

## Editor-in-Chief

*Kai Rannenber, Goethe University, Frankfurt, Germany*

## Editorial Board

### Foundation of Computer Science

*Jacques Sakarovitch, Télécom ParisTech, France*

### Software: Theory and Practice

*Michael Goedicke, University of Duisburg-Essen, Germany*

### Education

*Arthur Tatnall, Victoria University, Melbourne, Australia*

### Information Technology Applications

*Erich J. Neuhold, University of Vienna, Austria*

### Communication Systems

*Aiko Pras, University of Twente, Enschede, The Netherlands*

### System Modeling and Optimization

*Fredi Tröltzsch, TU Berlin, Germany*

### Information Systems

*Jan Pries-Heje, Roskilde University, Denmark*

### ICT and Society

*Diane Whitehouse, The Castlegate Consultancy, Malton, UK*

### Computer Systems Technology

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

### Security and Privacy Protection in Information Processing Systems

*Yuko Murayama, Iwate Prefectural University, Japan*

### Artificial Intelligence

*Tharam Dillon, Curtin University, Bentley, Australia*

### Human-Computer Interaction

*Jan Gulliksen, KTH Royal Institute of Technology, Stockholm, Sweden*

### 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. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

*IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of information technology for the benefit of all people.*

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIPWorld Computer Congress, held every second year;
- Open conferences;
- Working conferences.

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 small and 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.

Any national society whose primary activity is about information processing may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly, National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.

Matt Bishop · Natalia Miloslavskaya  
Marianthi Theocharidou (Eds.)

# Information Security Education Across the Curriculum

9th IFIP WG 11.8 World Conference, WISE9  
Hamburg, Germany, May 26–28, 2015  
Proceedings

*Editors*

Matt Bishop  
Department of Computer Science  
University of California at Davis  
Davis, CA  
USA

Natalia Miloslavskaya  
Moscow Engineering Physics Institute  
National Research Nuclear University  
Moscow  
Russia

Marianthi Theocharidou  
Institute for the Protection and the Security  
of the Citizen  
European Commission - Joint Research  
Centre  
Ispra  
Italy

ISSN 1868-4238 ISSN 1868-422X (electronic)  
IFIP Advances in Information and Communication Technology  
ISBN 978-3-319-18499-9 ISBN 978-3-319-18500-2 (eBook)  
DOI 10.1007/978-3-319-18500-2

Library of Congress Control Number: 2015937375

Springer Cham Heidelberg New York Dordrecht London  
© IFIP International Federation for Information Processing 2015

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.

Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media  
([www.springer.com](http://www.springer.com))

# Preface

This volume contains the papers presented at the Ninth World Conference on Information Security Education (WISE9) held during May 26–28, 2015 in Hamburg, in conjunction with the IFIP International Information Security and Privacy Conference (IFIP SEC 2015). WISE9 is organized by the IFIP Working Group 11.8, which is an international group of people from academia, military, government and private organizations who volunteer their time and effort into increasing knowledge in the very broad field of information security education. WG11.8 has worked to increase Information Assurance Education and Awareness for almost two decades and this is the 9th conference of a successful series.

This year's conference received 20 submissions of high quality. Each submission was reviewed by at least 3, and on the average 3.3, Program Committee members. The committee decided to accept 11 full papers for publication. The acceptance rate of papers is 0.55. Two more invited papers from IFIP SEC 2015 were included in this volume due to their quality and high relevance to the WISE9 conference.

This conference took place due to the support and commitment of several individuals. First, we would like to thank all TC-11 members for giving us the opportunity to serve WISE9 and the working group. Our sincere appreciation goes to the members of the Program Committee, to the external reviewers, and to the authors, who trusted their intellectual work in our hands.

In particular, we would like to thank our colleague Prof. S.E. Goodman for proposing and chairing the panel on the theme of “Building National Cybersecurity Workforces,” as well as our distinguished panel speakers for accepting our invitation and honoring the workshop with their presence and inspired discussions. We also thank the local organizers and hosts, first among them being the WISE9 Local and Logistics Chair Erik Moore. Last, but for sure not least, our appreciation goes to the WISE9 Conference Chair Lynn Fitcher for her continuous and timely support.

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

May 2015

Matt Bishop  
Natalia Miloslavskaya  
Marianthi Theocharidou

# Organization

WISE9 is organized by the IFIP Working Group 11.8 – Information Security Education in conjunction with IFIP SEC 2015.

## IFIP WG11.8 Officers

### WISE9 Conference Chair

Lynn Fletcher   Nelson Mandela Metropolitan University,  
South Africa

### WISE9 Program Chair and Conference Secretariat

Matt Bishop   University of California at Davis, USA

### WISE9 Program Chair

Natalia Miloslavskaya   National Research Nuclear University MEPhI,  
Russia

### WISE9 Publications Chair

Marianthi Theodoridou   European Commission, Joint Research Centre,  
Italy

### WISE9 Local and Logistics Chair

Erik Moore   Regis University, Colorado, USA

## Program Committee

|                    |   |
|--------------------|---|
| Matt Bishop        | University of California at Davis, USA                  |
| Reinhardt Botha    | Nelson Mandela Metropolitan University,<br>South Africa |
| William Caelli     | IISEC Pty Ltd, Australia                                |
| Nathan Clarke      | University of Plymouth, UK                              |
| Melissa Dark       | Purdue University, USA                                  |
| Tamara Denning     | University of Utah, USA                                 |
| Ronald Dodge       | United States Military Academy, USA                     |
| Lynette Drevin     | North-West University, South Africa                     |
| Lynn Fletcher      | Nelson Mandela Metropolitan University,<br>South Africa |
| Dimitris Gritzalis | Athens University of Economics and Business,<br>Greece  |
| Brian Hay          | University of Alaska Fairbanks, USA                     |
| Hans Hedbom        | Karlstad University, Sweden                             |

|                          |   |
|--------------------------|---|
| Borka Jerman-Blazic      | University of Ljubljana, Slovenia   |
| Erland Jonsson           | Chalmers University of Technology, Sweden   |
| Suresh Kalathur          | Boston University, USA  |
| Sokratis Katsikas        | University of Piraeus, Greece   |
| Hennie Kruger            | North-West University, South Africa   |
| Costas Lambrinoudakis    | University of Piraeus, Greece   |
| Javier Lopez             | University of Málaga, Spain   |
| Leonardo Martucci        | Karlstad University, Sweden   |
| Vashek Matyas            | Masaryk University, Czech Republic and Harvard University, USA                        |
| Natalia Miloslavskaya    | National Research Nuclear University MEPhI, Russia                                    |
| Erik Moore               | Regis University, Colorado, USA   |
| Kara Nance               | University of Alaska Fairbanks, USA   |
| Jacques Ophoff           | University of Cape Town, South Africa   |
| Ahmed Patel              | National University of Malaysia, Malaysia   |
| Sean Peisert             | Lawrence Berkeley National Laboratory, USA and University of California at Davis, USA |
| Günther Pernul           | Universität Regensburg, Germany   |
| Reinhard Posch           | IAIK, Graz University of Technology, Austria  |
| Rayne Reid               | Nelson Mandela Metropolitan University, South Africa                                  |
| Carlos Rieder            | Isec AG, Switzerland  |
| Ingrid Schaumüller-Bichl | University of Applied Sciences Upper Austria, Austria                                 |
| Corey Schou              | Idaho State University, USA   |
| Jill Slay                | University of South Australia, Australia  |
| Marianthi Theocharidou   | European Commission, Joint Research Centre, Italy                                     |
| Kerry-Lynn Thomson       | Nelson Mandela Metropolitan University, South Africa                                  |
| Alexander Tolstoy        | National Research Nuclear University MEPhI, Russia                                    |
| Johan van Niekerk        | Nelson Mandela Metropolitan University, South Africa                                  |
| Rossouw Von Solms        | Nelson Mandela Metropolitan University, South Africa                                  |
| Edgar Weippl             | Vienna University of Technology, Austria  |
| Stephen Wolthusen        | Royal Holloway, University of London, UK  |
| Louise Yngström          | Stockholm University, Sweden and KTH, Sweden  |

## Additional Reviewers

Leitold, Herbert  
Meier, Stefan

Nieto, Ana  
Stavrou, Vasilios

# **Building National Cybersecurity Workforces**

## **Panel Abstract**

S.E. Goodman

College of Computing and Sam Nunn School of International Affairs

Georgia Institute of Technology

Atlanta, GA 30332, USA

`goodman@cc.gatech.edu`

Issues of national cybersecurity workforces have become increasingly important as cybersecurity becomes a critical issue. This panel will explore several issues about cybersecurity workforces, including:

- How do we come up with need-based estimates of the size and make-up of national cyber security workforces?
- How would such workforces be characterized?
- What would be the balance between professionalization, functional duties, and relation to employing organizations and national needs?
- How might the answers to these questions differ across a range of nations?
- What might a broad spectrum of educational institutions do to stimulate supply and demand?



# Contents

## Innovative Methods

|   |    |
|---|----|
| Realism in Teaching Cybersecurity Research: The Agile Research Process . . .  | 3  |
| <i>Melissa Dark, Matt Bishop, Richard Linger, and Luanne Goldrich</i>   |    |
| Assurance Cases as a Didactic Tool for Information Security . . . . .   | 15 |
| <i>Roberto Gallo and Ricardo Dahab</i>  |    |
| Cognitive Task Analysis Based Training for Cyber Situation Awareness . . . .  | 27 |
| <i>Zequn Huang, Chien-Chung Shen, Sheetal Doshi, Nimmi Thomas, and Ha Duong</i>   |    |
| A Cyber Security Multi Agency Collaboration for Rapid Response that Uses AGILE Methods on an Education Infrastructure . . . . . | 41 |
| <i>Erik Moore and Dan Likarish</i>  |    |

## Software Security Education

|  |    |
|--|----|
| Cybersecurity Through Secure Software Development . . . . .  | 53 |
| <i>Audun Jøsang, Marte Ødegaard, and Erlend Oftedal</i>  |    |
| Security Injections 2.0: Increasing Engagement and Faculty Adoption Using Enhanced Secure Coding Modules for Lower-Level Programming Courses . . . . . | 64 |
| <i>Sagar Raina, Blair Taylor, and Siddharth Kaza</i>   |    |
| The Use of Software Design Patterns to Teach Secure Software Design: An Integrated Approach . . . . .  | 75 |
| <i>Johan van Niekerk and Lynn Fletcher</i>   |    |

## Tools and Applications for Teaching

|  |     |
|--|-----|
| Learn to Spot Phishing URLs with the Android NoPhish App . . . . .   | 87  |
| <i>Gamze Canova, Melanie Volkamer, Clemens Bergmann, Roland Borza, Benjamin Reinheimer, Simon Stockhardt, and Ralf Tenberg</i> |     |
| An Innovative Approach in Digital Forensic Education and Training . . . . .  | 101 |
| <i>Primož Cigoj and Borka Jerman Blažič</i>  |     |
| On Experience of Using Distance Learning Technologies for Teaching Cryptology . . . . .  | 111 |
| <i>Sergey Zapechnikov, Natalia Miloslavskaya, and Vladimir Budzko</i>  |     |

**Syllabus Design**

|   |     |
|---|-----|
| Reflections on the Ethical Content of the IT Honours Program<br>Project Module . . . . .                | 125 |
| <i>Lynette Drevin and Günther Drevin</i>  |     |
| Professional Competencies Level Assessment for Training of Masters<br>in Information Security . . . . . | 135 |
| <i>Natalia Miloslavskaya and Alexander Tolstoy</i>  |     |
| History of Cryptography in Syllabus on Information Security Training . . . . .                          | 146 |
| <i>Sergey Zapechnikov, Alexander Tolstoy, and Sergey Nagibin</i>  |     |
| <b>Author Index</b> . . . . .   | 159 |