Software and Intelligent Sciences:
New Transdisciplinary Findings

Yingxu Wang
University of Calgary, Canada
Table of Contents

Preface.......................................................................................................................... xxii
Acknowledgment............................................................................................................ xxxiii

Section 1
Computational Intelligence

Chapter 1
Convergence of Software Science and Computational Intelligence: A New Transdisciplinary Research Field................................................................................................................................. 1
   Yingxu Wang, University of Calgary, Canada

Chapter 2
On Abstract Intelligence: Toward a Unifying Theory of Natural, Artificial, Machinable, and Computational Intelligence.............................................................................................................. 14
   Yingxu Wang, University of Calgary, Canada

Chapter 3
Hierarchies of Architectures of Collaborative Computational Intelligence.......................... 32
   Witold Pedrycz, University of Alberta, Canada & Polish Academy of Sciences, Poland

Chapter 4
Challenges in the Design of Adoptive, Intelligent and Cognitive Systems................................. 47
   W. Kinsner, University of Manitoba, Canada

Chapter 5
On Visual Semantic Algebra (VSA): A Denotational Mathematical Structure for Modeling and Manipulating Visual Objects and Patterns....................................................................... 68
   Yingxu Wang, University of Calgary, Canada
Section 2
Cognitive Computing

Chapter 6
On Cognitive Computing ........................................................................................................83
Yingxu Wang, University of Calgary, Canada

Chapter 7
On the System Algebra Foundations for Granular Computing .............................................98
Yingxu Wang, University of Calgary, Canada
Lofti A. Zadeh, University of California, Berkeley, USA
Yiyu Yao, University of Regina, Canada

Chapter 8
Semantic Matching, Propagation and Transformation for Composition in Component-Based
Systems ...................................................................................................................................122
Eric Bouillet, IBM Research, USA
Mark Feblowitz, IBM Research, USA
Zhen Liu, IBM Research, USA
Anand Ranganathan, IBM Research, USA
Anton Riabov, IBM Research, USA

Chapter 9
Adaptive Computation Paradigm in Knowledge Representation: Traditional and Emerging
Applications ..............................................................................................................................142
Marina L. Gavrilova, University of Calgary, Canada

Chapter 10
Protoforms of Linguistic Database Summaries as a Human Consistent Tool for Using Natural
Language in Data Mining ......................................................................................................157
Janusz Kacprzyk, Polish Academy of Sciences, Poland
Slawomir Zadrozny, Polish Academy of Sciences, Poland

Chapter 11
Measuring Textual Context Based on Cognitive Principles ....................................................169
Ning Fang, Shanghai University, China
Xiangfeng Luo, Shanghai University, China
Weimin Xu, Shanghai University, China

Chapter 12
A Lexical Knowledge Representation Model for Natural Language Understanding ..................193
Ping Chen, University of Houston-Downtown, USA
Wei Ding, University of Massachusetts-Boston, USA
Chengmin Ding, IBM Business Consulting, USA
Chapter 13
A Dualism Based Semantics Formalization Mechanism for Model Driven Engineering
Yucong Duan, Capital University of Medical Sciences, China, & Pohang University of Science and Technology (POSTECH), South Korea

Section 3
Software Science

Chapter 14
Exploring the Cognitive Foundations of Software Engineering
Yingxu Wang, University of Calgary, Canada
Shushma Patel, London South Bank University, UK

Chapter 15
Positive and Negative Innovations in Software Engineering
Capers Jones, Software Productivity Research LLC, USA

Chapter 16
On the Cognitive Complexity of Software and its Quantification and Formal Measurement
Yingxu Wang, University of Calgary, Canada

Chapter 17
Machine Learning and Value-Based Software Engineering
Du Zhang, California State University, USA

Chapter 18
The Formal Design Model of a Telephone Switching System (TSS)
Yingxu Wang, University of Calgary, Canada

Chapter 19
The Formal Design Model of a Lift Dispatching System (LDS)
Yingxu Wang, University of Calgary, Canada
Cyprian F. Ngolah, University of Calgary, Canada
Hadi Ahmadi, University of Calgary, Canada
Philip Sheu, Univ. of California, Irvine, USA
Shi Ying, Wuhan University, China

Chapter 20
A Theory of Program Comprehension: Joining Vision Science and Program Comprehension
Yann-Gael Guéhéneuc, École Polytechnique de Montréal and Université de Montréal, Canada

Chapter 21
Requirements Elicitation by Defect Elimination: An Indian Logic Perspective
G. S. Mahalakshmi, Anna University, Chennai, India
T. V. Geetha, Anna University, Chennai, India
Chapter 22
Measurement of Cognitive Functional Sizes of Software ........................................... 392
Sanjay Misra, Attilim University, Turkey

Chapter 23
Motivational Gratification: An Integrated Work Motivation Model with Information System Design Perspective ................................................................. 403
Sugumar Mariappanadar, Australian Catholic University, Australia

Section 4
Applications of Computational Intelligence and Cognitive Computing

Chapter 24
Supporting CSCW and CSCL with Intelligent Social Grouping Services ....................... 420
Jeffrey J. P. Tsai, University of Illinois-Chicago, USA
Jia Zhang, Northern Illinois University, USA
Jeff J.S. Huang, National Central University, Taiwan
Stephen J.H. Yang, National Central University, Taiwan

Chapter 25
An Enhanced Petri Net Model to Verify and Validate a Neural-Symbolic Hybrid System ........... 434
Ricardo R. Jorge, National Centre of Investigation and Technological Development, Mexico
Gerardo R. Salgado, National Centre of Investigation and Technological Development, Mexico
Vianey G. C. Sánchez, National Centre of Investigation and Technological Development, Mexico

Chapter 26
System Uncertainty Based Data-Driven Knowledge Acquisition ..................................... 451
Jun Zhao, Chongqing University of Posts & Telecommunications, P.R. China
Guoyin Wang, Chongqing University of Posts & Telecommunications, P.R. China

Chapter 27
Hierarchical Function Approximation with a Neural Network Model .......................... 466
Luis F. de Mingo, Universidad Politécnica de Madrid, Spain
Nuria Gómez, Universidad Politécnica de Madrid, Spain
Fernando Arroyo, Universidad Politécnica de Madrid, Spain
Juan Castellanos, Universidad Politécnica de Madrid, Spain

Chapter 28
Application of Artificial Neural Computation in Topex Waveform Data: A Case Study on Water Ratio Regression ................................................................. 480
Bo Zhang, The Ohio State University, USA
Franklin W. Schwartz, The Ohio State University, USA
Daoqin Tong, University of Arizona, USA
Chapter 29
A Generic Framework for Feature Representations in Image Categorization Tasks

Adam Csapo, Budapest University of Technology and Economics, Hungary
Barna Resko, Hungarian Academy of Sciences, Hungary
Morten Lind, NTNU, Dept. of Production and Quality Engineering, Norway
Peter Baranyi, Budapest University of Technology and Economics, Hungary, & Hungarian Academy of Sciences, Hungary
Domonkos Tikk, Budapest University of Technology and Economics, Hungary

Compilation of References .................................................................................................................. 513

About the Contributors ....................................................................................................................... 551

Index .................................................................................................................................................. 563