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FOREWORD

These proceedings contain the papers of the International Conference "Information and Communication Technologies in Business and Education" which took place at the University of Economics – Varna, Bulgaria, 18 October 2019.

The international scientific conference is dedicated to the **50th anniversary of the Department of Informatics at the University of Economics – Varna.** The conference is also dedicated to the 100th anniversary of the University. The included papers describe recent scientific and practical developments in the field of information and communication technologies, information systems, and their applications in business and education.

The papers in the Proceedings are peer reviewed and are checked for plagiarism.

C O N T E N T S

COMPUTATIONAL INTELLIGENCE IN SMART EDUCATION AND LEARNING

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Abstract

Computational intelligence (CI) techniques are intelligent paradigms based on artificial intelligence (AI) concepts, approaches and theories. CI deals with the development of intelligent software that improves automatically through experience. Researchers have been used the CI algorithms in developing a new generation of smart tutoring and learning systems. This paper discusses the CI approaches for developing the digital e-Learning and intelligent tutoring systems. In addition, the paper presents some examples of the developed systems by the author and his colleagues during the last ten years.

Keywords: *Artificial intelligence, Computational intelligence, Machine learning, intelligent tutoring systems, Smart learning systems.*

INTRODUCTION

CI techniques aim to enable computers to learn from data and make improvements without any dependence on commands in a program. This learning could eventually help computers in building smart models such as those used in the prediction tasks. On the other side, artificial intelligence (AI) is an interdisciplinary science and based on many disciplines such as: computer science, mathematics, philosophy, psychology, life sciences, linguistics, library sciences and engineering. The goal of AI is to develop intelligent software models of the human behaviour, i.e. the abilities of thinking, hearing, talking, walking and also feeling. The AI field covers many research areas, e.g. knowledge engineering, action and perception, reasoning methodologies, cognitive computing and modelling, connectionist models, constraint satisfaction, machine learning, natural language processing, and AI planning and scheduling. The main AI technologies include: vision systems, robotics, intelligent games, expert systems, natural language (NL) understanding, intelligent multimedia systems, data mining and knowledge discovery systems and intelligent tutoring and learning systems.

On the other side, development of intelligent tutoring and learning systems are the very important industry in the area of AI in education. The main three components of efficient and robust intelligent tutoring and learning systems in any domain are the "knowledge base", "inference engine" and NL interface. Concerning the knowledge base there are many knowledge representation and management techniques, e.g.; lists, trees, semantic networks, frames, scripts, production rules, cases, and ontologies. The key to the success of such systems is the selection of the appropriate technique that best fits the domain knowledge and the problem to be solved (Greer, 1995; Mazza and Milani, 2005). That choice depends on the experience of the knowledge engineer. Regarding the inference engine, there are many methodologies and approaches of reasoning e.g.; automated reasoning, case-based reasoning, common sense reasoning, fuzzy reasoning, geometric reasoning, non-monotonic reasoning, model-based reasoning, probabilistic reasoning, causal reasoning, qualitative reasoning, spatial reasoning and temporal reasoning. In fact, these methodologies receive increasing attention within the AI in education and learning communities (Salem, 2011; Salem, 2008; Salem, 2007; Salem and Parusheva, 2018b).

1. INTELLIGENT TUTORING SYSTEMS (ITS) AND SMART LEARNING SYSTEMS (SLS)

ITS is a knowledge-based software that act as an intelligent tutor used in real teaching. ITS is also used in learning, and training situations (Greer, 1995). From the technical point of view, ITS is composed of the following software components: (a) expert model, (b) student mode, (c) instructional module, (d) interface and (e) knowledge acquisition module. On the other side, SLS are AI-based systems that imitates the human mind. The main characteristics of these systems are the ability of inference, reasoning, perception, learning, and knowledge-based systems. To a limited degree, AI permits SLS to accept knowledge from human input, then use that knowledge through simulated thought and reasoning processes to solve problems. Many types of ITS and SLS are in existence today and are applied to different domains and tasks, e.g., geology, biological sciences, medical sciences, health care, commerce, and education (Salem, 2011; Mazza and Milani, 2005). From the development and

computing aspects, intelligent software authoring tools and shells (SATS) allow a course instructor to easily enter domain and other knowledge without requiring computer programming skills. THE SATS automatically generates an ITS/IeLS focusing on the specified knowledge (Greer, 1995).

2. COMPUTATIONAL INTELLIGENCE FOR ITS AND SLS

A. Case Based Reasoning (CBR) Technique

CBR is an analogical reasoning method provides both a methodology for problem solving and a cognitive model of people (Kolonder,1993). CBR means reasoning from experiences or "old cases" in an effort to solve problems, critique solutions, and explain anomalous situations. People tend to be comfortable using CBR methodology for decision making, in dynamically changing situations and other situations were much is unknown and when solutions are not clear. From knowledge engineering point of view, the “case” is a list of features that lead to a particular outcome. From the CI perspective, CBR refers to a number of intelligent algorithms smart processes that can be used to record and index cases and then search them to identify the ones that might be useful in solving new cases when they are presented. In addition, there are techniques that can be used to modify earlier cases to better match new cases and other techniques to synthesize new cases when they are needed. CBR has already been applied in several different applications in many domains, e.g. medicine, industry, law, banking (Abdrabou and Salem, 2010; Kolonder, 1993).

B. Ontological Engineering (OE) Approach

The term “ontology” is inherited from philosophy, in which it is a branch of metaphysics concerned with the nature of being. The main objective of using ontologies is to share knowledge between computers or computers and human. Most of the usages of ontologies in the field of computer science are related to knowledge-based systems and intelligent systems. These types of ontologies include a small number of concepts and their main objective is to facilitate reasoning. During the last decade, increasing attention has been focused on ontologies (Tankelevciene and

Damasevicius, 2009). At present, there are applications of ontologies with commercial, industrial, medical, business and research focus (Salem, 2010; Salem and Alfonse, 2007; Su and Ilebrekke, 2002).

C. Data Mining and Knowledge Discovery in Databases Approach

Data mining methodology aims to extract useful knowledge and discover some hidden patterns from huge number of databases which statistical approaches cannot discover. It is a multidisciplinary field of research includes: AI, CI, machine learning, data science, and statistics, Data mining techniques aim at providing intelligent computational methods for accumulating, changing and updating knowledge in intelligent systems, and in particular learning mechanisms that will help us to induce knowledge from information or data.

From the intelligent soft computing and data science, knowledge discovery in databases (KDD) involves the following three main processes; (a) using the database along with any required selection, preprocessing, sub-sampling, and transformations of it, (b) applying data mining methods (algorithms) to enumerate patterns from it, and (c) evaluating the products of data mining to identify the subset of the enumerated patterns deemed knowledge. Data mining is supported by a host that captures the character of data in several different ways, e.g. clustering, classification, link analysis, sequence analysis, regression models, summarization, text mining, sequential pattern mining, association rules mining. In addition, there are a lot of intelligent techniques to perform these tasks e.g. bio-inspired algorithms, decision trees, k-means. For more technical details and aspects, we refer to the books (Cios, Pedrycz and Swiniarski, 1998; Witten and Frank, 2005).

3. BENEFITS OF CI TECHNIQUES TO ELEARNING/TUTORING SYSTEMS

This section discusses the benefits of the previous techniques in e-learning and tutoring systems.

A. Benefits of CBR Approach to eLearning/tutoring systems

There are several benefits where students/learners should be able to perform better using CBR methodology, e.g.:

- Students/learners will be able to recognize more situations and the solutions that go with these cases include failure cases, students will be able to benefit from the failures of others.

- Students/learners will have access to obscure cases that they otherwise would not able to make use of. These obscure cases can help with any of the tasks previously listed.

- During a training period CBR system provides the student with a model of the way decision making ought to be done.

* For tasks where there is much to remember, CBR systems can augment the memories of even educators.

* Both educators and students tend to focus on too few possibilities when reasoning analogically or to focus on the wrong cases.

B. Benefits of Ontologies to Intelligent Educational Systems

Ontologies usage in educational systems may be approached from various points of view: (a) as a common vocabulary for multi-agent system, (b) as a chain between heterogeneous educational systems,(c) ontologies for pedagogical resources sharing or for sharing data and (d)ontologies used to mediate the search of the learning materials on the internet (Cakula and Salem, 2011).An intelligent learning system based on a multi-agent approach consists in a set of intelligent agents, which have to communicate. They collaborate through messages. Software agents can understand and interpret the messages due to a common ontology or the interoperability of the private ontologies.

C. ***Benefits of data mining methods to e-learning***

This section presents the benefits of some of the data mining methods in e-learning domain. Further details can be found in (Salem, 2008):

1) Information Visualization (IV) in Smart Learning

The IV in e-learning can be used in the following educational tasks; admitted questions, complementary assignments, exam scores, etc. Moreover, intelligent visualization tools (e.g. GISMO CourseVis) enable instructors to manipulate the graphical representations generated, which allow them to gain an understanding of their learners and become aware of what is happening in distance classes.

2) Clustering and classification in Smart Learning

Clustering and classification approaches have been used in smart learning for the following tasks:

- Finding clusters of students with similar learning characteristics and to promote group-based collaborative learning as well as to provide incremental learner diagnosis.
- Discovering potential student groups with similar characteristics to a specific pedagogical strategy.
- Grouping learners/students as hint-driven or failure-driven and finding students' common misconceptions.
- Identifying learners/students with little motivation and finding remedial actions in order to lower drop-out rates.

4. SOME EXAMPLES OF SMART LEARNING AND TUTORING SYSTEMS

This section presents some of our intelligent learning/tutoring systems developed by the author and his colleagues during the last ten years

A. Expert Systems for Heart Diseases Diagnosis

In this application (Salem and Hodhod, 2002) we have developed two versions of expert systems for heart diseases diagnosis. The first one uses the rule-based reasoning while the second one uses case-based reasoning. The system's knowledge base of the first version is composed of 24 facts and 65 rules for 24 heart diseases. The system is implemented in Visual Prolog and has been tested for 13 real experiments (patients). The experimental results have shown 76.9% accuracy in estimating the right conclusion. In the CBR version, the knowledge is represented in the form of frames and built the case memory for 4 heart diseases namely; mistral stenosis, left-sided heart failure, left-sided heart failure, stable angina pectoris and essential hypertension. The system has trained set of 42 cases for Egyptian cardiac patients and has been tested by another 13 different cases. Each case contains 33 significant attributes resettled from the statistical analysis performed to 110 cases. The system has been tested for 13 real cases. The systems are able to give an appropriate diagnosis for the presented symptoms,

signs and investigations done to a cardiac patient with the corresponding certainty factor. It aims to serve as doctor diagnostic assistant and support the education for the undergraduate and postgraduate young physicians.

B. Web-Based Breast Cancer Ontology

The breast cancer ontology was encoded in OWL-DL format using the Protégé-OWL editing environment (Salem and Alfonse, 2007). The knowledge was collected from: MedicineNet, World Health Organization (Salem, 2010), breastcancer.org, ehealthMDand National Comprehensive Cancer Network. In this ontology we have two main super classes, namely, (a) MedicalThings which has sub classes Diseases, Medical_Interventions, Pathological_Category, References, and (b) People which has the sub classes; men and women. Our results indicate that, the breast cancer is described in terms of its symptoms, causes, stages, pathological category, diagnosis and treatment. In this context, we described causes, stages, and symptoms as references. While diagnosis and treatment are described as medical interventions. The main benefits from this ontology are to allow finding and locating information about breast cancer needed for interested users and domain experts.

C. Data Mining Approach for Slow Learners Students (SLS)

Recently, data mining approach have been improved in order to classify the students' records based on their educational activates. Slow learners students (SLS) suffers from low rate of understanding the educational materials; therefore, they need special education methods and strategies to educate them. In our research (Mohammad, Mahmud, El-Hobart, Rushdie, and Salem, 2013 a, b, c) we developed a smart classification model of English course e-Learning system for SLS. Our model is based on the decision trees technique to determine the most effective learning pattern for teaching English language for those students. The model was implemented on 300 students in the fourth grade at Kuwait, age 8 -10. We obtain promising results.

D. Ontology for e-business paradigms

Nowadays, e-business, or digital business, is the integrated execution of all business analytics processes of an enterprise by means of

smart computing and informatics. Recently we developed a web-based ontology for e-business paradigms (Salem and Parusheva, 2018a). In this work, five web-based ontologies were designed for the following:(a) e-business applications; (b) e-business participants; (c) e-business infrastructure; (d) e-business support areas, and (e) fields in e-business. The developed ontologies were implemented in ontology web-based language OWL2 using the Protégé smart tool version 5.0.0 editing environment.

E. Knowledge Discovery for Banking Risk Management

In the era of Internet of Things (IoT), decision makers and managers directed their efforts to use the knowledge discovery (KDD) and data mining (DM) process in order to enhance their decision-making policies, avoid unpredictable frauds and increase the revenue opportunities for their financial agencies. In our research labs (Sobhy, Abbas and Salem, 2015), we present a novel approach in banking data bases in order to spot the light on the most effective features, which affect the decision-making process. In the data preprocessing phase, the K-Nearest Neighbor algorithm has been implemented to measure the distance between objects' vectors. The feature selection process has been implemented using Microsoft SQL server analysis services and applied on real financial database obtained from PKDD'99. The results show that the features are reduced from 47 attributes into 17 significant attributes.

CONCLUSION

Computational intelligence (CI) techniques give tutoring and e-learning systems added computing capability, allowing them to exhibit more intelligent behavior. CI and Knowledge engineering paradigms offer robust intelligent techniques for accumulating, changing, updating, managing and representing knowledge. These techniques enable users with learning mechanisms that help to induce knowledge from raw data. Furthermore, ontological engineering offers a promising way to develop efficient tutoring and learning systems capable to facilitate knowledge sharing, refine, search, and reuse. On the other side, the development of intelligent tutoring and e-Learning systems is a very difficult and complex process that raises a lot of technological and research challenges that must be addressed in an interdis-

ciplinary way. Moreover, the convergence of artificial intelligence, data science machine learning, educational technology and web science is enabling the creation of a new generation of web-based intelligent e-learning and tutoring systems. The web based of such systems can enhance the online education/ learning/training processes.

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