

Also in this issue:

From Human Principles to Robot Instructions 76

Building the Web of Knowledge with Smart IoT Applications 83

Incorporating Sustainability into Computing Education 93



ontents

SEPTEMBER/OCTOBER 2016

Volume 31, Number 5

IEEE Intelligent Systems provides peer-reviewed, cutting-edge articles on the theory and application of systems that perceive, reason, learn, and act intelligently.

ARTICLES

Intelligent Cybersecurity Agents

- **Guest Editors' Introduction**
 - Jose M. Such, Natalia Criado, Laurent Vercouter, and Martin Rehak
- **Revani: Revising and Verifying Normative Specifications for Privacy** Özgür Kafali, Nirav Ajmeri, and Munindar P. Singh
- **Using Behavioral Similarity for Botnet Command-and-Control Discovery** Jan Jusko, Martin Rehak, Jan Stiborek, Jan Kohout, and Tomas Pevny
- **Case Studies of Network Defense with Attack Graph Games** Karel Durkota, Viliam Lisý, Christopher Kiekintveld, Branislav Bošanský, and Michal Pechoucek

Online Behavioral Analysis

Online Behavioral Analysis with Application to Emotion State Identification

Lei Gao, Lin Qi, and Ling Guan

Recommender Systems

A Social Influence Approach for Group User Modeling in Group 40 **Recommendation Systems**

Junpeng Guo, Yanlin Zhu, Aiai Li, Qipeng Wang, and Weiguo Han

Text Mining

Ordinal Classification of Imbalanced Data with 50 **Application in Emergency and Disaster Information** Services

Sungil Kim, Heeyoung Kim, and Younghwan Namkoong



Cover illustration: David Angel

changes to IEEE Intelligent Systems, Membership endorsement of any third-party products or services. Processing Dept., IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854-4141. Periodicals Postage Paid at New York, NY, and at additional mailing offices. Canadian GST #125634188. Canada Post Publications Mail Agreement Number 40013885. Return undeliverable Canadian addresses to 4960-2 Walker Rd., Windsor, ON N9A 6J3. Printed in the USA. Reuse Rights and Reprint Permissions: Educational suggestions but not the published version with photocopy for private use of patrons, provided the or personal use of this material is permitted without fee, copyediting, proofreading, and formatting added by provided such use 1) is not made for profit, 2) includes IEEE. For more information, please go to http://www.

accepted version of IEEE-copyrighted material on their own Web servers without permission, provided that the IEEE copyright notice and a full citation to the original work appear on the first screen of the posted copy.

An accepted manuscript is a version that has

Postmaster: Send undelivered copies and address the first page of the copy, and 3) does not imply IEEE paperversion policy, html. Permission to reprint/republish this material for commercial, advertising, or promotional Authors and their companies are permitted to post the purposes or for creating new collective works for resale or redistribution must be obtained from IEEE by writing to the IEEE Intellectual Property Rights Office, 445 Hoes Lane, Piscataway, NJ 08854-4141 or pubs-permissions@ ieee.org. Copyright © 2016 IEEE. All rights reserved. Abstracting and Library Use: Abstracting is permitted been revised by the author to incorporate review with credit to the source. Libraries are permitted to per-copy fee indicated in the code at the bottom of the first page is paid through the Copyright Clearance this notice and a full citation to the original work on ieee.org/publications_standards/publications/rights/ Center, 222 Rosewood Drive, Danvers, MA 01923.

www.computer.org/intelligent

Behavioral Modeling

58

DNA-Inspired Online Behavioral Modeling and Its Application to Spambot Detection

Stefano Cresci, Roberto Di Pietro, Marinella Petrocchi, Angelo Spognardi, and Maurizio Tesconi

DEPARTMENTS

66 Expert Opinion

Data Science: Nature and Pitfalls Longbing Cao

76 Human-Centered Computing

Bridging the Ethical Gap: From Human Principles to Robot Instructions Neil McBride and Robert R. Hoffman

83 Internet of Things

Building the Web of Knowledge with Smart IoT Applications Amélie Gyrard, Pankesh Patel, Amit Sheth, and Martin Serrano

89 Al in Government

Linked Open Cube Analytics Systems: Potential and Challenges
Evangelos Kalampokis, Efthimios Tambouris, and Konstantinos
Tarabanis

93 Al and Sustainability

Incorporating Sustainability into Computing Education Douglas H. Fisher, Zimei Bian, and Selina Chen

- 15 Advertiser Index
- 23 IEEE Computer Society Information

Circulation: IEEE Intelligent Systems (ISSN 1541-1672) is published bimonthly by the IEEE Computer Society. IEEE Headquarters, Three Park Ave., 17th Floor, New York, NY 10016-5997; IEEE Computer Society Publications Office, 10662 Los Vaqueros Circle, P.O. Box 3014, Los Alamitos, CA 90720-1314, phone +1 714 821 8389; IEEE Computer Society Headquarters, 2001 L St., Ste. 700, Washington, D.C. 20036-4910. Subscription rates: To subscribe to IEEE Intelligent Systems, visit www.computer.org/intelligentsystems



Intelligent Systems

Editor in Chief Daniel D. Zeng

University of Arizona

Associate Editor in Chief Bhavani Thuraisingham

University of Texas at Dallas
Editor in Chief Emeritus

Fei-Yue Wang

Chinese Academy of Sciences

EDITORIAL BOARD

Ahmed Abbasi University of Virgina Russ Biagio Altman Stanford University Richard Benjamins

Richard Benjamins
Telefónica R&D
Longbing Cao
University of Technology,

Sydney, Australia
Ulrich Furbach
University of Koblenz

Ashok Goel Georgia Institute of Technology James V. Hansen

Brigham Young University

Robert R. Hoffman Institute for Human and Machine Cognition

Heng Ji RPI

Subbarao Kambhampati Arizona State University Lefei Li Tsinghua University

Ee-Peng Lim
Singapore Management
University

Sean Luke George Mason University

Wenji Mao Chinese Academy of Sciences Enrico Motta

Enrico Motta Open University Daniel B. Neill

Carnegie Mellon University

Natasha Noy Stanford University

Terry Payne
University of Southampton
Raymond Perrault

SRI International
Alun Preece
Cardiff University

David Skillicorn Queen's University Canada Alessandro Sperduti

University of Padova, Italy **Jaideep Srivastava** University of Minnesota

Steffen Staab
University Koblenz-Landau
V S. Subrahmanian

V.S. Subrahmanian University of Maryland Fei-Yue Wang

Chinese Academy of Sciences
Ronald Yager

lona College Qiang Yang

Hong Kong University
of Science and Technology
Junping Zhang

Fudan University

Hai Zhuge

Chinese Academy of

Sciences

Chengqing Zong

National Laboratory of Pattern Recognition, China **Ning Zhong** Maebashi Institute of Technology

Peter Norvig

Google

Daniel E. O'Leary

University

of Southern California

Nigel Shadbolt

University of

Southampton

ADVISORY BOARD

James Hendler (chair) Rensselaer Polytechnic Institute

Richard J. Doyle Jet Propulsion Lab Dieter Fensel

University of Innsbruck **C. Lee Giles**Pennsylvania State

Pennsylvania Stat University

Haym Hirsh Rutgers University Eric Horvitz

Microsoft Research **Robert Laddaga** BBN Technologies

Richard H. Lathrop University of California, Irvine

University
Horvitz
University of Karlsruhe
ft Research
t Laddaga
University
University

William R. Swartout
University

of Southern California

Austin Tate

University
of Edinburgh

CS MAGAZINE OPERATIONS COMMITTEE

Forrest Shull (chair), Brian Blake, Maria Ebling, Lieven Eeckhout, Miguel Encarnacao, Nathan Ensmenger, Sumi Helal, San Murugesan, Ahmad-Reza Sadeghi, Yong Rui, Diomidis Spinellis, George K. Thiruvathukal, Mazin Yousif, Daniel Zeng

CS PUBLICATIONS BOARD

David S. Ebert (VP for Publications), Alain April, Alfredo Benso, Laxmi Bhuyan, Greg Byrd, Robert Dupuis, David S. Ebert, Ming C. Lin, Linda I. Shafer, Forrest Shull, H.J. Siegel

