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Preface

The term Web Intelligence is defined as a new line of scientific research and development, which is used to explore the fundamental roles and practical impact of Artificial Intelligence together with advanced Information Technology and its effect on the future generations of Web-empowered products. These include systems, services, amongst other activities, all of which are carried out by the Web Intelligence Consortium (http://wi-consortium.org/).

Web Intelligence was first coined in the late 1999's. From that time, many new algorithms, methods and techniques were developed and used extracting both knowledge and wisdom from the data originating from the Web. A number of initiatives have been adopted by the world communities in this area of study. These include books, conference series, and journals. This latest book encomposes a variaty of up to date state of the art approaches in Web Intelligence. Furthermore, it hightlights successful applications in this area of research within a practical context.

The present book aims to introduce a selection of research applications in the area of Web Intelligence. We have selected a number of researchers around the world, all of which are experts in their respective research areas. Each chapter focuses on a specific topic in the field of Web Intelligence. Furthermore the book consists of a number of innovative proposals which will contribute to the development of web science and technology for the long-term future, rendering this collective work a valuable piece of knowledge. It was a great honour to have collaborated with this team of very talented experts. We also wish to express our grattitude to those who reviewed this book offering their constructive feedbacks.

Our thanks are alsodue to the Springer-Verlag staff for their excellent support given to us during the preparation of this manuscript.

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Contents

1 Innovations in Web Intelligence 1
Gastón L'Huillier, Juan D. Velásquez, and Lakhmi C. Jain
1.1 Introduction 1
1.2 An overview of the Advanced Techniques used in Web Intelligence 2
1.3 Chapters Included in the Book 4
1.4 Summary 5
1.5 Resources 5
1.5.1 Journals 6
1.5.2 Conferences 7
1.5.3 Conferences Proceedings 7
1.5.4 Books 13
References 16

2 Advanced Techniques in Web Data Pre-Processing and Cleaning 19
Pablo E. Román, Robert F. Dell and Juan D. Velásquez
2.1 Introduction 19
2.2 The Nature of the Web Data: General Characteristics and Quality Issues. 21
2.2.1 Web Content 22
2.2.2 Web Site Structure 23
2.2.3 Web User Session 24
2.2.4 Privacy Issues 25
2.2.5 Quality Measures 26
2.3 Transforming Hyperlinks to a Graph Representation. 28
2.3.1 Hyperlink Retrieval Issues 28
2.3.2 Crawler processing 29
2.3.3 Large Sparse Distributed Storage 29
2.4 Transforming Web Content into a Feature Vector. 30
2.4.1 Cleaning Web Content 30
2.4.2 Vector Representation of Content 31
2.4.3 Web Object Extraction 32

2.5 Web Session Reconstruction. 34
2.5.1 Representation of the trails 35
2.5.2 Proactive Sessionization 36
2.5.3 Reactive Sessionization 38
2.5.4 Sessions in dynamic environments 42
2.5.5 Identifying Session Outliers 43
2.6 Summary 43
References 43

3 Web Pattern Extraction and Storage 51
Víctor L. Rebolledo, Gastón L'Huillier and Juan D. Velásquez
3.1 Introduction 52
3.1.1 From Data to Knowledge 53
3.1.2 About Knowledge Representation 54
3.1.3 General Terms and Definition of Terms 57
3.2 Feature Selection for Web data 57
3.2.1 Feature Selection Techniques 58
3.2.2 Feature Extraction Techniques 60
3.3 Pattern Extraction from Web Data 61
3.3.1 Supervised Learning Techniques 61
3.3.2 Unsupervised Techniques 64
3.3.3 Ensemble Meta-Algorithms 66
3.4 Web Mining model assessment 67
3.4.1 Evaluation of classifiers 67
3.4.2 Evaluation of Regression models 69
3.4.3 MDL Principle 70
3.4.4 Evaluation of Clustering models 70
3.4.5 Evaluating Association Rules 71
3.4.6 Other evaluation criteria 71
3.5 A Pattern Webhouse Application 72
3.5.1 Data Webhouse overview 72
3.5.2 About PMML 73
3.5.3 Application 74
3.6 Summary 76
References 78

4 Web Content Mining Using MicroGenres 83
Václav Snášel, Miloš Kudělka, and Zdeněk Horák
4.1 Introduction 84
4.2 Web Content Mining Summary 84
4.3 Web Usability Basics 86
4.3.1 Web Design Pattern Basics 90
4.4 Recent Methods 92
4.5 MicroGenre 100
4.5.1 Pattrio Method 102
4.5.2 Analysis 103

4.6 Experiments . . . 104
4.6.1 Accuracy of Pattrio method . . . 105
4.6.2 Analysis by Nonnegative Matrix Factorization . . . 108
4.7 Summary . . . 110
References . . . 111

5 Web Structure Mining . . . 117
Ricardo Baeza-Yates and Paolo Boldi
5.1 Introduction . . . 117
5.2 The Web as a Graph: Facts, Myths, and Traps . . . 118
5.2.1 The Web Graph . . . 120
5.2.2 Some Structural Properties of the Web . . . 121
5.2.3 Web Graph Models . . . 123
5.3 Link Analysis . . . 126
5.3.1 PageRank . . . 128
5.3.2 HITS . . . 130
5.3.3 Spam-related LAR Algorithms . . . 131
5.4 Structural Clustering and Communities . . . 133
5.5 Algorithmic Issues . . . 134
5.5.1 Streaming and Semistreaming Computation Models . . . 134
5.5.2 Web Graph Compression . . . 137
5.6 Summary . . . 142
References . . . 143

6 Web Usage Mining . . . 147
Pablo E. Román, Gastón L'Huillier and Juan D. Velásquez
6.1 Introduction . . . 147
6.2 Characterizing the Web User Browsing Behaviour . . . 148
6.2.1 Representative Variables . . . 149
6.2.2 Empirical Statistics Studies about Web Usage . . . 152
6.2.3 Amateur and Expert Users . . . 154
6.3 Representing the Web User Browsing Behaviour and Preferences . 154
6.3.1 Vector Representations . . . 155
6.3.2 Incorporating Content Valuations . . . 155
6.3.3 Web Object Valuation . . . 156
6.3.4 Graph Representation . . . 157
6.3.5 The High Dimensionality of Representation . . . 157
6.4 Extracting Patterns from Web User Browsing Behaviour . . . 157
6.4.1 Clustering Analysis . . . 158
6.4.2 Decision Rules . . . 159
6.4.3 Integer Programming . . . 159
6.4.4 Markov Chain Models . . . 160
6.4.5 Mixture of Markov Models . . . 160
6.4.6 Hidden Markov Models . . . 161
6.4.7 Conditional Random Fields . . . 161
6.4.8 Variable Length Markov Chain (VLMC) . . . 161

6.4.9 Biology Inspired Web User Model 162
6.4.10 Ant Colony Models 163
6.4.11 Matrix Factorization Methods 163
6.5 Application of Web Usage Mining 163
6.5.1 Adaptive Web Sites 164
6.5.2 Web Personalization 164
6.5.3 Recommendation 164
6.6 Summary 165
References 165

7 User-centric Web Services for Ubiquitous Computing 171
In-Young Ko, Hyung-Min Koo, Angel Jimenez-Molina
7.1 Introduction 172
7.2 Essential Requirements for Providing Web Services in Ubicomp . . 173
7.2.1 User Centricity 173
7.2.2 Context Awareness 175
7.2.3 Composability and Reusability 176
7.2.4 Dynamicity 176
7.3 Current Research in Ubicomp Web Services 177
7.3.1 Gaia 178
7.3.2 Aura 178
7.3.3 ABC Framework 179
7.3.4 IST Amigo 179
7.4 Task-oriented Service Framework for Ubiquitous Computing 180
7.4.1 Task and Action Definition 180
7.4.2 Overall Architecture of the Framework 180
7.4.3 Task and Action Semantic Representation Model 183
7.4.4 Processes for Web Service Composition and Execution in Ubicomp 186
7.4.5 Implementation and Evaluation 188
7.5 Summary 191
References 192

8 Ontological Engineering and the Semantic Web 195
José Manuel Gómez-Pérez and Carlos Ruiz
8.1 Introduction to knowledge representation and ontology engineering 195
8.2 A methodological approach to ontology engineering 197
8.2.1 The ontology development process according to METHONTOLOGY 198
8.2.2 The ontology lifecycle model according to METHONTOLOGY 200
8.2.3 Ongoing work: methodologies for developing networked ontologies 201
8.3 Reasoning 203
8.4 Modularization and costumization 205
8.4.1 State of the art 205

8.5 Networked ontologies . . . 209
8.5.1 Ontology mapping . . . 209
8.5.2 Collaboration . . . 210
8.6 Ontology development frameworks . . . 211
8.6.1 Comparison among the ontology development tools . . . 213
8.7 Applications . . . 214
8.7.1 Natural Interaction: Focus on the User . . . 216
8.7.2 Semantic Web Services . . . 218
8.7.3 Collaborative Scenarios for Semantic Applications . . . 219
8.7.4 Semantic Applications in Public Administrations . . . 219
8.7.5 Semantic Applications in eBusiness . . . 222
8.8 New challenges: from semantic islands to the semantic cloud . . . 223
References . . . 226

9 Web Intelligence on the Social Web . . . 229
Sebastián A. Ríos and Felipe Aguilera
9.1 Introduction . . . 230
9.2 Social Aspects on Communities and Social Networks . . . 231
9.2.1 Online Social Networks . . . 231
9.2.2 Virtual Communities . . . 232
9.2.3 Virtual Communities of Practice . . . 233
9.3 Social Networks and Virtual Communities Analysis Techniques . . 234
9.3.1 Social Network Analysis . . . 234
9.3.2 Virtual Comnunities Analysis . . . 237
9.3.3 Analysis Techniques Drawbacks . . . 238
9.4 Web Mining on Social Web Sites . . . 239
9.4.1 Basic Web Mining Applications to Study Social Web Sites . . . 240
9.4.2 Advanced Web Mining Applications to Study Social Web Sites . . . 242
9.5 Summary . . . 246
References . . . 247

10 Intelligent Ubiquitous Services Based on Social Networks . . . 253
Jason J. Jung
10.1 Introduction . . . 253
10.2 Interactive discovery of social networks . . . 256
10.3 Ontology-based context fusion . . . 259
10.4 Mobile services by social contexts: a case study . . . 261
10.5 Experimentation . . . 262
10.6 Discussion . . . 264
10.7 Summary . . . 264
References . . . 265

Index . . . 267

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Chapter 1
Innovations in Web Intelligence

Gastón L'Huillier, Juan D. Velásquez, and Lakhmi C. Jain

Abstract The information footprints of a rapidly increasing influx of Internet users present us with an immense source of information that ultimately contributes to the construction of innovative web technology suitable for the future generations. Likewise, Web Intelligence has been presented as the usage of advanced techniques in Artificial Intelligence and Information Technology for the purpose of exploring, analysing, and extracting knowledge from Web data. In this chapter, the use of Web Intelligence is discussed together with ways in which a wide range of research is benefiting this area for the long-term. Also the books' purpose and structure are introduced, together with all resources used in its construction.

1.1 Introduction

Web Intelligence has been considered during the last decade as one of the leading areas of research and development in modern science. Ever since the Web was invented by Tim Berners-Lee [3], data about human behaviour and activities has been gathered at different levels. This is specially in terms of their interests when they are arranged to follow a link, the buyers of a specific product, or the way in which they feel about a specific topic in a virtual community. This behaviour has left a footprint that must be considered for further analysis. This information, keeps feeding the Web constantly and which enable us to explore the the dynamics of our society, future trends in various aspects of our every-days life, and other questions which are as yet beyond our imagination.

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The rapid growth of the World Wide Web, the assembly of large scale volumes of web data, and ever exponentially increasing applications has lead to the development of ever smarter approaches to extract patterns and build knowledge with the aide of artificial intelligence techniques. These techniques have been used, together with information technology, in a wide range of applications. This is where semantics, social network analysis, web structure, content, usage, and other aspects have already been and will increasingly keep being included in many application domains.

To keep up-to-date in the research areas of Web Intelligence is fundamental to further contribute towards the understanding of how the Web can improve to our everyday life. This is the goal of this book, which is to present advanced techniques in Web Intelligence, show their main contributions, applications, and limitations. This book can be considered as a compendium of today's techniques that are likely to continue in the development of independent research of areas. Together these represent what the Web Intelligence concept stand for that is; to explore the fundamental roles and impacts of Artificial Intelligence and Information Technology for the next generations of Web-empowered products, Systems, Services, and Activities[1].

This chapter is structured as follows: First, in section 1.2 a brief overview of advanced techniques in Web Intelligence is presented, and different branches are discussed. Second, in section 1.3, all chapters included in this book are introduced, together with a discussion of their main characteristics. The summary of chapter 1.4. Is given In section 1.5, the main resources considered in writing this book are listed.

1.2 An overview of the Advanced Techniques used in Web Intelligence

Web Intelligence covers a wide area here artificial intelligence and information technology are integrated to enhance different web-based applications. Different techniques and technologies have been used by researchers and practitioners over the years. Concepts such as Web information repositories [25], Web user behaviour analysis [20, 23], Web content [15, 21] and structure mining [16], social network analysis [4], the semantic Web [17, 22]. In addition more general concepts such as Knowledge Discovery from Databases [7] and Knowledge Representation [5] are the key to understand the basics from which Web Intelligence has been assembled.

In terms of knowledge representation and storage, fields such as logic, ontology, and computation are critical in order to support the basic structure evolving from a Web of data to a Web of knowledge [24]. Furthermore, once knowledge is mined from the web data, different standards, such as the Predictive Model Mark-up Language (PMML) [18], have been developed to store and manage the different patterns extracted from the content. These repositories have been developed for use in Multidimensional Analysis architectures. This is where Extraction, Transformation, and

[1] As described by the WI consortium `http://wi-consortium.org`.

Loading from web-based resources, Data Web-house Meta-data Modelling, OLAP queries, and its visualization have been extensively studied [19].

As part of the collection, pre-processing, and cleaning of data, several issues on privacy and quality measures must be considered [24]. Different web mining applications, such as Web User Behaviour, Content of Different Web Sites, and the analysis of the web as a graph have been discussed in the areasof Web Intelligence, Data Mining, Machine Learning, Information Retrieval, and Artificial Intelligence communities in various conferences and journals (see section 1.5).

Applications oriented to the analysis of information preferences, web usability and usefulness considerations such as helping the web user to find information have been areas of intrust. They have found the centre of attention for web usage mining researchers [24]. Other applications, such as the identification of where, how, and items which must be considered in a particular content of a given web site has formed the focus for Web Content Mining researchers [6]. The structure, representation, and its analysis has been considered as part of Web structure mining [16] and the information retrieval [2]. In previous applications, traditional supervised and un-supervised machine learning algorithms [10, 14], and data quality, visualization, characterization, analysis techniques have been developed for the Web Intelligence Community [24].

In all of the latter applications, the original Web data is presented in appropriate formats that must be processed and represented in terms for the technique to be used. In this context, Web logs, the Web-site contents, and the Hyperlink Structure of the Web, have been considered as the main source of information. Privacy issues on the sessionization process, such as using invasive tools to identify the users [24], and social network analysis where the user's contacts are exposed, have been the focus of further developments in privacy preserving data mining for Web Intelligence applications [1, 26].

One of the most promising research and application areas in Web Intelligence are the social networks and in web communities' analysis [8, 12, 17]. First studies on web structure has led to different ranking algorithms and techniques that are currently used in the analysis on how communities are formed. This includes the HITS algorithm, where authorities and hubs are identified [13]. Nowadays the content is not exclusively reserved for expert web-masters. The content on the Web is being developed by almost all of its users in web blogging, web forums, microblogging, virtual encyclopedias, social network applications. This enables the storage and generation of linked and structured information, that can be associated with text messages and multimedia information such as pictures and videos. All of these are currently being considered as a rich source of many research projects, where techniques such as social network analysis, text mining, and web mining are used together.

Finally, advances in Web Intelligence research are being focused on the enhancement of the semantic Web. The main objective is to provide a Web of descriptive meaning. There are different key aspects of knowledge representation such as computational linguistics, and other related Computer Science areas which have contributed to its development [22, 27]. Several standards for meta-data processing

such as the Resource Description Framework (RDF) [11], Web Ontology Language (OWL) [9], and social network representations of RDF, such as Friend of a Friend (FOAF) [8], have been proposed as contributions to semantics considerations in the Web.

1.3 Chapters Included in the Book

This book contains ten chapters and is edited using the contributions of various researchers and experts in the Web Intelligence field. In a broad perspective, this book includes topics such as Knowledge Representation and Pattern Extraction Storage, Web Content Mining for Information Granules (introduced as MicroGenres), Web Structure Mining, Web Usage Mining, Web Services Applications for Ubiquitous Computing, Ubiquitous Services in Social Networks, Ontology Engineering, and Web Intelligence in the Social Web.

Chapter two, Advanced Techniques in Web Data Pre-Processing and Cleaning by Pablo R. Roman, Robert F. Dell, and Juan D. Velasquéz, presents different approaches and issues regarding the pre-processing and cleaning of Web data. Different characteristics for different Web Intelligence, such as Web Structure Mining, Web Content Mining, and Web Usage Mining Applicatiions are discussed.

Chapter three, Web Pattern Extraction and Storage by Victor L. Rebolledo, Gastón L'Huillier, and Juan D. Velásquez, addresses juvenal different technology based architectures used for knowledge representation and pattern storage. Here, a large number of techniques for pattern extraction, such as Feature Selection and Extraction, Data Mining models, Model Assessment, and Performance Measures, from Web Data and its Multidimensional Storage by using PMML is presented.

Chapter four, Web Content Mining Using MicroGenres by Václav Snášel, Miloš Kudělka, and Zdeněk Horák, introduces an specific application of web content mining using MicroGenres, where specific components of a web page are identified and analysed.

Chapter five, Web Structure Mining by Ricardo Baeza-Yates and Paolo Boldi, presents basic properties, concepts, and models of the Web graph. Also, Developments in Link Ranking and Web Page Clustering are discussed, as well as Algorithmic issues as Streaming Computation on Graphs and Web graph Compression.

Chapter six, Web Usage Mining by Pablo E. Roman, Gastón L'Huillier, and Juan D. Velásquez, presents different techniques and issues regarding the characterization of the web user browser behaviour, as well as the representation of its preferences, and further techniques used for its Pattern Extraction. Finally, recent applications on Adaptive Web Sites, Web Personalization, and Recommendation are discussed.

Chapter seven, User-Centric Web Services for Ubiquitous Computing by In-Young Ko, Hyung-Min Koo, and Angel Jimenez-Molina, presents a novel application of Web Services in Ubitiqitous Computing in which essential requirements, current research on different frameworks, and a Task-Oriented Services Framework are discussed together with a demo application example.

Chapter eight, Ontological Engineering and the Semantic Web by José Manuel Gómez-Perez and Carlos Ruiz, discusses fundamental concepts on Knowledge Representation and Ontology Engineering, as well as a Methodological Approach to Ontology Engineering, introduced as Methontology. Afterwards, a discussion on Reasoning, Modularization and Customization, Networked Ontologies, and Ontology development frameworks is overviewed, Applications such as Semantic web services, semantic applications in Public Administrations, semantic applications in eBusiness, and new challenges in the semantic cloud.

Chapter nine, Web Intelligence on the Social Web by Sebastián A. Ríos and Felipe Aguilera, presents an overview on how virtual communities and social networks could be analysed and how knowledge could be extracted. Also, different web mining techniques and how they could be applied to social network analysis introduced. A brief introduction on how web mining could be applied in Semantic Web Sites from a Social Network Analysis point of view is discussed.

The Final chapter, Intelligent Ubiquitous Services also Based on Social Networks by Jason J. Jung, presents an application how web intelligence could bring to Social ubiquitous services to social networks intelligent where different components, Network Intelligent Ubiquitous Services, where different components, such as the interactive discovery of social networks, and how an ontology-based context fusion can be applied to mobile services.

1.4 Summary

In this chapter broad areas of Web Intelligence have been discussed and analysed from this books perspective. A general overview of this book's chapters was introduced and a comprehensive list of the resources employed throughout this part of the book. The remaining chapters will consider on further details on recent advances in their respective Web Intelligence field.

1.5 Resources

A sample of the resources for the Web Intelligence used in this book is given. First, a list of the main Journals in the field is the given. Secondly, a list of the conferences, and their proceedings are listed by the preparation of conference series and years. Finally, the list of Web Intelligence Related Books used in this book are