


30 years of the Journal of Universal Computer Science: A bibliometric retrospective


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Abstract: This study presents a comprehensive bibliometric analysis of the Journal of Universal Computer Science (JUCS) covering the period 1994-2024, based on data retrieved from the Scopus database in April 2025. The analysis has been conducted following the scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR) protocol and using mathematical and statistical methods, *VOS viewer*, and *bibliometrix*. The article investigates the journal's publication trends, citation structures, collaboration networks, and thematic evolution over three decades. A comparative review with the study published in 2021 by Baloain and collaborators, shows improved journal metrics, enhanced global recognition, and alignment with emerging research trends. The co-citation and bibliographic coupling analyses highlight JUCS's strong intellectual connectivity across key domains of computer science, particularly in interdisciplinary areas. Thematic mapping and keyword analysis show a clear transition from classical computing themes to modern topics like artificial intelligence, deep learning, big data, and blockchain, demonstrating the journal's responsiveness to evolving scientific priorities. The study concludes with general findings, practical implications, and future research directions, emphasizing JUCS's role as a durable, adaptive, and impactful platform for scholarly output in the global computer science research community.

Keywords: Journal of Universal Computer Science, Bibliometrics, Scopus, Web of Science, *VOS viewer*, *Bibliometrix*.

Categories: A.0

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1 Introduction

The *Journal of Universal Computer Science* (JUCS) was established by Cris Calude (University of Auckland), Hermann Maurer (Graz University of Technology), and Arto Salomaa (University of Turku). The JUCS has been a high-quality, peer-reviewed, free open-access publication platform hosted at www.jucs.org and lib.jucs.org since 1994. It publishes general literature, hardware, software, and computer systems organization, theory of data and computation, information systems, mathematics of computing, data management, computing methodologies, computers and education, computer applications, personal computing, and knowledge management. Fully integrated with the Association for Computing Machinery (ACM) classification system, JUCS publish independently reviewed work from all over the world in monthly regular and special issues.

The journal has been published by the Graz University of Technology and supported by the Institute of Interactive Systems and Data Science (Graz University of Technology, Austria), in cooperation with the JUCS Consortium. Four editors-in-chief steer JUCS: Christian Gütl (Managing Editor-in-Chief, Austria), Christian Eckhardt (USA), Klaus Tochtermann (Germany), and Muhammad Tanvir Afzal (Pakistan). Under the leadership of the Managing Editor-in-Chief Christian Gütl, JUCS has undergone a significant improvement in quality. Since 2020, the open access licence CC BY-ND 4.0 was implemented by the journal, and in 2021 it was re-launched on a new and more contemporary open access platform, offering extended functionality like long-term archiving, reviewer recognition system and social media interfacing. From 2025, JUCS will be supported by the centre of excellence in computer science (2025–2027) KOALA, based on TIB (Leibniz Information Centre for Science and Technology).

JUCS is abstracted and indexed in many databases. In the Web of Science (WoS) database (Clarivate, 2024), JUCS is a Q3 SCIE indexed journal in the areas of theoretical computer science and software engineering. JUCS has an impact factor as well as 5-year impact factor of 0.9 and is one of the active journals in the WoS Core Collection. While in Scopus (Scopus, 2024), with a CiteScore of 2.7, ranked at 49th percentile for general computer science (117th out of 232 journals) and in the 48th percentile for theoretical computer science (67th out of 130) with Q3 quartile for both the categories. Other Scopus metrics include an SJR of 0.283 and a SNIP of 0.532.

JUCS has been publishing for over three decades. Thus, it becomes fundamental to understand its publication trends, citation impact, and standing within the academic community, and to evaluate its long-term academic influence, visibility, and scholarly contribution to the field of computer science. This study aims to provide researchers, authors, and editors with a comprehensive overview of the journal's evolution, strengths, and areas for further development, thereby supporting informed decisions about future contributions and collaborations.

The present study is organized as follows: Section 2 presents the literature review, and Section 3 presents the methodology employed. Section 4 showcases the main results, including the total number of papers, citation patterns, highly cited authors, key contributors, productive authors & institutions, and countries. Section 5 presents the visual study of bibliometric indicators through *VOS viewer*, and *bibliometrix* software. Finally, section 6 presents the conclusions of the study.

2 Literature Review

Bibliometrics, broadly defined as the quantitative study of scholarly publications, was first conceptualized by [Pritchard 1969] and further refined by [Broadus 1987]. Over the years, scholars have expanded its theoretical foundation and practical applications [Bar-Ilan 2008, Ding et al. 2014, Glänzel et al. 2019]. The field's origins [Rousseau, 2014] trace back to the pioneering work of Eugene Garfield, who introduced citation indexing and laid the groundwork for modern bibliometric analysis [Garfield 1955, 1972, 2006, Bensman 2007]. A central metric in bibliometrics is the *h*-index, proposed by [Hirsch 2005], and further examined by [Alonso et al. 2009], for evaluating individual researcher performance. Key bibliometric tools [Guan et al. 2025] and databases such as WoS [Clarivate 2024], Scopus [Scopus, 2024], SciVal [Scopus 2024], *VOS viewer* [Van Eck & Waltman 2010; 2023], and *bibliometrix* [Aria & Cuccurullo 2017], support various techniques including co-citation analysis [Small 1973], bibliographic coupling [Kessler 1963], and keyword co-occurrence mapping [Callon et al. 1983], enabling deeper insights into the structure and dynamics of scientific research.

Bibliometric studies of many computer science journals have been carried out to identify topic trends, historical and citation impact, and future perspectives [Waltman 2016, Moed 2005]. For example, [Waleed et al. 2019] analysed the *ACM Special Interest Group on Data Communications* (SIGCOMM) golden anniversary on data communications. [Wang et al. 2020] studied the 50-year development of *International Journal of Systems Science*, and [Guan et al. 2025] analysed the trends in *Computers & Operations Research* journal. Other researchers have focused on other journals, like the *Journal of Computer Assisted Learning* [Akturk 2022] and *Computers & Industrial Engineering* [Cancino et al. 2017]. [Merigó et al. 2018] studied trends in *Information Sciences*, and [Baloian et al. 2021] examined the *Journal of Universal Computer Science* on its 25th anniversary. In addition, [Monastersky & Van Noorden 2019] explored *Nature* on its 150th anniversary. Some other bibliometric studies have been implemented for journals such as *Technovation* [García-Merino et al. 2006], *Applied Mathematical Modelling* [Verma et al. 2020], *Information Systems Journal* [Paz et al. 2020], *ACM Transactions on Multimedia* [Hussain et al. 2024], *International Journal of Information Technology and Decision Making* [Liao et al. 2024] and *International Journal of Machine Learning and Cybernetics* [Xu et al. 2019].

Some general computer science fields have been examined through a bibliometric approach. For example, [Abuhay et al. 2018] proposed trend prediction methods in high-performance and cloud computing that helped conceptualize scientific evolution. [Garousi & Mäntylä 2016] examined the citation, research topics, and active countries in software engineering, and [Benabdelouahab et al. 2023] with focus on e-learning education. [De Carvalho Pereira et al. 2015] examined the information systems literature and [Fujs et al. 2020] its application on user training for secure use. [Zainab et al. 2009] studied publication trends of the *Malaysian Journal of Computer Science*. [Barata & Kayser 2023] predicted the destiny of Industry 5.0 and connected it with smart systems and cloud platform. [Budi & Suhendra 2022] discussed integration of machine learning and big data in cloud-based application, and [Ahmed & Raza 2018] reviewed the cloud computing resource management optimization techniques. [Zhang & Wang 2020], [Raja & Kaur 2019], and [Liu et al. 2017], studied cloud computing

trends and data systems. More recently, [Saqlain et al. 2025] studied the journal *Neutrosophic Sets and Systems* identifying potential growth in computer science and machine learning, and [Saqlain et al. 2025a, Saqlain et al. 2025b] presented the bibliometric study of fuzzy contributions in Turkey and Pakistan respectively. Collectively, these works demonstrate how bibliometrics, technological development, and computer science and cloud computing innovations intersect. Miraftebzadeh et al., (2024) explored deep learning usage in power systems and presented a summary of future trends. Kaur et al., (2025) examined a bibliometric mapping of the IoT-generative AI overlapping area, and Fan et al., (2024) reviewed the metaverse on Scopus data. Arifin et al. (2025) investigate big data analytics with Python and *VOS viewer*. Kaliisa et al., (2025) presented a criterion for review research in Computer-Supported Collaborative Learning and Focus on Computational Experiments in Computer Science. Lastly, Viduka et al. (2024) explored human-computer interaction. Collectively, these bibliometric studies show the variety and growth of the field of research and engineering in technology and computation.

3 Methods

This section presents the methodology adopted in the study. The framework and rationale for systematic literature reviews is employed in this study, specifically the SPAR-4-SLR methodology [Donthu et al. 2021, Paul et al. 2021] illustrated in Table 1, providing a comprehensive overview of the methodological approach adopted in this research. The current bibliometric study was carried out to investigate the profile and performance of JUCS.

Firstly, two major academic databases (Scopus and the WoS core collection) were used to extract the data for this bibliometric analysis [Scopus 2024, Clarivate 2024]. The search was performed on the source title, “Journal of Universal Computer Science” in Scopus, which resulted in 2,921. Selecting the year of publication from 1996–2024, resulting in the 2,918 documents. Applying additional filtering criteria and selecting only articles, reviews, and conference papers (including special issues), and number of documents found was 2,694. Moreover, only papers that had been marked as in the final publication stage were selected.

Simultaneously, WoS core collection data was used to augment visualizations and metrics, particularly for co-authorship, co-citation and bibliographic coupling maps created with *VOS viewer*. By searching publication title for “Journal of Universal Computer Science” yielded 2,634 results. Excluding documents from the year 2025, resulted in 2,628 documents. Doing further filtering and selecting only articles and reviews totalling 2,344 documents. Comparisons and spatial mapping throughout the manuscript were based on these data sets.

The research is conducted in the manner of performance analysis and mapping using Microsoft Excel and *VOS viewer* based on publication count, citations, h-index and average citation per document. Co-citation, bibliographic coupling and keyword co-occurrence networks are mapped with *VOS viewer*. Top findings, trending topics, and emerging trends are also provided through the article analysis. Findings are presented using numerical data, visual figures, tables, and narratives, following standard bibliometric reporting practices, while acknowledging limitations such as

language bias, coverage gaps, and methodological issues in comparing subfields with varying citation practices [Figuerola-Wischke et al. 2024].

Assembling		Arranging		Accessing
Identification	Acquisition	Purification	Evaluation	Reporting
<p>Domain: Journal of Universal Computer Science (JUCS). Research objective: To present a bibliometric retrospective of JUCS. Research questions: 1) How is JUCS positioned in the scientific community? 2) Which are the most cited documents of JUCS and what documents JUCS cite more frequently? 3) Who are the most productive authors, universities and countries? 4) What is the co-citation and bibliographic coupling structure of JUCS? 5) To find the topical evolution of JUCS? Comparison with Baloian et al. (2021) study?</p>	<p>Search platform: Scopus. Search period: 1994-2024. The search was performed in April 2025. Source Title: Journal of Universal Computer Science. Results: 2,921 documents. Search in Web of Science: (WoS) Core Collection (2001-2024) 2,634 documents. Additional results: JCR (WoS) and SciVal (Scopus).</p>	<p>Filter 1. Show Final Publication Year and Exclude 2025: 2,918. Filter 2. Article & Review & Conference Paper (Special issue): 2,694 documents. Secondary documents (1994-1995): 62 documents. Final number of documents: 2,756 documents. WoS (with equivalent filters: 2001-2024): 2,344 documents. Computer software: VOS viewer, Microsoft Excel, <i>bibliometrix</i> and <i>biblioshiny</i>.</p>	<p>Metric analysis: 1) Rankings based on bibliometric indicators. 2) Bibliometric indicators: Number of documents and citations, cites per paper, the <i>h</i>-index, papers and cites per capita, cites per year, and temporal classification. Graphical analysis: 1) Visualization with the <i>VOS viewer</i> and the <i>bibliometrix</i> software. 2) Techniques (<i>VOS viewer</i>): Co-citation, bibliographic coupling, and co-occurrence of keywords. 3) Methods with <i>bibliometrix</i>: Three-field plot, thematic map and word cloud. Agenda proposal method: 1) Show a general overview of JUCS and study the leading results. 2) Identify open questions for future research.</p>	<p>Reporting conventions: Explanations with numbers, tables and figures. Limitations: 1) The bibliographic data is from April 2025 but evolves and changes through time. 2) The limitations of the Scopus and WoS databases affect this study. 3) Each research topic and period may have different publication and citation characteristics.</p>

Table 1: Procedure of the study based on the SPAR-4-SLR protocol.

4 Results

In this section, we discuss the metric analysis of JUCS. It is further divided into four subsections. The first subsection studies the publication and citation structure along with SJR and JCR metrics. Subsection 2 signifies the information of citing articles in JUCS. Subsection 3 consists of influential papers in JUCS. The last subsection presents the most productive authors, influential institutes, co-authors and co-institutes from other countries, and most productive collaborating countries as well.

4.1 Publication and citation structure of JUCS

Figure 1 presents the number of papers published in JUCS from the very first volume in 1994 until 2024. The journal modestly started with less than 6 publications in its launch year, but its output gradually increased till 2010. This sharp upward trend reached a maximum 193 publications in 2008, a sign of increasing influence on the broader computer science. Interestingly the period between 2005-2011 is an extremely prolific period for JUCS, throughout which JUCS has always published more than 100 papers each year.

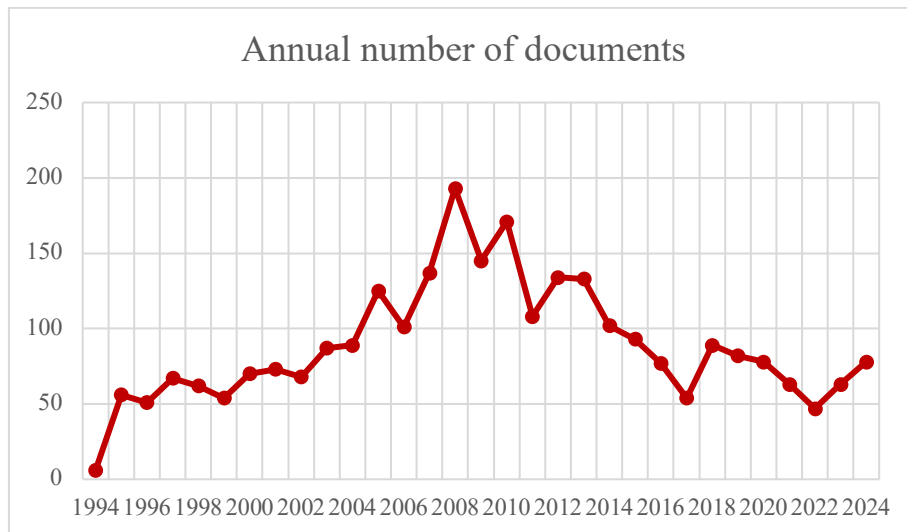


Figure 1: Annual number of papers published in JUCS

The publication volume fluctuates between 2011-2024, with the highest number of published (134) documents in 2012 and 47 recorded as lowest in 2022. This decline might be due to changes in editorial policy, higher selectivity, or more general trends in academic publishing. In general, the trend is indicative of a fluctuating publishing history both of growth and decline, providing an interesting context for in-depth bibliometric and editorial examination.

Table 2 shows the annual citation structure of JUCS from 1994 to 2024 and provides statistics on the long-term intellectual impact of JUCS's publications. In the 30 years, a total of 2,756 papers were published by the journal which accumulated

29,014 citations in total. The table presents papers grouped by citation thresholds (≥ 200 , ≥ 100 , ≥ 50 , ≥ 20 , ≥ 10 , ≥ 5 , and ≥ 1 citations) providing a granular view of how many papers have received (high to low) citations. The 87.12% of published documents have received at least one citation while 0.19% of documents with ≥ 200 citations, which reflects a citation rate distribution comparable to that found in many academic journals, with a small number of papers receiving an excessively large number of citations. The journal published 6 documents in its first volume in 1994 and gradually increased the publications and peaked at 193 in 2008. After this, it started following the pattern of fluctuation in both publications & citations and reached the lowest level in 2022 with 47 documents and 64 citations in 2024.

The years between 2001-2012 were found to be the most productive and the most highly cited. For example, papers published in 2008 received 2,424 citations, while 2006 was influential in terms of highly cited documents with 2 documents crossing the threshold of ≥ 200 citations. Additionally, 14 documents crossed the threshold of ≥ 100 citations between 2001 and 2012, highlighting a consistent trend of influential papers over this period. Notably, during these peak years, the number of papers with more than 50, and with more than 100 citations is relatively high, showcasing JUCS's capacity to disseminate widely read and referenced work during this era.

After 2012 the journal followed a fluctuation pattern in publication volume and citation impact. For citations, it is not surprising because of the time lag factor newer publications tend to need time to gather citations. Even those from the latest years the documents are already cited at least once, demonstrating that they had good initial visibility and relevance, and an indication of the impact of JUCS in the academic community. The citation distribution in Table 2 and the trends illustrated in Figure 1 of the publications reflect the evolving role of JUCS in computer science research and its fluctuating yet resilient bibliometric footprint. Overall, the 30-years citation and publication patterns of JUCS reveal its evolving role in the scholarly landscape of computer science, indicating broad and steady academic engagement.

Year	TP	TC	≥ 200	≥ 100	≥ 50	≥ 20	≥ 10	≥ 5	≥ 1
1994	6	18	0	0	0	0	0	2	4
1995	56	710	1	2	3	5	7	18	34
1996	51	353	0	1	1	3	8	16	41
1997	67	828	0	0	3	14	24	40	55
1998	62	585	0	0	1	8	18	34	51
1999	54	616	0	1	3	7	13	26	37
2000	70	564	0	0	2	8	18	33	54
2001	73	846	0	1	3	11	27	39	59
2002	68	1,247	1	2	6	10	25	40	58
2003	87	1,195	0	1	6	14	32	57	82
2004	89	1,475	0	2	8	22	37	56	81
2005	125	1,535	0	1	4	29	43	68	107
2006	101	1,637	2	2	6	24	35	53	87
2007	137	1,230	0	1	4	20	34	60	109
2008	193	2,424	0	1	7	37	81	125	181
2009	145	1,577	0	1	4	20	49	80	135
2010	171	2,443	0	3	9	35	61	98	152
2011	108	1,399	1	2	3	17	44	68	100
2012	134	1,472	0	2	3	16	39	80	121
2013	133	1,386	0	1	6	17	38	69	120

2014	102	859	0	0	2	12	28	52	90
2015	93	1,258	0	1	3	20	40	60	88
2016	77	909	0	0	3	12	26	52	70
2017	54	372	0	0	0	3	14	25	47
2018	89	891	0	0	3	11	32	53	85
2019	82	640	0	1	2	9	19	35	67
2020	78	567	0	0	0	8	22	35	60
2021	63	309	0	0	0	0	9	29	56
2022	47	185	0	0	0	0	2	17	41
2023	63	148	0	0	0	0	1	8	45
2024	78	64	0	0	0	0	0	2	30
Total	2,756	29,014	5	24	92	387	819	1410	2,309
%	100	100	0.19	0.97	3.53	14.55	30.66	53.08	87.12

Abbreviations: TP and TC = Total papers and citations; ≥ 200 , ≥ 100 , ≥ 50 , ≥ 20 , ≥ 10 , ≥ 5 , ≥ 1 = Number of papers with equal or more than 200, 100, 50, 20, 10, 5 and 1 citations.

Table 2: Annual citation structure of JUCS

In Figure 2, the yearly citation distributions of JUCS are represented with box-whisker plots for its publications from 1994 to 2024. Each box is equivalent to the interquartile range of the set of papers published each year. The cross inside each box shows the median number of citations achieved that year, thus showing the average citation performance. It is interesting to observe that the median citation counts are relatively low for all years, rarely exceeding 5 to 20 citations, which is at least clear evidence of a moderate, yet stable scholarly impact per paper. The vertical bars projected from the boxes are the whiskers that draw attention to the dispersion and the collection of the citation impact in different years. In several years, the whiskers are quite short, indicating that most of the papers were cited nearly as much as the central cluster.

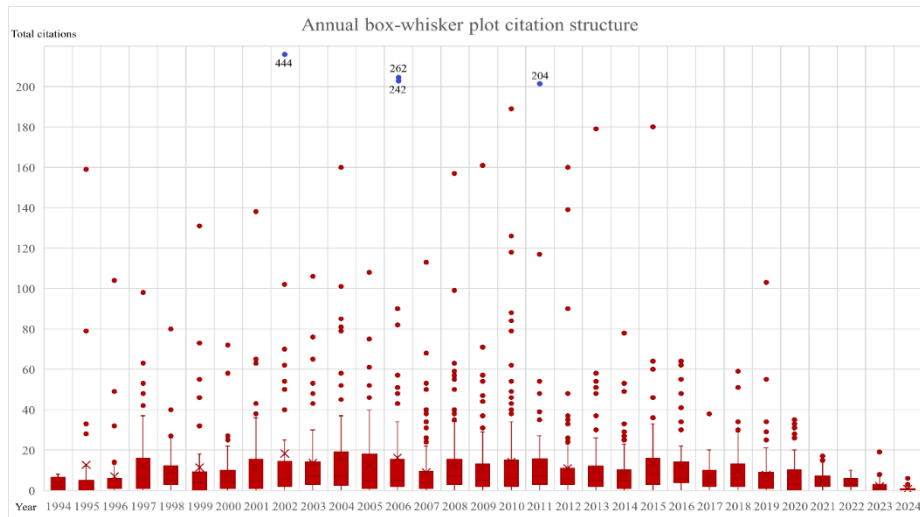


Figure 2: Annual box-whisker plot citation structure of all papers published in JUCS

Yet the fact that many individual dots are above the whiskers plotted as outliers indicates some papers had many more citations than most papers published in the same year. These outliers are particularly for the years 2002, 2006, and 2011, which are in line with earlier results that identified those as very productive and impactful years. The fact that the cluster of outliers appears around the mid-2000s reinforces our claim that this was a golden age for JUCS, in terms of volume and scholarly impact. Conversely, the post-2018 years are characterized by less stretched boxes, smaller whiskers, and fewer outliers, showcasing the reasons that are anticipated due to the time lag of citations. In general, this figure effectively presents the change and fluctuation of citation impact of JUCS publications in the past 30 years.

Table 3 presents a comprehensive analysis and academic progress of the journal and with its JCR and SJR metrics. The journal was first indexed by Scopus in 1994 and WoS in 2001, while it received its first impact factor (IF) in 2005. This shows the development of JUCS in the years from 2005 up to 2023. It covers several performance measures, including total citations (TC), impact factor (IF), 5-year impact factor (5YIF), article influence score (AIS), and rankings in subject category and discipline (both from the WoS and Scopus). The publications received their highest citations in 2021 peaking at 1,132 with their highest impact factor (1.13) and 1.03 (5YIF) in 2020. The table also indicates the development of the journal; we can see growth on important indicators like impact factors (IF), and 5YIF over the years till reaching the highest in 2020.

Year	TC	IF	5YIF	AIS	RCI	PCI	RIS	PIS	CS	PB
2005	238	0.33	-	-	68/79	14.56	64/71	10.56	-	-
2006	226	0.33	-	-	72/82	12.8	66/75	12.67	-	-
2007	318	0.31	0.41	0.17	74/84	12.5	72/79	9.49	-	-
2008	438	0.48	0.48	0.10	74/86	14.53	71/84	16.07	-	-
2009	710	0.66	0.78	0.18	70/93	25.27	70/92	24.46	-	-
2010	623	0.57	0.60	0.17	83/99	16.67	74/97	24.23	-	-
2011	560	0.39	0.48	0.19	85/104	18.75	84/99	15.66	1.8	66-GCS
2012	720	0.76	0.59	0.22	68/105	35.71	54/100	46.5	1.8	66-GCS
2013	680	0.40	0.53	0.20	99/105	6.19	89/102	13.24	2.1	69-GCS
2014	756	0.46	0.56	0.19	89/104	14.9	88/102	14.22	1.8	62-GCS
2015	860	0.54	0.68	0.18	89/106	16.51	90/105	14.76	1.9	63-GCS
2016	1,067	0.69	0.77	0.13	90/106	15.57	86/104	17.79	2.0	65-GCS
2017	1,079	1.06	0.86	0.14	66/104	37.02	58/103	44.17	2.2	69-GCS
2018	1,065	0.91	0.88	0.13	85/107	21.03	72/105	31.9	2.5	70-GCS
2019	954	0.70	0.76	0.10	97/108	10.65	90/108	17.13	2.3	65-GCS
2020	1,060	1.13	1.03	0.20	86/108	20.83	73/110	34.09	2.0	54-GCS
2021	1,132	1.05	1.02	0.16	96/110	13.18	80/110	27.73	2.7	59-GCS
2022	1,066	1.0	1.0	0.18	98/108	9.7	87/111	22.1	2.7	53-GCS
2023	849	0.7	0.9	0.15	117/132	11.7	104/144	28.1	2.7	49-GCS

Abbreviations: TC = Total citations; IF = Impact factor; 5YIF = 5-year impact factor; AIS = Article Influence Score; RCI = Ranking in the WoS category of Computer Science, Information Systems; PCI = Journal impact factor percentile in Computer Science, Information Systems; RIS = Ranking in the WoS category of Library Science & Information Science; PIS = Journal impact factor percentile in Library Science & Information Science; CS = CiteScore (Scopus); PB = Best Percentile in Scopus among the two categories that indexes JUCS (GCS = General Computer Science; TCS = Theoretical Computer Science).

Table 3: Analysis of JUCS in the JCR of the WoS (Clarivate, 2024; Scopus, 2024)

Table 3, also presents other performance measures that give insight into the journal's relative standing within its field especially article influence score (AIS), ranking in the WoS category of Computer Science, Information Systems (RCI), journal impact factor percentile in Computer Science, Information Systems (PCI), ranking in the WoS category of Library Science & Information Science (RIS), and journal impact factor percentile in Library Science & Information Science (PIS). This clarifies the role of the journal in the larger academic realms, thus showing its relevance for both theoretical and practical aspects of computer science. The WoS-category rankings demonstrate a steady performance for many years in the upper percentiles, with only minor fluctuations, corresponding to a high-impact presence of JUCS in the respective field.

Lastly, the table shows comparative rankings according to Scopus metrics, CiteScore (CS), and the best percentile in Scopus (PB), confirming the rising visibility of the journal. Its performance stability, particularly in the last five years, and the increase of the 5-year impact factor demonstrate JUCS's capability to draw high-level research and to stand as a major journal in the academic arena. By covering these statistics from year to year, the table serves as a history of JUCS's academic progress, allowing glimpses into its trials and successes in the fluctuating context of scientific research in the field.

This reflects a broadened academic acknowledgment and impact of JUCS in the computer science community. The chart also demonstrates some ups and downs in the number of citing articles from 2016-2024, which could reflect inconsistent research trends or varied publication forms. Yet overall, things are looking up, with the number of citing articles reaching peak levels in the early 2020s. The latter is an indication to the continued influence of the journal in the field and on higher citation of its articles. The increasing volume of citing articles spanning almost 30 years demonstrates the growing importance and impact of JUCS, becoming an important source of information, and research outputs in the computer science field. A gradually increasing number of citations reflects its significance for researchers and academics in this area.

The authors, universities, and countries citing articles from JUCS are presented in Table 4. It lists the order by the total papers published by them (TP) and indicates the number of citing papers by them respectively. Among the authors column at the top of the list is Jung (58) followed by Peng (46), García-Peñalvo (44), and Colomo-Palacios (41) respectively. Institutionally, most citing articles have been published by CNRS, France (133 papers), University of Sevilla, Spain (127 papers) and University of Castilla-La Mancha (117 papers) indicating a rich academic quality of the JUCS article publications. They are among the leading organizations in contributing to the journal visibility and citation influence in the worldwide research community. The table also provides an indication of the geographical distribution of JUCS citing countries. China, Spain, USA, UK, Germany, and India are the top countries contributing to the citation counts of the journal with China leading the list with 1,964 citing papers. France, Italy, and Australia are among other countries where JUCS has participated, showing how JUCS has spread worldwide. This data demonstrates the worldwide impact of the journal in which researchers from all over the world and different institutions conduct research in the field of computer science.

4.2 Citing articles of JUCS

Figure 3 shows the annual number of citing articles for JUCS from the years 1996-2024. It reveals a quite steady increase in the number of papers referring to JUCS over the years. Starting at around 2003 the number of citing articles is higher, but from around 2005 it has increased sharply till 2014.

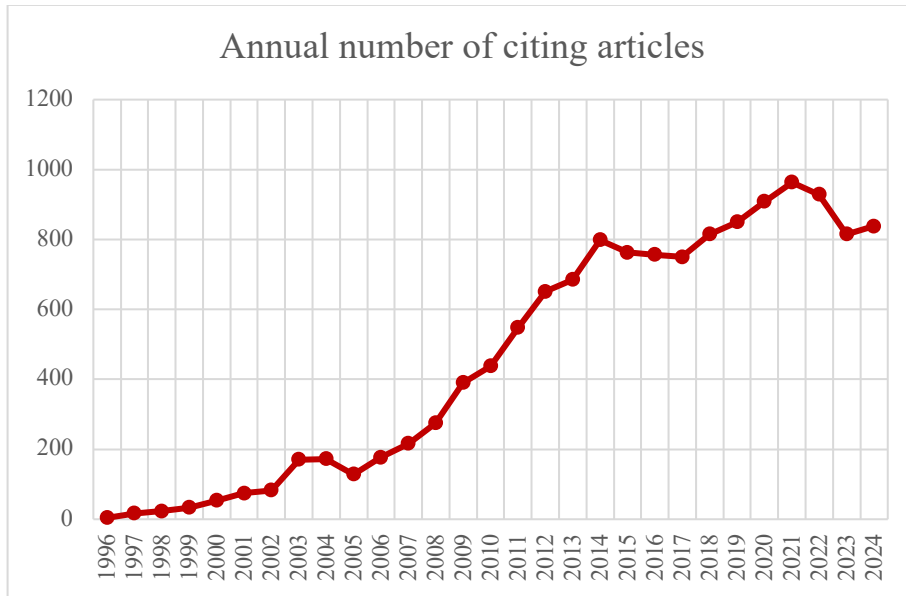


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This reflects a broadened academic acknowledgment and impact of JUCS in the computer science community. The chart also demonstrates some ups and downs in the number of citing articles from 2016-2024, which could reflect inconsistent research trends or varied publication forms. Yet overall, things are looking up, with the number of citing articles reaching peak levels in the early 2020s. The latter is an indication to the continued influence of the journal in the field and on higher citation of its articles. The increasing volume of citing articles spanning almost 30 years demonstrates the growing importance and impact of JUCS, becoming an important source of information, and research outputs in the computer science field. A gradually increasing number of citations reflects its significance for researchers and academics in this area.

The authors, universities, and countries citing articles from JUCS are presented in Table 4. It lists the order by the total papers published by them (TP) and indicates the number of citing papers by them respectively. Among the authors column at the top of the list is Jung (58) followed by Peng (46), García-Peñalvo (44), and Colomo-Palacios (41) respectively. Institutionally, most citing articles have been published by CNRS, France (133 papers), University of Sevilla, Spain (127 papers) and University of Castilla-La Mancha (117 papers) indicating a rich academic quality of the JUCS article publications. They are among the leading organizations in contributing to the journal

visibility and citation influence in the worldwide research community. The table also provides an indication of the geographical distribution of JUCS citing countries. China, Spain, USA, UK, Germany, and India are the top countries contributing to the citation counts of the journal with China leading the list with 1,964 citing papers. France, Italy, and Australia are among other countries where JUCS has participated, showing how JUCS has spread worldwide. This data demonstrates the worldwide impact of the journal in which researchers from all over the world and different institutions conduct research in the field of computer science.

R	Author	TP	University	TP	Country	TP
1	Jung, J.J.	58	CNRS France	133	China	1,964
2	Peng, H.	46	U Sevilla	127	Spain	1,507
3	García-Peñalvo, F.J.	44	U Castilla-La Mancha	117	United States	1,406
4	Colomo-Palacios, R.	41	U Polytech Madrid	101	United Kingdom	878
5	Pérez-Jiménez, M.J.	38	Polytech Wroclaw	99	Germany	869
6	Margenstern, M.	33	Min Educ PR China	98	India	787
7	Maurer, H.	33	U Murcia	89	France	626
8	Szczerbicki, E.	32	Chinese Academy Sci	86	Italy	568
9	Barbosa, J.L.V.	27	U Carlos III de Madrid	80	Australia	485
10	Nguyen, N.T.	27	U Granada	79	Canada	416
11	Salomaa, K.	27	Tech U Graz	77	Brazil	410
12	Ogata, K.	25	Huazhong U Sci Tech	75	South Korea	401
13	Song, X.	24	U Polytech Valencia	71	Taiwan	358
14	Valencia-Cabrera, L.	22	U Complutense Madrid	70	Malaysia	350
15	Yang, Q.	22	U Lorraine	70	Poland	338
16	Pan, L.	21	Yeungnam U	65	Netherlands	328
17	Song, T.	21	King Abdulaziz U	64	Iran	323
18	Futatsugi, K.	20	U Tech Malaysia	64	Greece	318
19	Song, B.	20	INRIA France	63	Japan	314
20	Zeng, X.	20	U Salamanca	60	Saudi Arabia	297
21	Zhang, G.	20	Xihua U	60	Austria	263
22	Cusick, T.W.	19	U Nat Educ Dist	57	Turkey	256
23	Iljazović, Z.	19	U Belgrade	57	Finland	227
24	Karnalim, O.	19	U Polytech Catalunya	56	Pakistan	222
25	Müller, K.R.	19	U Bucharest	55	Portugal	211
26	Pauly, A.	19	U Malaga	55	Romania	188
27	Blankertz, B.	18	King Saud U	55	Mexico	181
28	Lytras, M.D.	18	Xidian U	55	Switzerland	169
29	Orellana-Martín, D.	18	U Newcastle, Australia	54	New Zealand	163
30	Sarker, I.H.	18	Open U	54	Russia	153

Abbreviations: R = Rank; TP = Total papers.

Table 4: Citing articles of JUCS: Authors, Universities, and Countries

Table 5 lists the journals and research areas where JUCS papers are highly cited. At the top of the list is the journal itself, Journal of Universal Computer Science, with 534 cited articles, so it seems that it is heavily cited in its field. Followed by journal IEEE Access and Lecture Notes in Computer Science with 256 and 234 citing papers, respectively. These journals cover a wide range of topics, mainly in the areas of computer science, engineering, and mathematics, thus confirming the cross-discipline character of JUCS. The table represents the diversity of academic journals that cite JUCS published research as many journals cover a wide range of contents from

materials science, physics, psychology, and chemistry to health professions. This reflects the significance and interdisciplinary reach of the journal across numerous scientific and academic disciplines. The richness of citing journals shows that the development of research was not only in computer science but also in related fields that JUCS can be seen to play out its central role in the global community. The list also shows subject areas to which the journal is cited, such as Computer Science, Mathematics, Engineering, and Social Sciences.

R	Journal	TP	Research Area	TP
1	J Universal Computer Science	534	Computer Science	9,417
2	IEEE Access	256	Mathematics	3,641
3	Lecture Notes in Computer Science	234	Engineering	3,501
4	Theoretical Computer Science	153	Social Sciences	2,700
5	Computers in Human Behavior	133	Business, Management & Acco.	977
6	Expert Systems with Applications	133	Decision Sciences	719
7	Applied Sciences	101	Arts and Humanities	573
8	Sensors	99	Materials Science	526
9	Sustainability	95	Physics and Astronomy	501
10	Information Sciences	91	Psychology	383
11	Electronic Notes Theo. Comp. Sci.	86	Biochem., Genetics Molecular Bio.	311
12	Knowledge Based Systems	78	Medicine	304
13	Science Computer Programming	78	Environmental Science	291
14	Multimedia Tools and Applications	77	Chemistry	249
15	J Systems Software	74	Energy	208
16	Computers and Education	66	Chemical Engineering	199
17	Fundamenta Informaticae	65	Multidisciplinary	187
18	Information & Software Technology	65	Neuroscience	175
19	Education & Information Tech	64	Econ., Econometrics & Finance	148
20	Neurocomputing	64	Earth and Planetary Sciences	119
21	Studies in Computational Intell.	62	Agricultural and Biological Sciences	95
22	Electronics Switzerland	55	Health Professions	95
23	Soft Computing	55	Nursing	37
24	Software & Systems Modeling	55	Pharmacology, Toxicology Pharma.	32
25	ACM Computing Surveys	49	Immunology and Microbiology	21
26	Interactive Learning Environments	49	Veterinary	5
27	IEEE Trans Learning Technologies	48	Dentistry	2
28	Mathematics	47		
29	Computer J	45		
30	J Theoretical Appl Inform Tech	45		

Abbreviations: R = Rank; TP = Total papers.

Table 5: Citing articles of JUCS: Journals and Research Area

Among other prominent areas, it's worth mentioning that other fields (e.g., business, decision science, environmental science, and medicine) are also located prominently in journals citing JUCS article, which indicated that JUCS also has a wide influence over varied research.

4.3 Influential papers in JUCS

Table 6 present the most cited papers of JUCS ranked by the most citations received. These papers come from diverse areas of computer science like algorithms and computation models to learning systems and data analytics, reflecting the wide range

of topics addressed by the journal. The most referenced paper from the list is “Finding plagiarisms among a set of programs with JPlaq”, by Prechtelt et al. from 2002, had 444 citations in total and an average of 19.30 citations per year. Followed by “Plagiarism – A survey” with 262 citations. There are more works like “The transformation of the Web: How emerging communities shape the information we consume” (2006) of Kolbitsch and Maurer, which has 242 citations, and “A clustering approach for collaborative filtering using social network analysis” (2011) of Pham et al. with 204 citations. These papers represent major contributions to web-related technologies and the analysis of social networks, which have inspired a great deal of current research in computing.

The list also validates the increasing impact of categories like mobile tech, AI and smart devices. Papers such as “Development of learning analytics dashboard to assess students learning performance” (180 citations, 2010) and “Energy-efficient smartphone-based activity recognition using fixed-point arithmetic” (179 citations, 2013) highlight the rise of mobile computing and evidence-based computing-based educational resources. Another example of the highly cited paper is “Multilayer ensemble pruning via novel multi-sub-swarm particle swarm optimization” (2009), with 161 citations, demonstrating the interest in optimization in the domain of machine learning. The tables show the latest highly cited paper from 2019 and earliest from 1996 with cites per year (C/Y) ranging from 2.5-19.5 that is the witness of steady growth from start to present. Overall, JUICS has moderate citations in terms of highly cited papers, but these papers are foundational in high impact areas such as mobile computing, learning analytics, and computational optimization, highlighting their sustained impact in the field of computer science.

R	TC	Title	Author/s	Year	C/Y
1	444	Finding plagiarisms among a set of programs with JPlaq	Prechtelt L.; Malpohl G.; Philippsen M.	2002	19.30
2	262	Plagiarism – A survey	Maurer H.; Kappe F.; Zaka B.	2006	13.79
3	242	The transformation of the Web: How emerging communities shape the information we consume	Kolbitsch J.; Maurer H.	2006	12.74
4	204	A clustering approach for collaborative filtering recommendation using social network analysis	Pham M.C.; Cao Y.; Klamma R.; Jarke M.	2011	14.57
5	189	Situational method engineering: State-of-the-art review	Henderson-Sellers B.; Ralyté J.	2010	12.60
6	180	Development of the learning analytics dashboard to support students' learning performance	Park Y.; Jo I.-H.	2015	18.00
7	179	Energy efficient smartphone-based activity recognition using fixed-point arithmetic	Anguita D.; Ghio A.; Oneto L.; Parra X.; Reyes-Ortiz J.L.	2013	14.92
8	161	Multilayer ensemble pruning via novel multi-sub-swarm particle swarm optimization	Zhang J.; Chau K.-W.	2009	10.06
9	160	Exploiting the potential of concept lattices for information retrieval with CREDO	Carpineto C.; Romano G.	2004	7.62
10	160	A review of mobile location-based games for learning across physical and virtual spaces	Avouris N.; Yiannoutsou N.	2012	12.31
11	157	Quality of experience in communications ecosystem	Kilkki K.	2008	9.24

12	139	Discovering consumer insight from twitter via sentiment analysis	Chamlertwat W.; Bhattarakosol P.; Rungkasiri T.; Haruechaiyasak C.	2012	10.69
13	138	Towards a systematic study of representational guidance for collaborative learning discourse	Suthers D.D.	2001	5.75
14	131	Fast hashing and rotation-symmetric functions	Pieprzyk J.; Qu C.X.	1999	5.04
15	126	Mining feature-opinion in online customer reviews for opinion summarization	Somprasertsri G.; Lalitrojwong P.	2010	8.40
16	118	Toward the next wave of services: Linked services for the web of data	Pedrinaci C.; Domingue J.	2010	7.87
17	117	Opening learning management systems to personal learning environments	García-Peñalvo F.J.; Conde M.A.; Alier M.; Casany M.J.	2011	8.36
18	113	Spiking neural P systems with astrocyte-like control	Păun G.	2007	6.28
19	108	Automatic test data generation for data flow testing using a genetic algorithm	Girgis M.R.	2005	5.40
20	106	On the use of graph transformation in the formal specification of model interpreters	Karsai G.; Agrawal A.; Shi F.; Sprinkle J.	2003	4.82
21	104	ProFusion: Intelligent fusion from multiple, distributed search engines	Gauch S.; Wang G.; Gomez M.	1996	3.59
22	103	A systematic mapping study on soft skills in software engineering	Matturo G.; Raschetti F.; Fontán C.	2019	17.17
23	102	Descriptive complexity of machines with limited resources	Goldstine J.; Kappes M.; Kintala C.M.R.; Leung H.; Malcher A.; Wotschke D.	2002	4.43
24	101	Game-based learning in universities and lifelong learning: "UniGame: Social skills and knowledge training" game concept	Pivec M.; Dziabenko O.	2004	4.81
25	99	An evaluation technique for binarization algorithms	Stathis P.; Kavallieratou E.; Papamarkos N.	2008	5.82
26	98	Corporate memories for knowledge management in industrial practice: Prospects and challenges	Kühn O.; Abecker A.	1997	3.50
27	90	AR Learn: Augmented reality meets augmented virtuality	Ternier S.; Klemke R.; Kalz M.; van Ulzen P.; Specht M.	2012	6.92
28	90	The Berlin brain-computer interface: Machine learning based detection of user specific brain states	Blankertz B.; Dornhege G.; Lemm S.; Krauledat M.; Curio G.; Müller K.-R.	2006	4.74
29	88	A context model based on ontological languages: A proposal for information visualization	Hervás R.; Bravo J.; Fontecha J.	2010	5.87
30	88	Watermarking techniques for relational databases: Survey, classification and comparison	Halder R.; Pal S.; Cortesi A.	2010	5.87
31	85	Population P systems	Bernardini F.; Gheorghe M.	2004	4.05
32	84	A selection process based on additive consistency to deal with incomplete fuzzy linguistic information	Cabrerizo F.J.; Heradio R.; Pérez I.J.; Herrera-Viedma E.	2010	5.60
33	82	Health monitoring and assistance to support aging in place	Cook D.J.	2006	4.32
34	81	Etiquette, empathy and trust in communities of practice: Stepping-stones to social capital	Preece J.	2004	3.86

35	80	A study of user model based link annotation in educational hypermedia	Brusilovsky P.; Eklund J.	1998	2.96
36	80	P systems with active membranes and separation rules	Pan L.; Ishdorj T.-O.	2004	3.81
37	79	User context aware delivery of e-learning material: Approach and architecture	Schmidt A.; Winterhalter C.	2004	3.76
38	79	Systematic management of variability in UML-based software product lines	Oliveira Jr. E.A.; Gimenes I.M.S.; Maldonado J.C.	2010	5.27
39	78	Proposal for a conceptual framework for educators to describe and design MOOCs	Alario-Hoyos C.; Pérez-Sanagustín M.; Cormier D.; Delgado-Kloos C.	2014	7.09
40	76	A formal approach to ontology-based semantic match of skills descriptions	Colucci S.; Di Noia T.; Di Sciascio E.; Donini F.M.; Mongiello M.; Mottola M.	2003	3.45
41	75	KMDL capturing, analysing and improving knowledge-intensive business processes	Gronau N.; Müller C.; Korf R.	2005	3.75
42	73	On the power of membrane computing	Dassow J.; Păun G.	1999	2.81
43	72	Behavioural coherence in object-oriented algebraic specification	Diaconescu R.; Futatsugi K.	2000	2.88
44	71	A DCM based orientation estimation algorithm with an inertial measurement unit and a magnetic compass	Phuong N.H.Q.; Kang H.-J.; Suh Y.-S.; Ro Y.-S.	2009	4.44
45	70	Finding median partitions using information-theoretical-based genetic algorithms	Cristofor D.; Simovici D.	2002	3.04
46	68	An OWL ontology of set of experience knowledge structure	Sanin C.; Szczerbicki E.; Toro C.	2007	3.78
47	66	Identifying employee competencies in dynamic work domains: Methodological considerations and a case study	Ley T.; Albert D.	2003	3.00
48	66	Propositional interval neighborhood temporal logics	Goranko V.; Montanari A.; Sciavicco G.	2003	3.00
49	65	VOC: A methodology for the translation validation of optimizing compilers	Zuck L.; Pnueli A.; Fang Y.; Goldberg B.	2003	2.95
50	65	ASM-based testing: Coverage criteria and automatic test sequence generation	Gargantini A.; Riccobene E.	2001	2.71

Abbreviations: R = Rank; TC = Total citations; C/Y = Cites per year.

Table 6: The 50 most cited documents of JUCS

Table 7 shows the variation in top-cited document ranking as compared between the present study and [Baloian et al. 2021]. The result shows clear changes in the thematic focus of the *Journal of Universal Computer Science* (JUCS) over the past four years. Although some papers with ranks 1, 15, and 16 maintained the same rank in both studies, others had considerable changes. For example, as low as 43rd in the previous study, while currently 6th ranked, similarly, 20th in previously ranked is currently at 12 position shows a continuously increasing interest. In contrast, some of the dominant themes in the Baloian et al. analysis: e.g. documents at rank (8, 9, 11, 25, 28, 29, and 30-33) are now not among the top-ranked documents in this study.

The data indicates the emerging research topics inside JUCS. The list includes several documents that are not present in the current or previous list and some topics that were not central in earlier analysis but have now reached a significant presence in the journal, suggesting the journal's evolving focus in response to trends in the broader

field of computer science. By contrast, subjects whose ranking has been stable, or has only slightly fluctuated maintained a sustained scholarly engagement. The comparison demonstrates that bibliometric patterns might change over time because of innovative technological developments, shifting research priorities, or editorial policy. Table 7 is not only an historical guide but also a diagnostic tool to evaluate how the intellectual architecture of JUCS has evolved during the last few years.

TS	PS	TS	PS	TS	PS	TS	PS	TS	PS
1	1	11	6	21	-	31	22	41	40
2	3	12	20	22	-	32	13	42	-
3	4	13	11	23	-	33	25	43	-
4	8	14	-	24	26	34	-	44	29
5	7	15	15	25	19	35	-	45	35
6	43	16	16	26	-	36	32	46	18
7	12	17	9	27	24	37	-	47	-
8	2	18	-	28	10	38	-	48	23
9	5	19	-	29	14	39	28	49	34
10	-	20	27	30	46	40	-	50	37

Abbreviations: TS = Ranking in this study; PS = Ranking in the previous work of Baloian et al. (2021).

Table 7: Changes in the ranking between this study and Baloian et al. (2021)

Table 8 showcases the documents that are most referred to in JUCS publications from 2001-2024, indexed in the WoS. These citations show the intellectual roots and seminal works of the research trends in the journal, during the last two decades. The list comprises a combination of books, journal articles, and conference papers across a wide range of fields including artificial intelligence, computer science theory, software engineering, knowledge systems, and human-computer interaction. At the top of the list is the document by Gruber (1993) with 26 total citations, followed by Gamma (1994) with 25 citations. These documents showcase the pioneer and influential work with intellectual patterns that are contributing to the development of the theoretical part of the JUCS. These most cited articles emphasize the fundamental importance of conceptual modeling, system architecture, and computational paradigms for JUCS published research.

Analysis shows a heavy reliance on journal articles "A" type as primary sources, while some referenced documents are books "B" type indicating the lasting influence of comprehensive, monographic works. For example, books by Gamma and Weihrauch are influential and were directly or indirectly referenced in more than one JUCS article. These books are a part of the theoretical discourse and methodical apparatus in the journal's scope. Furthermore, the presence of the conference paper by Kiczales indicates a varied role of published literature in the development of JUCS authors.

Rank	First author	Reference	Year	Vol	Page	Type	TC
1	Gruber TR	Knowl Acquis	1993	v5	p199	A	26
2	Gamma E	Design Patterns-Elem Reusable Obj Softw	1994	-	-	B	25
3	Weihrauch K	Texts Theoretical Computer Science	2000	-	-	B	20

4	Dey AK	Pers Ubiquit Comput	2001	v5	p4	A	19
5	Davis FD	MIS Quart	1989	v13	p319	A	19
6	Nonaka I	Knowledge Creation Company	1995	-	-	B	17
7	Adomavicius G	IEEE T Knowl Data En	2005	v17	p734	A	16
8	Berners-Lee T	Sci Am	2001	v284	p34	A	16
9	Weiser M	Sci Am	1991	v265	p94	A	16
10	Borger E	Abstract St Machines. High-Level Syst	2003	-	-	B	15
11	Päun G	J Comput Syst Sci	2000	v61	p108	A	15
12	Otsu N	IEEE T Syst Man Cyb	1979	v9	p62	A	15
13	Gary MR	Computers And Intractability	1979	-	-	B	14
14	Jung JJ	Inform Sciences	2012	v182	p30	A	13
15	Ricci F	Recommender Systems Handbook	2011	p1	-	B	13
16	Kiczales G	Lect Notes Comput Sc	1997	v1241	p220	C	13
17	Vygotsky LS	Mind Soc Dev Higher	1978	-	-	B	13
18	Wenger E	Communities Practice	2009	-	-	B	12
19	Aun GP	Membrane Computing	2002	-	-	B	12
20	Abrial J	B-Book-Assigning Programs to Meanings	1996	-	-	B	12
21	Hoare C	Communicating Sequential Processes	1985	-	-	B	12
22	Allen JF	Commun ACM	1983	v26	p832	A	12
23	Herlocker JL	ACM T Inform Syst	2004	v22	p5	A	11
24	Czarniecki K	Generative Programmi	2000	-	-	B	11
25	Clarke EM	Model Checking	1999	p1	-	B	11
26	Gruber TR	Int J Hum-Comput St	1995	v43	p907	A	11
27	Deerwester S	J Am Soc Inform Sci	1990	v41	p391	A	11
28	Bryant RE	IEEE T Comput	1986	v35	p677	A	11
29	Bishop E	Grundlehren Math Wis	1985	v279	-	A	11
30	Zadeh LA	Inform Control	1965	v8	p338	A	11
31	Jung JJ	Expert Syst Appl	2011	v38	p2206	A	10
32	Jung JJ	Inform Sciences	2010	v180	p3248	A	10
33	Hall M	ACM SIGKDD Explor Newslett	2009	v11	p10	A	10
34	Jung JJ	J Univers Comput Sci	2008	v14	1031	A	10
35	Jung JJ	Knowl-Based Syst	2008	v21	p573	A	10
36	Demsar J	J Mach Learn Res	2006	v7	p1	A	10
37	Baader F	Description Logic Handbook	2003	-	-	B	10
38	Deb K	IEEE T Evolut Comput	2002	v6	p182	A	10
39	Resnick P	Commun ACM	1997	v40	p56	A	10
40	Storn R	J Global Optim	1997	v11	p341	A	10

Abbreviations: TC = Total citations; A = Article; B = Book; C = Conference.

Table 8: Top 40 most cited documents in JUCS (Web of Science 2001-2024)

The time distribution of such references demonstrates the lasting influence of significant papers published in the 1980s and 1990s, together with a relatively small number of important papers from the 2000s. It is also worthwhile to mention the fact that many papers written decades ago, e.g. Davis (1989), Bryant (1986), and Zadeh (1965), continue to be widely cited as a testament to their long-standing importance in the field. Meanwhile, emerging documents, like Jung's (2010), reflect emerging

influence in JUCS's bibliographic landscape. Thus, this table serves as a benchmark to understand the journal's citation patterns and changing topical trends with their contributions.

4.4 Leading authors, institutions and countries

Table 9 shows the most productive authors in JUCS in terms of most publications. It presents key indicators such as the number of total papers published (TP), number of total citations (TC), *h*-index (H), and their ranking positions (R) and (R*) ranking in [Baloian et al. 2021] study. It is important to acknowledge that the growing recognition and awareness of JUCS have likely influenced these statistics over time. The longer JUCS has been in existence, the more widely it has become known to authors submitting their work, particularly in Austria and Europe, where the journal has a strong presence. Additionally, other factors, such as open access publishing and free reviewing, may have made JUCS an attractive publishing option, particularly for authors from institutions with fewer resources to pay for high-cost journal publishing. It provides the academic productivity of the author, the citation impact, and the influence of the author with respect to the computer science world.

Leading the list is the author Maurer from the Technical University of Graz (Austria) with a remarkable 32 publications and 669 citations with an *h*-index of 9 and cites per paper values of 20.91. His earlier rank (R*) was also 1st, evidencing continued academic productivity and influence. The second place in the table is Jung from Chung-Ang University (South Korea) with 17 papers, 262 citations, and an *h*-index of 9 with 15.41 citations per paper. Among other prominent authors, Garcia-Peñalvo from the University of Salamanca (Spain) with 14 papers, and 380 citations, and Baloian from the University of Chile (Chile), with 14 papers and 97 citations secure 3rd and 4th positions respectively in the list. Interestingly, the period D1-D3 shows that the number of publications for these authors declined in the recent decade D3, indicating the varying interest of authors.

Among other authors Pino from University of Chile (Chile), with 13 documents, Börger, from University of Pisa (Italy) with 12 publications and Kloos from University of Carlos III Madrid (Spain) with 12 publications is currently at 5th, 6th and 7th position respectively. These factors, in addition to the number of contributions, demonstrate the ongoing impact and citation of these researchers. Their *h*-index, D1-D3 values, and rank shifts over time show that they are still contributing to the subject (with some evidence of significant influence gain, measured in the rise in the R ranks against the R* ranks from previous years). Overall, the tables highlight the rank in both studies, some authors maintained their positions, while others had considerable changes, it also showcases emerging authors like Abraham from the USA, Klamma from Germany, and Calude from New Zealand among others. On the other hand, this list also presents the authors that are losing their prominence in the journal with their topic trends like Ierusalimschy from Brazil and Asensio-Pérez from Spain among others who already disappeared from the list.

R	R*	Author Name	University	Country	TP	TC	H	C/P	D1	D2	D3
1	1	Maurer, H.	Tech U Graz	AUT	32	669	9	20.91	21	9	2
2	3	Jung, J.J.	Chung-Ang U	KOR	17	262	9	15.41	0	14	3
3	2	García-Peñalvo, F.J.	U Salamanca	ESP	14	380	11	27.14	0	13	1
4	5	Baloian, N.	U Chile	CHL	14	97	7	6.93	0	7	7
5	11	Pino, J.A.	U Chile	CHL	13	115	6	8.85	0	5	8
6	17	Börger, E.	U Pisa	ITA	12	167	6	13.93	8	3	1

7	4	Kloos, C.D.	U Carlos III Madrid	ESP	12	166	8	13.83	0	8	4
8	7	Lins, R.D.	U Federal Pernambuco	BRA	10	72	4	7.2	3	7	0
9	8	Nguyen, N.T.	Wrocław U Science and Tech	POL	9	126	5	14	0	7	2
10	13	Zurita, G.	U Chile	CHL	9	73	6	8.11	0	5	4
11	14	Barbosa, J.L.V.	U Vale do Rio dos Sinos	BRA	8	129	7	16.13	0	1	7
12	-	Abraham, A.	MIR Labs	USA	8	99	6	12.38	0	8	0
13	10	Ochoa, S.F.	U Chile	CHL	8	96	4	12	0	7	1
14	6	Ierusalimschy, R.	Pontificia U Católica	BRA	8	58	4	7.25	4	3	1
15	-	Klamma, R.	RWTH Aachen U	GER	7	228	3	32.57	0	3	4
16	12	Colomo-Palacios, R.	U Politécnica Madrid	ESP	7	202	6	28.86	0	7	0
17	9	Asensio-Pérez, J.I.	U Valladolid	ESP	7	83	5	11.86	0	5	2
18	29	Fernández-Medina, E.	U Castilla-La Mancha	ESP	7	71	4	10.14	0	6	1
19	-	Calude, C.S.	U Auckland	NWZ	7	64	3	9.14	5	2	0
20	-	Schewe, K.D.	Toulouse INP	FRA	7	39	3	5.57	0	6	1
21	-	Keller, J.	Fern U Hagen	GER	7	37	3	5.29	2	1	4
22	-	Păun, G.	Inst Mathematics Rom Acd	ROM	6	255	5	42.5	5	1	0
23	19	Bravo, J.	U Castilla-La Mancha	ESP	6	216	5	36	0	6	0
24	-	Schellhorn, G.	U Augsburg	GER	6	130	3	21.67	5	1	0
25	25	Thalheim, B.	U Kiel	GER	6	118	4	19.67	0	6	0
26	26	Weihrauch, K.	Fern U Hagen	GER	6	106	4	17.67	0	6	0
27	-	Margenstern, M.	U Lorraine	FRA	6	96	4	16	5	1	0
28	24	Ortega, M.	U Castilla-La Mancha	ESP	6	86	4	14.19	0	6	0
29	37	Redondo, M.A.	U Castilla-La Mancha	ESP	6	85	4	14.17	0	6	0
30	-	Piattini, M.	U Castilla-La Mancha	ESP	6	71	4	11.83	0	4	2
31	15	Barbosa, L.S.	U Minho	POR	6	69	4	11.5	2	4	0
32	16	Borba, P.	U Federal Pernambuco	BRA	6	50	3	8.33	1	5	0
33	-	Tochtermann, K.	ZBW	GER	6	50	4	8.33	6	0	0
34	-	Hertling, P.	U Bundeswehr Munich	GER	6	37	4	6.17	5	1	0
35	-	Vrhovec, S.	U Maribor	SVN	6	37	4	6.17	0	0	6
36	-	Banach, R.	U Manchester	UK	6	36	3	6	4	2	0
37	-	Luther, W.	U Duisburg-Essen	GER	6	33	4	5.5	1	0	5
38	30	Gallud, J.A.	U Castilla-La Mancha	ESP	6	32	3	5.33	0	6	0
39	-	Nedjah, N.	U do Estado do Rio	BRA	6	20	1	3.33	0	6	0
40	-	Dumitrescu, D.	U Babeş-Bolyai	ROM	6	1	1	0.17	0	6	0

Abbreviations: R = Rank; R* = Rank in Baloian et al. (2021); TP = Total papers; TC = Total citations; H = *h*-index; C/P = Cites per paper; D1 = TP between 1995-2004; D2 = 2005-2014; D3 = 2015-2024.

Table 9: Top 30 most productive authors in JUCS

Table 10 shows the 40 most productive institutions with the greatest number of publications and impact on JUCS, and these institutions are ranked by the total number of publications. The table also highlights the citation impact and other performance indicators. The rankings (R) and previous study rankings (R*) in [Baloian et al. 2021] study helps to make a comparison with the institutions that have made the most significant contributions, and interestingly all the first four institutes maintained their top positions, while others had considerable changes either improved their standings or declined.

Leading the list is the Technical University of Graz (Austria) with 66 total publications and 981 citations, with an *h*-index of 14. This institution has maintained its top position, having been ranked 1st (R*) in the previous study as well. University of Castilla-La Mancha (Spain) is in second position with (52 papers, and 600 citations). Followed by the University of Carlos III de Madrid (Spain), with 37 publications and 551 citations, and Polytech Wrocław (Poland), with 35 publications and 438 total citations. Shows a consistent trend in academic output and impact, with their previous rank (R*). Among other productive institutes is the University of Bucharest (Romania), which holds position 9 with 27 papers and 201 citations, and Open University (Netherlands) listed at number 11 with 21 papers and 406 citations. This illustrates

more general international academic contributions in JUCS that span from Europe to Asia including South America and Oceania.

The D1, D2, and D3 columns offer further information on the institutional contributions in terms of different periods and institutional contributions or trends can be accessed. For example, the University of São Paulo (Brazil), University of Duisburg-Essen (Germany), and University of Alcalá (Spain) have published more papers in the last decade D3 as compared to previous D2, showcasing the emerging research or alignment with the journal. On the other hand, some institutes participated with less documents in the last decade D3 as compared to their previous D2 period showcasing the losing prominence or changing author's interest. Overall, this ranking underscores the diverse and influential nature of research within JUCS, with top institutions from a variety of countries and regions, contributing significantly to the ongoing development of computer science research.

R	R*	Institution	Country	TP	TC	H	C/P	D1	D2	D3
1	1	Tech U Graz	AUT	66	981	14	14.86	26	28	12
2	2	U Castilla-La Mancha	ESP	52	600	13	11.54	0	43	9
3	3	U Carlos III de Madrid	ESP	37	551	13	14.89	0	25	12
4	4	Polytech Wroclaw	POL	35	438	12	12.51	0	24	11
5	14	U Auckland	NZ	35	239	8	6.83	27	6	2
6	5	U Chile	CHL	31	212	9	6.84	0	21	10
7	9	Fern U Hagen	GER	29	270	10	9.31	11	13	5
8	6	U Fed Pernambuco	BRA	28	142	6	5.07	5	17	6
9	18	U Bucharest	ROM	27	201	8	7.44	21	6	0
10	8	U Complutense Madrid	ESP	22	249	8	11.32	3	14	5
11	7	Open U	NLD	21	406	11	19.33	0	12	9
12	-	CNRS	FRA	19	138	8	7.26	4	7	8
13	11	U Polytech Catalunya	ESP	18	446	7	24.78	3	12	3
14	13	U Polytech Madrid	ESP	18	250	7	13.89	0	12	6
15	16	U Fed Rio Janeiro	BRA	18	182	9	10.11	1	14	3
16	-	Karlsruhe Inst Tech	GER	17	663	9	39	17	0	0
17	-	U Pisa	ITA	17	217	7	12.76	11	5	1
18	12	U Murcia	ESP	17	190	7	11.18	0	13	4
19	-	U Málaga	ESP	17	168	8	9.88	1	15	1
20	-	U São Paulo	BRA	17	165	4	9.71	1	7	9
21	10	U Minho	PRT	17	164	7	9.65	2	13	2
22	-	U Duisburg-Essen	GER	17	128	6	7.53	3	5	9
23	17	Yeungnam U	KOR	16	226	8	14.13	0	12	4
24	-	Tech U Wien	AUT	16	180	8	11.25	5	9	2
25	15	U Salamanca	ESP	15	417	11	27.8	0	14	1
26	39	U Natl Educ Dist	MEX	15	255	9	17	1	5	9
27	22	U Granada	ESP	15	156	6	10.4	1	10	4
28	21	U Belgrade	SRB	15	126	6	8.4	0	11	4
29	24	U Alcalá	ESP	15	122	7	8.13	0	7	8
30	34	U Sevilla	ESP	14	237	6	16.93	4	8	2
31	-	Know-Center, Graz	AUT	14	134	6	9.57	8	4	2
32	30	U Valladolid	ESP	14	109	6	7.79	0	7	7
33	31	U Rey Juan Carlos	ESP	14	93	7	6.64	0	8	6
34	-	RWTH Aachen	GER	13	265	5	20.38	1	6	6
35	47	Pontif U Cath Rio Janeiro	BRA	13	173	6	13.31	3	10	0
36	20	U Polytech València	ESP	13	139	7	10.69	1	8	4

37	36	U Vigo	ESP	13	110	7	8.46	0	10	3
38	-	U Turku	FIN	13	84	5	6.46	13	0	0
39	-	Tech U Dortmund	GER	13	36	3	2.77	7	5	1
40	-	12 universities	-	12	-	-	-	-	-	-

Abbreviations: R = Rank; R* = Rank in Baloian et al. (2021); TP = Total papers; TC = Total citations; H = *h*-index; C/P = Cites per paper; D1 = TP between 1995-2004; D2 = 2005-2014; D3 = 2015-2024.

Table 10: The 40 most productive and influential institutions in JUCS

Table 11 presents the most productive and influential countries in JUCS. This includes some of the primary statistics such as total papers, total citations, *h*-index, and citation per paper (C/P), as well as temporal publication records for D1, D2, and D3 periods. It also presents the publications per population (P/Po) (millions) and the citations per population (C/Po) (millions) that give more detailed insight into the research impact by country according to population. At the top of the list is the country Spain with 410 total documents, 4,916 citations, an *h*-index of 33, and 13.99 citations per paper. Spain with P/Po = 8.56 and a C/Po = 102.61 also testify its impact around the globe. Spain maintained its top position as in the study of [Baloian et al. 2021] which was also 1st, indicating that Spain's dominance has been sustained over time. Germany is 2nd with 317 papers, 4,023 citations, 3.75 P/Po, and 47.58 C/Po.

Followed by the United States with 232 papers and 2,551 citations, with 0.67 P/Po and 7.39 C/Po respectively. Despite the lower number of publications for period D3, it indicates the impact of its steady output with highly cited papers. Brazil, the United Kingdom, and Austria rank 4th, 5th, and 6th, respectively, which reflects their continuous impact on JUCS published research. Austria with 144 papers, P/Po of 15.79, and C/Po of 205.46 demonstrates high-level research output.

Countries like France, India, Turkey, Tunisia, and Jordan with a significant number of increasing documents during the last decade (D3) indicate the emerging role of these countries that are transforming their computer science research. While some countries lose their interest may be due to the journal rankings or changing research interest over time. The rankings R and R* going up or down indicate a long-term evolution of the relative research productivity rank of a country, and we observe a dynamic change in the research productivity, in which countries like India, Romania and Oceania have an upward trajectory and a high potential to evolve in a rapidly changing context of related computer science research contributions to JUCS.

R	R*	Country	TP	TC	H	C/P	D1	D2	D3	P/Po	C/Po
1	1	Spain	410	4,916	33	11.99	25	270	115	8.56	102.61
2	2	Germany	317	4,023	30	12.69	142	132	43	3.75	47.58
3	3	U States	232	2,551	23	11	92	102	38	0.67	7.39
4	4	Brazil	206	1,581	20	7.67	24	114	68	0.97	7.46
5	6	U Kingdom	190	1,949	23	10.26	41	94	55	2.75	28.19
6	5	Austria	144	1,874	21	13.01	59	61	24	15.79	205.46
7	7	China	135	1,114	16	8.25	3	79	53	0.10	0.78
8	8	France	130	1,348	20	10.37	39	62	292	1.95	20.26
9	9	Italy	119	1,757	21	14.76	44	53	22	2.01	29.61
10	11	Poland	89	957	18	10.75	1	41	47	2.31	24.83

11	10	South Korea	82	1,017	16	12.4	5	56	21	1.59	19.66
12	16	Japan	70	573	14	8.19	22	29	19	0.57	4.63
13	14	Australia	66	1,115	18	16.89	15	36	15	2.47	41.74
14	12	Netherlands	65	816	18	12.55	8	37	20	3.57	44.76
15	18	New Zealand	65	402	12	6.18	35	26	4	12.47	77.10
16	13	Portugal	64	713	16	11.14	7	45	12	6.14	68.39
17	22	India	62	524	12	8.45	2	20	40	0.04	0.36
18	27	Romania	59	696	13	11.8	32	25	2	3.10	36.60
19	15	Greece	58	948	18	16.34	9	35	14	5.77	94.35
20	19	Canada	58	580	14	10	23	31	4	1.46	14.59
21	17	Chile	52	431	11	8.29	0	28	24	2.63	21.81
22	20	Finland	50	693	14	13.86	20	23	7	8.90	123.37
23	-	Taiwan	47	381	11	8.11	5	26	16	2.02	16.41
24	26	Turkey	43	342	10	7.95	1	8	34	0.49	3.91
25	21	Saudi Arabia	42	430	10	10.24	0	24	18	1.24	12.66
26	25	Mexico	35	369	12	10.54	0	18	17	0.27	2.82
27	24	Switzerland	33	630	12	19.09	8	24	1	3.70	70.61
28	23	Hungary	31	140	7	4.52	3	27	1	3.20	14.47
29	29	Belgium	28	436	14	15.57	8	15	5	2.39	37.14
30	28	South Africa	28	205	7	7.32	5	12	11	0.44	3.20
31	30	Sweden	25	263	10	10.52	1	13	11	2.36	24.79
32	33	Iran	25	169	6	6.76	1	14	10	0.27	1.85
33	31	Argentina	24	121	6	5.04	0	15	9	0.53	2.65
34	34	Ireland	23	258	8	11.22	6	10	7	4.38	49.10
35	32	Serbia	23	213	8	9.26	0	16	7	3.41	31.62
36	42	Tunisia	21	99	6	4.71	0	8	13	1.71	8.06
37	37	Slovenia	20	167	7	8.35	0	10	10	9.44	78.82
38	35	Pakistan	20	108	5	5.4	0	11	9	0.08	0.43
39	36	C Republic	20	106	6	5.3	4	8	8	1.86	9.87
40	46	Jordan	19	233	9	12.26	0	1	18	1.64	20.17

Abbreviations: R = Rank; R* = Rank in Baloian et al. (2021); TP = Total papers; TC = Total citations; H = *h*-index; C/P = Cites per paper; D1 = TP between 1995-2004; D2 = 2005-2014; D3 = 2015-2024 and P/Po and C/Po = Papers and cites per million inhabitants.

Table 11: The most productive and influential countries in JUCS

Table 12 provides a publication structure classified by supranational regions, highlighting the productivity and influence of research contributions across different global regions within JUCS. The table also indicates publications per million population (P/Pop) and citations per million population (C/Pop) to enrich the comparison of relative contributions to research in each region. Europe ranks first with (1,698 Total Papers, 19,907 Total Citations, and 53 *h*-index) showing leadership in JUCS with high citations per paper of 11.62. Followed by Asia with (607 papers, 5,667 citations, C/P of 9.33) and despite the huge number of papers, it has low P/Pop and

C/Pop values of 0.13 and 1.18 respectively. North America stands 3rd with 333 papers, 3,579 citations, and a C/P ratio of 10.75. Regions such as Latin America, Oceania, and Africa showcase fewer contributions.

R	Region	TP	TC	H	C/P	D1	D2	D3	P/Pop	C/Pop
1	Europe	1,698	19,907	53	11.62	432	875	391	2.28	26.72
2	Asia	607	5,667	35	9.33	48	299	260	0.13	1.18
3	North America	333	3,579	28	10.75	115	153	65	0.86	9.29
4	Latin America	301	2,356	24	7.83	24	164	113	0.45	3.55
5	Oceania	129	1,499	20	11.62	50	61	18	2.80	32.52
6	Africa	72	634	10	8.80	5	27	40	0.05	0.42

Abbreviations: TP = Total papers; TC = Total citations; H = *h*-index; C/P = Cites per paper; D1 = TP between 1995-2004; D2 = 2005-2014; D3 = 2015-2024 and P/Pop and C/Pop = Papers and cites per million inhabitants.

Table 12: Publication structure classified by supranational regions

Latin America holds 4th position with 301 papers and 2,356 citations. Its P/Pop (0.45) and C/Pop (3.55) indicate one of the relatively low types of research impacts per capita as compared to Europe, Oceania, and North America. Oceania has the 5th best per capita production with a P/Pop of 32.52 compared with a C/Pop of 2.80. Africa secures 6th position with the lowest scientific output with 72 papers and 634 citations. This gives P/Pop and C/Pop of 0.05 and 0.42, respectively, which reflects the struggles of many African countries to participate in global academic research. In general, the table shows the heterogeneity of the contribution of the regions to JUCS: Europe dominates, followed by large number of publications from Asia, and the emergence of Oceania.

5 Mapping JUCS with the *VOS viewer* and *bibliometrix* software

Mapping scientific literature using tools like *VOS viewer* [Van Eck & Waltman 2010] and *bibliometrix* software [Aria & Cuccurullo 2017] allows researchers to visually explore complex patterns in large datasets. *VOS viewer* makes it easier to identify patterns, research collaborations, leading documents, and emerging trends by creating intuitive network maps of co-citation, bibliographic coupling, and keyword co-occurrence.

Note that in all the figures generated with the *VOS viewer* software, the objective is to provide an optimal visualization of the current bibliographic connections. For doing so, the graphical analysis is generated in *VOS viewer* by selecting a specific citation (or publication) threshold and a representative number of co-citation (or bibliographic coupling or co-occurrence) links. However, it is possible to consider a different threshold and a different number of links. This would generate a different figure that would include a higher or lower number of results.

In this study, *bibliometrix* is also essential for uncovering the intellectual structure like word cloud of topics, thematic maps, and trending topics within JUCS, providing a clear visual insight to complement the quantitative bibliometric analysis.

5.1 Co-citation analysis of JUCS

Co-citation analysis [Small 1973] looks at how often two documents or journals are cited together by another research publication. It helps map the knowledge structure and identify the key sources that shape a research field. In the context of JUCS development, co-citation analysis reveals which journals and research areas are the most influential and how different scientific fields are interconnected through shared citations.

Figure 4 presents the co-citation analysis of journals that are most cited in JUCS. The plot shows the relationship between diverse journals with coloured clusters, consisting of nodes and interconnected lines; each node's size is determined by the frequency of citations, i.e., the larger the nodes are, the more frequently the journals are cited. For Figure 4, the most representative visualization was obtained with a minimum citation threshold of 30 and 100 co-citation links.

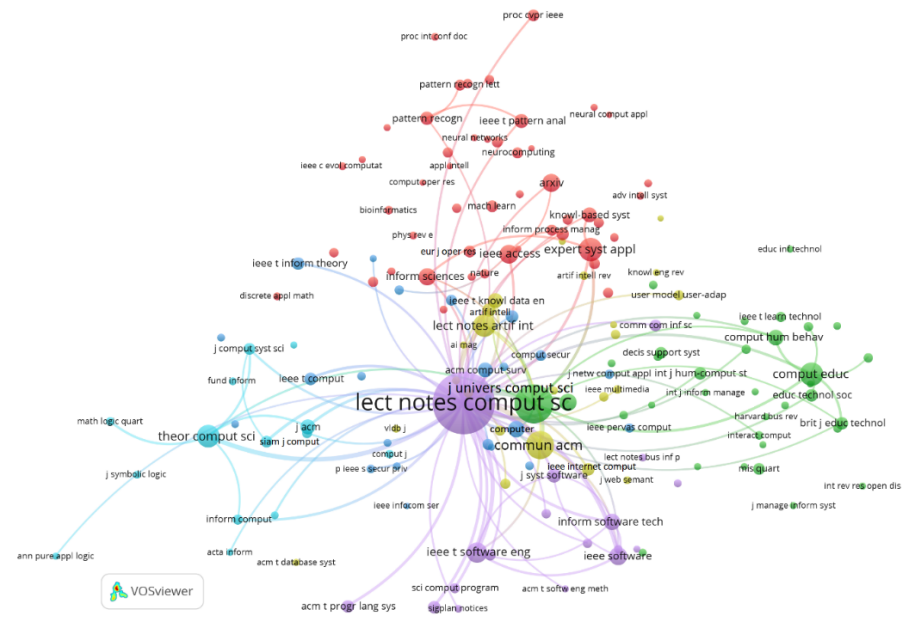


Figure 4: Co-citation of journals cited in JUCS: minimum citation threshold of 30 and 100 links. (Web of Science 2001-2024)

At the heart of the cluster are the nodes representing “Lecture Notes in Computer Science” and “Journal of Universal Computer Science (JUCS)” that are well-interconnected with journals like “IEEE Software” and “IEEE Transactions on Software Engineering” and can be seen with strong interconnected lines. The plot shows that the purple cluster is the most connected and contains many core journals that are most cited in JUCS. Among other core journals represented with blue cluster feature the journals that are focused on theoretical computer science, algorithms, and mathematical logic. The green cluster includes education and technology-oriented journals with a clear focus on computing in education, computer-human behaviour, and

technological innovation. The red cluster is composed of journals in neural networks, pattern recognition, and artificial intelligence.

The analysis also identifies distinct research themes based on journal co-citations. It has a relation to the more applied areas of expert systems and knowledge-based systems. This showcases the interdisciplinary connection of computer science journals within JUCS. The less connected or distinct clusters highlight the multidisciplinary nature of the work published in them, that cited JUCS work. Moreover, the co-citation network suggests the growing trend of interdisciplinarity in computer science research. For example, the edges between the red and green clusters indicate that the intersection between artificial intelligence and educational technology is emerging as a major theme of research in JUCS.

Similarly, the yellow and green clusters also reflect the relationship of the system applications and educational technologies, which further demonstrates the wide domain of topics that JUCS covers. In general, this co-citation analysis presents the intellectual landscape of JUCS and its different research areas through shared references that are interlinked, providing insights and enabling researchers to have a general idea of highly influential journals and emerging trends of research in the field of computer science.

Table 13 presents the temporal analysis of the most cited journals (co-occurrence) in JUCS in the past 30 years, it highlights the global interest, as well as for the period 2020–2024, 2010–2019, and 2001–2009. Worldwide, *Lecture Notes in Computer Science* is the leading journal with 2,449 citations. Among other globally cited journals were JUCS itself (975 citations), *Communications of the ACM* (510 citations), and *Computers & Education* (357), which illustrates the strong emphasis of these journals on mainstream computing and educational technology subjects over JUCS history.

The temporal analysis for 2020–2024, highlights the emerging journals with new trends over time. During the period journals such as *Lecture Notes in Computer Science* appeared with (315 citations), *Arxiv* (210 citations), *IEEE Access* (209), *JUCS* (142), *Expert Systems with Applications* (101), *Sensors-Basel* (80), and *Information Sciences* (54) among others appear as leading journals, indicating the presence of open access and multidisciplinary research presence within JUCS.

For the period 2010-2019, the journals *Lecture Notes in Computer Science* (1,158), *JUCS* itself with (627 citations), and *Computers & Education* (288) appear in JUCS. Traditional academic journals like *Expert Systems with Applications* (235), *Computers in Human Behavior* (131), and *Journal of System Software* (77) had relatively stronger citations, showcasing the balanced attention on applied computing.

For the period (2001–2009), classic computing journals *Lecture Notes in Computer Science* (1,000 citations), *Communications of the ACM* (233 citations), *JUCS* (212 citations), *Journal of the ACM* (96), *SIAM Journal of Computing* (69), *IEEE Software* (55), and *ACM Sigplan Notices* (51) were more dominant, suggesting a reliance on foundational theory and systems research during this period. These changes in citation patterns apparently reflect the development of JUCS along with computer science as a field, as well as changing publishing interests such as the rise of open access, the increasing emphasis on interdisciplinary research, and evolving trends in scholarly communication and collaboration.

R	Global		2020-2024		2010-2019		2001-2009	
	Journal	Cit	Journal	Cit	Journal	Cit	Journal	Cit

1	Lect Notes Comput Sc	2,449	Lect Notes Comput Sc	315	Lect Notes Comput Sc	1,158	Lect Notes Comput Sc	1,000
2	J Univers Comput Sci	975	Arxiv	210	J Univers Comput Sci	627	Commun ACM	233
3	Commun ACM	510	IEEE Access	209	Comput Educ	288	J Univers Comput Sci	212
4	Comput Educ	357	J Univers Comput Sci	142	Expert Syst Appl	235	Theor Comput Sci	208
5	Expert Syst Appl	343	Expert Syst Appl	101	Commun ACM	227	Lect Notes Artif Int	135
6	Lect Notes Artif Int	332	Sensors-Basel	80	Thesis	156	IEEE T Software Eng	128
7	Theor Comput Sci	321	Comput Educ	76	Lect Notes Artif Int	143	J ACM	96
8	IEEE T Software Eng	261	Knowl-Based Syst	69	Comput Hum Behav	131	ACM T Progr Lang Sys	86
9	IEEE Access	226	Proc Cvpr IEEE	63	IEEE Software	123	SIAM J Comput	69
10	IEEE Software	214	Lect Notes Artif Int	56	Inform Sciences	122	Computer	67
11	Arxiv	213	Inform Sciences	54	IEEE T Software Eng	115	J Comput Syst Sci	64
12	Inform Sciences	188	Comm Com Inf Sc	52	Inform Software Tech	105	Artif Intell	59
13	Thesis	188	Commun ACM	52	Theor Comput Sci	102	IEEE Software	55
14	Computer	179	IEEE Internet Things	52	Computer	93	IEEE T Pattern Anal	55
15	Inform Software Tech	174	Inform Software Tech	50	Educ Technol Soc	89	ACM Sigplan Notices	51
16	Comput Hum Behav	159	Appl Soft Comput	47	Brit J Educ Technol	82	Inform Comput	51
17	ACM Comput Surv	150	Future Gener Comp Sy	45	IEEE T Knowl Data En	79	Inform Process Lett	49
18	IEEE T Knowl Data En	149	Multimed Tools Appl	45	J Syst Software	77	ACM Comput Surv	48
19	J ACM	145	ACM Comput Surv	43	IEEE Internet Comput	71	IEEE T Comput	47
20	Knowl-Based Syst	138	PLOS One	43	Knowl-Based Syst	67	IEEE T Knowl Data En	47
21	J Syst Software	136	Neurocomputing	42	MIS Quart	65	Pattern Recogn	42
22	IEEE T Pattern Anal	124	Appl Sci-Basel	41	Int J Hum- Comput St	62	Math Logic Quart	41
23	Pattern Recogn	117	J Syst Software	39	ACM Comput Surv	60	Mach Learn	38
24	Artif Intell	113	Pattern Recogn Lett	37	Decis Support Syst	55	Sci Comput Program	38
25	IEEE Internet Comput	109	IEEE Software	36	Future Gener Comp Sy	55	IEEE Multimedia	37
26	Future Gener Comp Sy	106	Adv Neur In	35	Pattern Recogn	53	Software Pract Exper	37
27	Brit J Educ Technol	105	Procedia Comput Sci	35	Pers Ubiquit Comput	51	IEEE T Inform Theory	36
28	Sensors-Basel	105	J Mach Learn Res	32	Procd Soc Behv	51	SIGPLAN Notices	36
29	Int J Hum- Comput St	104	AAAI Conf Artif Inte	27	IEEE Pervas Comput	50	IEEE T Comput Aid D	35
30	4 Journals	102	Comput Secur	27	2 Journals	50	IEEE Internet Comput	32

Table 13: Most cited journals in JUCS: Global and temporal analysis

Figure 5 illustrates the co-citation analysis of documents most cited in JUCS, with a minimum citation threshold of 7 and 100 co-citation links, which provides detailed visualization and the relationship between influential publications. The different colored clusters represent different research fields, and the size of the nodes reflects

the frequency of co-citations. Bigger nodes correspond to more influential works, those cited together more in other papers. The study reveals some common research trends and topics. The prominent clusters of Jung Ji or Berners-Lee represent core topics and the main papers of the field in JUCS.

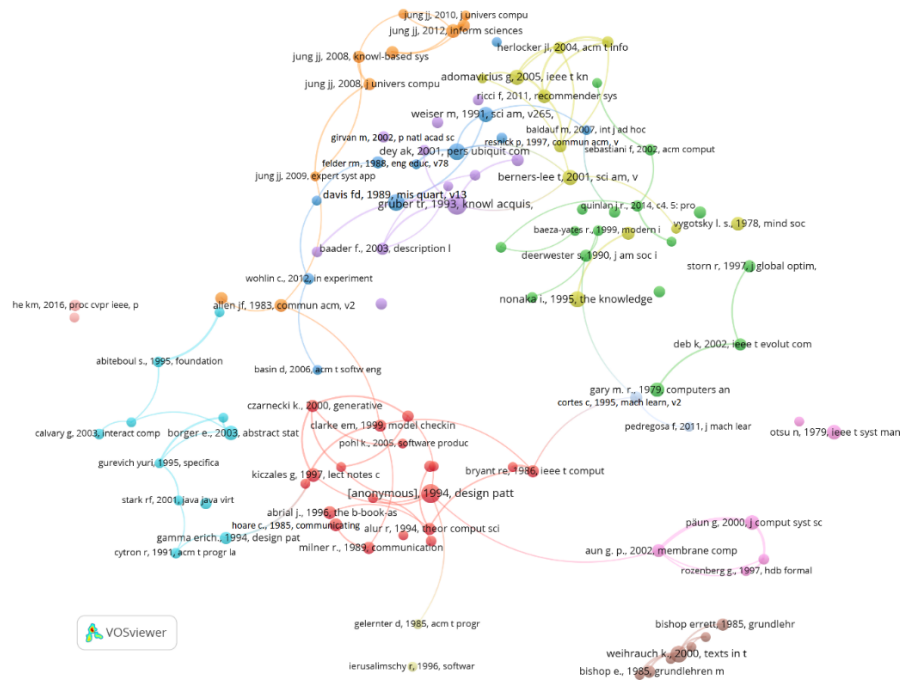


Figure 5: Co-citation of documents cited in JUCS: minimum citation threshold of 7 and 100 links (Web of Science 2001–2024)

The clusters, shown in blue and purple, contain impactful publications about the computer science theory like Allen J.F. (1983), Gruber T.R. (1993), Baez-Yates R. (1999) and the ‘knowledge acquisition and modern information systems. There is an additional red cluster that identifies seminal works on software engineering, design patterns, and programming languages that cite key references like Czarnecki, K. (2000), Bryant, R. (1994), and Gelernter, D. (1985). This cluster suggests a strong legacy of early computer science theory in contemporary work on software design and engineering.

Furthermore, the plot shows a pattern of interconnections between areas of research through mutual citations. The intersection of groups of clusters, e.g., of yellow and green, points to interdisciplinary relations of AI (e.g., Adomavicius G. (2005)) with social sciences, and papers like Bishop E. (1985). In the same way, a combination of computer science, information systems, and education emerges in certain clusters, which might reflect prospective interdisciplinary areas in JUCS. This analysis shows

the development of JUCS i.e. the increasing significance of human-computer interaction, machine learning, and knowledge-based systems.

5.2 Bibliographic coupling of JUCS

Bibliographic coupling [Kessler 1963] occurs when two documents cite the same references, indicating a similarity in their research focus or methodology. Analyzing bibliographic coupling among documents, authors, and countries provides insights into collaboration patterns and thematic connections. This study uses bibliographic coupling to uncover the network of researchers and nations with common research topics in JUCS.

Figure 6 presents the bibliographic coupling of authors publishing in JUCS generated by considering a minimum of 4 documents and 100 links. The plot reveals a network of authors (connectedness) with node size varying in proportion to the number of all publications of an author. The overlay visualization of the clusters reflects the publication year of the papers, ranging from the early 2000s to the late 2020s. The different colors illustrate the temporal progression of authors' work, early work shown in blue, and later works are shown in red, thereby indicating trends in contemporary topics of research in JUCS. The biggest cluster in the core area includes Hermann Maurer, José Bravo, Francisco J. García-Peñalvo and José A. Pino, and they have many papers published with many shared references. These researchers demonstrate a high level of academic cooperation and formation on central topics of JUCS.

The network also shows some small, but meaningful, clusters of authors representing niches or sub-domains within JUCS published research. For example, Egon Börger, Rafael Lins, and Klaus-Dieter Schewe, with a focus on formal methods and software engineering, are clustered in the same group. Another cluster of Eduardo Hernández, Crescencio Bravo, and Jörg Keller showcases the contributions towards technological advancement.

The color gradient used to give an insight into how different research subfields of JUCS have developed over time. The early 2000s were dominated by foundational topics, as demonstrated by authors such as Börger and Schewe (blue), while recent years exhibited a clear trend towards emerging topics, such as machine learning and big data analytics, as demonstrated by authors such as Yang Xu and Alok Mishra (red). Overall, the bibliographic coupling network reveals the collaborative nature of the research within JUCS, and the ongoing diversification of the topics considered in the journal over time, which is evidence of the constant expansion of the field of study and development of new trends.

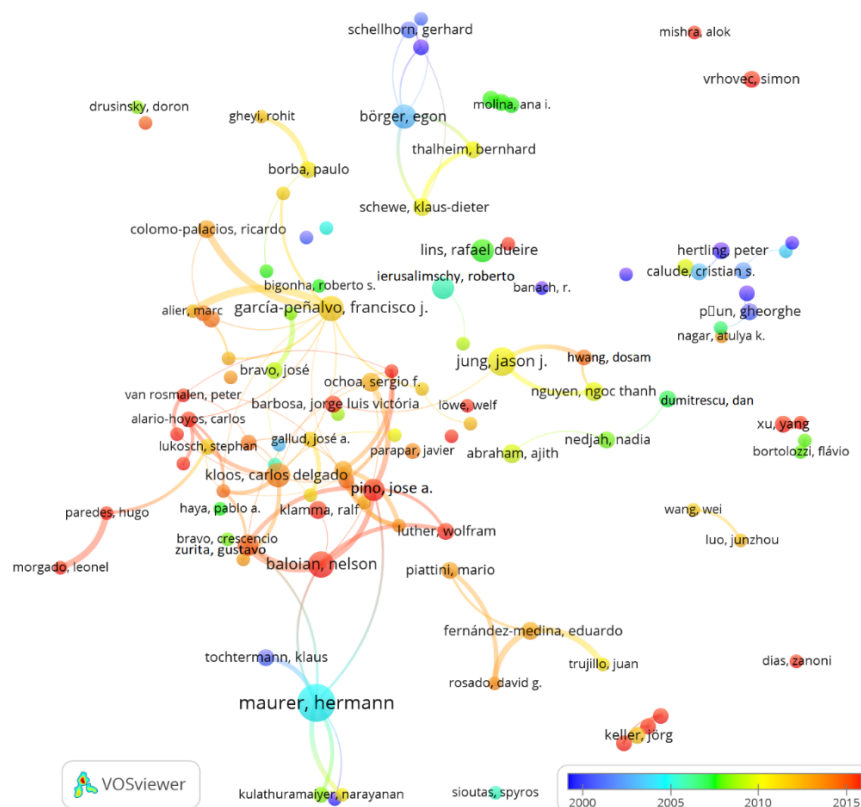


Figure 6: Bibliographic coupling of authors publishing in JUCS: minimum publication threshold of 4 documents and 100 links

Figure 7 presents the bibliographic coupling of institutions published in JUCS, plotted by considering a minimum of 10 documents and 100 links. This provides a clear picture of academic collaboration and the interconnections between institutions by analysing co-referenced documents. In a network cluster, the nodes represent universities or research institutions around the world, and the size of the nodes represents the number of publications, while the colour gradient represents the publication period from the early 2000s to the late 2020s. The network illustrates the collaboration relation between institutions based on shared citations of their published works. The colour gradient helps to determine the evolution period that showcases the most recent publications with red-orange colour, while early developments with blue to green.

In JUCS, there are well-established institutions from the central cluster, such as the University of Chile, the Complutense University of Madrid, the University of Carlos III Madrid, and the University of Castilla La Mancha, showing efficient research contribution in JUCS. Most of these institutions are linked by thick lines, which reflects the high rate of co-citations between them. The remaining clusters are centred around the Graz University of Technology, the University of Auckland, and the

University of Wrocław, indicating diverse collaborations. Such links indicate active joint research efforts among institutions from different continents and demonstrate that JUCS is a truly international platform for the dissemination and advancement of computer science knowledge. The fact that many of the participants come from different academic institutions in Europe, South America, and Asia reflects the worldwide participation and recognition of both JUCS itself as well as of advancements in computer science.

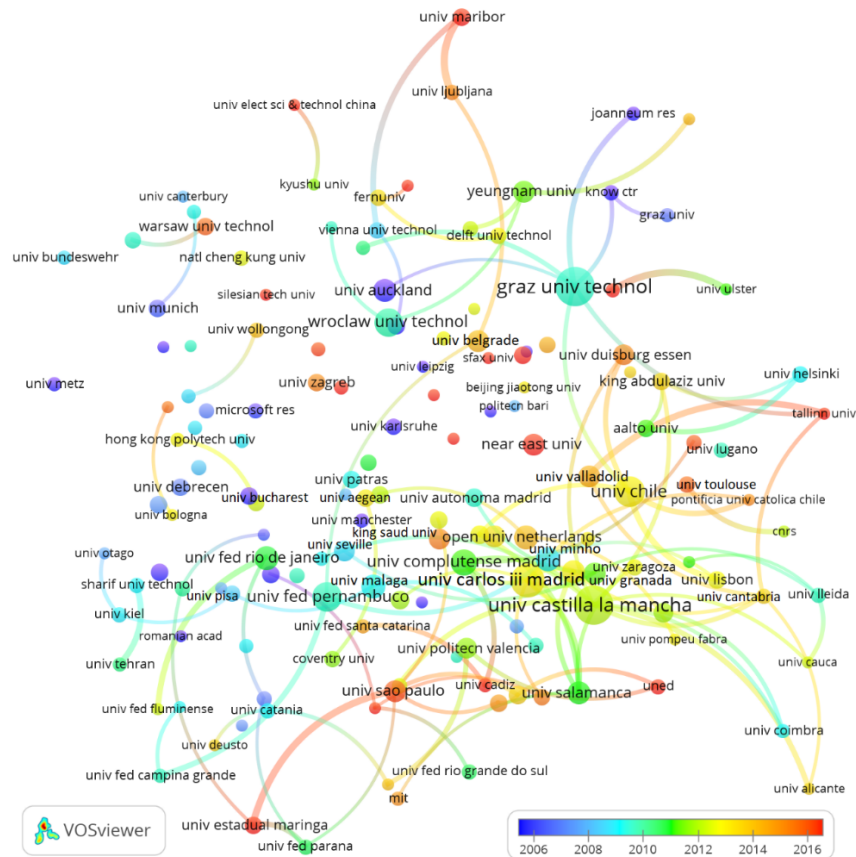


Figure 7: Bibliographic coupling of institutions publishing in JUCS: minimum publication threshold of 10 documents and 100 links (Web of Science 2001-2024)

The colour gradient timeline indicates that publication patterns have changed significantly over the years. We observe that nodes in orange and red suggest that more recent works are more influential. The University of Helsinki, the University of Lisbon, and University of Munich, are some of the institutions in dense blue and green nodes, indicating that their influential research occurred mainly in the early 2000s. In contrast, organizations like the University of Chile, the University of Valladolid, and the University of Campinas Grande, are depicted with yellow-orange nodes, indicating an increase in the volume of research during the latter half of the study period. This

indicates a temporal trend, with certain regions and institutions becoming more prominent in recent years of the analysis, reflecting the evolving academic interests and research trends reflected within JUCS. Overall, this bibliographic coupling network showcases the growing worldwide network of institutions and scholars in the computer science field and their collaborations with JUCS.

Figure 8 illustrates the bibliographic coupling of countries publishing in JUCS, generated by considering at-least five publications and 50 links. The cluster consists of the nodes representing countries, while their size showcases the total contributions, the interconnected lines represent the strength of collaboration, and colour gradients highlight the timeline of the contribution, ranging from early 2005 to late 2020. The network structure reveals clear clusters of countries that have strong academic ties, based on their shared references in JUCS. The prominent dense nodes representing Germany, United States, Spain, United Kingdom, Brazil, Austria, China, and France. The strength and thickness of the connections between these countries imply there are strong collaborations and contributions among them and highlight substantial academic exchanges in the field of computer science. Spain is surrounded by several countries like, Brazil, Portugal, Mexico, and Argentina, and is strongly interconnected bibliographically.

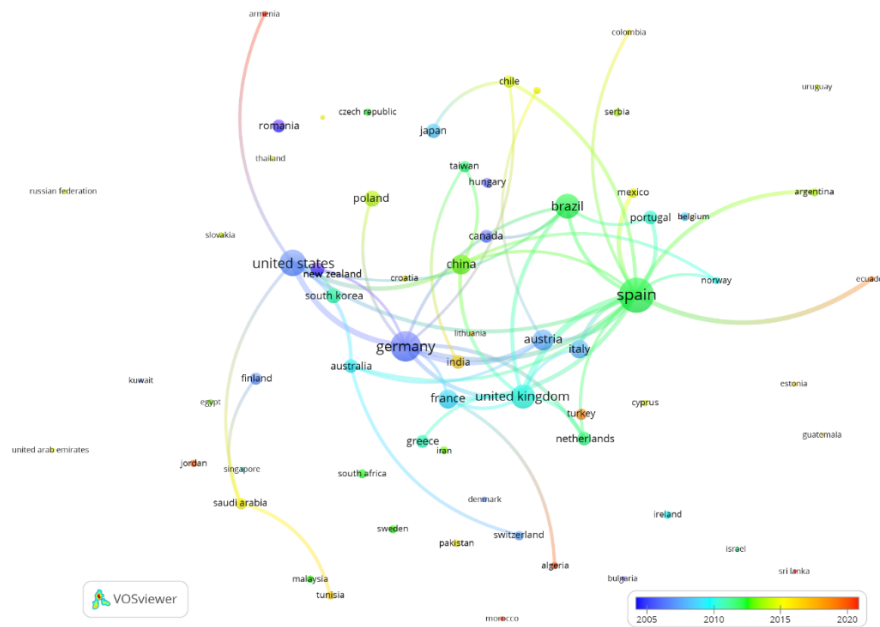


Figure 8: Bibliographic coupling of countries publishing in JUCS: minimum publication threshold of 5 documents and 50 links

Among other major clusters, the nodes and links between Germany, United States, and United Kingdom reflect significant academic exchanges in computer science. The colour gradient indicates the evolution of these collaborations, and surprisingly it

highlights that the collaboration between these countries is very old, and the output is shaping global research of computer science and JUCS.

Additionally, the regional collaborations are also highlighted by the network. The distinct cluster of Asian countries, such as China, India, South Korea, and Japan, further illustrates the reach and global impact of the research published in JUCS. The graph also illustrates the continental linkages or cross-country collaborations with countries like Australia, South Africa, Greece, and Italy contributing to the expansion of the field. Overall, this bibliographic coupling analysis reveals the global contributions in JUCS and the dynamic publishing trends over time.

5.3 Keyword and topic analysis of JUCS

For understanding the thematic structure of a research field, topical, keyword, and co-occurrence analysis is necessary [Callon et al. 1983]. *VOS viewer* maps the visualizations that show important research themes, recent trends, and interdisciplinary links by analysing the co-appearance of terms. To analyse the world cloud (visual representation of the most frequent terms), thematic evaluations and trending topics the analysis was done using *bibliometrix* [Aria & Cuccurullo 2017] software. The findings and interpretations of this subsection helps us to detect the major areas of emphasis, the evolution of key concepts, and the intellectual environment of JUCS.

The co-occurrence analysis of index terms in JUCS is represented by Figure 9 and was generated by considering a minimum threshold of five keyword occurrences and 100 co-occurrence links. Note that the reason for selecting a minimum threshold of five is because it provides an optimal graphical representation of the current keyword co-occurrence structure of JUCS. The map highlights the interrelations between the keywords, the size of the nodes correlates with the frequency of occurrence of the keywords, and the colour scale shows the publication years ranging from 2006 (blue) to 2014 (red). This visualization showcases the associated links between the topics and the evolution of prominent topics in JUCS. The prominent nodes representing “Knowledge Management”, “Machine Learning”, “Data Mining”, “natural language processing”, “big data”, “Semantic Web”, “Security”, and “E-learning”. These keywords represent major areas of focus in the journal.

Machine Learning and Data Mining clusters are closely related to Deep Learning, Classification, and Clustering, which indicates the growing importance of data-driven methodologies in JUCS. These clusters reflect the growing interest in leveraging technology for information management, knowledge sharing, and its integration with machine learning methods. One more noticeable cluster representing specific fields of research, like Internet of Things (IoT), Cybersecurity, Natural Language Processing, and Artificial Intelligence, is directly related to core areas such as Security, Privacy, and Sentiment Analysis.

The evolution of topics can be seen from the plot with early developmental topics (e.g., Formal Methods or Functional Programming) to more modern and application-oriented fields like feature detection, network security, Machine Learning, Artificial Intelligence, and Sentiment Analysis or social media. This transition is indicative of an increased focus on applied research in the latter part of the decade, which is consistent with overall computer science trends. The co-occurrence network also successfully demonstrates both the foundational and emerging research areas to JUCS.

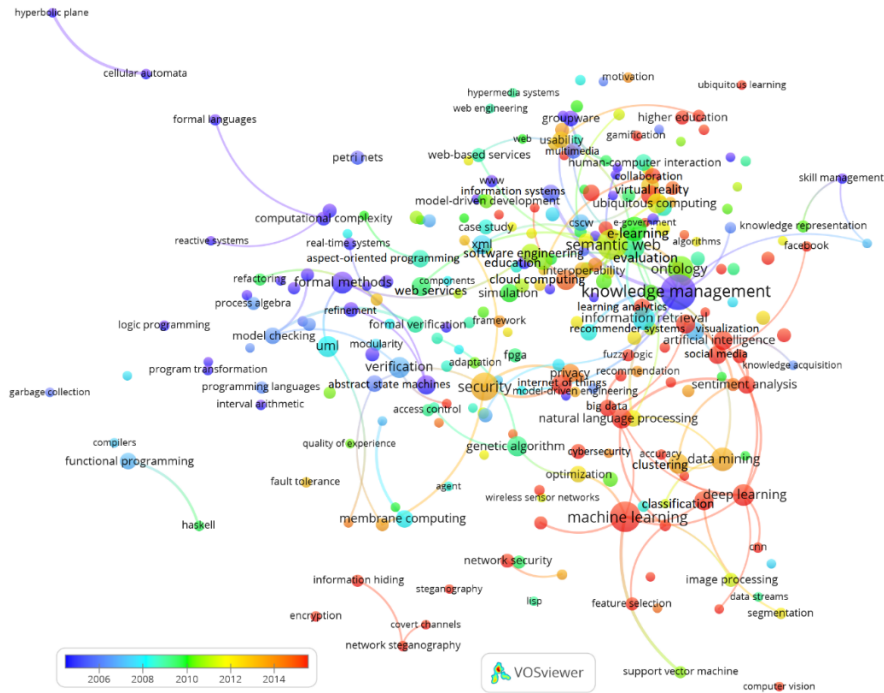


Figure 9: Co-occurrence of index keywords in JUCS: minimum occurrence threshold of 5 and 100 links

Table 14 shows the most productive and influential index keywords in JUCS and provides a very clear view of the thematic evolution of the journal. Prominent fields like Knowledge Management (68 papers, 978 citations), Machine Learning (49 papers, 533 citations), and Semantic Web (48 papers, 776 citations) have always played a predominant role in the development of the journal's scientific profile, highlighting their role within computer science itself. Interestingly, the most frequent keyword, Semantic Web has the highest citation-per-paper ratio (16.17 C/P), suggesting that it is always a hot topic and has significant influence.

Moreover, the distribution of papers over the decades (D1-D3) shows a clear upward trend in Artificial Intelligence and Deep Learning. The keywords Machine Learning (40), Deep Learning (25), Security (16), Data mining (13), Internet of Things (17), Classification (10), Artificial Intelligence (12), and Virtual reality (14) with most documents published in D3 period shows the changing thematic interest within JUCS. It also shows the JUCS's sensitivity to new technologies and contemporary scientific interests. The notable rise of Deep Learning, despite a modest citation count, further suggests a proactive engagement with frontier research domains that are gaining momentum in the global academic landscape.

R	Keyword	TP	TC	H	C/P	D1	D2	D3
1	Knowledge Management	68	978	16	14.38	43	22	3
2	Machine Learning	49	533	11	10.88	0	9	40

3	Semantic Web	48	776	15	16.17	6	32	10
4	Security	40	348	10	8.7	2	22	16
5	Ontology	35	375	10	10.71	8	20	7
6	Data Mining	30	295	12	9.83	0	17	13
7	Evaluation	29	440	11	15.17	9	11	9
8	Information Retrieval	28	404	9	14.43	13	7	8
9	Deep Learning	25	163	8	6.52	0	0	25
10	Formal Methods	25	399	12	15.96	11	13	1
11	E-learning	23	287	8	12.48	4	14	5
12	Verification	23	274	11	11.91	10	9	4
13	Clustering	22	387	7	17.59	1	13	8
14	Natural Language Processing	22	293	7	13.32	2	5	15
15	Ontologies	22	379	10	17.23	5	13	4
16	UML	22	139	7	6.32	6	15	1
17	Cloud Computing	21	185	8	8.81	0	16	5
18	Genetic Algorithm	21	214	8	10.19	3	15	3
19	Internet of Things	21	128	6	6.1	0	4	17
20	Ubiquitous Computing	21	379	11	18.05	0	17	4
21	Classification	20	204	7	10.2	1	9	10
22	Education	20	257	8	12.85	7	6	7
23	Web Services	20	230	7	11.5	2	16	2
24	XML	20	151	6	7.55	7	12	1
25	Abstract State Machines	19	508	14	26.74	14	5	0
26	Artificial Intelligence	19	271	8	14.26	1	6	12
27	Recommender Systems	19	201	9	10.58	0	10	9
28	Software Engineering	19	564	9	29.68	5	8	6
29	Virtual Reality	19	287	11	15.11	0	5	14
30	Simulation	18	218	8	12.11	4	10	4

Abbreviations: TP = Total papers; TC = Total citations; H = *h*-index; C/P = Cites per paper; D1 = TP between 1995-2004; D2 = 2005-2014; D3 = 2015-2024 and P/Po and C/Po = Papers and cites per million inhabitants.

Table 14: The most productive and influential index keywords in JUCS

Figure 10 presents the topic trends in JUCS from 1996-2024, plotted with *bibliometrix* software [Aria & Cuccurullo 2017] online (*biblioshiny*). The size of the nodes represents the occurrence of the keywords while the horizontal bars showcase the duration for each term’s appearance in respective years. Recently, from 2020 to 2024, some terms, for example, “convolutional neural network (CNN)”, “deep learning,” “blockchain,” “big data,” “virtual reality”, and “internet of things,” appeared with larger node of “machine learning” suggesting that the journal is aligned with the latest technological trends. The occurrence of “CNN” and “semi-supervised learning” near the 2024 endpoint further suggests JUCS’s expanding interest in both theoretical developments and machine learning techniques. The horizontal lines for the terms “security”, “evaluation”, “natural language processing”, and “information retrieval” highlight the long-lasting research themes within JUCS publication trends.

From 1996-2010 the terms like “www,” “abstract state machines,” “knowledge management”, and “information systems” denotes the structure and formal methods that shaped in the beginning of JUCS and supported its scope. The thematic evolution from mid-2000s is towards more application centric themes “e-learning”, “semantic web” and “security”. The 2010s are characterized by fast thematic diversification, with new fields such as “clustering”, “data mining”, “learning analytics” and “natural

language processing”. These trends show the growing involvement of JUCS in data-centric and AI-driven research.

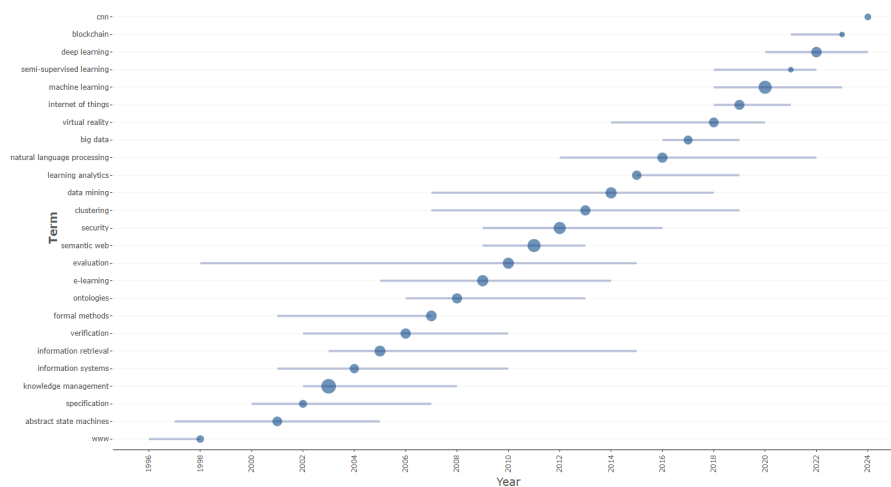


Figure 10: Trend topics in JUCS from 1996-2024

The figure, overall, shows a significant chronological timeline from foundational research for computing theory to data driven applied and AI-focused work. This development not only reflects international developments in computer science but furthermore demonstrates the flexibility of JUCS in addressing new frontiers in research.

Figure 11 showcases the thematic map of the 250 most frequent author keywords in JUCS generated with the *walktrap* clustering algorithm [Pons & Latapy 2006] in *bibliometrix* software [Aria & Cuccurullo 2017] online. The distribution of themes is categorized into four groups “motor theme”, “basic theme”, “niche theme”, and “emerging or declining theme” based on their centrality (relevance degree) and density (development degree). The motor theme: This quadrant is well developed and robust with high values of centrality and density, and consists of topics like machine learning, deep learning, data mining, natural language processing, clustering, evaluation, software engineering, verification, and simulation. These keywords are also closely related and are considered as the frontier areas in the journal’s scope. The basic theme quadrant, on the other hand, consists of high-centrality but low-density topics such as knowledge management, semantic web, ontology, e-learning, and information retrieval. Moreover, niche theme quadrant consists of terms like computational complexity, Petri nets, as well as constructive mathematics, which cover relatively specific research topics with lower central relevance, pointing to more focused but less interrelated research threads.

Finally, the emerging or declining topics quadrant includes premature or decreasing keywords such as membrane computing, functional programming, and genetic algorithms, which indicate upcoming or declining interest. As a curious point, middle relevance topics, such as web services, software architecture, and security, are

located near the centre, meaning relevance transition. This map provides a strategic overview of the conceptual structure of JUCS, highlighting both its core strengths and areas of potential thematic shift.

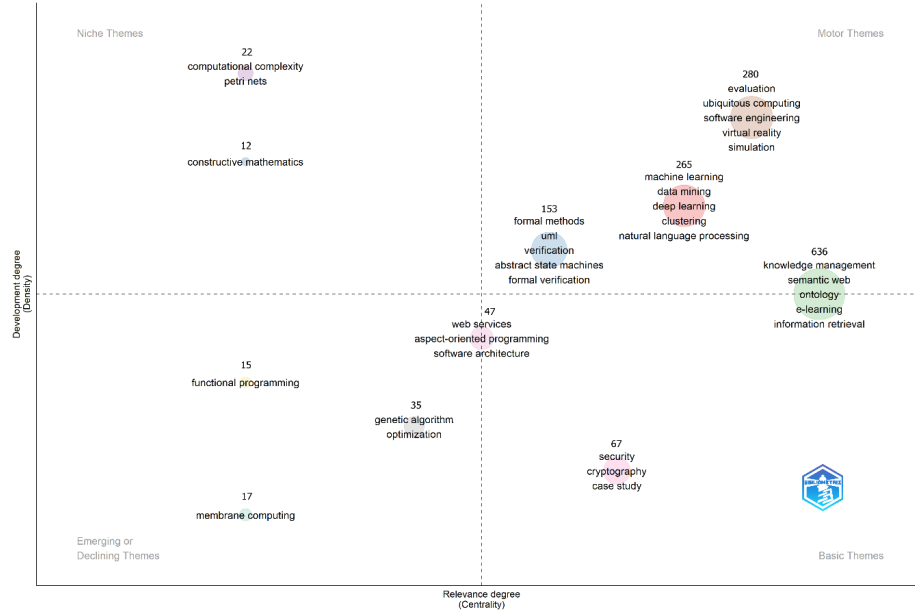


Figure 11: Thematic map built with the 250 most frequent author keywords and minimum cluster frequency of 4 (Clustering algorithm: Walktrap)

Figure 12 presents an intuitive overview of the journal's emphasis and is illustrated with a word cloud of the most frequent index keywords of JUCS, which was plotted by using Scopus data in *bibliometrix* software [Aria & Cuccurullo 2017] online. The most common terms “knowledge management,” “machine learning,” “semantic web,” and “security” with the biggest size reflect their centrality and recurrence across JUCS publications. These keywords reflect the sustained commitment and interest of the journal to the foundational fields (e.g., knowledge management, semantic web) and rapidly evolving domains (e.g., machine learning, data mining, deep learning). Furthermore, the keywords “e-learning”, “information retrieval”, “ontology”, “natural language processing”, and “data mining” appear prominently, indicating that JUCS emphasizes educational technology, information system, and intelligent computation. Emerging keywords such as “cloud computing,” “virtual reality” or small topics such as “blockchain”, “privacy”, and “metadata” also show JUCS’s role in current and interdisciplinary research areas.

Overall, this visual reinforces findings from bibliometric and thematic analyses, offering a clear picture of the journal’s scholarly output. Ranging from traditional computer science topics to state-of-the-art AI techniques. The broad research bases on these keywords reflects JUCS’s wide scope and its development along with the research foci of the world.

Table 15 showcases the most prominent research topics in JUCS during the period from 2014 to 2023 that are retrieved from [SciVal 2024] within the Scopus database. It shows the total publications (TP), field-weighted citation impact (FWCI) [Purkayastha et al. 2019], and global prominence percentile (PP) [Klavans & Boyack 2017], of data highlighting the multidimensional view of the topic relevance. FWCI, where 1.0 represents the global average in the field; values above 1.0 indicate above-average impact, and values below 1.0 indicate below-average impact. FWCI has no fixed upper limit. PP = Percentile in the field, ranging from 0 to 100, where higher values indicate stronger performance relative to similar publications in the same field and year. The FWCI of the topics “E-learning; Membership Function; Data Mining”, “E-learning; Online Learning; Massive Open Online Course”, and “Learning Analytics; E-learning; Computer-Aided Instruction” with 4.85, 2.21, and 2.57 respectively, highlight the significance of the topics within JUCS. The impact of journal publications on “Social Networking (Online); Sentiment Classification; Data Mining”, “Smart City; Sustainable Development; Internet of Things”, and “Educational Data Mining; Decision Trees; and Machine Learning”, with 99.32, 99.86, 99.42 prominence percentile values, respectively.

Several other topics exhibit the continuous and sustained output range of JUCS’s recent academic production. Domains, such as Software Product Line, Language Instruction, Mobile Technology, Sentiment Classification, and Virtual Reality have moderate to high field-weighted citation impacts, which is evidence for JUCS covering both classical and very recent fields. The data highlights the compliance between JUCS and current trends of research, particularly in the areas of education technology, artificial intelligence, and human-computer interaction. The top prominence percentile topics are noteworthy as they imply JUCS’s strategic role in contributing to the global scientific world. This data reflects JUCS’s evolving scholarly profile in the last decade, with a growing interest in interdisciplinary, socially relevant high-quality subjects.



Figure 12: Word cloud of the most frequent index keywords in JUCS

R	Topic	TP	FWCI	PP
1	E-learning; Online Learning; Massive Open Online Course	16	2.21	98.82
2	Learning Analytics; E-learning; Computer-Aided Instruction	10	2.57	98.79
3	Software Product Line; Computer Software Reusability; Software Design	9	0.4	92.38
4	Language Instruction; Electronic Learning; Mobile Technology	8	0.85	96.75
5	Social Networking (Online); Sentiment Classification; Data Mining	7	0.83	99.32
6	Covert Channel; Network Protocols; Steganography	7	0.44	78.52
7	Virtual Reality; Second Life; Computer-Aided Instruction	6	0.96	76.58
8	Context Awareness; Noncommunicable Disease; Ubiquitous Computing	6	0.64	57.03
9	Virtual Reality; Human Computer Interaction; User Experience	5	0.67	97.53
10	Process Engineering; Automotives; Cybersecurity	5	0.43	54.97
11	Smart City; Sustainable Development; Internet of Things	4	0.36	99.86
12	Educational Data Mining; Decision Trees; Machine Learning	4	0.62	99.42
13	Recommender Systems; Collaborative Filtering; E-Commerce	4	0.62	98.53
14	Anomaly Detection; Learning Systems; Log Analysis	4	0.63	96.83
15	Mobile Learning; E-learning; Computer-Aided Instruction	4	0.65	95.99
16	Learning Style; E-learning; Computer-Aided Instruction	4	0.52	92.45
17	Mobile Learning; Engineering Education; Computer-Aided Instruction	4	1.06	78.49
18	Approximation Algorithms; Molecular Evolution; Permutation	4	0.17	72.06
19	E-learning; Membership Function; Data Mining	4	4.85	59.87
-	24 Topics	3	-	-
-	72 Topics	2	-	-
-	420 Topics	1	-	-

Abbreviations: R = Rank; TP = Total papers; FWCI = Field-weighted citation impact (data from Scopus); PP = Worldwide prominent percentile (according to Scopus and FWCI).

Table 15: Leading topics in JUCS between 2014 and 2023 (Scopus – SciVal)

Table 16 further advance the topical study and showcases the topic clusters in JUCS (2014-2023) based on Scopus [SciVal 2024] analytics to get a more in-depth analysis of the topical trends and impact. The clusters reflect interdisciplinary intersections across computer science domains, and the clustering reflects the source database’s organization rather than our own subjective categorization. The leading cluster with the largest number of articles, “social media; Data Mining; COVID-19”, with 44 articles and a high PP (94.89), which shows JUCS is more relevant to social problem-solving. Followed by the topic cluster “Sentiment Analysis; Natural Language Processing; Machine Learning”, with a percentile prominence of 99.67 and 35 publications, which means this research area matters worldwide despite having only a modest field-weighted citation impact (FWCI = 0.59).

Among other prominent clusters “Internet of Things; Network Security; Cloud Computing” with (TP = 8, FWCI = 2.67, PP = 89.14), can be seen for its high citation impact, whereas “Gamification; Serious Game; Computer-Aided Instruction” with (TP=29, FWCI=1.00) demonstrates JUCS strong focus in educational technologies. On the other hand, clusters Edge Computing; Computation Offloading and Image Segmentation; and Object Detection, are globally positioned, indicating JUCS’s orientation to current hot topics with global interest. The data table shows that JUCS has strategically increased its thematic range of problem solving range from emerging

to cross-disciplinary topics. From classic topics like Software Engineering to emerging areas like Deep Neural Networks and Augmented Reality. The inclusion of clusters with high PP and growing FWCI further confirms JUCS’s increasing integration into globally impactful research conversations.

R	Topic Cluster	TP	FWCI	PP
1	Social media; Data Mining; COVID-19	44	1.63	94.89
2	Sentiment Analysis; Natural Language Processing; Machine Learning	35	0.59	99.67
3	Software Engineering; Open-Source Software; Information System	32	0.65	88.03
4	Gamification; Serious Game; Computer-Aided Instruction	29	1	87.18
5	Data Mining; Artificial Intelligence; e-Commerce	20	0.45	85.41
6	Machine Learning; Data Mining; Artificial Intelligence	18	0.35	93.39
7	Edge Computing; Internet of Things; Computation Offloading	18	0.22	87.90
8	Image Segmentation; Deep Neural Network; Object Detection	16	0.84	100
9	Augmented Reality; Gesture Recognition; Image Processing	16	0.87	97.05
10	Self-Regulation; Computer-Aided Instruction; Self-Efficacy	14	0.72	52.91
11	Ontology; Semantic Web; Linked Data	14	0.34	49.24
12	Authentication; Network Security; Cloud Computing	12	0.53	79.79
13	Data Mining; Artificial Intelligence; Information System	12	1.82	79.13
14	Steganography; Watermarking; Data Hiding	12	0.42	51.86
15	Computer-Aided Instruction; Intelligent Tutoring System; Learning Style	12	1.15	48.72
16	Ubiquitous Computing; Internet of Things; Information System	12	0.88	5.69
17	Network Security; Cybersecurity; Machine Learning	10	0.67	90.19
18	Data Mining; Artificial Intelligence; Machine Learning	10	0.27	57.55
19	Automaton; Automata Theory; Formal Verification	10	0.35	34.92
20	Internet of Things; Network Security; Cloud Computing	8	2.67	89.14
21	Cloud Computing; Data Center; Network Security	8	0.24	83.51
22	Web Service; Quality of Service; Data Mining	8	0.5	48.20
23	Software Testing; Open Source Software; Web Application	8	0.22	24.39
24	Particle Swarm Optimization; Mathematical Optimization; Benchmarking	7	0.65	96.59
25	Internet of Things; Routing Protocol; Energy Engineering	7	0.55	79.39
26	Social media; Computer Forensics; Cybersecurity	7	0.16	71.15
27	Network Security; Quality of Service; Time-Sensitive Networking	7	0.31	34.00
28	Concurrency; Software Testing; Data Structure	7	0.46	22.49
-	4 Topic Clusters	6	-	-
-	15 Topic Clusters	5	-	-

Abbreviations: R = Rank; TP = Total papers; FWCI = Field-weighted citation impact (data from Scopus); PP = Worldwide prominent percentile (according to Scopus and FWCI).

Table 16: Leading topic clusters in JUCS between 2014 and 2023 (Scopus – SciVal)

Overall, the topical analysis shows that the journal JUCS has consistently adapted to the evolving landscape of computer science over the past three decades. The journal showcases the developments in computer science, with strong foundations in Knowledge Management, Semantic Web, and Machine Learning, while also integrating new and multidisciplinary fields like Deep Learning, the Internet of Things, E-learning, and Sentiment Analysis. The PP and FWCI metrics of the journal confirm that JUCS is vigilant to global research and societal needs, about educational technology, human-computer interaction, and social challenges as well as data analysis. This thematic evolution underscores JUCS's growing prominence, impact, and strategic stance within the scientific world.

6 Conclusions

This study presents a bibliometric analysis of JUCS for the period 1994-2024. The data was retrieved from Scopus database in April 2024, and was analysed mathematically, statistically, and graphically using (*VOS viewer* and *Bibliometrix* software). The study shows the wide international scope of the journal and the changing academic evolution.

The combination of graphical and tabular data reveals the growing global collaboration network in computer science research. Earlier studies were dominated by traditional European research institutions, while recent ones show a geographical expansion and the emergence of institutions from South America and Asia, reflecting the increasing global engagement and diversification of research contributors in the field. The key findings were also compared with the bibliometric study conducted back in 2021 by [Baloian et al. 2021]. Surprisingly, the journal has improved its metrics since 2021 and gaining global prominence by adopting the emerging technologies and research trends. The ranking of many authors, journals, institutes has improved while with the changing research topics, some declined or totally replaced by others.

The conclusion of the study is divided into three parts. Firstly, we present the main findings. Second, the practical implications and recommendations are discussed. Finally, the limitations of the study are illustrated with future research directions.

6.1 General findings

The bibliometric analysis of JUCS over its 30-year history reveals a dynamic yet consistent academic trajectory marked by intellectual impact and evolving research themes. The annual publication and citation structure reveals that 87.12% of the 2,756 papers published in the journal received at least one citation, which is a sign of sustained academic impact, while few documents received high citations i.e. ≥ 200 citations. Performance metrics of JUCS, such as impact factor (IF) and CiteScore, peaked in 2020–2021, which reinforces its credibility and growing academic visibility, especially in interdisciplinary areas.

Other metric analysis demonstrates JUCS's international spectrum and the depth of its interdisciplinary focus. China, Spain and the USA are among the top citing countries, while authors including Maurer, and institutions such as the Technical University of Graz and University of Castilla-La Mancha are at the forefront in both production and citations. The journal is often referenced in prestigious source publications such as *Lecture Notes in Computer Science* and *IEEE Access* proving its influence in interdisciplinary studies. Most frequently cited articles address historical

fundamental issues such as plagiarism detection systems, social network analysis, and mobile learning technologies, with a notable shift in topical focus since the [Baloian et al. 2021] study. The topical analyses of JUCS identify the intellectual roots in classical works from AI, human computer interaction, system design, and educational technology. It also identifies authors and institutional productivity patterns. Overall, JUCS has distinguished itself as a durable and impactful journal, publishing scholarly work that has been recognized across disciplines, regions, and the global research landscape, contributing significantly to the advancement of knowledge and fostering collaboration in the field of computer science.

The graphical analysis of JUCS shows that the influence of the journal has increased consistently over time, reflected in more citing articles with a larger outlier and a smaller increase in the early 2020s. The co-citation analysis of documents and journals reveals the intellectual links between JUCS and the major areas of computer science, reflecting its multidisciplinary coverage and its emergent thematic importance.

The bibliographic coupling of authors, institutions, and countries reinforces the journal's collaborative nature with a significant contribution from Europe, Latin America, and Asia. The keyword analysis shows a clear shift from classical computing related keywords to more recent hot issues such as AI, big data and blockchain. The thematic map classifies these areas into motor, basic, niche, and emerging themes, illustrating JUCS's responsiveness to evolving scientific trends while maintaining continuity in core domains. Overall, the journal establishes a stable and adaptive research publication platform contributing significantly to the global computer science research.

6.2 Practical implications

JUCS has strengthened its editorial focus on emerging trends that have significantly influenced the field in recent years. The journal may also consider issuing special issues or thematic collections on topics such as artificial intelligence, machine learning, blockchain, data mining, security, deep learning, and image processing to attract high-impact research and further solidify its position as a leading platform for cutting-edge developments in computer science. Also, by promoting co-authorship with highly cited authors and institutions, it can contribute to enhance the visibility and academic impact of the journal. By focusing on early-career researchers can increase the outreach and impact. Collaborating with active research groups in underdeveloped regions such as Asia and Latin America could also strengthen the authorship of the journal and its international reach.

The journal should periodically review its thematic coverage using bibliometric insights, it'll help to align itself with the emerging needs of the international research community while keeping its core competencies in the computer science community. Encouraging interdisciplinary submission, and industry collaboration in domains like educational technology and human-computer interaction could reinforce the journal position. Finally, by continuous evaluation of citations and co-citation patterns, it can guide editorial policy and enhance data-driven decision making about the future of the journal.

6.3 Limitations and future research

There are several limitations in this bibliometric study. It is a general analysis of JUCS up to 2024. But future emerging topics, authors and institutes, can vary due to publication trends. Therefore, future updates of these results will be needed, for example, for the 40th or 50th anniversary of JUCS.

The study is done using Scopus database but may exclude significant contributions from platforms like WoS or Google Scholar. Moreover, citation-based impact measures may not adequately capture the impact of recent publications because of the time lag of getting cited. The study is mainly based on universal quantitative indicators, the publication and citation number, and may not reflect qualitative factors such as theoretical significance of individual work.

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