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Knowledge Bases in the Field of Expert Systems and Artificial Intelligence

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Abstract: *This paper presents analysis of existing knowledge bases in the field of expert systems and artificial intelligence, i.e. published standards, web site eXpertise2Go, as well as standardized and non-standardized glossaries. Analysis was performed by searching the available knowledge bases in order to find a complete knowledge bases for the area. According to the results obtained ISO has published the highest number of standards, eXpertise2Go is the most consistent website with information about using and building expert systems, and there are glossaries which are accessible and free to readers related with expert systems and artificial intelligence.*

Keywords: *knowledge base, expert systems, artificial intelligence, standards, glossaries.*

INTRODUCTION

There are enormous Internet content search possibilities due to the increase in the amount of available information. Nowadays more quickly and easily obtaining information, as well as the sharing of this information is very important.

By searching the available content, we find the knowledge bases or create our own by extracting the relevant information and combining them, into one entity in a given area. Depending on where knowledge is stored either in the computer or in the human brain, certain factors may influence the further course of the research, [1]. Knowledge identification is the first step towards defining relevant knowledge in order to achieve the goals. Within this phase, it is necessary to identify the available knowledge, [2].

The aim of research is to analyze the existing knowledge bases in the field of expert systems and artificial intelligence. Data that are shown in this paper were collected from the official websites of international and national organizations, the eXpertise2Go website, and the websites containing non-standardized glossaries. Published standards, description/structure of website eXpertise2Go and glossaries that is relevant for the given area has been investigated and shown in this paper.

1. INTERNATIONAL AND NATIONAL STANDARDS IN THE FIELD OF THE ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Standardization differs between common standards and specifications as follows:

Formal standards ("de-jure standards"): As a result of the consensus reached by the official standardization organizations The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) were established.

Community specifications: They are open specifications, available to the public which are developed by communities or forums, i.e. The Institute of Electrical and Electronics Engineers, Inc. (IEEE) and the World Wide Web Consortium (W3C).

Industrial specifications: They are developed by closed or open specifications and available to branches of industrial consortia, [3].

Table 1 shows the standards published by the International Organization for Standardization during the period from 2004 to 2017. During this period, 13 standards, the total value of which is 1,236.00 Swiss francs (1,072.00 euros), were published. The published standards were developed in the field of health informatics.

Table 1. *An overview of published international standards in the field of expert systems and artificial intelligence*

No.	Standard number and title	Price
1.	ISO/IEC 2382:2015 Information technology -- Vocabulary	1,072.00
2.	ISO/TR 13054:2012 Knowledge management of health information standards	1,040.00
3.	ISO 21667:2010 Health informatics -- Health indicators conceptual framework	188.00

4.	ISO/IEC 24779-9:2015 Information technology -- Cross-jurisdictional and societal aspects of implementation of biometric technologies -- Pictograms, icons and symbols for use with biometric systems -- Part 9: Vascular applications	315.00
5.	ISO 16278:2016 Health informatics -- Categorial structure for terminological systems of human anatomy	89.00
6.	ISO/TR 13054:2012 Knowledge management of health information standards	184.00
7.	ISO/TS 18062:2016 Health informatics -- Categorial structure for representation of herbal medicaments in terminological systems	243.00
8.	ISO 15924:2004 Information and documentation -- Codes for the representation of names of scripts	388.00
9.	ISO/TS 17938:2014 Health informatics -- Semantic network framework of traditional Chinese medicine language system	88.00
10.	ISO/IEC 30122-2:2017 Information technology -- User interfaces -- Voice commands -- Part 2: Constructing and testing	38.00
11.	ISO/IEEE 11073-10101:2004 Health informatics -- Point-of-care medical device communication -- Part 10101: Nomenclature	198.00
12.	ISO 13119:2012 Health informatics -- Clinical knowledge resources -- Metadata	118.00
13.	ISO 19152:2012 Geographic information -- Land Administration Domain Model (LADM)	198.00
	Total:	1,236.00
Note: The prices of the standards are expressed in Swiss francs.		

In the period from 2010 to 2017, IEEE published 7 de facto standards in field of artificial intelligence and expert systems. Among the published standards, both international and national, the most precisely defined standards in the field of artificial intelligence are those published by IEEE. The total value of these standards is 1,040.00 euros.

Slovenia published 4 standards in the field of expert systems and artificial intelligence in the period from 2005 to 2015.

Table 2. *An overview of published de facto IEEE standards in the field of artificial intelligence and expert systems*

No.	Standard number and title	Price
1.	IEEE Std 1855-2016 - IEEE Standard for Fuzzy Markup Language	1,072.00
2.	IEEE Std 1232-2010 (Revision of IEEE Std 1232-2002) - IEEE Standard for Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE)	1,040.00
3.	IEEE Std 1232.3-2014 - IEEE Guide for the Use of Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE)	188.00
4.	IEC 62243 Second edition 2012-06 IEEE Std 1232 - IEC 62243:2012(E) (IEEE Std 1232-2010): Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE)	315.00
5.	IEEE Std 2755-2017 - IEEE Guide for Terms and Concepts in Intelligent Process Automation	89.00
6.	IEEE Std 1872-2015 - IEEE Standard Ontologies for Robotics and Automation	184.00
7.	IEEE 11073-10207-2017 - IEEE Approved Draft Standard for Domain Information & Service Model for Service-Oriented Point-of-Care Medical Device Communication	243.00
	Total:	1,236.00
Note: The prices of the standards are expressed in US dollars.		

Table 3 shows the standards published in Slovenia, the total value of which is 184 euros. Bulgaria, Macedonia and Montenegro have published the same number of standards (4).

Table 3. *An overview of published standards in the field of artificial intelligence and expert systems in Slovenia*

No.	Standard number and title	Price
1.	SIST EN ISO 11073-10201:2005 Health informatics - Point-of-care medical device communication - Part 10201: Domain information model (ISO/IEEE 11073-10201:2004)	132.00
2.	SIST EN ISO 13119:2013 Health informatics - Clinical knowledge resources - Metadata (ISO 13119:2012)	60.00
3.	SIST EN 62559-2:2015 Use case methodology - Part 2: Definition of use case template, actor list and requirement list	80.00

4.	SIST EN ISO 19152:2013 Geographic information - Land Administration Domain Model (LADM) (ISO 19152:2012)	116.00
	Total:	388.00
Note: The prices of the standards are expressed in euros.		

The Croatian Standards Institute has published 5 standards in the field of expert systems and artificial intelligence. The total value of these standards is 1,810.00 kunas. Serbia and Bosnia and Herzegovina (5) have published the same number of standards.

Table 4. *An overview of published standards in the field of artificial intelligence and expert systems in Croatia*

No.	Standard number and title	Price
1.	HRN ISO/IEC 2382:2016 Information technology -- Vocabulary (ISO/IEC 2382:2015)	-
2.	HRN EN 62559-2:2015Use case methodology -- Part 2: Definition of the template for use cases, actor list and requirements list (IEC 62559-2:2015; EN 62559-2:2015)	390.00
3.	HRN EN ISO 11073-10201:2008Health informatics -- Point-of-care medical device communications -- Part 10201: Domain information model (ISO/IEEE 11073-10201:2004; EN ISO 11073-10201:2005)	590.00
4.	HRN EN ISO 19152:2013Geographic information -- Land Administration Domain Model (LADM) (ISO 19152:2012; EN ISO 19152:2012)	525.00
5.	HRN EN ISO 13119:2014Health informatics -- Clinical knowledge resources -- Metadata (ISO 13119:2012; EN ISO 13119:2012)	305.00
	Total:	1,810.00
Note: The prices of the standards are expressed in Croatian kunas.		

Table 5 shows the published international standards (ISO [4]), de facto standards (IEEE [5]) and national Serbian [6], Bulgarian [7], Macedonian [8], Montenegrin [9], Croatian [10], Slovenian [11], as well as the standards published in Bosnia and Herzegovina [12] in the field of artificial intelligence and expert systems during the period from 2001 to 2016. The standards were searched using the ISO / IEC 2382-28: 1995 Information Technology - Vocabulary, Part 28: Artificial Intelligence: Basic Concepts and Expert Systems, [13], and ISO/IEC 2382:2015 Information Technology – Vocabulary, [14].

ISO standards are the most expensive standards. Serbia, Croatia and Bosnia and Herzegovina have the same number of published standards, and the same standards can be bought in Serbia at a lower price. Bulgaria, Macedonia, Montenegro and Slovenia have the same number of published standards (5). The price of the standards is the lowest in Macedonia, whereas the same standards cost twice as much in Montenegro, and even four times as much in Bulgaria and Slovenia.

During the period from 2001 to 2016, 20 international standards were published (including IEEE de facto standards), the total value of which is 2,112.00 euros. As to the national level, 35 standards were published in seven countries, the total value of which was 1,628.00 euros.

Table 5. *An overview of published standards in the field of artificial intelligence and expert systems in the 2001-2016 period*

No.	Organization	Number of published standards	Price
1.	ISO	13	1,072.00
2.	IEEE (de facto)	7	1,040.00
3.	SRPS	5	188.00
4.	BDS	4	315.00
5.	MKS	4	89.00
6.	MEST	4	184.00
7.	HRN	5	243.00
8.	SIST	4	388.00
9.	BAS	5	221.00
	International:	20	2,112.00
	National:	35	1,628.00
Note: The prices of the standards are expressed in euros.			

In 2017, ISO / IEC JTC 1 established the subcommittee SC 42 for the development of artificial intelligence. In May 2018, ITU is organizing the second AI for Good Global Summit in Geneva, aimed at identifying practical applications of AI, as well as the strategies to ensure the development of AI technologies and equitable access to their benefits. America, the United Kingdom, Japan, China and France make enormous investments in the strategy for the development of artificial intelligence, so significant results are expected in the future.

eXpertise2Go WEBSITE

The website eXpertise2Go's Rule-Based Expert System Web Content provides sources of information about using and building expert systems. Demonstrations are provided along with free expert system building and delivery tools that

implement expert systems such as Java applets, Java applications and Android apps. Decision Table and Rule Induction knowledge base building/data mining tools are also provided, [15].

Figure 1. *Content/structure of eXpertise2Go website*

The mini-course comprises nine modules and notes:

1. Is this the right technology for your problem?

2. Acquiring and installing the software (providing files to download and install, and instructions);

3. Introduction to expert systems;

4. Creating first knowledge base (with instructions and the code for creating a database);

5. Inference methods and uncertainty (a simulation of reasoning mechanism: forward chaining);

6. Introduction to knowledge engineering that is presented theoretically, through guidelines and suggested readings;

7. Designing and implementing knowledge bases that deliver knowledge (where some ideas about designing, building and debugging a data base are illustrated);

8. Building internationalized expert systems which delivers knowledge bases in Chinese and Cyrillic;

9. Advanced applications:

Using the e2gRuleEngine/JavaScript interface to dynamically control inferencing;

Modules 3, 5 and 6 are generic eXpertise2Go.com tutorials that introduce basic concepts needed to understand to build one's own expert systems.

When starting the Introduction to expert systems module, a glossary appears on the right, where we can find the explanation of unfamiliar terms at any time, [15].

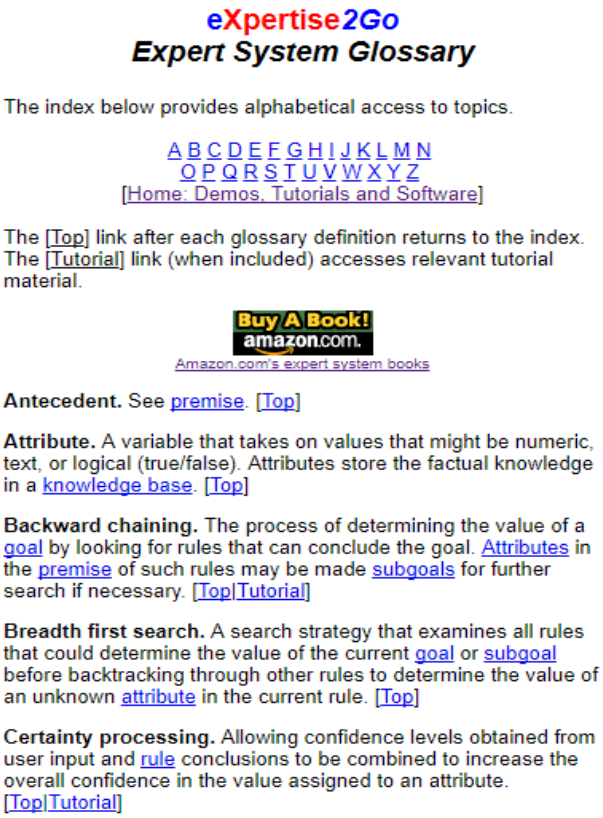

Figure 2. *Glossary – expert system*

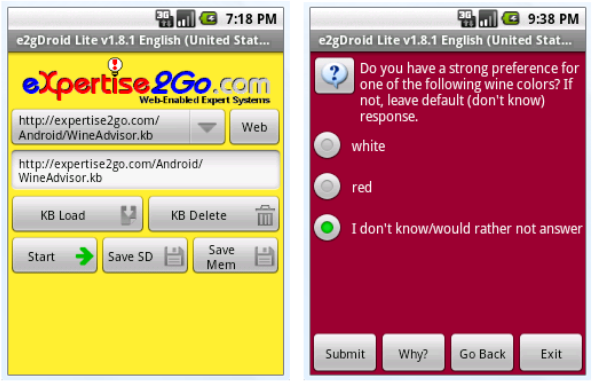

Figure 3. *Inference engine for Android platform*

The PCAI website (http://www.pcai.com/) contains links to expert systems information on the Internet, companies dealing with expert systems, and a review of literature published until 2000.

GLOSSARIES

Research in a certain field leads to the creation of a large number of new concepts. The development of standard technology is conditioned by terminological principles and methods by combining the findings of scientific terminology and practical use. Terminologists, describe the desired terminology in a certain field, after which the concepts are defined systematically with the respective terms.

The principles of standardization can be applied in all areas of human activity (areas of specialized

communication), although not necessary. [16, pp. 8, 9].

By searching the Internet content, we can find glossaries of expert systems and artificial intelligence. Standardized glossaries have been published by the International Organization for Standardization, or some other organization. Non-standardized glossaries are in the form of online dictionaries that can be searched or sorted alphabetically.

The non-standardized of expert systems and artificial intelligence available on the Internet are as follows:

- website: thenextweb containing of basics artificial intelligence terms and concepts.
- (https://thenextweb.com/artificial-intelligence/2017/09/10/glossary-basic-artificial-intelligence-terms-concepts/)
- website: phrasee, glossary of Artificial Intelligence terms represents key terms, including graphics for each term and links to more detailed information.
- (https://phrasee.co/ultimate-glossary-artificial-intelligence-terms/)
- website: businessdictionary where there is contained text about expert systems and links to another relevant terms.
- (http://www.businessdictionary.com/definition/expert-system.html)
- website: quizlet contains terms which are audio supported.
- (https://quizlet.com/77946069/vocabulary-for-expert-systems-and-artificial-intelligence-flash-cards/)

ISO / IEC 2382-28: 1995 Information Technology - Vocabulary, Part 28: Artificial Intelligence: Basic Concepts and Expert Systems is a standardized glossary [13]. Some of the terms defined by this standard are as follows: artificial intelligence, cognitive modeling, computer-based learning, deduction, domain, expert systems, expert system shell, fuzzy logic, knowledge, knowledge acquisition, knowledge-based system, machine learning, machine vision, neural network...

One of the term relating to artificial intelligence and expert systems that is defined by the standard is given below:

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expert system

knowledge-based system that provides for solving problems in a particular domain or application area in a professional manner by drawing inferences from a knowledge base developed from human expertise

Note 1 to entry: The term "expert system " is sometimes used synonymously with "knowledge-based system ", but should be taken to emphasize expert knowledge.

Note 2 to entry: Some expert systems are able to improve their knowledge base and develop new inference rules based on their experience with previous problems.

Note 3 to entry: This is an improved version of the definition in ISO/IEC 2382-1:1993.

Note 4 to entry: expert system; ES: term, abbreviation and definition standardized by ISO/IEC [ISO/IEC 2382-28:1995].

Note 5 to entry: 28.01.06 (2382)

[SOURCE: ISO-IEC-2382-28 * 1995 * * *]

CONCLUSION

Due to the increasing amount of the available information, their selection becomes more difficult, and so does the selection of the appropriate information relating to expert systems and artificial intelligence.

The knowledge base searched for the purpose of writing this paper comprises published standards, standards setting organisations, eXpertise2Go website and glossaries.

According to the results presented above, ISO has published the highest number of standards in the field of expert systems and artificial intelligence (13), and it is followed by the IEEE, which has published 7 de facto standards. SRPS, HRN and BAS have published an equal number of standards (5). Fewer standards (4) have been published by BDS, MKS, MEST and SIST. The same standards are the cheapest in Macedonia, whereas in Slovenia, they are four times as expensive.

Standardized and non-standardized glossaries are available on the Internet, and they can serve as a basis for searching standards. There is also eXpertise2Go website, which can serve as a complete knowledge base in the field of expert systems, providing the instructions for expert systems development, as well as relevant literature in the field.

The need for standardization results from the growing number of products and services that use artificial intelligence. The standards will enable interoperability and functionality in order to ensure maximum capacity in the field of artificial intelligence and market competitiveness. The countries in the region should take part in the development of standards in the field of expert systems and artificial intelligence.

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