

Bibliographic Analysis of Soft Computing Components from 1999– 2018 in India

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Highlights

- A Study on Soft Computing and its applications from Scopus Database from the year 1999 – 2018 for India.
- We focused to find the best institution with a maximum number of publications in the field of Soft Computing and its techniques.
- We identify the authorship productivity in the field of Soft Computing techniques for India.

Abstract: The core component of the Soft Computing (SC) domain gives outstanding performances for solving problems compared to other problems solving techniques. In order to solve difficult problems, the majority of researchers are concentrating on the soft computing field. The sub-domains of the soft computing field include Genetic Algorithms, Fuzzy Logic, Machine Learning, Neural Networks, and others. In this paper, we aimed to investigate the contributions made by Indian organizations and authors on the topic of soft computing and its applications for the years 1999 to 2018 for the Scopus database. The study confirmed that the most number of papers published in the neural network with a count of 2127 and the most productive author was M.ChintamaniDeo, with 22 papers with the highest h-index and the Indian Institute of Technology, The most productive institution in the subject of Soft Computing is Roorkee, which has contributed 109 publications overall, garnered 355 citations, and has an h-index of 9. This led us to the conclusion that, in comparison to other sub-domains in the field of Soft Computing and its Applications, Indian Institutions and Indian Authors have produced the majority of publications in Neural Networks and Artificial Intelligence.

Keywords: *Soft Computing, Neural Networks, Machine Learning, VOS Viewer, Scopus.*

1. Introduction

Soft Computing (SC) is a platform that links academic fields like expert systems, fuzzy logic, genetic algorithms, artificial intelligence and neural networks [1]. It is one of the important forums for all the researchers, scientists and academicians engaged in research related to emerging fields due to its efficient performance and problem-solving skill in the real world [2]. It is a tool to provide a

rapid solution for all complex problems compared to other applied methods [3]. Unlike

hard computing methodologies, SC provides a good solution, robustness and tolerance at very low costs [4].

SC is classified into two types they are approximate reasoning and functional Approximation or Randomized search to evaluate the solution for all complex problems so modern researchers determined the solutions very easily than that hard computing [5].

Recently Bibliometric analysis has an incredible growth in the research community to identify the scientific contribution made in a particular area [6]. It is a study that is used to track research output, contribution and impact created by a particular field or particular journal through bibliometric indicators [7]. Bibliometric is a tool to analyze the research area and summarize the clear outline in the form of structural data therefore this analysis gives an entire view of the research activity [8]. This is one of the parts of the library and information science to estimate the publication and contribution made in the specific area [9] – [11].

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Scopus database is scientific, international, and multidisciplinary literature made by Elsevier in November 2004 for bibliographic review [12]. It provides full-text literature on worldwide research fields and it has been accessed through a subscription [13]. The Scopus data contains a variety of indicators and statistics on scientific and scholarly publishing articles, patents or books [14]. Currently, it has 78 million records from a discipline like physical science, life science, health science and social science from 11,678 publications with 34,346 peer-reviewed journals [15]. It has coverage from different sources like journals, book series and trade journals [16]. The quality of the Scopus database was measured by every year by using four parameters like SCImago Journal rank, CiteScore, SNIP (Source Normalized impact per paper) and H-index [17].

VOS viewer is an application used to visualize the bibliometric network for individual publications for journals, conferences, book series and specific journals [18]. It performs the functionality based on the citations, keywords, author-wise, institution wise and year-wise using the text mining functionality frameworks to visualize the data obtained from the major database like Web of Science, Scopus and PubMed [19]. Utilizing this visualization tool, scholars can examine relationship networks such as co-occurrence bibliographic coupling, authorship. [20]. The visualized graph obtained from the VOS viewer has a scroll and zoom function. Currently, the VOS viewer version 1.6.18 was released in January 2022. The latest version solves the problems from the database like a semantic scholar and dimension and also it provides extra functionality supporting Microsoft Academia similarly [21]. By employing bibliometric indicators such as year-by-year, institution, keyword, and author data for India during the period of 1999 to 2018, we intended to analyse the contribution made in the field of soft computing techniques and its Applications through this work.

2. Literature Survey

Several studies have been conducted in the various sub-fields of soft computing using different indicators. Some of the studies were described here. X.He and Y. Wu (2017) has identified the most cited publications in the intuitionistic fuzzy field using some of the bibliometric methods like country Wise, Region Wise, Author Wise and institutions Wise from the WoS database for the past decade [22]. I. Park and B. Yoon (2018) have proposed bibliometric information of scientific papers and patents in pattern recognition technology from the WoS database for ten years [23]. In 2019, Y. Li et al. conducted the bibliometric evaluation of deep learning from the SC domain using the WoS database from 2007 to 2019 utilizing indicators including institution, author, and country specific indicators. The resulting data were then

visualized using the VOS viewer [24]. H. Mokhtari et.al (2019) prepared bibliometric research on JASSS journal using the bibliometric indicators like active institutions, keywords, prolific authors and countries for the period of 2000 – 2018 from the Scopus and visualized the data through VOS viewer by author co-citation and other formats [25]. F. Gao et.al (2019) conferred the bibliometric analysis over the most concerned topics of AI from 2008 to 2018. In this study Web of Science database was used to retrieve the articles published in the AI journals by implementing indicators like country-wise, country collaboration wise, Year Wise and Institution Wise [26].

A.K.Shukla et.al (2020) analyzed a scientometric study on fuzzy techniques in big data analysis using bibliometric indicators like total citations, total paper, CPP, highly cited author, institution wise, country wise and highly influential papers from the Scopus and Web of Science databases for the years from 2000 to 2019 [27]. H.Jin et. al(2020) analyzed the bibliometric analysis on pattern recognition from the applications of Machine Learning by implementing the bibliographic indicators like keywords, institutions and co-occurrence cluster analysis for the top most five countries from the Web of science core collection database for the years from 1997 to 2019 [28]. R.Cioffi et.al (2020) performed a bibliometric study from Scopus and WoS database for the applications of artificial intelligence and machine learning methods from SC using the bibliometric indicators like authors, keywords, institutions and publication year for the period from 1999 to 2020 [29]. S.J.Dramsh (2020) has done a bibliometric analysis on the development of Machine learning techniques in Geoscience for the period of 1988 to 2017 from the WoS database by using indicators like year-wise and country-wise [30]. H. Chen and Z. Deng (2020) used bibliometric indicators such the H-Index and Co-Citation Analysis to study the bibliometric analysis of the Convolutional Neural Networks (CNNs) from the Web of Science database for the years 2010, 2011, 2012 upto 2020.[31]. G.Yugi et al. (2020) examined papers published in the field of AI between 1995, 1996, 1997 upto 2019 using the WoS database. This study was conducted using variables such as the growth rate of all publications, research activities, and pattern and a significant contribution to the field of AI [32].

A.J. Lopez and A.M.Gil (2020) have described the comparison and overview of the fuzzy logic from the Web of Science database for the period of 52 years from 1965. During this study, they implemented bibliometric indicators like publications wise, institutions wise, and countries wise to determine the growth and impact made in the fuzzy research [33]. B. M. Gupta and S. M. Dhawan (2020) implemented the bibliometric research in India on

Artificial Neural networks (ANN). In this study, data was collected from the Scopus database using bibliometric indicators like keywords wise, authors wise and institution-wise data from 1999 to 2018 [34]. S. Vinit and Dr. G. Saikat (2020) determined the bibliometric approach in the Artificial Intelligence in Health and Medicine by using indicators like country wise, authors wise and total publication from the Web of Science database from 2008 to 2019 [35]. S. Ramkumar et al. (2021) conducted a Bibliometric analysis of SC and its uses for the top Asian nations using bibliometric measures such as country-wise and author-wise most productive authors for the fields of neural networks, artificial intelligence, and pattern recognition between 1999 to 2018 for the PubMed database [36]. M. B. Kesavan et al. (2022) discussed about the bibliometric study of SC for institution-wise and country-wise counts from the PubMed database for the period of 1999 – 2018 [37]. From the analysis, we finalized that all the bibliometric analyses were carried out for individual subdomains of SC components. But in our study, we focused to analyze the top components of the Soft Computing technique.

3. Data Collection And Methodology

The primary objective of our study was to obtain data from Scopus Repository from the year 1999 to 2018 for SC components keywords like Fuzzy logic, Machine Learning, Neural Networks, Artificial Intelligence, Genetic algorithm, and Expert Systems for India from the Asian Continent. We started to collect data from the year 1999 and end with the year 2018 for the SC Keywords, in order to calculate the impact made in the field of SC, bibliometric parameters such as Year, Author, Institution, and Keyword that were connected to India. Scopus database is one of the most important multidisciplinary repositories to store the different journal publications with several bibliometric indicators like Authors, Affiliations, keywords, etc. which was indicated in fig. 1.

Step 1: Open any web browser, Search Scopus from Google to open the Scopus database. In the Scopus Search Page, below the Start Exploring tab shown in fig.1, type the keyword with the country India in the search documents related to the keywords mentioned in Table 1.

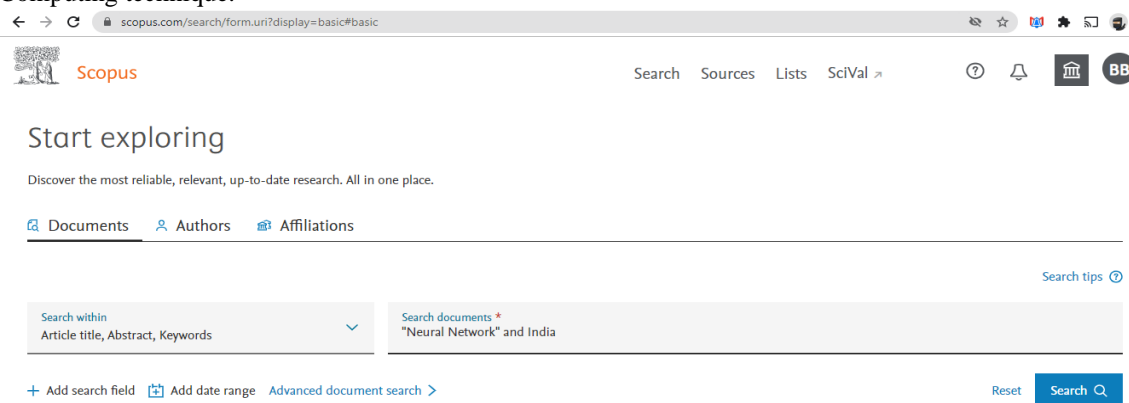


Fig 1: Scopus exploring window

Table 1: Keyword for SC Components

S.no	Soft Computing Components
1.	Artificial Intelligence
2.	Genetic Algorithm
3.	Fuzzy Logic
4.	Evolutionary Algorithms
5.	Deep Learning
6.	Expert Systems
7.	Pattern Recognition
8.	Optimization Algorithms
9.	Neural Networks
10.	Soft Computing
11.	Machine Learning
12.	Probabilistic Reasoning
13.	Approximate Reasoning

Step 2: Now select the Article title, Abstract, and Keyword in search within the column and select add date

range from the year 1999 to 2018 which was represented in fig. 3. Click Search to view all the data.

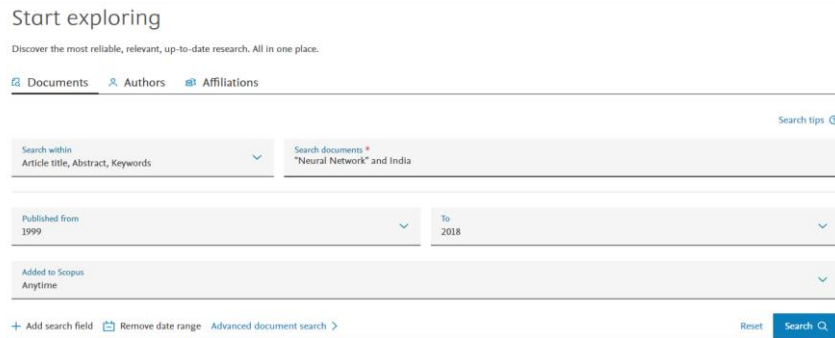


Fig 2: Setting Date range from Scopus database

Step 3: Next on the document result page, we can view all the data related to the keyword and country. In that, the total number of data will show on the top of the result page which was represented in fig. 4. In the Refine results tab we can limit to year-wise, top author, subject area, document type, keyword, affiliations and country, etc.

Select all data to export by clicking the Export button in the Analyze search results tab, next in the export tab Select CSV to download the dataset. During the data, collection query strings were generated from the Scopus database were shown below.

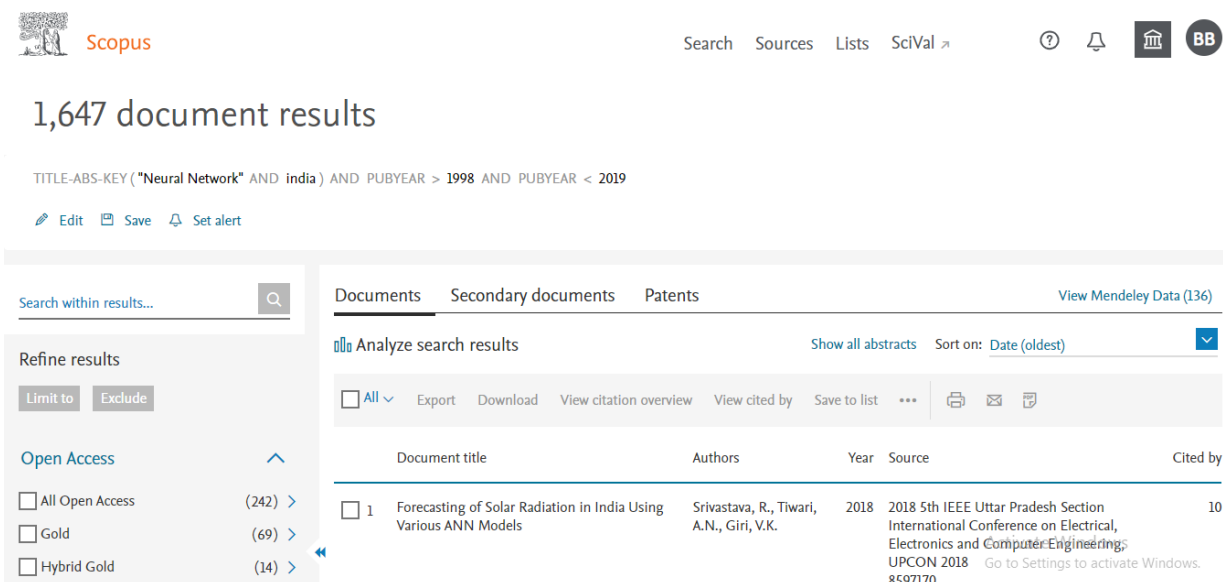


Fig 3: Search results for Neural Networks in India from 1998 to 2018.

A. String Query

The data collected for different types of keywords with India in the date range of 1999 to 2018 were given below.

TITLE-ABS KEY ("Neuralnetworks" AND india) AND PUBYEAR > 1998 AND PUBYEAR < 2019, TITLE-ABS-KEY ("ArtificialIntelligence" AND india) AND PUBYEAR > 1998 AND PUBYEAR < 2019, TITLE-

ABS-KEY ("Genetic Algorithm" AND india) AND PUBYEAR > 1998 AND PUBYEAR < 2019, TITLE-ABS-KEY ("Pattern Recognition" AND india) AND PUBYEAR > 1998 AND PUBYEAR < 2019

Step 4: Collected CSV file for each keyword and country India was applied with VOS viewer to view the bibliographic data.

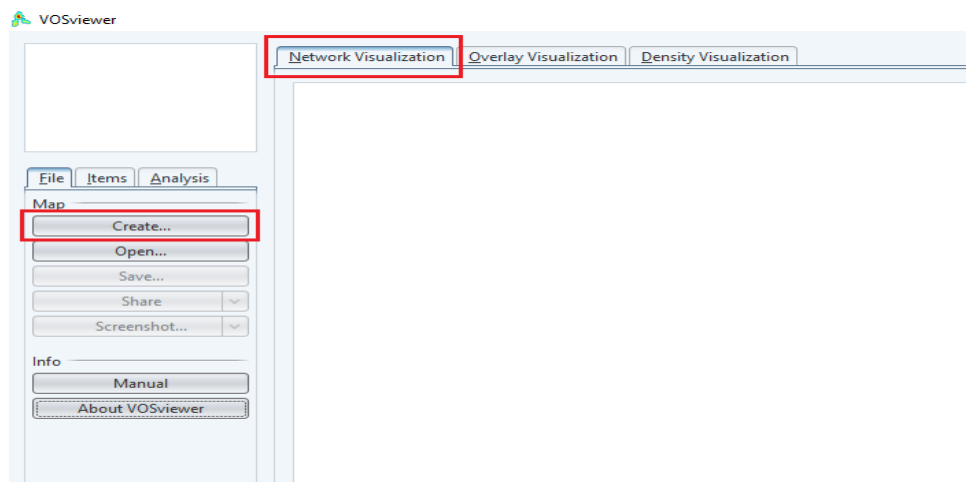


Fig 4 :VoS Viewer Home page.

Step 5: Launch VoS Viewer, then To find keywords, select "Create a map based on bibliographic data" from the Create menu after selecting the Network visualisation tab. Then, select "Citations based on bibliographic data" and click Next.

Step 6:From a bibliographic filter like Scopus, select the data source, then click the next button. Now pick Scopus and Import the CSV file from the Select Files window and then click Next.

Step 7: From the create map windows; choose the type of analysis like citation author, organization and Country and to view the data from Scopus, click the Finish button.

4. Results and Discussion

From the scientometric analysis, we calculated the impact created by SC Components from 1999-2018 for India using bibliometric indicators like keyword-wise, author-wise, institution wise and year-wise. The results acquired from the study were specified in Table. 2 to Table. 5.

A. *Most Productivity Keywords in Soft Computing fields:*

The bibliographic data obtained for the most influential keywords of SC components from the Scopus database was shown in Table. 2. Table. 2 include the main keywords of SC components, total papers published, total citations, Citation per paper and h-index in their particular subdomains. These data are filtered from the Scopus database for SC Components which were published in India. The order of the keywords was determined by the total number of publications that were published under each unique subdomain.

From the Table. 2 we determined that Neural Networks lead the Table. 2 with 2127 total papers and was leading in the first position, Artificial intelligence with 1422 total papers and standing in second position, Genetic algorithm with 988 total papers in third place and the minimum

number of papers with a count of 6 and 4 in Approximate reasoning and Probabilistic Reasoning which was shown in fig. 5. Neural Networks leads the Table. 2 with TP = 2127, TC = 21,382, CPP = 10.05 and h-index = 61 and was leading in the first position, Artificial intelligence with TP = 1422, TC = 5898, CPP = 4.15 and h-index = 31 and standing in second position and Genetic algorithm with TP = 988, TC = 6191, CPP = 6.27 and h-index = 37 in third place. The highest citation analyses for the top leading keywords were visualized from fig. 6 to fig. 8. The minimum contribution was achieved by approximate reasoning with TP = 6, TC = 5, CPP = 0.83 and h-index = 2 and Probabilistic Reasoning with TP = 4, TC = 8, CPP = 2 and h-index = 2. From the result obtained, we concluded that the Neural Network contribution was high compared to other SC components. Fig. 6 represents the citation analysis of neural networks which can see as the main and biggest node among all the other nodes. Fig. 7 shows the citation analysis of Artificial Intelligence as the largest node which has the strongest links between other keywords. Fig. 8 shows the citation analysis of the Genetic Algorithm in which the node is central to the structure and has all linked nodes with it.

Neural networks lead the Table. 2 with 2127 total papers and it was the main developing field in India. It is followed by Artificial intelligence with 1422 total papers in second Position and Genetic algorithm with 988 total papers in third place. The ranking of the most citations is highest by neural networks (TC = 21,382) and the second most keywords published in India was genetic algorithm (TC = 6191). The third place in citations wise goes to Artificial intelligence (TC = 5898). These total papers and total citations for these keywords are clearly represented in fig. 5. According to CPP throughout the Table. 2 Pattern Recognition with the highest 12.82 and then comes neural networks with 10.05 and Experts system with 9.18 CPP. Relating to h-index Neural Network has 61 followed by Genetic Algorithm with a count of 37.

Table. 2: Total number of paper published in SC and its related domains in India from 1999 – 2018.

S.no	Keywords	TP	TC	CPP	h-index
1	Neural Networks	2127	21382	10.05	61
2	Artificial intelligence	1422	5898	4.15	31
3	Genetic Algorithm	988	6191	6.27	37
4	Soft Computing and its Applications	961	2709	2.82	21
5	Fuzzy Logic	766	4641	6.06	31
6	Machine Learning	632	2961	4.69	23
7	Evolutionary Algorithms	457	1845	4.04	16
8	Pattern Recognition	353	4524	12.82	29
9	Optimization Algorithms	321	1208	3.76	19
10	Expert Systems	158	1451	9.18	16
11	Deep Learning	43	213	4.95	8
12	Approximate reasoning	6	5	0.83	2
13	Probabilistic Reasoning	4	8	2	2

*Abbreviation:CPP – Citation per Paper,TP – Total Paper and TC – Total Citation

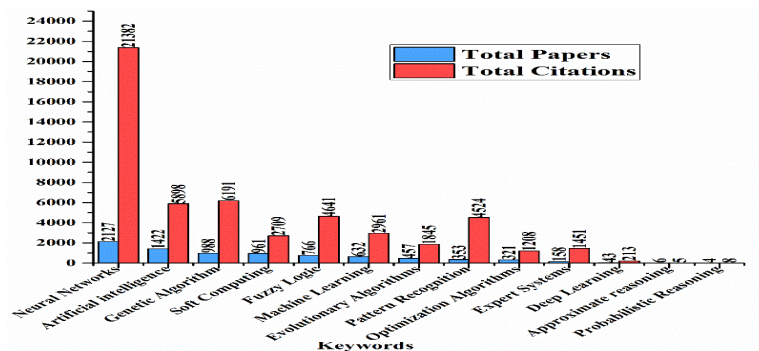


Fig 5: Total Papers and Total Citations of Keywords used in the study.

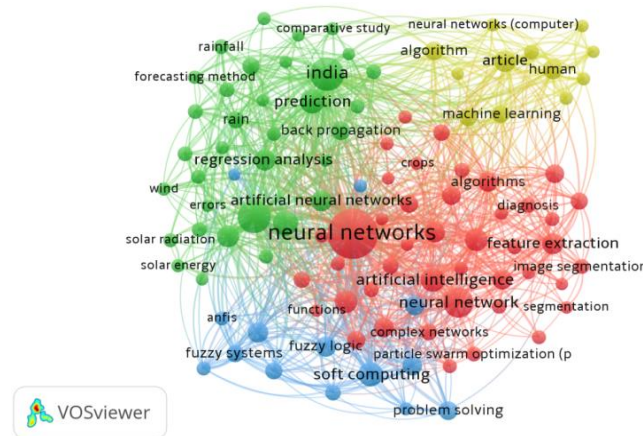


Fig 6: Citations analysis of Neural networks in India from 1999-2018

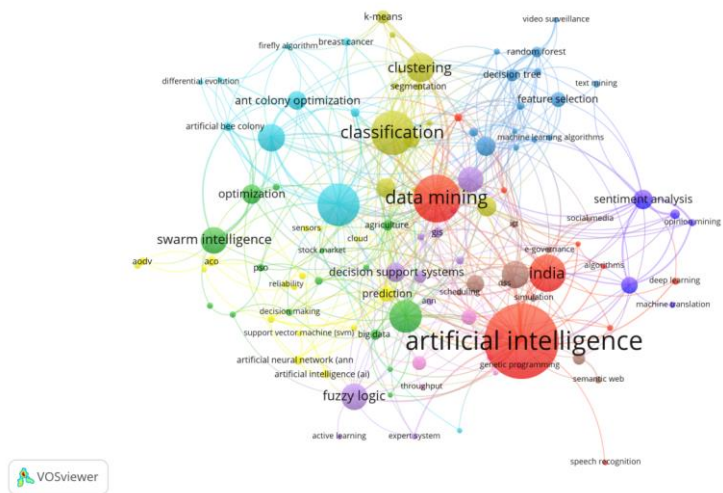


Fig 7: Citations analysis of Artificial Intelligence in India from 1999-2018

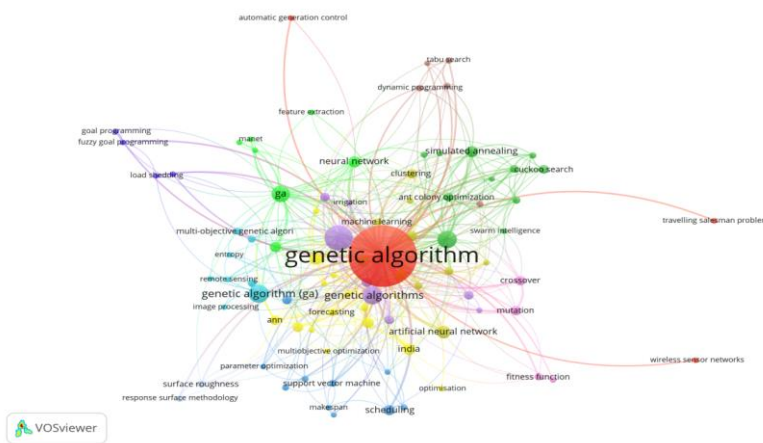


Fig 8: Citations analysis of Genetic Algorithm in India from 1999-2018

B. Most Productivity Authors in India

By analyzing the dataset from the Scopus database for the years 1999 to 2018 in the SC domain and its related components by applying the selected keywords shown in fig 2. For all of the SC sub-domains included in the study, the top leading author's names were filtered and sorted

according to the total number of publications from the Scopus database, as shown in the Table 3. The most articles were found in each particular sub-field of the SC fields, as shown in Table 3. Table 3 lists each keyword chosen for this study, together with its maximum number of publications and information on its authors.

Table 3: Keywords having most productive authors in India (1999-2018).

S.no	Author name	Keywords	TP	TC	CPP	h-index
1	Deo, M.C.	Neural Networks	22	790	35.91	11
2	Pant, M.	Soft Computing and its Applications	20	66	3.3	5
3	Pant, M.	Evolutionary Algorithms	19	89	4.68	6
4	Behera, H.S.	Artificial intelligence	15	71	4.73	2
5	Deep, K.	Genetic Algorithm	10	39	3.9	4
6	Behera, H.S.	Machine Learning	9	17	1.89	2
7	Deshpande, A.	Fuzzy Logic	6	77	12.83	3

8	Chaudhuri, B.B.	Pattern Recognition	5	497	99.4	4
9	Sharma, H.	Optimization Algorithms	5	20	4	3
10	Soman, K.P.	Deep learning	3	38	12.67	3
11	Khandelwal, M.	Expert Systems	2	27	13.5	2
12	Biswas, A.	Probabilistic Reasoning	1	4	4	1
13	Saraf, P.	Approximate reasoning	1	3	3	1

*Abbreviation:CPP – Citation per Paper,TP – Total Paper and TC – Total Citation

In the Neural Network area Deo, M.C. is the most productive author and attained the first position with the 22 papers which has the highest total citation 790 and also has the highest h-index 11 of the total document. Pant. M achieved the second position and is the leading author in the field of both Soft Computing (TP = 20) and Evolutionary Algorithm (TP = 19) and he took the second place in the Table 3. The Third position goes to Behera H.S with 15 Total papers having total citations of 71 in Artificial Intelligence and he also has 9 total papers having 17 total citations in Machine Learning respectively which was illustrated in fig.10 to fig.12. Followed by Deep, K (TP = 10) in Genetic Algorithm, Deshpande.A (TP = 6) in Fuzzy Logic and Chaudhuri, B.B (TP = 5) in Pattern Recognition which was displayed in Table 3. Biswas, A., and Saraf, P. provided the least amount of

work, each publishing just one paper in the categories of approximate reasoning and probabilistic reasoning.

The Total Citations of Table. 3 are visualized in fig. 9. In that fig. 9 the first position is acquired by Deo. M.C. with 790 total citations and has a leading place in Neural Network. Chaudhuri B.B. finished in second place overall. In fig. 9, he is identified with 497 total pattern recognition citations. In the evolutionary algorithm, which is depicted in fig. 9, Pant.M, who had 89 total citations, came in third place. Followed by Deshpande. A (TC = 77) in Fuzzy Logic, Behera, H.S (TC = 71) in Artificial intelligence, Deep, K. (TC = 39) in Genetic algorithm. The minimum contributed authors are Biswas, A. (TC = 4) and Saraf, P. (TC = 3) in Probabilistic Reasoning and Approximate reasoning.

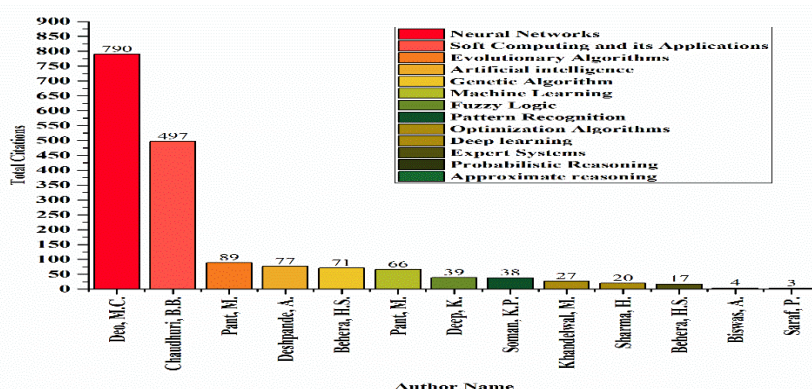


Fig 9: Total citations of Most Productive Authors

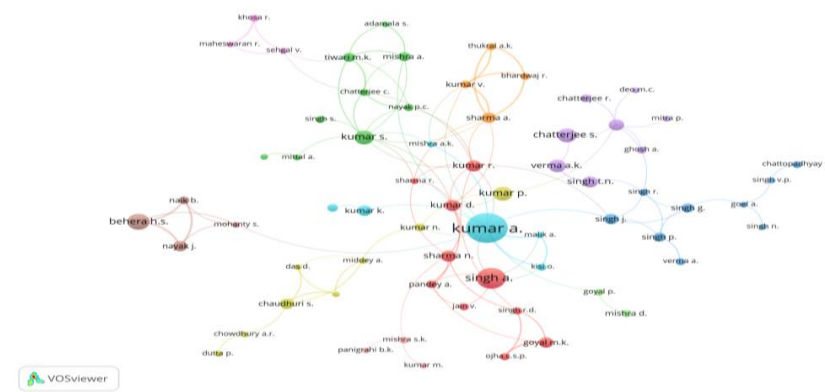


Fig 10: Citations analysis of authors in Neural Network for India

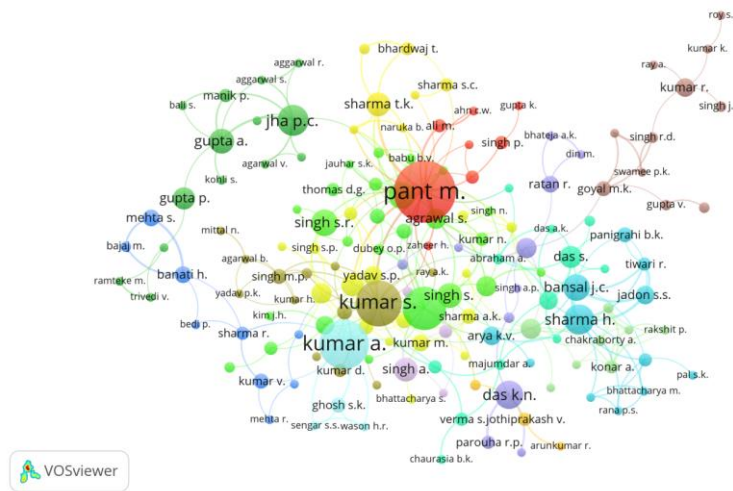


Fig 11: Citations analysis of authors in Soft Computing for India

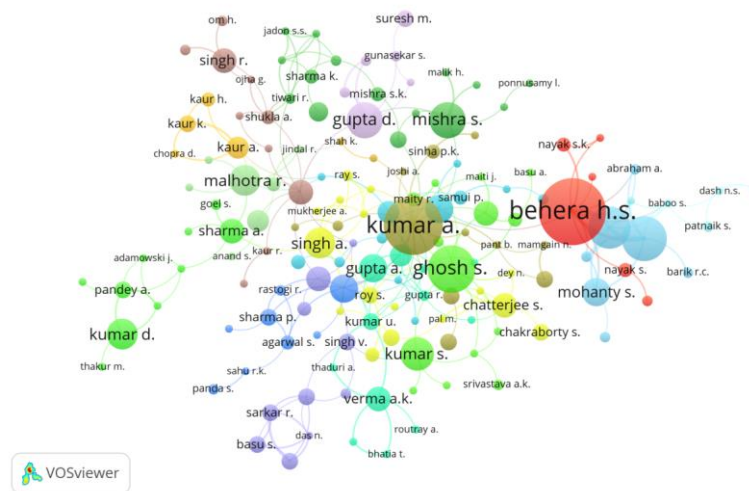


Fig 12: Citations analysis of authors in Artificial Intelligence for India

C. Best Productivity and Influential Institutions

In India, there are a huge number of institutions were available in that more researchers are currently doing their research works in various fields related to SC components. Only particular institutions had made their key contributions and published numerous papers that were pertinent to the area of SC sector. The Table 4

included a list of India's most significant and effective institutions working in the subject of SC and related fields. The majority of the papers published in India's leading universities between 1999 and 2018 were used to compile this data. The Table. 4 contains information like h-index, total papers, Citations per paper, keywords, total citations and Institution name.

Table. 4: Keywords having maximum productive Institutions in India (1999-2018).

S.no	Institutions name	Keywords	TP	TC	CPP	H-index
1	Indian Institute of Technology Roorkee	Soft Computing and its Applications	109	355	3.26	9
		Neural Networks	83	2166	26.1	21
		Genetic Algorithm	45	442	9.82	11
2	Amrita VishwaVidyapeetham University	Artificial intelligence	58	191	3.29	7
		Machine Learning	32	105	3.28	6

		Evolutionary Algorithms	29	85	2.93	5
		Deep Learning	6	54	9	4
		Fuzzy Logic	33	474	14.36	3
3	Anna University	Optimization Algorithms	14	43	3.07	4
		Expert Systems	6	5	0.83	1
4	Jadavpur University	Pattern Recognition	14	417	29.79	8
5	University of Kalyani	Probabilistic Reasoning	1	4	4	1
6	K.B.V. Mahavidyalaya	Approximate reasoning	1	3	3	1

*Abbreviation: CPP – Citation per Paper, TP – Total Paper and TC – Total Citation

The Table. 4 illustrates the active institutions and their contributions associated with the sub-domains of SC components in the Scopus database for India from 1999 to 2018. With a contribution of 109 total publications, 355 total citations, 3.26 citations per paper, and an h-index of 9, the Indian Institute of Technology, Roorkee leads the pack in terms of prolific institutions. The same institution published 45 total papers with 442 total citations and citations per article of 9.82 with an h-index of 11 in genetic algorithms, and it published 83 total papers with 2166 total citations and a citation per paper of 26.1 with an h-index of 21 in neural networks. These publications are shown in fig. 14 along with the total number of citations for each type of study. The Second Position was attained by Amrita Vishwa Vidyapeetham University which has contributed to Artificial Intelligence of 58 total papers with 191 total citations and 3.29 citations per paper with an h-index of 7. The same institution contributed 32 total papers with total citations of 105 and citations per paper of 3.28 with an h-index of 7 in Machine learning

and has published 29 total papers with total citations of 85 and citations per paper of 2.93 with an h-index of 5 in Evolutionary Algorithms were represented in fig. 15. The Third place was obtained by Anna University, which contributed to fuzzy logic with 33 total papers, totaling 474 citations, and averaged 14.36 citations per paper with an h-index of 3, as well as optimization algorithms with 14 total papers, totaling 43 citations, and averaging 3.07 citations per paper with an h-index of 4, as shown in fig. 16. The least contribution was obtained by University of Kalyani and K.B.V. Mahavidyalaya in Probabilistic reasoning and approximate reasoning with only one paper with 4 and 3 total citations.

From the Table. 5 we verified that the Indian Institute of Technology, Roorkee was the top-ranking institution in the soft computing domains indicated in fig. 13. The minimum contribution was done by the University of Kalyani and K.B.V. Mahavidyalaya in Probabilistic reasoning and approximate reasoning.

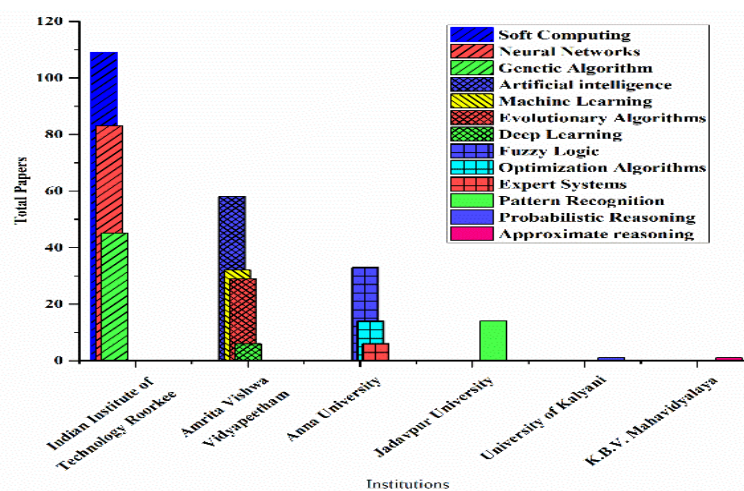


Fig 13: Total Paper of the Top Influential Institutions in India

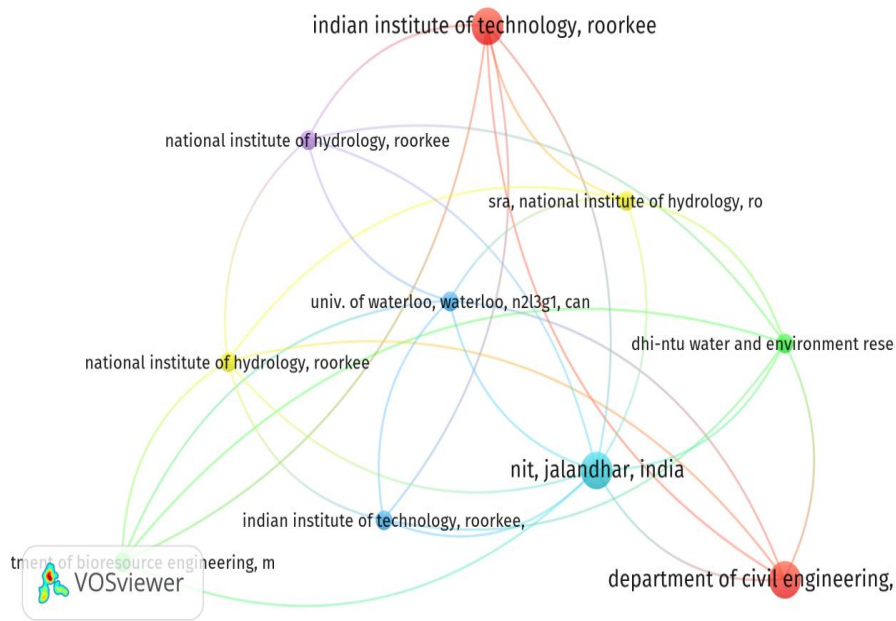


Fig 14: Citations analysis of Institutions in Soft Computing for India

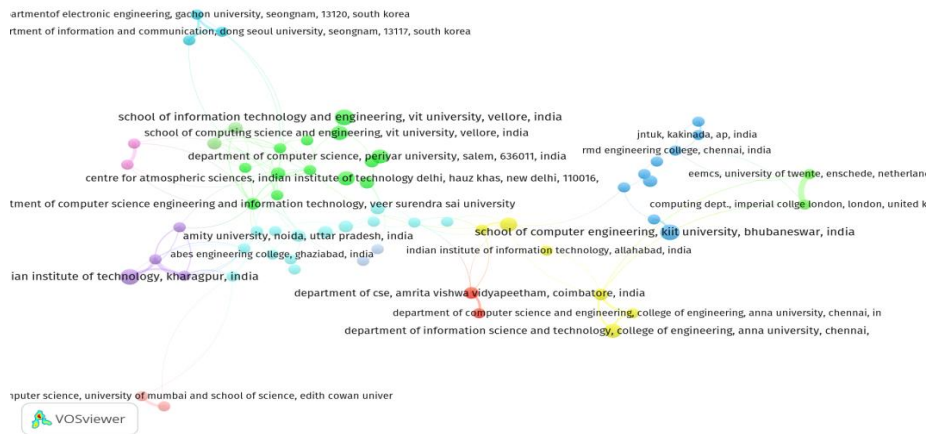


Fig 15: Citations analysis of Institutions in Artificial Intelligence for India

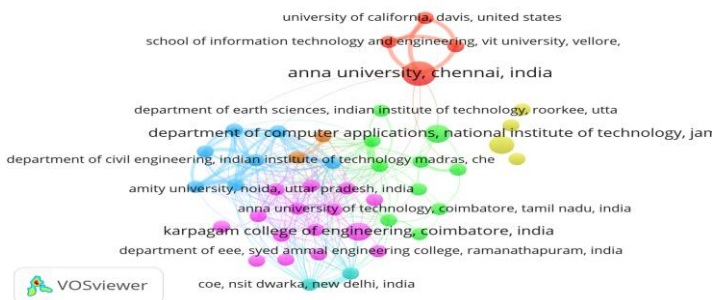


Fig 16: Citations analysis of Institutions in Fuzzy Logic for India

D. Year-wise publications for Sub-domains of Soft Computing Applications

From the complete discussion of the study, we displayed the year-wise publications from 1999 to 2018 for the top leading components of SC. This Table. 5 have the three

main categories which represent the main components of SC which published their papers in leading author wise.

Data obtained from the Scopus database for the country India from the year 1999 -2018 using the indicators like specified keywords, total Citations, h-index, Citation per

paper and total papers for the SC domains was mentioned year wise order in Table 5.

Table. 5: Year wise publications for top most fields in Soft Computing Applications

Years	Neural networks				Artificial Intelligence				Genetic Algorithm			
	TP	TC	CPP	HI	TP	TC	CPP	HI	TP	TC	CPP	HI
2018	318	1075	3.38	13	167	602	3.60	9	86	252	2.93	8
2017	273	1243	4.55	15	155	557	3.59	11	131	501	3.82	12
2016	338	1520	4.50	19	369	1091	2.96	15	157	776	4.94	15
2015	486	1556	3.20	20	494	1086	2.20	12	303	618	2.04	12
2014	313	1739	5.56	23	167	747	4.47	13	181	689	3.81	13
2013	111	1038	9.35	18	45	338	7.51	11	39	243	6.23	10
2012	152	1281	8.43	21	45	299	6.64	10	83	391	4.71	10
2011	95	1128	11.87	21	30	170	5.67	8	41	245	5.98	9
2010	90	1457	16.19	23	22	128	5.82	6	32	368	11.50	10
2009	77	2211	28.71	23	26	210	8.08	7	40	749	18.73	14
2008	52	1157	22.25	19	19	411	21.63	8	13	329	25.31	8
2007	54	1352	25.04	20	26	521	20.04	13	20	603	30.15	10
2006	40	1915	47.88	16	4	154	38.50	3	12	750	62.50	8
2005	40	847	21.18	17	14	213	15.21	6	8	94	11.75	5
2004	23	1140	49.57	12	9	513	57.00	3	6	403	67.17	5
2003	20	880	44.00	12	4	30	7.50	2	6	191	31.83	4
2002	20	685	34.25	8	2	7	3.50	1	8	139	17.38	4
2001	6	282	47.00	4	1	26	26.00	2	3	44	14.67	2
2000	8	297	37.13	4	3	26	8.67	2	1	1	1.00	1
1999	10	675	67.50	9	2	222	111.00	1	1	14	14.00	1

*Abbreviation:CPP – Citation per Paper,TP – Total Paper, TC – Total Citation and HI – h-index.

According to Table. 4, the most papers were published in the year 2015 (TP = 486), the year 2009 had the most citations (2211), and the years 2014, 2010 and 2009 for Neural Networks had the greatest document h-indexes (23).In terms of Artificial Intelligence, the most papers were published in 2015 (TP = 494), the most citations were received in 2016, and the greatest document h-index of 15 was obtained in 2016.The Genetic Algorithm published the most articles in 2015 (TP = 303), received the most citations (776) and had the highest document h-index (15) in 2016.From the Table. 4 we concluded that

in the year 2015, all the top leading SC components like Neural Networks, Artificial Intelligence and Genetic algorithm have produced their highest number of papers and high impact respectively were showed in fig. 17 to fig. 19. The minimum number of publications of 6, 1 and 1 was achieved during the year, 2001 and 2000 for Neural Networks, Artificial Intelligence and Genetic algorithm. From the analysis, with a total count of 2526 publications over the years from 1999 to 2018, we came to the conclusion that papers on neural networks had the most.

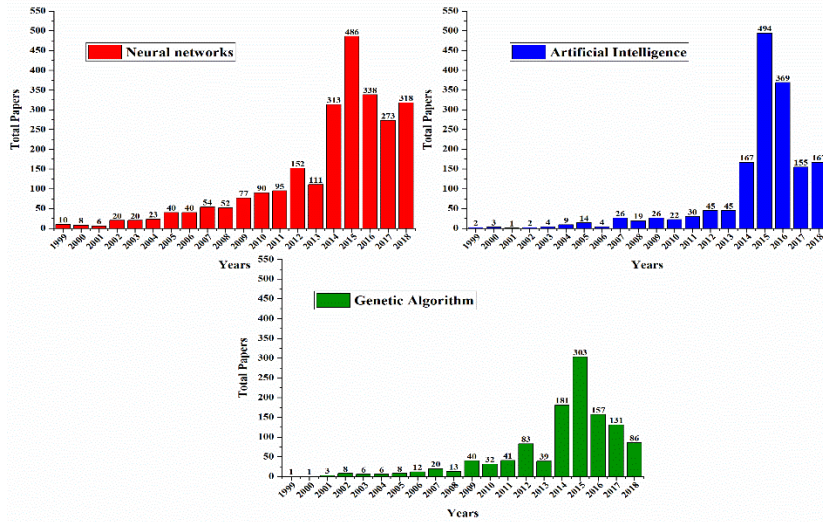


Fig 17 : Yearwise total numbers of papers publications

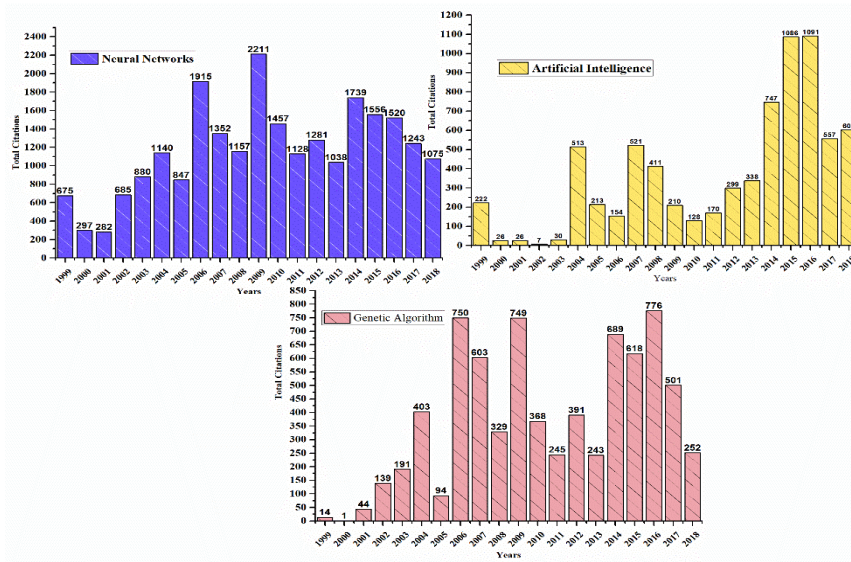


Fig 18 : Yearwise total numbers of citations

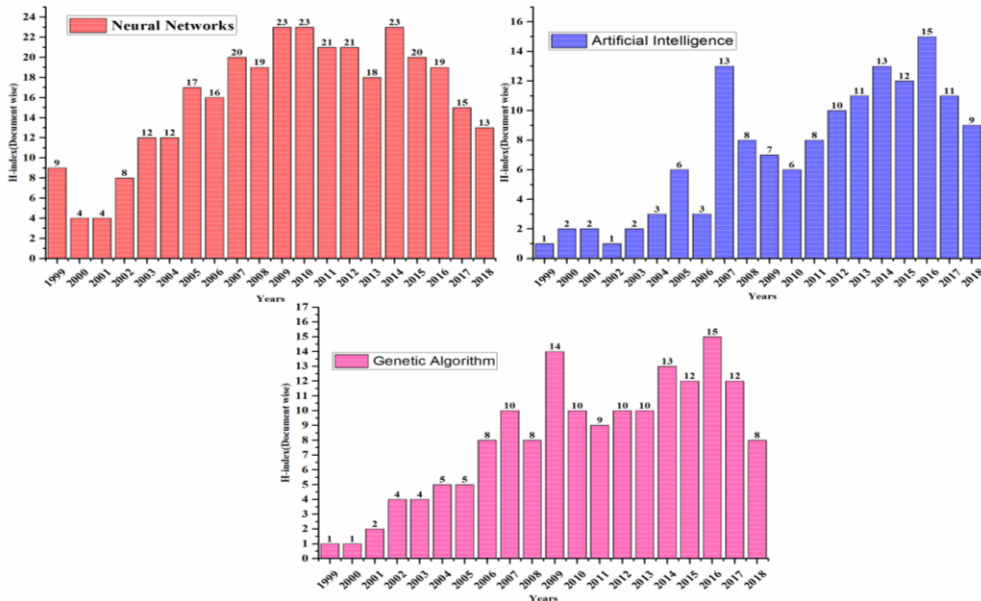


Fig 19 : Yearwise Total Numbers of h-indexes

5. Conclusion

The bibliometric study proposed outcomes of soft computing techniques and their application development in India from the Scopus database from the year 1999-2018. Using the Scopus database we calculated Average citations per paper, total citations, and h-index and visualized them through VOS viewer for individual subdomains of SC. For the keyword-wise contribution, Neural Networks have obtained a higher impact and produced more papers from 1999 to 2018. For the author-wise analysis Deo, M.C. has made a bigger impact and has achieved the maximum number of publications in Neural Networks. For the institution's wise contribution Indian Institute of Technology, Roorkee has an outstanding paper production in Neural Networks and Genetic Algorithm from SC domains. For year-wise contribution, Neural Networks has attained a major impact and has produced 2526 total papers from 1999 to 2018. From the whole study, we concluded that Neural Networks were the most dominating component in the SC domain for bibliometric indicators like Author wise, year-wise, keyword wise and institutions-wise. The second place was obtained by Artificial Intelligence and the third position was achieved by Genetic Algorithm for all the bibliometric indicators implemented in the study respectively. The minimum contribution was achieved by the keywords like Probabilistic Reasoning and Approximate reasoning in India for the last decade.

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