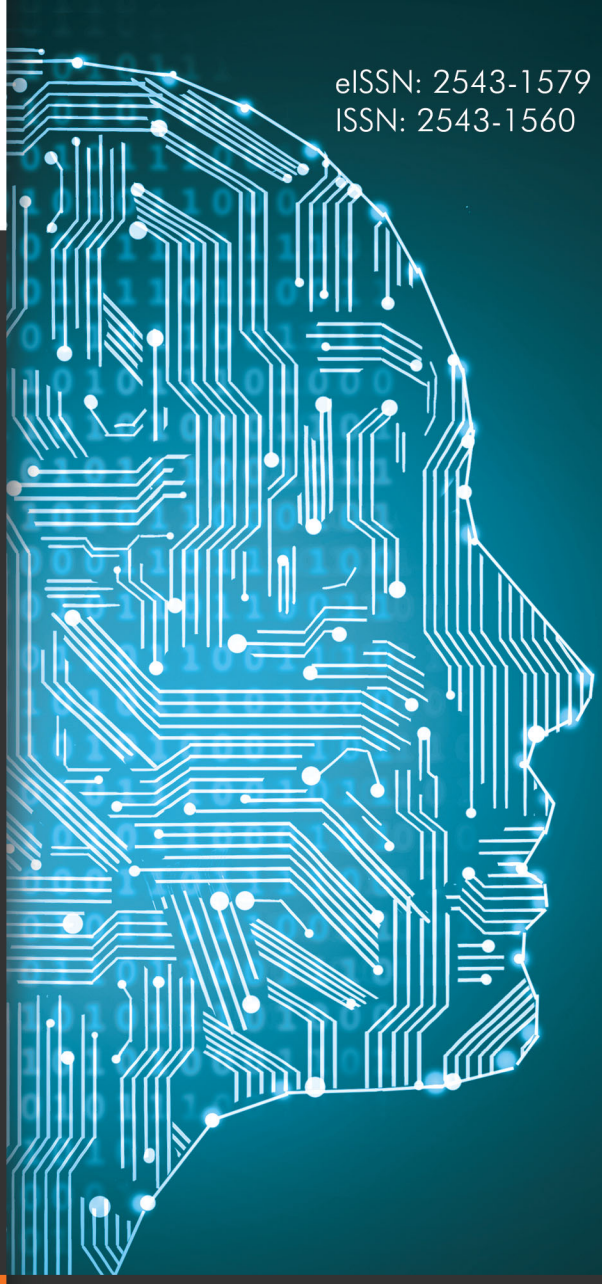
eISBN: 978-1-68108-502-9
ISBN: 978-1-68108-503-6

eISSN: 2543-1579
ISSN: 2543-1560



CURRENT AND FUTURE DEVELOPMENTS IN ARTIFICIAL INTELLIGENCE

VOLUME 1

INTELLIGENT COMPUTATIONAL SYSTEMS: A MULTI-DISCIPLINARY PERSPECTIVE

Editor:
Faria Nassiri-Mofakham

Bentham Books

Current and Future Developments in Artificial Intelligence

(Volume 1)

(*Intelligent Computational Systems: A Multi-Disciplinary Perspective*)

Edited by

Faria Nassiri-Mofakham
University of Isfahan, Isfahan, P.O.Code 81746-72441, Iran

Current and Future Developments in Artificial Intelligence

Volume # 1

Intelligent Computational Systems: A Multi-Disciplinary Perspective

Editor: Faria Nassiri-Mofakham

ISSN (Online): 2543-1579

ISSN (Print): 2543-1560

ISBN (Online): 978-1-68108-502-9

ISBN (Print): 978-1-68108-503-6

General:

1. Any dispute or claim arising out of or in connection with this License Agreement or the Work (including non-contractual disputes or claims) will be governed by and construed in accordance with the laws of the U.A.E. as applied in the Emirate of Dubai. Each party agrees that the courts of the Emirate of Dubai shall have exclusive jurisdiction to settle any dispute or claim arising out of or in connection with this License Agreement or the Work (including non-contractual disputes or claims).
2. Your rights under this License Agreement will automatically terminate without notice and without the need for a court order if at any point you breach any terms of this License Agreement. In no event will any delay or failure by Bentham Science Publishers in enforcing your compliance with this License Agreement constitute a waiver of any of its rights.
3. You acknowledge that you have read this License Agreement, and agree to be bound by its terms and conditions. To the extent that any other terms and conditions presented on any website of Bentham Science Publishers conflict with, or are inconsistent with, the terms and conditions set out in this License Agreement, you acknowledge that the terms and conditions set out in this License Agreement shall prevail.

Bentham Science Publishers Ltd.
Executive Suite Y - 2
PO Box 7917, Saif Zone
Sharjah, U.A.E.
Email: subscriptions@benthamscience.org

CONTENTS

FOREWORD

After more than six decades of research, artificial intelligence is now being used for many endeavors, helping people manage their lives, secure their homes and information, perform routine tasks in homes, hospitals, and offices, and automate their travel. The applications are widespread and so are the technologies needed to create them. This book provides a comprehensive treatment of intelligent systems and includes contributions from leading researchers and developers in a range of disciplines.

The need for the book appears obvious: computational systems are fast becoming ubiquitous and pervasive and we would like them to be effective and friendly. They are *ubiquitous* because computing power and access to the Internet are being made available everywhere; they are *pervasive* because computing is being embedded in the very fabric of our environment. For example, our houses, our furniture, and our clothes will contain computers that will enable our surroundings to adapt to our preferences and needs. This leads also to unprecedented complexity in our envisioned systems, because commercial, educational, and industrial enterprises will be linked, and human spheres previously untouched by computing and information technology, such as our personal, recreational, and community life, will be affected.

In the midst of the complexity, we need the computational systems with which we interact to behave intelligently, *i.e*., rationally, and there are many facets to intelligent behavior. These facets do not exist in isolation, although they can be investigated individually. This has been the primary investigative approach so far in computer science research. However, the next major advances will come from more comprehensive approaches, where combinations of the facets will produce intelligent behaviors needed for complex and realistic domains. Creating effective combinations will require that researchers understand the various facets, and this book provides some of the required understanding.

Dr. Faria Nassiri Mofakham has assembled papers that span the *fundamental areas* of interactions among intelligent software agents, robot languages, ethical behavior of agents, and human language, and the *application areas* of manufacturing, finance, and education. She leads with a paper by Ghasem-Aghaee, Ören, and Yilmaz that covers both areas, in that it surveys the use of simulation to investigate agent-based behaviors and to control agent-based behaviors in applications. The paper is exceptionally thorough and provides a basis for considering the papers that follow, notably the paper by Coelho that considers simulated worlds of intelligent systems, the paper by Aydogan et al. that considers simulated negotiations, and the paper by Magessi and Antunes that simulates human attitudes using agents.

For computational systems to be considered intelligent, they must be able to interact with humans in ways that seem natural, *i.e*., as other humans would. This requires the systems to understand human emotions, as Basiri et al. investigate, and to behave ethically, as Ören and Yilmaz analyze. They must also operate efficiently and yield plausible results when processing large amounts of information, as Esmaelian, Shahmoradi, and Nemati show in their paper on classification.

Finally, the fundamental advances must be applied to important problems to demonstrate their utility and capabilities. The paper by Nazemi and Heidenreich uses advances in machine learning to improve the understanding of bond rates in financial markets. The paper by Gostar, Hoseinnezhad, and Bab-Hadiashar addresses sensor management from the perspective

of intelligent sequential decision-making in the presence of stochastic uncertainty. Their results have broad applicability, including to the Internet of Things. Basiri and Ghasem-Aghaee consider how complexity can be reduced in large-scale systems using an AI approach based on multi-agent holonic systems that self-organize and behave autonomously. Modern manufacturing can benefit from this approach. The paper by Tafazoli and Parra describes how robots and artificial intelligence can improve education, specifically the learning of natural languages.

In summary, I am excited by the possibilities for new computational systems that are engendered by this book, as well as by the challenges that remain. This book provides a solid foundation for advances in the intelligent behavior of computational systems.

Dr. Michael N. Huhns
Distinguished Professor Emeritus of Computer Science and Engineering,
University of South Carolina,
Columbia, SC,
USA

PREFACE

Any knowledge is as old as its date revealed. The idea of editing a book as a planet in the galaxy of AI will make you as old as AI and as young as what has been and is being published today.

What is of concern in this contemporary life, at the intellectual level, where machine -the digital in specific- governs the manner by which the different aspects of human perceptions are applied in a given field is to enhance human's comprehension. On one to one basis, not even a temporary success will be registered in this realm, unless the problem is analyzed in a multi-dimensional and multi aspect sense. Books like this provide the interested readers in academic world different access channels, found so far, in having a broader perspective on the subjects of the matter(s) in AI. Many literary packages, each one better than the previous ones, are published in order to quench this never ending quest.

The objective of research on the constituent theme here is to promote their advances made towards accomplishments. In this multi-disciplinary package, the authors seek to present their innovative views on their themes of interest in this realm; consequently, pronouncing a general statement would be wrong, and for not committing this wrong I would suffice by bulleting the content of each one of the chapters presented to provide a panorama of what is defined and expected in Simulation, Interaction with humans, and Application categories:

1. Simulation of intelligent behavior
2. An individualized view on schools of artificial intelligence
3. The vast span of dealing with incomplete information in automated negotiation
4. Reverse perception effect on cognition leading to stimulated behavior
5. Lack of lexicon-based sentiment analysis in Persian language
6. Regressive retrospect counter-intuitive view of ethics, autonomy and cooperation of agents
7. Minimizing estimation error through polynomial utility function
8. Prediction in the world of finance
9. The role of stochastic geometry in multi-object filters
10. Multi-agent architecture applied in parallel process Holonic systems
11. Robot-assisted language learning alternate to CALL and MALL

The authors here challenge the theoretical meta-problems that manipulate the existing practical problems

This book could not have been published without the substantial contribution of many interested and involved in this endeavor. I wish to express my cordial gratitude to the enthusiastic researchers for their significant contribution in the chapters, anonymous reviewers for their valuable comments, Mr. Haidouk Vartevan, a freelance proofreader and the editorial staffs and partners of Bentham Science Publishers, especially Ms. Fariya Zulfiqar, Publications Assistant Manager, for their kind cooperation.

It is a pride to have the Foreword of this eBook written by Dr. Michael N. Huhns, Distinguished Professor Emeritus of Computer Science and Engineering.

Dr. Faria Nassiri-Mofakham
University of Isfahan,
Isfahan, P.O.Code 81746-72441,
Iran
E-mail: fnasiri@eng.ui.ac.ir

List of Contributors

Abdolreza Nazemi	School of Economics and Business Engineering, Karlsruhe Institute of Technology, Karlsruhe, Germany
Ahmad Reza Naghsh-Nilchi	Faculty of Computer Engineering & Information Technology, University of Isfahan, Isfahan, Iran
Alireza Bab-Hadiashar	Aerospace, Mechanical and Manufacturing Engineering, RMIT University, Melbourne, VIC 3000, Australia
Amirali K. Gostar	Aerospace, Mechanical and Manufacturing Engineering, RMIT University, Melbourne, VIC 3000, Australia
Catholijn M. Jonker	Interactive Intelligence Group, Delft University of Technology, Delft, The Netherlands
Dara Tafazoli	Department of English and German Philologies, University of Córdoba, Córdoba, Spain
Faria Nassiri-Mofakham	Department of Information Technology Engineering, University of Isfahan, Isfahan, Iran
Fateme Nemati	Department of Artificial Intelligence, Faculty of Computer Engineering, University of Isfahan, Isfahan, Iran
Hadi Shahmoradi	Department of Management, Faculty of Administrative Sciences and Economics, University of Isfahan, Isfahan, Iran
Helder Coelho	BioISI and Mind-Brain College, Faculty of Science, University of Lisbon, Lisbon, Portugal
Imane Basiry	Computer Engineering Department, Sheikh Bahaei University, Baharestan, Iran
Katsuhide Fujita	Faculty of Engineering, Tokyo University of Agriculture and Technology, Tokyo, Japan
Kohei Hayakawa	Department of Computer Science and Engineering, Nagoya Institute of Technology, Nagoya, Japan
Konstantin Heidenreich	School of Economics and Business Engineering, Karlsruhe Institute of Technology, Karlsruhe, Germany
Levent Yilmaz	Deptartment of Computer Science and Software Engineering, Auburn University, Auburn, USA
Luis Antunes	BioISI/MAS/Faculdade de Ciências da, Universidade de Lisboa, Lisboa, Portugal
Mª Elena Gómez-Parra	Department of English and German Philologies, University of Córdoba, Córdoba, Spain
Majid Esmaelian	Department of Management, Faculty of Administrative Sciences and Economics, University of Isfahan, Isfahan, Iran
Michael N. Huhns	Department of Computer Science and Engineering, University of South Carolina, Columbia, SC 29208, USA
Mohammad Ehsan Basiri	Department of Computer Engineering, Faculty of Engineering, Shahrekord University, Shahrekord, Iran

Nasser Ghasem-Aghaee	Faculty of Computer Engineering & Information Technology, University of Isfahan, Isfahan, Iran Department of Computer Engineering, Sheikh Bahaei University, Baharestan, Iran
Nuno Trindade Magessi	BioISI/ MAS/ Faculdade de Ciências da, Universidade de Lisboa, Lisboa, Portugal
Rafik Hadfi	Department of Computer Science and Engineering, Nagoya Institute of Technology, Nagoya, Japan
Reyhan Aydoğan	Department of Computer Science, Özyeğin University, Istanbul, Turkey Interactive Intelligence Group, Delft University of Technology, Delft, The Netherlands
Reza Hoseinnezhad	Aerospace, Mechanical and Manufacturing Engineering, RMIT University, Melbourne, VIC 3000, Australia
Takayuki Ito	Department of Computer Science and Engineering, Nagoya Institute of Technology, Nagoya, Japan
Tim Baarslag	Agents, Interaction and Complexity Group, University of Southampton, Southampton, UK
Tuncer Ören	School of Electrical Engineering and Computer Science, University of Ottawa, Ottawa, Canada

PART I:
SIMULATION

CHAPTER 1

Simulation, Intelligence and Agents: Exploring the Synergy

Nasser Ghasem-Aghaee[1,2,*], Tuncer Ören[3] and **Levent Yilmaz[4]**

[1] *Department of Computer Engineering, Sheikh Bahaei University, Baharestan, Iran*

[2] *Faculty of Computer Engineering & Information Technology, University of Isfahan, Isfahan, Iran*

[3] *School of Electrical Engg. and Computer Science, University of Ottawa, Ottawa, ON, Canada*

[4] *Computer Science and Software Engineering, Samuel Ginn College of Engineering, Auburn University, Auburn, AL, USA*

Abstract: Simulation is applied to exhibit the extent of how the offered valuable functionalities of given issues are appreciated. A systematic glossary of about twenty types of intelligence provides a synoptic background for intelligent behavior that can be represented by agents. The three categories of the synergy of simulation and software agents are discussed in the following three sections: agent simulation, agent-supported simulation, and agent-monitored simulation. Extensive bibliographic analysis which is based on about 440 references supports each category of the synergy of simulation and software agents. Discussion of some desirable research directions and a conclusion section terminate the article.

Keywords: Agent-directed simulation, Agent-monitored simulation, Agent simulation, Intelligence, Software agent, Supported simulation.

1. INTRODUCTION

The synergy of simulation and intelligent software agents is explored here. Many possible applications of simulation are highlighted in Sec. 2 to appreciate the research patterns it offers. A review of intelligence and intelligent entities and the agents is reviewed in Sec. 3. A systematic glossary of about twenty types of intelligence provides a synoptic background for intelligent behavior that can be represented in agents. The possibilities of the synergy of simulation and agents are reviewed in Sec. 4. Three categories of the synergy of simulation and software agents of: agent simulation, agent-supported simulation, and agent-monitored simulation, are discussed in the following three sections. Each of these three

[*] **Corresponding author Nasser Ghasem-Aghaee:** Department of Computer Engineering, Sheikh Bahaei University, Baharestan, Iran; Tel/Fax: 00983136816760; E-mail: ghasemaghaee@shbu.ac.ir

Faria Nassiri-Mofakham (Ed)

sections is supported by a bibliographic analysis of about 440 references. Discussion on some desirable research directions and drawing a conclusion constitutes the last section.

2. SIMULATION: HIGHLIGHTS

To be able to grasp the full potential of the synergy of simulation and software agents, acquiring knowledge on different types of simulation is essential. Modeling and simulation can be perceived from the following perspectives: (1) Purpose of use, (2) Problem to be solved, (3) Connectivity of operations, (4) Types of knowledge processing, and (5) Philosophy of science. The three purposes of simulation are: (1) Perform experiments, (2) Provide experience and (3) Imitation, pretense [1]. In this article, the focus is on the experimental aspect of simulation. In this context, simulation is a goal-directed experimentation with dynamic models, (*i.e.*, models with time-dependent behavior). One way to distinguish different types of simulations is to consider whether a simulation program runs independent from the real system, two categories of simulation became possible: stand-alone simulation and embedded simulation [2].

2.1. Stand-alone Simulation

Here, the simulation program runs independent of the system of interest; almost all types of conventional simulations are stand-alone simulation. As listed in Table **1**, there exist six types of applications of stand-alone simulation: decision making, training to enhance decision skills, training to enhance motor and related decision skills, training to enhance operational skills, understanding and education, and entertainment.

Table 1. Applications of stand-alone simulation.

Decision making for: - *Prediction* of behavior and/or performance of the system of interest - *Evaluation* of alternative models, parameters, experimental or operating conditions on model behavior and/or performance - Sensitivity analysis - Planning - Acquisition - Design - Prototyping - Proof of concept
Training to enhance *decision skills* (gaming simulation) (also called constructive simulation)
Training to enhance *motor skills* and related decision skills (simulators) (also called virtual simulation)

(Table 1) contd.....

Training to enhance *operational skills*
Understanding and education
Entertainment (simulation games, animation of dynamic systems)

Simulation for decision making is run for prediction, evaluation, sensitivity analysis, planning, acquisition, design, prototyping, and proof of concept. *Gaming simulation* is run for training to enhance decision skills. In defense applications, this type of simulation is named *constructive simulation* and includes *war gaming*, while, it is applicable for operations other than defense like, conflict management and peace assurance. In business applications, gaming simulations include *business games* which can be run in zero-sum environments to enhance decision making skills subject to competition or in non-zero-sum environments to enhance decision making skills subject to cooperation [3]. *Simulators* are often *human-i--the-loop simulations* where operators use virtual equipment to develop motor skills and the associated decision skills. In defense applications they are named *virtual simulation*. In complex systems like scientific and social systems, simulation provides the possibility to test the given hypotheses on the nature and behavior of a system and makes them easy to *understand*. Simulation is an enabling technology applicable in enhancing *learning*/*teaching* many topics. In *entertainment*, simulation is run for simulating games and for the animation of dynamic systems.

2.2. Embedded Simulation

In *embedded simulation*, simulation program runs together with the system of interest. The embedded simulation is of the two purposes of: enrichment and support of real system operations (Table **2**).

Table 2. Embedded simulation application.

Enrichment of real system operation (The system of interest and the simulation program operate *concurrently*) Goals: - simulation-based augmented/enhanced reality operation (for training to enhance motor skills and related decision skills) - on-line diagnostics
Support of real system operation (The system of interest and the simulation program operate *alternately* to provide predictive displays) - parallel experiments while real system is running

In *enrichment of real system operation*, the system of interest and simulation program runs *concurrently*. Depending on the objectives, there exist different possibilities like: simulation-based augmented/enhanced reality and on-line

CHAPTER 2

Living with Digital Worlds: A Personal View of Artificial Intelligence

Helder Coelho*

MAS-BioISI and Mind-Brain College, Faculty of Science, University of Lisbon, Campo Grande, 1749-016 Lisbon, Portugal

Abstract: In recent years, Artificial Intelligence (AI) has been in the news again due to advances in machine learning, speech processing, natural language generation, robotics and agent technology, not to mention due to big investments. Examples, such as Google Translate, Microsoft's Skype Translator, Google's RankBrain, IBM's Watson, Apple's Siri, Honda's ASIMO and new startups mix with movies, healthcare, social and political simulation and energy management. AI achieved some success in education, medicine, cognitive and complexity sciences due to better interfaces, algorithms and mechanisms, and due to interdisciplinary research in techniques that mirror biological behaviour. A closer look at animal and human behaviour (mimicking nature) and to how brains store/process information may help AI continue innovating to further develop. Today, there is a different stance in schools of AI and a cooperative way of viewing different technologies working together in an integrative way, including understanding limitations and dangers (*e.g.* Facebook emotion study). Furthermore, this is a strong signal of more democracy and respect for approaches to consider intelligence at large, thus also indicating a more mature field. In this chapter, I give an overview of the field of Artificial Intelligence to explain why recent breakthroughs and better algorithms have tackled big data.

Keywords: Algorithms, Areas and territories, Digital worlds, Mechanisms, Models, Paradigm shifts techniques,.

1. INTRODUCTION

'Invariance hypothesis is a powerful approach to bridge the large gap between contemporary machine learning, with its emphasis on millions of labeled examples, and the primate visual system that in many instances can learn from a single example.'
Cristof Koch, Allen Institute for Brain Science, 2015.

* **Corresponding author Helder Coelho:** MAS-BioISI and Mind-Brain College, Faculty of Science, University of Lisbon, Campo Grande, 1749-016 Lisbon, Portugal; Tel: +351 21 750 0122; Fax: +351 21 750 0084; E-mail: hcoelho@di.fc.ul.pt

Faria Nassiri-Mofakham (Ed)

When I arrive in a town that I have been to before, my brain senses where I am again and recreates the mental map of my environment. It uses the same brain regions where I store new memories. I do not require any GPS as I am sure I found my place and I use my skills for pathfinding, two key components for survival. I can also answer two navigating questions: Where am I? Where am I going?

In order to look at Artificial Intelligence (AI) as one of the ideas that will play a role in our future [1 - 3], we need to picture a map of new sciences, moving from this discipline to Artificial General Intelligence (AGI), to gain versatility and adaptability of human intelligence, influenced by the knowledge of the human brain and again by all of AI's schools. But this pedestrian walk to a generalised type of intelligence is not enough, because there is a network of other disciplines with which AI interacts often. In fact, some disciplines, namely mathematics, philosophy and psychology, were incorporated into the foundation of AI from the start at the Dartmouth Conference of 1956.

Children learn everything based on experiences, always finding general patterns, and in this way, they create a large number of other patterns in linguistics, logic, and even mathematics. They build new knowledge based on previous knowledge, and they can explore their own overall knowledge to draw new conclusions. A group formed by Professor Claes Strannegard from the University of Gothenburg made an AI program that can learn how to solve problems, imitating how children develop intelligence [4].

During the 1980s, AI had its golden years with more than 5,000 people attending IJCAI-85 at UCLA, including a large amount of startups involved in high level programming languages and expert systems, yet some disasters (or false promises) put into question the value of its creativity and innovation. Nevertheless, ingenuity and a desire for mysteries were still strong. Toffler published *The Third Wave* [5] and called our attention to a shift from the analogue to the digital. Steve Jobs (remember his mantra 'focus and simplicity'?) discovered that the consumer switch to PCs was difficult to overcome that year, left Apple and founded Next, General Magic and Pixar, and the AI scientific community came back to the trenches to think more in depth. It was too early to sing victory and the signs of huge breakthroughs were not yet visible. Crick and Koch proposed a new theory about consciousness based upon vision, yet the neurosciences were starting their march towards new explorations. The decade of the brain was the 1990s and the one of the mind was during the following decade.

A disruption occurred when informatics moved from a centralised to a distributed computing power, from closed to open problems, and AI from individual to social

systems. The area of Agents was consolidated with the emergence (scale-freeness) of agency and connectionism became stronger, opening the way to evolutionary computation and to bonds with human sciences. Also, with the disaster of expert systems (rules were not the solution for everything) toy examples were wrapped up on the shelf and complex problems started to be solved, but with difficulties.

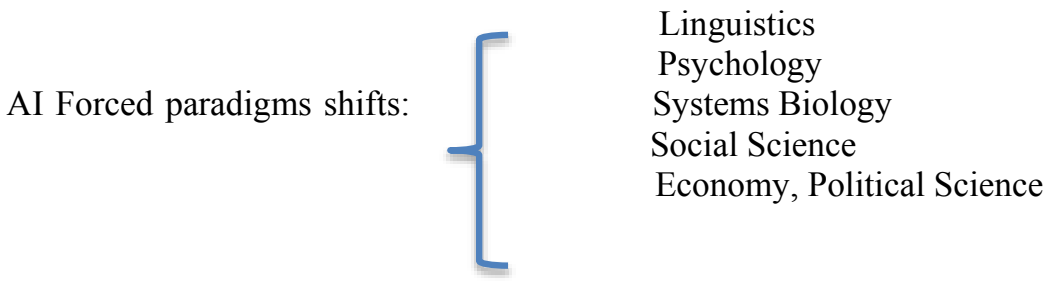


Fig. (1). Impacts of Artificial Intelligence.

Over the years, AI was not well structured, and we thought we could design new powerful artefacts with only models, algorithms and systems [6]. Rules were strong with knowledge-based and expert systems, but insufficient to guarantee a solution for hard and complicated problems. To arrive at general intelligence, *i.e.* to be inspired by human beings, it was necessary much more and not only environments with digital worlds [7, 8]. AI influenced a lot of disciplines (see Fig. **1**) and several schools of thought (see Fig **2**), helping the creation of cognitive psychology, computational linguistics and social simulation. Also, mathematics influenced AI, namely logic aided knowledge representation and reasoning, statistics was crucial to natural language understanding (machine translation and speech recognition), optimisation gained with Monte Carlo techniques influenced games (computer Go), and probability was decisive for dealing with uncertainty in language processing.

Symbolic	Pattern Recognition	Logic Programming
Neural Networks	Fuzzy Systems	Genetic Algorithms
Evolutionary Programming	Artificial Life	Agents
Social Simulation	Deep Learning	

Fig. (2). Schools of Artificial Intelligence.

CHAPTER 3

A Baseline for Nonlinear Bilateral Negotiations: The full results of the agents competing in ANAC 2014

Reyhan Aydoğan[1,2,*], Catholijn M. Jonker[2], Katsuhide Fujita[3], Tim Baarslag[4], Takayuki Ito[5], Rafik Hadfi[5] and **Kohei Hayakawa[5]**

[1] *Deaparment of Computer Science, Özyeğin University, Istanbul,Turkey*

[2] *Interactive Intelligence Group, Delft University of Technology, Delft, The Netherlands*

[3] *Faculty of Engineering, Tokyo University of Agriculture and Technology, Tokyo, Japan*

[4] *Agents, Interaction and Complexity Group, University of Southampton, Southampton, UK*

[5] *Department of Computer Science and Engineering, Nagoya Institute of Technology,Nagoya, Japan*

Abstract: In the past few years, there is a growing interest in automated negotiationin which software agents facilitate negotiation on behalf of their users and try to reach joint agreements. The potential value of developing such mechanisms becomes enormous when negotiation domain is too complex for humans to find agreements (*e.g.* e-commerce) and when software components need to reach agreements to work together (*e.g.* web-service composition). Here, one of the major challenges is to design agents that are able to deal with incomplete information about their opponents in negotiation as well as to effectively negotiate on their users' behalves. To facilitate the research in this field, an automated negotiating agent competition has been organized yearly. This paper introduces the research challenges in Automated Negotiating Agent Competition (ANAC) 2014 and explains the competition set up and results. Furthermore, a detailed analysis of the best performing five agent has been examined.

Keywords: Automated Negotiation, Nonlinear Utility Functions, Agent Competition.

1. INTRODUCTION

Conflict is an omnipresent phenomenon in human society [1 - 3]. It spans from daily situations like discussing a holiday plan with friends and arranging a meeting between colleagues to complex scenarios like politics and business. Automated negotiation tools provide an important mechanism for decision makers

* **Corresponding author Reyhan Aydoğan**: Computer Science, Özyeğin University, Istanbul, Turkey; Tel/Fax: +90-216 564 94 75; E-mail: reyhan.aydogan@ozyegin.edu.tr

Faria Nassiri-Mofakham (Ed)

to resolve their conflicts and to reach mutually acceptable agreements. There is a growing interest and need for automated negotiation mechanisms [3, 4]. To facilitate the research in automated negotiation, an international competition namely Automated Negotiating Agent Competition (ANAC)[1] [5] is yearly organized. This competition challenges researchers to design and develop fully-automated negotiating agents that can negotiate under certain protocols and conditions. To compete, one has to develop a negotiating agent that can negotiate across a variety of negotiation scenarios. In all variants of the competition, the agents have to negotiate with incomplete knowledge - agents do not know neither their opponents preferences nor their negotiation strategy.

From May 2010 to May 2013 four instances of the ANAC competition [6 - 9] have been held in conjunction with the International Conference on Autonomous Agents and Multiagent Systems (AAMAS). This competition follows in the footsteps of a series of successful competitions that aim to advance the state-o--the-art in artificial intelligence (other examples include the Annual Computer Poker Competition and the various Trading Agent Competitions (TAC) [10]). ANAC focuses specifically on the design of practical negotiation strategies. In particular, the overall aim of the competition is to advance the state-of-the-art in the area of bilateral, multi-issue negotiation, with an emphasis on the development of successful automated negotiators in realistic environments with incomplete information (where negotiators do not know their opponent's strategy, nor their preferences) and continuous time (where the negotiation speed and number of negotiation exchanges depends on the computational requirements of the strategy). One of the successes of ANAC lies in the development of state-of-t-e-art negotiation strategies that co-evolve every year; some notable examples include [11 - 22]. The previous four incarnations of ANAC already yielded more than 60 new strategies and scenarios [6] which can be used as benchmarks to test the efficacy of subsequent work in this area. This is in line with the goal of ANAC to build a community in which work on such negotiating agents can be compared by standardized negotiation benchmarks and performance metrics.

Each year, the organizers bring up a new challenge for the participants. This year, ANAC 2014's focus is on negotiating with nonlinear utility functions as well as dealing with large-scale outcome spaces [23]. In ANAC 2014, negotiating agents were not allowed to access the structure of the nonlinear utility functions directly; therefore, they needed to explore the outcome space smartly to generate their bids. The main challenge in ANAC 2014 is to explore a large-scale outcome space effectively. In this paper, we explain the competition setup and results of the qualification and final rounds. Furthermore, we analyze the performance of the best performing five agents in an additional experimental set up. Following the competition, we systematically generated 108 different negotiation scenarios and

tested the performance of the best performing five agents elaborately. We studied the effect of the domain size, the number of constraints and issue-constraint distribution on the performance of the agents.

Our experimental results show that the agent applying a Genetic Algorithm namely *Gangster* outperforms the other agents in terms of the individual utility gained by the agents. The performance of the agents using Simulated Annealing in their strategy, namely *Agent M* and *Whale Agent* is closed to the performance of *Gangster* agent. On average, the performance of *Agent M* with respect to the distance to Pareto optimal outcome and Nash outcome is slightly better than *Gangster* agent. Their overall performance regarding to the utilitarian social welfare metrics is almost the same. Moreover, our evaluation results also show that the performance of the agents highly depends on their opponents and the negotiation scenarios played. For example, *DoNA* agent, which was ranked at second place in ANAC 2014, was outperformed by all agents in the second experiment. In the second experiment DoNA had less opponents and in the second experiment a greater variety of scenarios was used.

The rest of this paper is organized as follows: Section 2 gives an introduction on ANAC 2014 rules and competition setup. Section 3 provides an overview of agents participated in ANAC 2014. Section 4 explains ANAC 2014 qualification and final round results while Section 5 provides a detailed analysis of best performing five ANAC 2014 agents. Finally, Section 6 concludes the paper with directions to future work.

2. ANAC 2014

Each year, the ANAC organizers bring a new challenge to the participants (*e.g.* discount factors in ANAC 2011 [7, 24], private reservation value for each agent in ANAC 2012 [9], learning from past negotiation sessions in ANAC 2013 [25]). The 2.1 ANAC 2014 Rules focus of ANAC 2014 is on bilateral multi-issue negotiation, in which each agent's preferences are represented in the form of nonlinear utility functions as well as dealing with large-scale negotiation domains. In such complex domains, exploring the outcome space is not as straightforward as it was in the former competition, in which linear additive utility functions were used on relatively small-size domains. To sum up, the main challenge in ANAC 2014 is to find efficient exploration strategies for interdependent preferences, particularly on large-size domains.

As in previous years, the General Environment for Negotiation with Intelligent multi-purpose Usage Simulation (GENIUS)[2] [26] has been used in ANAC 2014. GENIUS is a research tool for automated multi-issue negotiation that enables ANAC participants to develop and to test their negotiating agents. It also provides

CHAPTER 4

A Multi Agent Model for Reverse Perception Effect

Nuno Trindade Magessi* and **Luis Antunes**

BioISI/ MAS/ Faculdade de Ciências da Universidade de Lisboa, Lisboa, Portugal

Abstract: One of the most intriguing and challenging problems in cognitive science is the difference between the individuals' perception about reality and the reality itself. Until the last decade, the main focus has been on the behaviour of individuals and the evidences of their biases, according to some stimulus. Now, researchers have centred their focus on the main reasons why these biases occur. Consequently, it is important to analyse deeply what are the consequences of these biases to society. For that purpose, we tackle the problem by using the case study of Acquired Immune Deficiency Syndrome (AIDS) and how people perceive it. In this article, we built a multi agent model to understand the consequences to the society when individuals do not perceive correctly, the reality. The obtained results reveal that the agents who perceive more correctly the danger of HIV are the ones who have more propensities to be infected and contaminate the rest of population. This is the opposite of what is expected from perception demonstrating the existence of a reverse effect.

Keywords: Cognitive Psychology, Health Risk Assessment, HIV dissemination, Multi-agent Model, Risk Perception.

1. INTRODUCTION

According to the United Nations, the number of individuals infected by Human Immunodeficiency Virus (HIV) in 2014 is estimated to be around 36,900,000 varying between 34,300,000 and 41,400,000 persons all over the world [1]. People infected with this virus, have been increasing constantly over the last decades. Adults with more than 15 years old are the group with more prevalence of this disease. Fundamentally, the sub-group comprehends between 25 and 49 years old. On the other hand, children under 15 years old have less prevalence of HIV virus as the young adults between 15 to 24 years old [1]. The results reveal the importance of sexuality on the dissemination of virus.

The prevention is small because of the knowledge about HIV prevention among young people (15-24) [2]. The percentage of young people between 15–24 of age

* **Corresponding author Nuno Trindade Magessi:** BioISI/ MAS/ Faculdade de Ciências da Universidade de Lisboa, Lisboa, Portugal; Tel/Fax: +351- 96 253 82 12; E-mail: nmaggessi@hotmail.com, xarax@ciencias.ulisboa.pt

Faria Nassiri-Mofakham (Ed)

who correctly identify various ways for the prevention of the sexual transmission of HIV and reject major misconceptions about HIV transmission is in average 30,48% for females and 34,73% for males. The condoms work and are cornerstone of safer sex practices and a greater responsible for the reduction of HIV transmissions worldwide. If condoms guarantee safety, why only 65% of men use condoms on a consistent basis? And how is it possible that more than 20% of HIV-negative men are willing to put themselves at risk by engaging condom free sex? In the case of women, a mere 11% report ever using a condom. Worse yet, women are far less likely overall to use condoms than their heterosexual male counterparts even if they are aware of consequences.

Regarding these numbers, we claimed to analyse the reasons and raise questions about why people who have awareness about the dangers of HIV are the ones that have less cautions in protecting themselves. What are the implications to the evolution of society? Should Governments supply condoms for free?

In order to explore this problem, we built a multi-agent based model under the theoretical approach of perception, where sometimes exists a cognitive bias to reality. The model took as baseline the AIDS model developed by Longenecker [3]. However, we did substantive changes in order to pursuit our experiments.

Our changes are related with the inclusion of perception in the model. For that, we divided the agents in three groups. The first one is composed by agents who perceive the real problem of AIDS and their consequences in life. The second one has individuals who perceive the problem partially. And the third one is the group where each member does not perceive the danger of AIDS, at all.

The article is organised as follows. Next section explains how the perception works. Section 3 is a travel around the existent theories of perception and their significance. Section 4 explores and explains the differences between perception and reality. In section 5, we analysed the relation between stimuli and perceptibles with repercussions in all chain process of perception. After that, in section 6, we characterise the role of cultural matrix as a filter of perception. In section 7, we do incursions inside the perception of reality. In section 8, we explain the choice of AIDS as a case study to explore.

In section 9, we present our model with subsequent changes done to the Steve Longenecker work. Section 10 explores the obtained results and in section 11, we discuss them under the theoretical approach of perception. Finally, in section 12, we conclude our article with the principally achieved ideas and inducing future steps in our research.

2. EXPLAINING PERCEPTION

Perception involves the organization, identification, and interpretation of information given by senses in order to represent and understand the environment [4]. All perception processes are made of signals from the nervous system, with repercussions on the sense organs through physical and chemical stimulation [5]. For example, smell is influenced by odor molecules, vision involves light striking the retina of the eye and hearing as a percussion of sound waves. Perception is not only a receptor of these signals but an active agent of the brain. Learning and consequent knowledge mediates the way that people perceive things. Perception is also modulated by memory, expectations and attention [6, 7].

Some authors argued that perception can be composed by two processes [7] that work in a constant and dynamically interactive way. Perception starts with processing sensory input. This process has the incumbency of transforming this low-level information to higher-level information. For example, when an individual wants to recognize an object, the first process is to assimilate the shape of the object in order to compare with the shape that he has on his mind. After this, we have the process where the connection is established with what was conceptualized in the people's mind and according to their expectations. Then, this process in conjunction with the concepts, knowledge and the selective mechanisms of attention influences perception. In the past, senses were typically understood as passive receptors. However, when scientific community started to study illusions and ambiguous images, it was found that the brain's perceptual systems, instead of acting passively are in fact active. Besides that, it was demonstrated that perception is a pre-conscious attempt to make sense of their input [6]. There is still dynamic scientific discussion about the degree to which perception is an active process with a dynamic hypothesis subject to be tested. Comparing it with science, or whether practical tangible information brought by senses is sufficiently rich to make this procedure pointless [6].

In this sense, the perceptual systems of the brain allow people to view the environment around them as stable. Even considering that, the information brought by senses is normally considered as incomplete and constantly mutable. Human brains are structured as puzzles or by modules, where different areas process distinct types of information. Most of these brain parts follow a logic of sensory maps. Maps with the incumbency of situating and guiding some features of the surrounding environment make them part of the brain's surface. These distinct pieces or modules are interconnected and influence each other. A good example to understand this, is for instance, that taste is strongly influenced by smell, like vision is strongly influenced by noise.

PART II:
INTERACTION WITH HUMANS

CHAPTER 5

Lexicon-based Sentiment Analysis in Persian

Mohammad Ehsan Basiri[1,*], Nasser Ghasem-Aghaee[2,3] and **Ahmad Reza Naghsh-Nilchi[2]**

[1] *Department of Computer Engineering, Faculty of Engineering, Shahrekord University, Shahrekord, Iran*

[2] *Faculty of Computer Engineering & Information Technology, University of Isfahan, Isfahan, Iran*

[3] *Department of Computer Engineering, Sheikh Bahaei University, Isfahan, Iran*

Abstract: Sentiment analysis is a field of study concerning the extraction of people's opinion and attitude from their writings on the Web. Most research efforts in the area of sentiment analysis have focused on English texts and few works considered the problem of Persian sentiment analysis. Persian is spoken by more than a hundred million speakers around the world and is the official language of Iran, Tajikistan, and Afghanistan. From a computational point of view, Persian is a challenging language due to its derivational nature and the use of Arabic words, informal style of writing, and different forms of writing for compound words. In this chapter, we present a lexicon-based framework for sentiment analysis in Persian. Specifically, we develop a Persian lexicon which associates sentiment words with their sentiment strengths. Furthermore, in the proposed framework, we address several problems of sentiment analysis in Persian, such as misspelling, word spacing, and stemming. We used the proposed framework in the problem of polarity detection and rating prediction of cell-phone reviews. The results show that our approach outperforms supervised machine learning techniques in terms of accuracy and mean absolute error.

Keywords: Lexicon-based review classification, Natural language processing, Opinion mining, Sentiment analysis, Text mining.

1. INTRODUCTION

Sentiment analysis (SA) aims to extract opinions, evaluations, and emotions from online sources such as product reviews, discussion forums and personal blogs [1, 2]. Due to its wide range of applications, SA has been successfully applied to academic and industrial applications in recent years [3]. From the industrial point of view, finding consumer and public opinions about services or products may

[*] **Corresponding author Mohammad Ehsan Basiri:** Department of Computer Engineering, Faculty of Engineering, Shahrekord University, Shahrekord, Iran; Tel/Fax: +98 3832324401; E-mail: basiri.sku@gmail.com

Faria Nassiri-Mofakham (Ed)

support strategic market decisions [4]. On the other hand, since there are many challenging research problems which had never been studied before, sentiment analysis provides a strong motivation for academic research as well. Furthermore, in order to know the choice that best fits their preferences, potential consumers want to know the opinions of current customers of a product before purchasing. People also prefer to be aware of others' opinions about the candidates of a political election before making a voting decision [4, 5].

Although earlier studies on sentiment analysis have focused on English texts, some recent works deal with other languages such as Chinese, Turkish, Arabic, Urdu, and Russian [6 - 10]. However, there are few works for sentiment analysis in Persian [9, 11 - 13]. Persian is spoken in Iran, Afghanistan, and many states of former Soviet Union [9]. From a computational point of view, Persian is a challenging language for several reasons [12, 14]. Firstly, some Persian letters have three or four forms of writing. Secondly, there are several informal words in Persian documents. Thirdly, there are a lot of frequent exceptions in word order. Fourthly, declensional suffixes are widely used in Persian. Fifthly, there are some imported sounds from Arabic which may be written or ignored, resulting in various forms of writing for the word containing them [12, 14]. Therefore, in this paper we investigate these challenges and propose a new framework to dealing with them.

For the sentiment detection component of our framework we had two choices: either using corpus-based machine learning approaches or using lexicon-based methods [15, 16]. One of the advantages of machine learning approaches is that they can identify implied sentiment expressed with non-sentiment words [17]. Nevertheless, the main drawback of machine learning approach is that it requires a corpus of human-annotated texts to train a classifier. Moreover, for domains other than those used for training, they have a poor performance [1, 15]. On the other hand, lexicon-based methods are robust and domain-independent methods that may utilize multiple sources of knowledge to show better performance [15]. Furthermore, existing sentiment lexicons can be easily combined to improve the performance of lexicon-based approach [18].

However, pure lexicon-based approach is not adequate for sentiment analysis and hence, combined methods are sometimes more beneficial. Such combined approaches usually use additional information, such as semantic rules to handle negation and intensification [15], booster word list [19], and emoticon list [16, 20]. In this work, we preferred the combined approach.

Earlier researches on sentiment analysis have focused on subjectivity analysis [21 - 24] and polarity detection [25 - 27]. Subjectivity analysis aims to determine

whether a given text is subjective or not, while the goal of polarity detection is to assign an overall positive/negative sentiment label to subjective texts. In more recent works, some methods were proposed to detect the strength of sentiment [15, 16, 28]. These algorithms try to specify the degree of positivity or negativity of a given document. However, on Persian text, there are few works which all are proposed to detect sentiment polarity [11, 12]. In the current study, we consider the sentiment strength detection problem for Persian product reviews. Specifically, we proposed a new framework for lexicon-based Persian sentiment analysis and carry out our experiments on two collections of cell phone reviews.

The main contributions of this study are as follows:

- We propose an unsupervised, lexicon-based approach for sentiment analysis in Persian.
- We introduce two resources for Persian sentiment analysis: a Persian lexicon that associates Persian sentiment word and their sentiment strength. A manually gathered dataset that is annotated by human coders for rating prediction.
- We compare the accuracy of supervised machine learning methods and the proposed framework for the task of review rating prediction.
- We augment the proposed system with the ability to find the polarity and evaluate its performance on two datasets.

In the remainder of the paper we first review background and related work in Section 2; then, in Section 3 the proposed methodology and the proposed system will be illustrated; we report experimental results and discuss the examined methods in Section 4; finally, in Section 5 we conclude the chapter and present future work.

2. RELATED WORK

In this section, we first present a brief review of related research on sentiment analysis. Then, we provide an overview of existing sentiment analysis on Persian text. Finally, we talk about sentiment strength detection and its applications.

2.1. Sentiment Analysis

Sentiment analysis and opinion mining usually describe the same field of study and most researchers use them interchangeably [6]. Dave *et al.* used the term opinion mining for the first time in [29] and Nasukawa and Yi proposed the term sentiment analysis for the first time in [30]. However, the study of sentiments and opinions started earlier [22, 31, 32]. Since then, SA has changed to an active research area in natural language processing and data mining communities. Therefore, a huge amount of research literature exists on this field. However,

CHAPTER 6

The Age of the Connected World of Intelligent Computational Entities: Reliability Issues including Ethics, Autonomy and Cooperation of Agents

Tuncer Ören[1,*] and **Levent Yilmaz**[2]

[1] *School of Electrical Engineering and Computer Science, University of Ottawa, Ottawa, ON, K1N 6N5 Canada*

[2] *Dept. of Computer Science and Software Engineering, Auburn University, Auburn, AL, 36849 USA*

Abstract: In this chapter, Internet of Things is perceived as a special case of Connected World which in turn is considered a step in tool making. Five major stages of tool making in the history of civilization are outlined and it is pointed out that passing from one era to the next one requires a new entity which are: energy, knowledge processing ability, intelligence, connectedness, and superintelligence. The eras thus identified are: hunter-gatherer and agriculture age, industrial age, information age (also called knowledge age, informatics age), cybernetics age, connected age, and post-human era. Then what may go wrong in a connected world is elaborated on; some counter-intuitive views about cooperation and autonomy are expressed and role of ethics is stresses especially in connected world.

> 'Would you tell me, please, which way I ought to go from here?' `That depends a good deal on where you want to get to,' said the Cat.
>
> 'I don't much care where--' said Alice. `Then it doesn't matter which way you go,' said the Cat.
>
> '--so long as I get SOMEWHERE,' Alice added as an explanation. `Oh, you're sure to do that,' said the Cat, `if you only walk long enough' [1].

Keywords: Connected world, Cybernetics age, Industrial age, Industry 4.0, Informatics age, Internet of things, Knowledge age, Levels of tool making, post-human era.

[*] **Corresponding author Tuncer Ören:** School of Electrical Engineering and Computer Science, University of Ottawa, Ottawa, ON, K1N 6N5, Canada; Tel: +1(613)271-1214; E-mail: oren@eecs.uOttawa.ca

Faria Nassiri-Mofakham (Ed)

1. INTRODUCTION

We live in a connected smart world dominated by especially non-human autonomous entities with knowledge processing abilities (mostly software agents). The increase of the connectedness as well as the intelligence of the knowledge processing entities are accelerating. The increases of this connectedness and the ambient intelligence lead us to an era which is already identified by different terms such as Internet of Things (IoT) a term coined in 1999 by Kevin Ashton [2] and the variants of the term IoT such as Industrial Internet of Things, Military Internet of Things [3], and Internet of Nano-Things [4, 5]; infohabitants [6]; cyber-physical systems [7]; Internet of Services (IoS) [8]; and Industry 4.0 or the fourth industrial revolution [9]. Similar to the case of any new important technology which brings its own culture, the increasing connectedness of intelligent entities brings and will continue to bring its own culture. In addition to the desirable contributions, technological advancements may also bring undesirable and unwanted side effects.

The increased reliance on computerization, coupled with dynamic environments laden with uncertainty makes ethical decision-making become more pronounced with outcomes that have serious life-death consequences. Internet of things –mostly with software agents– is also being used widely and its domain of application is broadening rapidly. Another aspect of computerization is super-intelligence which may have some humanly uncontrollable and undesirable effects.

1.1. Significance of the Problem

As autonomous cars [10] and trains [11] transition into use and drones are deployed to conduct remote missions [12], there is an increasing fear of causing civilian casualties [13] and the question is raised on how these smarter computers will be used [14]. Concomitantly, recent reports [15] indicate that drone operations are becoming more demanding and stressful, leading to increased rate of turnover and cuts in flights. Moreover, as millions of vehicles are expected to be endowed with autonomy, taking algorithmic morality seriously has never been more urgent. We believe increased levels of autonomy can be allowed if and only if trust can be instilled in the moral decision-making capacity of cyber agents. Such ability can also assist human operators, who are prone to making mistakes in their technology-mediated inter actions with the social, physical, and natural environment [13]. Hence, there is a need for a balanced integrated approach to support ethical decision-making that takes into consideration the person characteristics, as well as the situational factors.

1.2. Motivating Scenarios

Suppose an Unmanned Aerial Vehicle (UAV) is about to crash and needs to choose a crash site. There are two options: a small village and a location in the vicinity of where the operator's relatives live. Clearly, the operator has a conflict of interest and may not choose the action that is consistent with a moral principle. In this case, should the cyber agent predict the potential for deviation from ethical rules of behavior and take over the authority or act as an ethical advisor by explaining the ethical rationality of other courses of actions?

Similarly, suppose a natural disaster occurs, requiring immediate response from a diverse group of agencies and groups. Effective response requires timely situational awareness, which can be provided by autonomous systems. During the mission, the execution of a plan may require evaluation of decisions and consensus on measures of acceptable decisions: Is it the utility in terms of "greatest number of lives saved" or a policy aimed at "the number of years of lives saved", which give priority to vulnerable young. Moreover, deciding on resource reallocation from one community to another based on predictions of best outcome for the most persons should also be moderated by the obligations that individuals vest in federal, state, and local governments. The duties perspective also necessitates protection of first responders, who have obligations to save members of the community. Such conflicts between consequences, duties, and obligations should be resolved while recognizing the significance of rights, fairness, and cultural norms.

In modeling and simulation (M&S), several techniques are used to assure the reliability of the models used. Once, relevant aspects of the characteristics of a model are assumed to be acceptable, its computerization is scrutinized using several verification techniques (V&V) [16, 17]. Failure avoidance (FA) was introduced as an additional layer of protection in M&S to assure that the problem related with the simuland will be solved properly without any undesirable consequences [18]. Most of the three aspects of reliability assurance techniques, *i.e.*, V&V, Quality Assurance (QA) [19, 20], and Failure Avoidance [18, 21] would be applicable in Internet of Things and in superintelligence studies.

However, additional reliability assurance (RA) issues [22] need to be resolved for Internet of Things as well as for superintelligence. Some vital issues include autonomy, cooperation, misunderstanding as well as unethical behavior by intelligent agents.

1.3. Organization of the Chapter

In section 2, the concept of connectedness and its several dimensions are clarified.

CHAPTER 7

P-UTADIS: A Multi Criteria Classification Method

Majid Esmaelian[1,*], **Hadi Shahmoradi**[1] and **Fateme Nemati**[2]

[1] *Department of Management, Faculty of Administrative Sciences and Economics, University of Isfahan, Isfahan, Iran*

[2] *Department of Artificial Intelligence, Faculty of Computer Engineering, University of Isfahan, Isfahan, Iran*

Abstract: In this chapter, a new multi criteria classification technique is presented. This method is a developed/advanced UTilites Additives DIScriminantes (UTADIS) method which applies a polynomial function as its utility function for each attribute rather than a piecewise linear approximation. The method, named P-UTADIS, is applied for both nominal and ordinal group and by calculating coefficients of polynomials, threshold limits of classes and weights of attributes, tends to minimize the classification errors. Unknown parameters of a classification problem are estimated through a hybrid algorithm including Particle Swarm Optimization algorithm (PSO) and Genetic Algorithm (GA). The results of implementing P-UTADIS on different data sets and comparing them with some other previous methods indicate the high efficiency of P-UTADIS.

Keywords: Classification, Genetic algorithm, PSO algorithm, UTADIS method, Utility function.

1. INTRODUCTION

Over the last 20 years, data has increased worldwide and according to the International Data Corporation (IDC), the total created and copied data has become nine fold within five years [1]. In order to manage information overload, techniques like machine learning are employed to organize and categorize it. Data mining as a joint effort from databases, machine learning and statistics, contributes to breaking large data into pieces, so it is used for automated processing of the huge amount data. A key element in data analysis procedure is the unknown data grouping through analysis. Classification is one of the important and widely-applied tasks in data mining when data arrangement and grouping is sought [2 - 5].

[*] **Corresponding author Majid Esmaelian:** Faculty of Administrative Sciences and Economics, University of Isfahan, Isfahan, Iran; Tel/Fax: +98 3137935204; E-mail: m.esmaelian@ase.ui.ac.ir

Faria Nassiri-Mofakham (Ed)

Discrimination, classification and sorting are the most common terms, used in addressing specific problems where a limited set is mapped into known groups. In spite of the fact that these three terms refer to the assignment of a set of alternatives into predefined groups, a difference among the problems that they describe is evident. Discrimination and classification refer to problems, which cover nominal groups with different attributes and there is no preference relation between them. Iris classification and pattern recognition are two examples of this type. Sorting addresses problems that are defined in an ordinal manner, where bankruptcy risk evaluation problem is a typical example of this type. For simplicity the general term "classification" is mostly used instead [4]. Clustering is a data organization method, which structures data into clusters based on similarity. In fact, this method seeks to find hidden pattern(s) among data sets and group data objects into disjoint clusters are sought through this method [6].

It is necessary to understand the difference between classification and clustering: in classification, problems data is assigned into specific groups with known attributes; while in clustering, problems of the structure in data are identified and then categorized. In classification, the groups are defined in advance, so the analyst knows the results, whereas in clustering, the objective is to identify clusters (groups) and the analyst tries to manage the knowledge in a data set in an appropriate manner (Fig. **1**) [4].

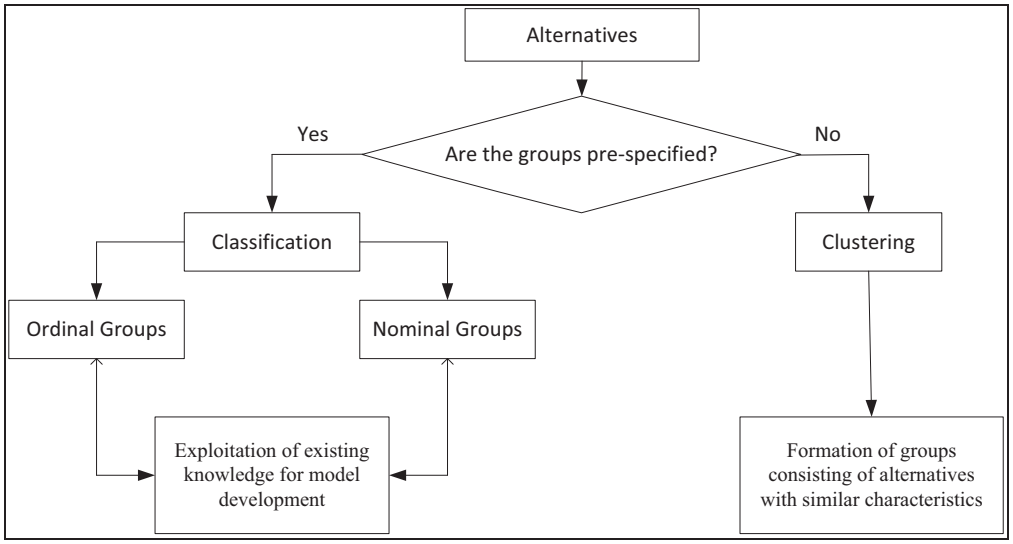


Fig. (1). Classification *VS* Clustering [4].

After a brief review of classification, the discussion will elucidate a technique in classification and compare it with some other methods.

2. CLASSIFICATION

The classification problem is very important in many research fields. The importance of classification is evident in many practical fields like Medicine [7, 8], Pattern recognition [9 - 11], Production management [12, 13], Marketing [14, 15], Environmental management and energy policy [16], and Financial management and economics [17, 18].

Data classification, as the most widely-applied technique, consists of grouping data instances into a specific class that can be used to classify new instances by measurements which are indirectly related to the class attributes. Data classification process involves learning and testing phases. In learning phase, the classification algorithm analyzes the training data, while in testing phase, the test data are used to estimate the accuracy of classification rules and assign a label to an unlabeled test instance. The rules can be implemented to the new tuples if the accuracy is acceptable. In fact, the classification rule or empirical correlation can be developed from a training data set, which has the known properties of interest and measurements. Then the rule can be implemented to predict the property of a new sample [3, 19].

In some cases, like lazy learning, there is no learning phase, so the classification is performed directly from the correlation of the training instances to the test instances. The instance-based methods like the nearest neighbor classifier are some other examples [5].

Most classification methods operate based on the regression philosophy and try to apply knowledge in the prior definition of the groups. The procedure of developing a classification model is presented in Fig. (**2**) [4].

In general, the existing classification methods address classification similar to that of traditional statistical regression. These methods tend to determine the functional relationship between a dependent variable and a vector of independent variables with a difference that in classification problem, the dependent variables are not real valued variables and are discrete. Therefore, the dependent variable, which identifies the classification of the alternatives, will be presented by C and its discrete groups will be presented by C_1, C_2,..., C_q, where, q is the number of the groups. Symbol G represents the independent variables' vector and they referred to as criteria or attributes. Attribute defines a nominal description of alternatives, while criterion defines an ordinal description; criterion can be used when an alternative is preferred over another [20].

PART III:
APPLICATIONS

CHAPTER 8

Artificial Intelligence Techniques for Credit Risk Management

Abdolreza Nazemi[*] and **Konstantin Heidenreich**

School of Economics and Business Engineering, Karlsruhe Institute of Technology, Karlsruhe, Germany

Abstract: For calculating the expected loss besides the exposure at default two measures, namely the probability of default and the loss given default (LGD), have to be taken into account. While in literature much attention has been paid to the default rate the loss given default is still comparatively less investigated. Especially, as a consequence of the enhanced regulation by Basel II accord loss given default has become a much more critical measure for banks and other financial institutions as it has been before.

Therefore, in this study artificial intelligence and statistical techniques are used to predict the recovery rate of corporate bonds that defaulted between 2002 and 2012. Macroeconomic factors, bond characteristics and industry specific factors are taken into account as covariates for the techniques. Starting from the base case of a plain-vanilla Least Squares-Support Vector Machine (LS-SVM) two further modifications of a LS-SVM are presented. The performance of the LS-SVM happens to be significantly better than the performance of a casual linear regression approach. So, it is empirically shown that support vector regression is an approach to LGD modeling which has significant potential to be used for forecasts of the recovery rate both for banks and other financial institutions as well as for investors in distressed debt.

Keywords: Loss given default, Recovery rate, Credit Risk, Support Vector Machine.

1. INTRODUCTION

There are two sources of capital for companies. Equity financing gives the equity holders a residual claim on the companies' assets after all debt holders have been paid back the amount of debt, that is principal (the initial nominal amount of debt) and interest. In case of a bankruptcy the debtholders' claims are senior to the

[*] **Corresponding author Abdolreza Nazemi:** School of Economics and Business Engineering, Karlsruhe Institute of Technology, Karlsruhe, Germany; Tel/Fax: 004972160847954; E-mail: abdolreza.nazemi@kit.edu

Faria Nassiri-Mofakham (Ed)

equityholders' claims. Therefore, if a company files for bankruptcy the debtholders' debt has to be paid back out of the remaining capital as long as there are any assets left.

The recovery rate, also known as 1 - Loss given default (LGD), denotes the remainder of the debt that is paid back to the creditors in case of a default. For calculating the expected loss besides the exposure at default (EAD) two measures, namely the probability of default (PD) and the loss given default (LGD), have to be taken into account. According to Schuermann *et al*. [1] the expecting loss amounts to:

$$\text{Expected Loss} = \text{EAD} * \text{PD} * \text{LGD} \tag{1}$$

While in literature much attention has been paid to the default rate the loss given default is still comparatively less investigated[1]. Especially, as a consequence of the enhanced regulation by Basel II accord loss given default has become a much more critical measure for banks and other financial institutions as it has been before. According to Loterman *et al*. [2] within the required framework of Basel II loss given default has a linear impact on the minimum capital which banks and other financial institutions have to hold. Therefore any changes in the estimate of loss given default have a strong influence on the required minimum capital and more accurate forecasts can have immediate economic benefits. In the following we will focus on the recovery rate which is equivalent to 1-LGD. So higher recovery rates bring a lower LGD.

As stated by Schuermann *et al*. [1] the Basel II accord shows two different approaches for calculating the credit risk requirements: First a standardized approach using the results from rating agencies on a risk-weighted asset basis can be used. Alternatively, an internal ratings based (IRB) approach can be implemented. The IRB approach allows to use internal estimates for the risk parameters for the calculation of credit risk capital. Financial institutions using the latter method need to develop proprietary methods for estimating these key risk parameters. As one relevant parameter is loss given default both banks and supervisors need to know reliable calculation methods for this parameter.

Moreover, Jankowitsch *et al*. [3] conclude that the magnitude and variability of defaults during the global financial crisis have added additional weight to the importance of calculating accurate forecasts of loss given default. In a low default world inaccurate forecasts might have been less risky and might have been not detected for the simple reason that there occurred less default events.

Therefore, in this study artificial intelligence and statistical techniques are used to predict the recovery rate (RR) of corporate bonds that defaulted between 2002 and 2012. Macroeconomic factors, bond characteristics and industry specific factors are taken into account as covariates for the techniques. Starting from the base case of a plain-vanilla Least Squares-Support Vector Regression (LS-SVR) two further modifications of a LS-SVR are presented. The performance of the LS-SVR happens to be significantly better than the performance of a casual linear regression approach. So, it is empirically shown that support vector regression is an approach to LGD modeling which has significant potential to be used for forecasts of the recovery rate both for banks and other financial institutions as well as for investors in distressed debt.

There are a wide range of bond characteristics that have predictive power for the recovery rate of the respective bond. In our study we make use of these characteristics to predict the recovery rates of corporate bonds.

As far as we know and demonstrate in Table **1**, very little attention has been paid in literature to predicting recovery rates with Support Vector techniques. However, there are two studies that have dealt with this topic. Loterman *et al*. [2] present a comprehensive comparison of 24 techniques for the prediction of recovery rates of diverse instruments such as corporate loans, mortgage loans and personal loans. They show a clear trend that non-linear techniques like Support Vector Machines and artificial neural networks have more predictive power than traditional linear models. Moreover, it is stated that two-stage models, a combination of non-linear and linear models, have similar predictive power like non-linear models with the advantage of an improved comprehensibility.

Table 1. Overview of models in literature, based on Hochstotter and Nazemi [6].

Author	Models	Author	Models
Acharya *et al*. [7]	Linear Regression	Gurtler & Hibbeln [8]	Linear regression model
Altman *et al*. [9]	Multivariate regression	Han & Jang [10]	Generalized linear model, OLS
Altman & Kalotay [11]	Mixtures of Gaussian	Hartmann *et al*. [12]	OLS Regression, FMMs
Ando [13]	Bayesian Method	Hoechstoetter *et al*. [14]	LR, NN, KNN, CHAID, CART, SVM
Bastos [15]	Fractional Response Regression, RT	Jacobs *et al*. [16]	beta-link generalized linear model
Bastos [17]	Fractional Regression, Neural Network	Jankowitsch *et al*. [3]	Linear Regression
Bastos [18]	Bagging Predictors	Jokivuolle & Viren [19]	Time-series models

CHAPTER 9

A Novel Task-Driven Sensor-Management Method in Multi-Object Filters Using Stochastic Geometry

Amirali K. Gostar[*], **Reza Hoseinnezhad** and **Alireza Bab-Hadiashar**

RMIT University, Melbourne, VIC 3000, Australia

Abstract: Multi-object estimation refers to applications where there are unknown number of objects with unknown states, and the problem is to estimate both the number of objects and their individual state vectors, from observations acquired by sensors. The solution is usually called a multi-object filter. In many modern complex systems, multi-object estimation is one of the most challenging problems to be solved for satisfactory performance of the dedicated tasks by the system. A wide range of practical applications involve multi-object estimation, from multi-target tracking in radar to visual tracking in sport, to cell tracking in biomedicine, to data clustering in big data analytics. In the past decade, a new generation of multi-object filters has been developed and rapidly adopted by researchers in various fields, that is based on using stochastic geometric models and approximations. In such methods, the multi-object entity is treated as a random finite set (RFS) variable (with random variations in its cardinality and elements), and the stochastic geometric-based notions of density and integration, developed in the new theory of finite set statistics (FISST), are used to formulate Bayesian filters for estimation of cardinality (number of objects) and state of the multi-object RFS variable. Examples of such solutions include PHD filter, CPHD filter and the recent trend of multi-Bernoulli filters. In many applications, the observations are acquired through a controlled sensing procedure, either by controlling a mobile sensor (*e.g.* in radars and visual surveillance) or by selecting a sensor node (*e.g.* in sensor networks). This chapter reviews the most recent developments in sensor management (control or selection) solutions devised for multi-Bernoulli solutions in various applications. It first presents basics of random set theory and formulation of the cardinality-balanced and labeled multi-Bernoulli filters. The most recent sensor-control and sensor-selection solutions that have been proposed by the authors and other researchers active in the field are then presented and comparative simulation results are discussed.

Keywords: Stochastic Geometry, Random Sets, Point Process, Finite Set Statistics, Multi-Target Tracking, Sensor Management, Sensor Selection, Sensor Control, Multi-Bernoulli Filter, OSPA, PEECS.

[*] **Corresponding author Amirali K. Gostar:** RMIT University, 124 La Trobe St, Melbourne VIC 3000, Australia; Tel: +61-3-9925-6135; Fax: +61-3-9925-6108; E-mail: amirali.khodadadian@rmit.edu.au

Faria Nassiri-Mofakham (Ed)

1. INTRODUCTION

Sensor fusion techniques have attracted substantial interest due to their increasing utilization in a variety of applications such as radar, sonar, guidance, navigation, and air traffic control [1], image processing [2 - 6], oceanography [7 - 9], autonomous vehicles and robotics [10, 11], remote sensing [12, 13] and biomedical research [14 - 16].

Relative to multi sensor systems, the information acquired by a single sensor system is very limited. Employing multiple sensors can provide sufficient information of the environment in an integrated manner, increase machine perception and improve awareness of the state of the world.

In recent years, due to the rapid progress in sensor technology development, sensors are becoming more common. In order to sense the complex nature of the environment in different scenarios, numerous sensors are needed. This increases the amounts of acquired data which is needed to be processed and motivates the emerging interest in research into intelligent management of sensor resources to improve performance of data fusion.

1.1. Multi-Sensor Management

Multi-sensor management is formally described as a system or process that designed to manage the usage of a set of sensors or measurement devices in a dynamic, uncertain environment. The aim is to improve the performance of data fusion and ultimately to improve the perception of the environment [17].

In a sensor network, multi-sensor management solutions may also be designed to avoid increasing amount of storage and computational requirements in a sensor network system by controlling the data gathering process such that only the necessary data are collected and stored [18].

The why and what issues of both single-sensor and multi-sensor management were thoroughly discussed in the papers [19 - 23].

The basic objective of multi-sensor management is to select the right sensors or choose the best states of controllable sensors to do the right task on the right object at the right time. The sensor manager is responsible for addressing questions like [24, 25]:

- Which observation tasks are to be performed and what are their priorities?
- How many sensors are required to meet an information request?
- When are extra sensors to be deployed and in which locations?
- Which sensor sets are to be applied to which tasks?

- What is the action or mode sequence for a particular sensor?
- What parameter values should be selected for the operation of sensors?

The fundamental task of sensor management is to choose the optimal sensor parameter values given a set of sensors with respect to a given task, see for example, the paper [26]. In general, sensor management solutions are decision making procedures in which the algorithm decides on what sensors to use and for which purposes, as well as when and where to use them.

Widely acknowledged is the fact that it is not realistic to continually observe everything in the environment, and therefore, selective perception becomes necessary, requiring the sensor management system to decide when to sense what and with which sensors. Typical temporal complexities, which must be accommodated in the sensor management process, were discussed in [27].

1.2. Sensor-Selection and Sensor-Control in Target Tracking Scenarios

Sensor management solutions are broadly used in multi-target tracking scenarios usually in the form of sensor-selection in sensor networks or sensor-control for a set of mobile sensors. Tracking targets in a sensor network could result in a large amount of sensor measurement data. However, as it was mentioned earlier, due to physical and computational constraints, it is required that at each epoch, only a subset of sensors is selected to communicate with the central processor. In such cases, the sensor-selection problem is to select the right sensor nodes that maximize observability of the network for tracking multiple targets. In general, sensor-selection problem comprises of two underlying frameworks:

- a multi-object filtering process,
- a decision-making method.

This is a sequential decision making process under stochastic uncertainties. These uncertainties stem either from the multi-target tracking process or from the effects of selecting different sensor nodes. An example of the sensor-selection problem is demonstrated in Fig. (**1**) in which a sensor network is used for traffic monitoring.

The sensor-control problem is fundamentally similar to the sensor-selection problem. In sensor-control, a set of sensor commands is used to change mobile sensors' states and applying the right command results in estimates of the number and states of targets with maximum expected accuracy. A practical example of sensor-control is shown in Fig. (**2**), in which a UAV needs to be navigated point by point in such a way that the number and states of multiple vehicle targets can be estimated with maximum expected accuracy.

CHAPTER 10

Parallel Processing in Holonic Systems

Imane Basiry[1,*] and **Nasser Ghasem-Aghaee**[2]

[1] *Department of Computer Engineering of Sheikh Bahaei University, Baharestan, Iran*

[2] *University of Isfahan, Isfahan, Iran*

Abstract: Scheduling is a basic activity in large scale systems with unexpected and high complexity demands. Instances of these complex systems are found in manufacturing, logistics, economics, traffic control, and biology. The number of entities and their interconnections are the reasons motivate researchers to find solutions which are not based on central control structures. Multi-agent based architecture is a distributed collections of interacting entities which function without a supervisor. The advantage of holonic self-organization concepts lies in the fact that they contribute to achieve more efficient performance. According to these principles, several approaches have been and are being designed, which are considered weak in handling emergency demands in an industrial environment. The concepts of multi-agent and holonic systems are addressed and discussed in this chapter where their advantages and weak points are revealed with a focused in holonic control architecture in overcome the weak points. The main objective of this architecture is to reduce time and complexity overload. The concept of parallel processing and task priority are of concern here. Task priority reduces time delay in an unexpected situation causes for handling critical tasks. The techniques like self-organization methods, high percentage of autonomy for controller holons, use of common data source, and increasing parallel processes are applied in reducing output delivery time. This newly proposed architecture is tested in a simulation environment.

Keywords: Holonic systems, Multi-agent systems, Parallel processing, Scheduling, Self-organization, Task priority.

1. INTRODUCTION

For the purpose of developing new approaches regarding parallel process, time reduction in this case, there exist several definition .Multi-agent systems consist of multiple interacting computing factors known as agents. Agents are computer systems with two important abilities: 1) they are, at least to some extent, capable of the autonomously deciding what they need to do to accomplish their goal and

* **Corresponding author Imane Basiry:** Department of Computer Engineering of Sheikh Bahaei University, Baharestan, Iran; Tel: +989370910954; E-mail: I.basiry@gmail.com

2) they are able to interact with other agents not by exchanging data, but by engaging in analogues of the kind of social activities like cooperation, negotiation, coordination, *etc.* which everyone is a part of daily life [1]. In the related literature, the agents provide viable solution in complex systems modeling. In particular, Multi-Agent Systems successful manner in a large variety of distributed intelligence settings [2].

The organization of a multi-agent system consist of the set of roles, authority and structures' relation which control its behavior. All multi-agent systems contain some or all of these features, therefore, they all have some form of organization, although it might be implicit and unofficial. Just as with human organizations, such agent organizations determine how the members of a given population interact, not necessarily on a moment by moment basis, but in long-term with respect to a particular objective(s). The above mentions facts, might affect data flow, authority relation, coordination patterns, resource allocation, or any number of other system features [3 - 6].

Many researchers have demonstrated that in an organizational design where the agent system is adopted, a significant effect on of performance is observed. A series of organizational strategies are developed in this line of research, where each strategy has its own strengths and weaknesses. Hierarchy, holarchy, and absolute autonomous are the types of multi-agent systems organizations.

The hierarchy or hierarchical organization is the earliest type of structured organizational design for multi-agent system and earlier distributed AI architectures [8]. The data made by lower-level agents in a hierarchy usually flow upwards to get a general view, while the control signal or supervisory orders flow downwards [9].

A holon, just like an agent, is an intelligent entity able to interact with the environment and to take decisions in solving a specific problem; holons are able to be a whole and a part at the same time. This unique nature of holons affect the organization systems in three levels: holarchy functions as autonomous wholes in supra-ordination to their parts, as affiliate parts in sub-ordination to control on upper levels, and in coordination with their environment [2]. A comparison between holarchies and hierarchies in organizations reveals that holarchies are more easily applied to domains where the objectives can be broken down into subtasks which can be allocated to individual holons in a recursive manner. The degree of autonomy in an individual holon is undefined and could differ between the levels or even between the holons at a same level. It is assumed that the level of autonomy is neither complete nor completely absent [7].

The holonic organizations are derived primarily from the partially autonomous and encapsulated nature of holons. Holons are usually endowed with enough autonomy to define how efficiently assess the requests they receive. Because the requester does not need to know exactly how the order will be completed, the holon has the great flexibility degree in its choice of behaviors, which can enable it to nearly coordinate potential conflicting or complementary tasks. This feature decreases the knowledge burden placed on the requester and allows the holon's behavior to adapt to new situations without coordination in future in a dynamic manner, so long as the original commitment's needs are met [10].

Many architectures and developments in holonic structure are presented with different application domains, like scheduling, manufacturing and control, material handling, machine controller and assembly systems [11].

2. LITERATURE REVIEW

The concept of Agent-oriented programming and the concept of agent centering software were first applied by Yoav Shoham in 1990. His developed agents follow a specific pattern as one method with a single parameter [12].

Multi-agent systems consist of agents and their environments. Typically, studies regarding multi-agent systems are software agent oriented. However, the agents in a multi-agent system could be a team of robots or humans [13]. Topics of research in MAS contain scientific [14, 15], agent-oriented software engineering, and robotic issues [16].

Horling and his team conducted a survey on multi-agent organizational patterns, including: hierarchies, holarchies, teams, coalitions, congregations, societies, federations, and matrix organizations. He provides an explanation for each one of the above mentioned organizations, by considering their advantages and disadvantages, and offering examples of how they may be instantiated and maintained [7].

The term 'holon' was first defined by Arthur Koestler in his book, '*The Ghost in the Machine*'. According to his description, a holon (Greek: ὅλον, holon neuter form of ὅλος, holos "whole") is something which is simultaneously a whole and a part [17].

Holonic organizations have proven to be effective and efficient solutions to many problems with hierarchical and self-organizing structures [18] and have been and are being applied in a grate range of complex systems in a successful manner, (*e.g*. in transportation [19], manufacturing systems [20], adaptive mesh problem [21] and health organizations [22]).

CHAPTER 11

Robot-Assisted Language Learning: Artificial Intelligence in Second Language Acquisition

Dara Tafazoli[*] and **M[a] Elena Gómez-Parra**

Department of English and German Philologies, University of Córdoba, Córdoba, Spain

Abstract: The wide spread and development of Technologies in our daily lives provides lots of opportunities for language teachers and learners to benefit though it may also result in some pedagogical difficulties. At its first stage, this chapter aimed at introducing Computer-Assisted Language Learning (CALL) as the first step in applying Artificial Intelligence (AI) to language learning and teaching; then, the new concept of Robot-Assisted Language Learning (RALL) defined both theoretically and applied to show the new trends in the educational purposes of AI.

Keywords: Artificial Intelligence (AI), Computer-Assisted Language Learning (CALL), Robot-Assisted Language Learning (RALL), Second Language Acquisition (SLA), Language learning, Language teaching.

1. INTRODUCTION

Shifting from a pedagogical paradigm is not always necessarily successful. Similarly, language teaching and learning have the same position. The wide spread and development of Information and Communication Technologies (ICT) in our daily lives provides lots of opportunities for language teachers and learners to benefit though it may also result in some pedagogical difficulties. Learning a foreign language (such as English, Spanish, French, *etc*.) has increased in popularity, and therefore evolved into a necessity in our communicative world. Moreover, the need to combine both technology and language has become a vital part of language scholars and researchers' jobs. The literate, communicative, and technology-based world has to accept the challenges of applying this new movement in education regardless of being either negative or positive. Several e-learning technologies are available to be used in educational contexts. Although its forms are different in different contexts based on the economical situations,

[*] **Corresponding author Dara Tafazoli:** Department of English and German Philologies, University of Cordoba, Córdoba, Spain; Tel: +34 957 212 563; E-mail: z52tatad@uco.es

Faria Nassiri-Mofakham (Ed)

almost allof the settings are trying to apply technologies in their educational programs to meet the demands of both learners and teachers.

The concept of "Artificial Intelligence" (AI) has been specified to certain software besides computer programs in general [1]. Therefore, it would not be possible to consider all the data processors programs (*i.e*. calculators) as an artificial intelligent device. The non-artificial intelligent devices are predictable based on their finite number of alternative procedures. On the other hand, artificial intelligence can learn new procedures to solve a problem by which it could be considered as a proper assistant for language teachers and learners. At its first stage, this chapter is aimed at introducing Computer-Assisted Language Learning (CALL) as the first step in applying AI to language learning and teaching; then, the new concept of Robot-Assisted Language Learning (RALL) is defined both theoretically and applied to show the new trends in the educational purposes of AI.

2. THE BEGINNINGS OF AI: COMPUTER-ASSISTED LANGUAGE LEARNING

Levy defined Computer-Assisted Language Learning (CALL) as "the search for and study of applications of the computer in language teaching and learning" [2. p.1]. Although the name includes "computer", the term CALL embraces any application of Information and Communication Technologies (ICT) to teaching and learning foreign languages. Two different terms such as CALI (Computer-Assisted Language Instruction) and CAI (Computer-Assisted Instruction) were used instead of CALL before the early 1980s [3]. Around the early 1990s, alternative terms such as TELL (Technology-Enhanced Language Learning) also emerged.

The application of technology in education is not a recent story; however, applying technology in language learning is very new for language learners, teachers and scholars. Computer-assisted instruction was first used in 1950s for other purposes than language teaching. Learning from a colleague in physics [4], used the university's mainframe for computer-assisted instruction in a French program. A computer-based diagnostic French test was reported [5]. Individual language teachers such as Rex Last and Graham Davies started to use technology for language learning purposes in the UK [6]. Richard Atkinson and Patrick Suppes initiated the best-known early CALL project at Stanford University, in the US. This project, in collaboration with IBM, was based on Atkinson's mathematical learning theory rather than language learning theories [7]. The importance of this project came from the point that Atkinson and Suppes formed the Computer Curriculum Corporation in 1967, which continued to provide

instruction in English as a Second Language [8 as cited in 6].

The Computer-Assisted Learning Exercises for French (CLEF) project began by the cooperation of three universities in Canada to teach basic French grammar [9]. The Programmed Logic for Automatic Teaching Operations (PLATO) and the Time-Shared, Interactive, Computer-Controlled Information Television (TICCIT) projects were developed to teach different languages. The former system was used for English, French, German, Spanish and Italian in 1980 [10]; and the later for those languages in addition to many others such as Arabic, Chinese, Hindi, Hebrew and Swedish. The courseware developed on PLATO system supported audio, graphics and flexible response analysis which Hart found it very successful [11].

The 1983 annual TESOL (Teaching English to Speakers of Other Languages) convention in Canada was the milestone in CALL from two aspects: 1. The CALL was the expression agreed upon. 2. A suggestion was made to establish a professional organization titled "CALICO" (Computer-Assisted Language Instruction Consortium). By that time, CALL flourished in education and market settings: a course on CALL at Lancaster University, EuroCALL professional organization, production of introductory materials, and publication of a large number of books on CALL.

Computer-assisted language learning and teaching provides students and teachers with lots of opportunities. The gradual development of the role of the technology in language courses has introduced a few different phases. Each phase relates to a certain level of technology and pedagogical level. These phases are called: behavioristic CALL, communicative CALL, integrative CALL [cf. 12 - 14]. Each phase has its own advantages and disadvantages.

2.1. Phases of CALL

2.1.1. Behavioristic CALL

This phase was conceived in the 1950s and implemented in the 1960s and 1970s. In that time, three main factors affected the use of CALL: (a) programmed instruction based on behaviorism; (b) the enhanced sophistication of data processing; and (c) the use of time sharing system for CALL purposes [15]. As the psychological basis of this phase declared, (according to the behaviorism) activities should be entailed "drill and practice". In that time, the role of the computer was limited to a vehicle to deliver instructional materials to learners. Taylor stated that such function was the same as that of a tutor, where the delivered materials were repetitive language drills, vocabulary, grammar and translation tests [16]. The most famous tutorial system was PLATO which was

SUBJECT INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

> Recent advances in infrastructure for sensing, computing, and communications are leading to new applications and a resurgence of interest in intelligent systems. This timely volume provides an interesting collection of articles on emerging topics, including intelligent agents, human-computer interfaces, and simulation.
>
> ***Professor Munindar P. Singh***
> *Department of Computer Science*
> *North Carolina State University*
> *USA*

> Besides the tremendous growth of computation power of modern computers, an important reason for the recent revival of artificial intelligence is that the research work has become multi-disciplinary. This book nicely presents many such results, and will shed light on the future research work.
>
> ***Professor Ho-Fung Leung***
> *Department of Computer Science and Engineering*
> *The Chinese University of Hong Kong*
> *China*

Faria Nassiri-Mofakham

Dr. Faria Nassiri-Mofakham received her PhD in Computer Engineering from University of Isfahan (UI). She was a committee member in Central Bank of Iran and consultant of Iranian Ministry of Commerce, visited Intelligent Agent Technology group in Swinburne University of Technology in Australia, participated in ALP/GULP International School on Computational Logics/Declarative Agent Languages and Technologies in Italy, joined Department of Information Technology at UI as an Assistant Professor, and is also a research and technology committee member for internationalization of UI. She was awarded Distinguished Student of UI, The Best Thesis of Iran, The Best Woman Researcher of Iran, and Nationwide Outstanding Education and Research. She has been committee member of several domestic and international conferences and reviewer of journals including INS, ECRA, and KnoSys, was selected as outstanding reviewer of ECRA, and has become a member of ECRA editorial board. Her *BraveCat*, *ParsAgent* and *ParsCat* teams were chosen as finalists of the International Automated Negotiating Agents Competition (ANAC). She also supervised a team in Alibaba Tianchi international big data competition for *Purchase and Redemption Forecasts*. Her research interests are in e-commerce with a focus on computational theories, methods and technologies in the field of computer science especially Artificial Intelligence interdisciplined with sociology, economics, marketing, and psychology, where automated negotiation, complex auctions, game theory, multiagent systems, machine learning, data mining, and computational social choice for modeling the mechanisms and users in Smart Markets are of most interest to her.