting concepts based upon the discipline; and application areas, which help define the coverage for each knowledge areas.

The Joint Task Force is seeking community feedback to improve the current draft curricular guidelines. Two workshops have been held; the third, and the first international one, is this workshop. As other nations and communities have differing needs and educational environments, comments from those communities will be invaluable in making the guidelines as useful to all as possible.

Thus, this workshop will explore the current guidelines, their goals, the organization, and how the guidelines might be used. We will invite the audience to provide insights, identify problems their institutions might have in using the guidelines, and propose changes and additions that will improve the guidelines.

¹ <http://www.csec2017.org>.

Acknowledgements. We gratefully acknowledge the work of the Joint Task Force on Cybersecurity Education in developing these guidelines, and the valuable contributions of participants in our 15 community engagement efforts. This workshop is based upon work supported by the National Science Foundation under Grant No. DGE-1623104, the National Security Agency's CNAP Curriculum Development effort (RFI-2017-00022), the Education Board of the ACM, and Intel Corporation. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation, the National Security Agency, the ACM Education Board, or Intel Corporation.

Contents

Information Security Education

Cybersecurity Curricular Guidelines.	3
<i>Matt Bishop, Diana Burley, Scott Buck, Joseph J. Ekstrom, Lynn Fitcher, David Gibson, Elizabeth K. Hawthorne, Siddharth Kaza, Yair Levy, Herbert Mattord, and Allen Parrish</i>	
Designing Degree Programmes for Bachelors and Masters in Information Security	14
<i>Natalia Miloslavskaya and Alexander Tolstoy</i>	
Assessing the Effectiveness of the Cisco Networking Academy Program in Developing Countries	27
<i>Odwa Yekela, Kerry-Lynn Thomson, and Johan van Niekerk</i>	
Pathways in Cybersecurity: Translating Theory into Practice.	39
<i>Susanne Wetzel</i>	

Teaching Information Security

Evaluating Secure Programming Knowledge.	51
<i>Matt Bishop, Jun Dai, Melissa Dark, Ida Ngambeki, Phillip Nico, and Minghua Zhu</i>	
Studying Formal Security Proofs for Cryptographic Protocols.	63
<i>Konstantin G. Kogos and Sergey V. Zapechnikov</i>	
Introducing Mobile Network Security Experiments to Communication Technology Education	74
<i>Stig F. Mjølunes and Ruxandra F. Olimid</i>	

Information Security Awareness and Culture

A Linguistic Approach to Information Security Awareness Education in a Healthcare Environment	87
<i>Lynette Drevin, Hennie Kruger, Anna-Marie Bell, and Tjaart Steyn</i>	
Cybersecurity Culture: An Ill-Defined Problem.	98
<i>Noluxolo Gcaza and Rossouw von Solms</i>	

A Study into the Cybersecurity Awareness Initiatives for School Learners in South Africa and the UK	110
<i>Elmarie Kritzinger, Maria Bada, and Jason R.C. Nurse</i>	
South African Computing Educators' Perspectives on Information Security Behaviour	121
<i>Thandolwethu Mabece, Lynn Fletcher, and Kerry-Lynn Thomson</i>	
Training Information Security Professionals	
ISO/IEC Competence Requirements for Information Security Professionals. . . .	135
<i>Natalia Miloslavskaya and Alexander Tolstoy</i>	
Evaluating a Multi Agency Cyber Security Training Program Using Pre-post Event Assessment and Longitudinal Analysis	147
<i>Erik Moore, Steven Fulton, and Dan Likarish</i>	
"Network Security Intelligence" Educational and Research Center.	157
<i>Natalia Miloslavskaya, Alexander Tolstoy, and Anton Migalin</i>	
Author Index	169