

An Analysis of Scientific Publications from Serbia: The Case of Computer Science

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Introduction

In Serbia, like in other countries all over the world, career opportunities in computing are growing faster than most of the other professions. This trend should be in accordance with the growth of the number of study programs and consequently the number of teaching staff. The most important researchers' and university teaching staff's promotion criteria, according to the regulations in Serbia, are the papers published in journals from the JCR list, which is, for the area of computing, reduced to the SCIE list. The number of such papers is also relevant for projects financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

In this paper, we present an analysis of the references of Serbian researchers retrieved from the Web of Science. Using the bibliometric indicators from the Web of Science, we also examine the distribution of such references across WoS categories that belong to the broader area of computing. We show the distribution of such publications over the years, cities and universities and identify the relations with global trends in Serbian science.

Data Set

Data used in this paper were taken from Thompson Reuters Web of Science on 29 September 2014, selecting Science Citation Index Expanded (SCIE) journal articles. A basic search was conducted using the keyword "Serbia" in the field address and the retrieved results were limited to articles published during the period 2006–2013. All document information, including names of authors, titles, years of publications, source journals, contact addresses, and number of citations for each article, for every year, were downloaded into Microsoft Excel worksheets. The custom program in C# programming language was developed in order to perform data analysis.

The same data extraction was performed for WoS categories, that we considered the subcategories of the broader scientific area of Computer Science. The distribution of the number of papers from the year

2006 till 2013 (since results for 2014 were incomplete) is presented on Figure 1, and the number of papers over years and WoS categories is presented on Figure 2.

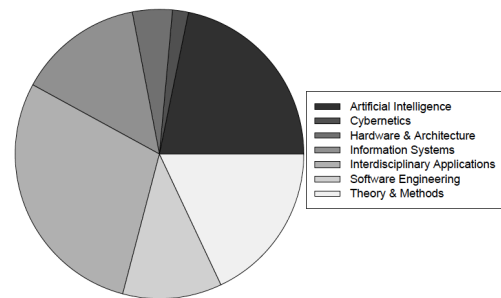


Figure 1. The number of papers in subcategories.

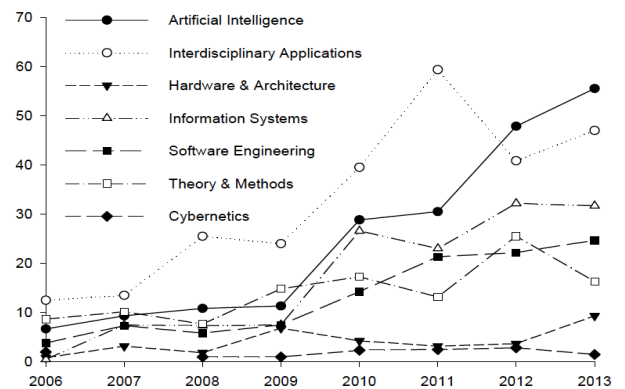


Figure 2. The number of papers in subcategories for each year.

To get numbers presented in Figure 2, disciplinary affiliation is computed fractionally, by assigning $1/N$ to each category, for a journal paper published in a journal indexed in N different categories.

The name of the country was not always correct for papers submitted before 2006, since our country changed its name to Serbia in 2006, and some papers had the former name Serbia and Montenegro, or even Yugoslavia in their affiliation. Therefore, the additional search was performed using only the names of significant Serbian cities and university centres. It was noticed that our dataset did not hold absolutely correct

information, because of unintentional mistakes in the authors' signatures or other elements of the affiliation. Incorrectly entered data propagate errors to later identification and grouping, as stated in Mitrovic (2014). This issue can be solved partially using text similarity matching algorithms. Our program uses Jaro-Winkler algorithm as proposed in Winkler (1995), also known as JWSF, "Jarod-Winkler similarity function" to overcome this problem. Distribution of papers over major cities and institutions show interesting results. For the Serbian capital city of Belgrade, only 65.4% of all papers have affiliation of the state University of Belgrade, the biggest and oldest Serbian university, ranked between positions 300 and 400 on the ARWU list. For other university centres in Serbia, the share of publications of state universities is: 93.3% for Novi Sad, 87.4% for Niš and 97.9% for Kragujevac. We conclude that bigger cities have greater potential for scientific productivity outside the university, but this ratio also reflects some problems identified in the past, that institutes belonging to the University of Belgrade did not include the name of the University in affiliation before the initiative to do so, started during the procedure and efforts to qualify for ARWU ranking. The significant growth in the number of papers started in 2008, probably as the result of accreditation procedure regulated by national accreditation body CAQA (www.kapk.org).

Table 1. Journals with more than 20 papers published in the period from 2006 till 2013.

Journal Name	No.	5 years IF
MATCH-communications in mathematical and in computer chemistry	101	1.829
ComSIS - Computer science and information systems	67	0.575
Mathematical and computer modelling	47	2.020
Expert systems with applications	42	1.965
Advances in electrical and computer engineering	28	0.642
Fuzzy sets and systems	27	1.880
International journal of computers communications & control	23	0.694
Information sciences	21	3.893
Journal of multiple-valued logic and soft computing	21	0.667

The list of journals with more than 20 papers in the Table 1 shows that journals in multiple WoS categories are predominant. The journal MATCH publishes the mathematical results and applications in solving chemical problems, without significant content in computing research. The second journal on

the list, ComSIS (Computer Science and Information Systems), is an international journal published in Serbia, dedicated to computing, that appeared for the first time on the SCIE list in 2010. In fractional counting, it has been shown that some other disciplines are represented in the comparable quantity to the basic computer science disciplines: Engineering, Electrical & Electronic (71.65), Mathematics, Applied (62.75) and Chemistry, Multidisciplinary (41.67) are in-between Computer Science, Theory & Methods (76.98) and Computer Science, Hardware and Architecture (22.83). Since the leading category is Computer Science, Interdisciplinary Applications (153.00), it is obvious that computer science in Serbia can be viewed predominantly as applied science, blended with electrical engineering, applied mathematics and multidisciplinary chemistry. The leading scientists are I. Gutman with 74 papers in total and 26 in fractional counting, and M. Ivanovic with 23 papers in total and 6.33 in fractional counting.

Conclusions

Considerable growth of publications from Serbia since 2006 was identified in Ivanovic (2014). Serbian national system that transfers data from WoS on weekly bases kobson.nb.rs shows that there were 1746 publications of Serbian authors during 2006 and the yearly production tripled in 2013. At the same time, the number of all publications in Computer Science categories in WoS core collection increased from 123 to 286, while articles only increased from 60 to 204, which was about 3.9% of total Serbian production and 0.47% of the world production in aforementioned categories in the year 2013. The ratio of total world production and total Serbian production is 0.39%, so the results of computer science disciplines are better than average, mostly due to the interdisciplinary approach.

Acknowledgments

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