

BIBLIOMETRIC SURVEY ON DEEP LEARNING BASED RECOMMENDATION SYSTEM

¹Mrs. Aarya Devendra Joshi and ²Mr. Aniruddha M Phadke

¹Assistant Professor Shree L. R. Tiwari Degree College of Commerce, Science, Management, Mira Road (e), Mumbai

²Industry Expert, Panvel, Navi Mumbai- 410206

¹aarya.joshi@slrtcd.in / ²phadke067@gmail.com

ABSTRACT

For predicting the correct choices and improving user experience of a product, recommendation systems are essential in research to prove their productivity. The goal of the scientometrics study is to recognize growth of the Recommendation system by implementing deep learning algorithm. This paper shows the research work in deep learning-based recommendation system through bibliometric study by exploring the twenty years of work from 2001 to 2020. Scopus is the largest database which consists of information about abstract with citation databases of peer-reviewed in various areas. study gathers the publication from Scopus database and retrieves total 6,813 publications in different types such as conference paper, journal and reviews articles, book chapter etc. the China and India are the most prominent countries for publishing recommendation system research work. Keywords plays the important role to search the documents, in this study collaborative, content and deep learning are the important terms to identify the documents. The computer science, decision science, mathematics and Engineering are effective research subject areas were recommendation system work, Hence the deep learning base recommendation system applicable to all domain.

Keywords: Bibliometric, Recommendation System, deep learning, Collaborative filtering, content base, information overload

1. INTRODUCTION

During the last few decades, volume of information increases day-to-day for sharing, buying or selling product, educational related information and many more. The use of recommender system is to overcome the information overload problem on online platform where information is generated; it provides the solutions that find in less time instead of searching whole problem and participate to making a decision process. The recommendation system [1, 3] produce their responses based on user preferences, item features and its past interactions and some other additional information. Recommender system estimates the user choice on selection of different items and provide the recommended items that user want to need. The system classified into three category such as collaborative filtering, content-based, and hybrid respectively. In collaborative filtering, makes recommendation from user or item interaction between them. Content based recommendation provides the difference between items and user's auxiliary information, Last recommendation system [3] hybrid system that integrates two or more types of recommendation strategies to predict the final decision.

In informational industry, recommender system helps to enhance the user choices and its experience for example, Movie recommendation [6] which predict the watching patterns base on user past history. The [7] complementary recommendation system provides the substitute items that similar to original source. Music recommendation system [8] captures the mood of user and predicts the songs. On e-commerce sites variety of [4] recommendation system and its algorithm available for narrow the selection of product such as ratings base recommendation, sentiment base recommendation, user's interactions, product features and other attributes. The Recommendation system also parallel work as [2] information retrieval areas where amount of digital information increases over the internet, online shops, online music, video and image libraries, search engines etc.

The deep learning (DL) become a most important implementation platform for [10] industries and researcher that helps to overcome more complex problem easily. Deep NLP base recommender system help to improve the user experience when selecting the product on e-commerce sites by observing product images, product reviews and interactions between items respectively. Natural language processing (NLP) helps to understand the text that the machine wants to process, the basic use of NLP to capture the [11] position of every word i.e. Verb, Noun, Adverb, etc. to make sentence structure. For automatic processing the NLP task uses deep learning methods which work like as human brain in processing the data for identifying objects, recognizing speech, language translation, and decision-making process. The role of NLP in recommendation system is to automatically describe the product image in sentence and understand the user provided text in [11] product reviews which help for finding sentiment about product. Deep learning (DL) is to understand [9] deep representation between multiple levels of data, DL is use for [9] understanding internal structure of product features which is describe by NLP techniques. DL consists of various architectures like as Convolutional Neural Network (CNN), Recurrent Neural Network (RNN) etc to represents internal structure of items.

To get broader idea about Recommendation System research in particular subject areas we need to understand their bibliometric survey. Bibliometric study was simple [5] statistical techniques of counting and identifies the growth of the subject. This paper presents bibliometric study of Recommendation system algorithm by highlighting preliminary data collection in Section.2. In section 3 gives the overall bibliometric analysis about recommendation system. Finally Section.4 and Section 5 provides the limitations and future work about Recommendation System research areas followed by concluding the remark in last section.

2. INITIAL DETAILS

Mainly two types of publication databases to access via paid and open access. Many publications access through institutes login or individual websites. Scopus is the sizable database which consists of an abstract and citation database of peer-reviewed research literature in many fields such as science, engineering, technology, medicine, social sciences, arts, and humanities. In this paper use Scopus database by using important keywords as mentioned in below.

2.1 Important Keyphrases

Significant keyphrases for the recommendation system were separated into two parts like main keyword and initial keywords. For deep learning based recommendation system research table.1 represents a list of keywords which identifies the current status of the research.

Table.1 Planned search keywords.

Main Keyword	"Recommendation System"
Initial-keyword (AND)	"deep learning" OR "collaborative filtering" OR "content base" OR "CNN" OR "RNN" OR "LSTM"

2.2 Initial Search Result

For constructing bibliometric survey on Recommendation system, we consider Scopus is the main database for accessing published articles. By using planned keywords conduct Preliminary investigation in Scopus database and found total 6,813 search result. The researchers published their deep learning base Recommendation system research in conferences 63% conference proceedings papers and 32.60% of journals and articles papers. All the types of publication and its count shown in below table,

Table.2 Publication type in Recommendation system

Type of Publication	Total Publications Count	Total avg.
Conference article	4289	63.00%
Journal and Article	2223	32.60%

Conference Review with publication	107	1.60%
Book Chapter	110	1.60%
Review	67	1.00%
Book	10	0.1%
Retracted	2	0.1%
Editorial	2	0.0%
other	3	0.0%
Total	6,813	100 %

Source : <https://ww.scopus.com> (accessed on 14th July 2021)

2.3 Initial highlight of study

Deep learning base recommendation system related documents extracted as conference articles, reviews, book chapters etc. Last twenty years starting from 2001 to 2020. The tendency and publication count year wise show in table and figure,

Table.3 trends of yearly issuing recommendation system

Years	Publications	Years	Publications
2001	10	2011	247
2002	31	2012	304
2003	35	2013	326
2004	48	2014	354
2005	58	2015	377
2006	69	2016	530
2007	94	2017	605
2008	118	2018	808
2009	168	2019	1110
2010	219	2020	1302
Total		11,477	

<https://ww.scopus.com>(accessed on 14th July 2021)

Documents by year

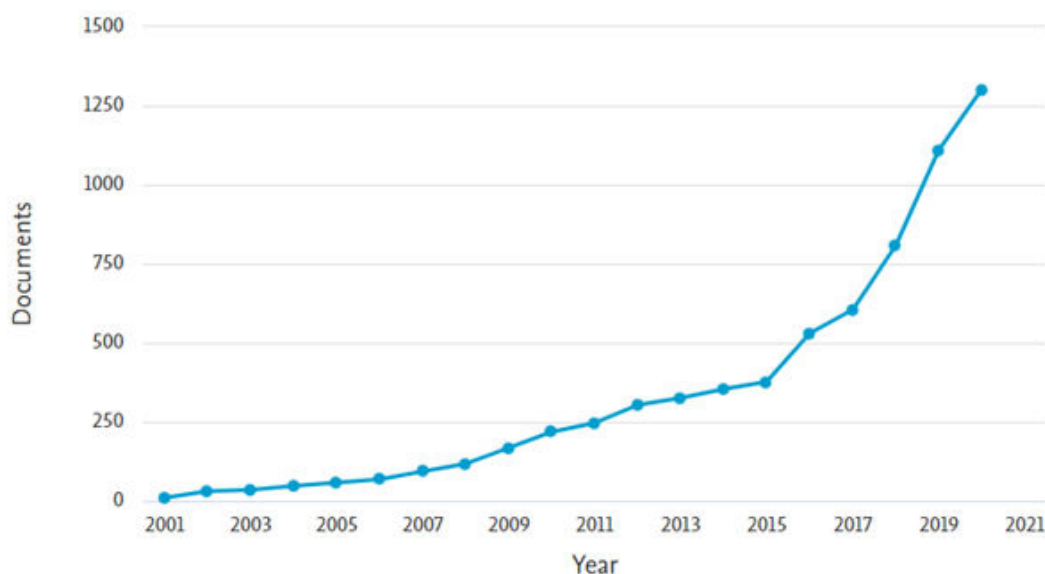


Figure.1 Year wise issuing trends in deep learning based recommendation system

2.4 Data Investigation

Through scientometrics survey to know the prominent researches and researchers in Recommendation system by analyzing geographical research, affiliation details, authors contributions in research, journals on which papers are published and their detailed, along with analysis of citation and collaboratives studies.

3. BIBLIOMETRIC ANALYSIS

For analysing bibliometric study in Recommendation system we applied different ways such as Geographical region analysis, keywords statistics, Network analysis, Subject areas, Affiliation statistics, Author statistics, Journal statistics, and Source Statistics.

Country base analysis: the figure 4 shows the country wise analysis for published articles of recommendation system research and gives the top most countries publication in Recommendation system research. The Figure.4 clearly shows that China lead with total 2389 publications followed by United States with 881 publications and the India with total 906 articles.

Documents by country or territory

Compare the document counts for up to 15 countries/territories.

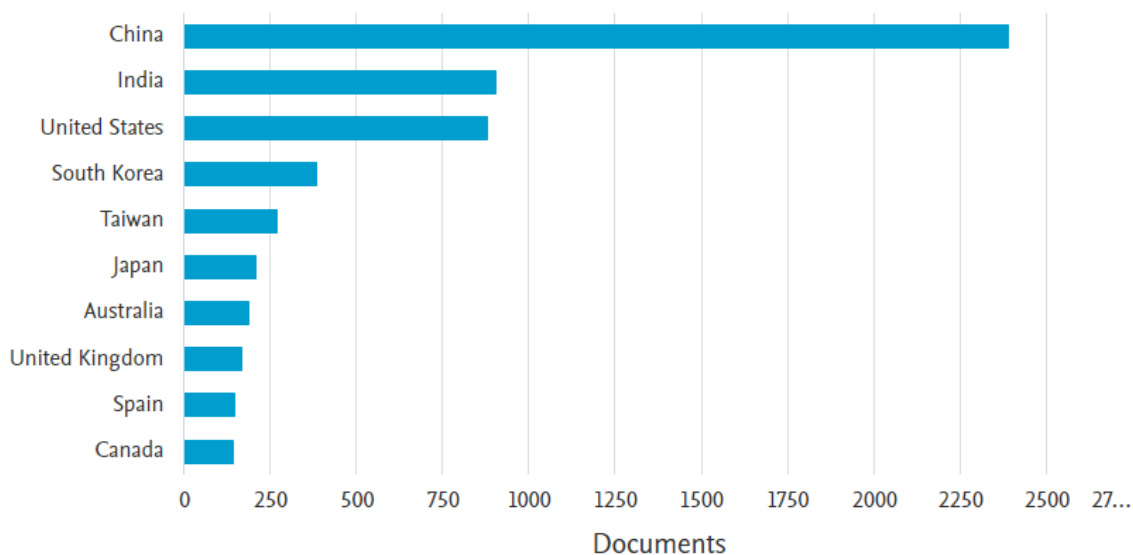


Figure.2 Top Countries publishing articles on Recommendation system research

Subject Areas

The Figure.3 represents the subject area wise analysis of Recommendation system publications. It is clearly indicates maximum research in Computer science area followed by Engineering and Mathematics. The Decision sciences and social sciences are another interested subject areas were recommendation system work. From study, observed that less research in Energy, medicine and Physics and astrology subjects.

Documents by subject area

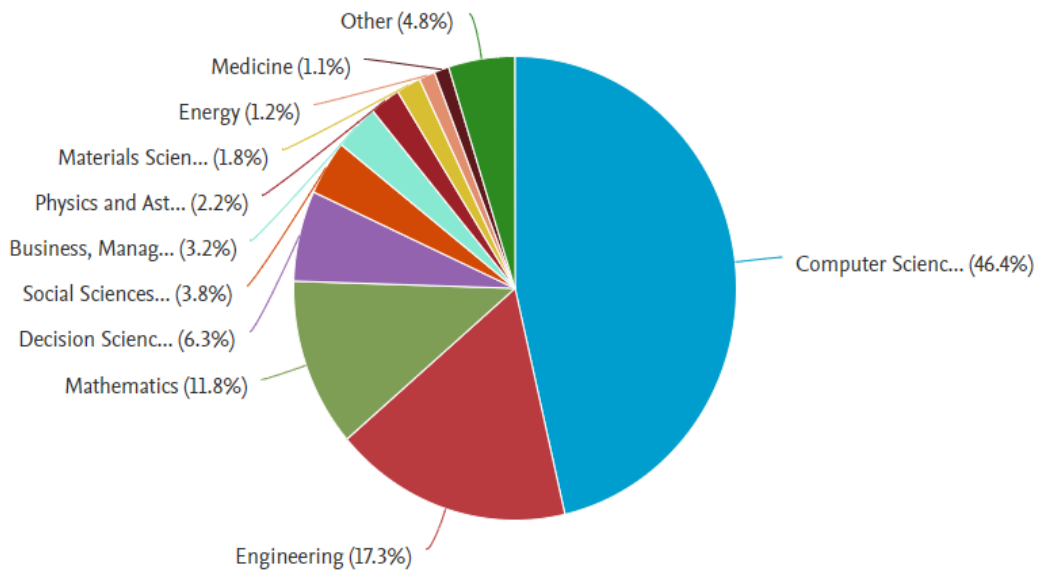


Figure 3: Subject analysis of Recommendation system

Source: <https://www.scopus.com> (accessed on 14th July 2021)

Associating statistics and details

The Fig .4 shows the top universities, institutes and organizations contributing in recommendation system research. The most of universities belongs from China to contribute in recommendation system research; the Chinese Academy of Sciences is the top most university having total 105 documents followed by Beijing University of Posts and Telecommunications with total 104 documents.

Documents by affiliation

Compare the document counts for up to 15 affiliations.

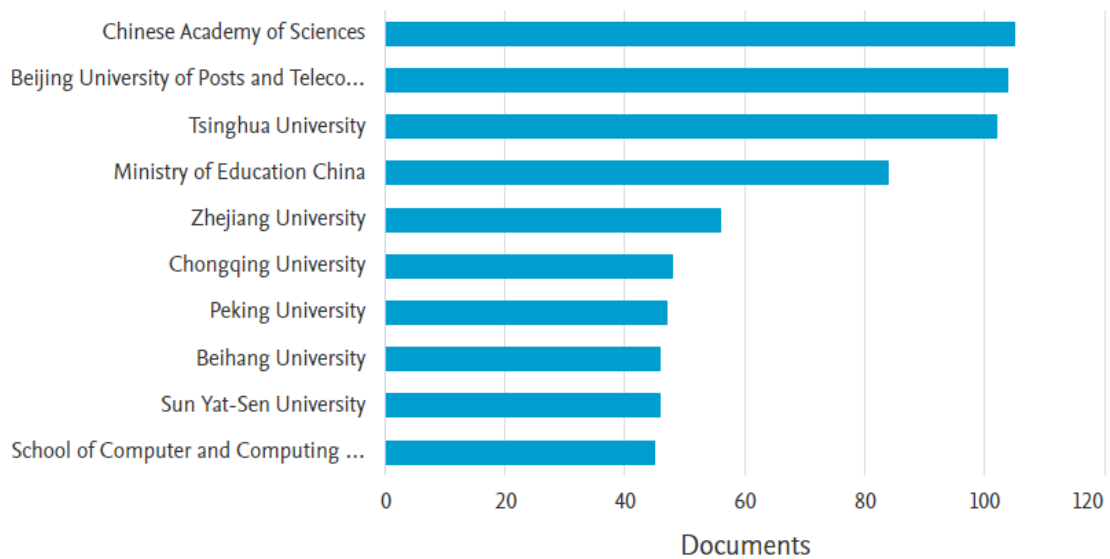


Figure 4: Associations details for recommendation system

<https://www.scopus.com> (accessed on 14th July 2021)

Authors details

The fig. 5 depicts top authors contributing their expertise in recommendation system research.

Documents by author

Compare the document counts for up to 15 authors.

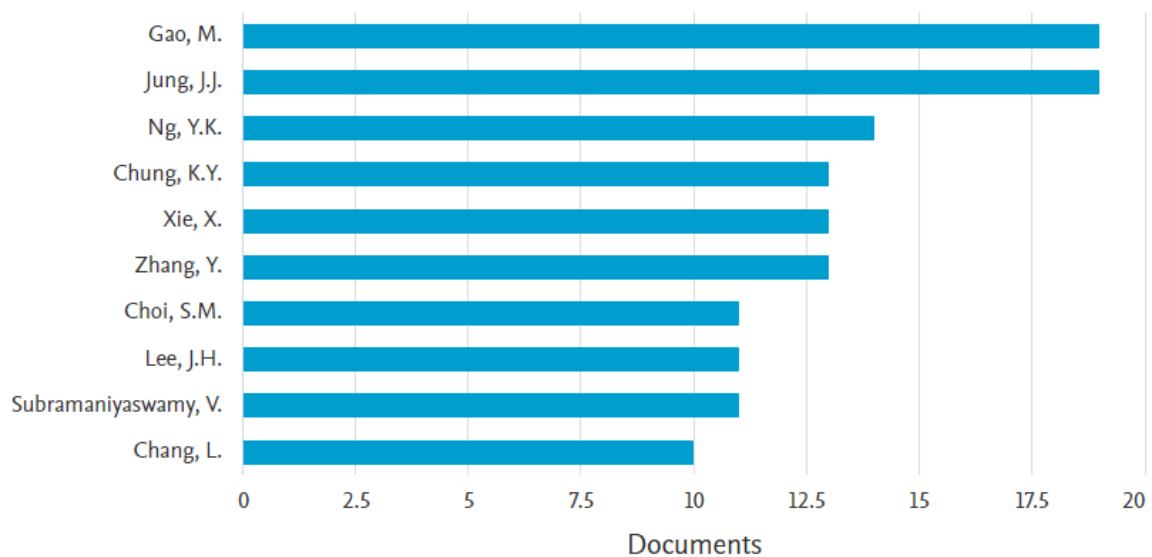


Figure 5 : Key contributg authors

<https://scopus.com> (accessed on 14th July 2021)

Source details

Source statistical mention in Fig. 6 publication in deep learning base recommendation system, So it is clear that Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics having total 502 documents while ACM International Conference Proceeding Series containing total 195 publications.

Documents per year by source

Compare the document counts for up to 10 sources.

Compare sources and view CiteScore, SJR, and SNIP data

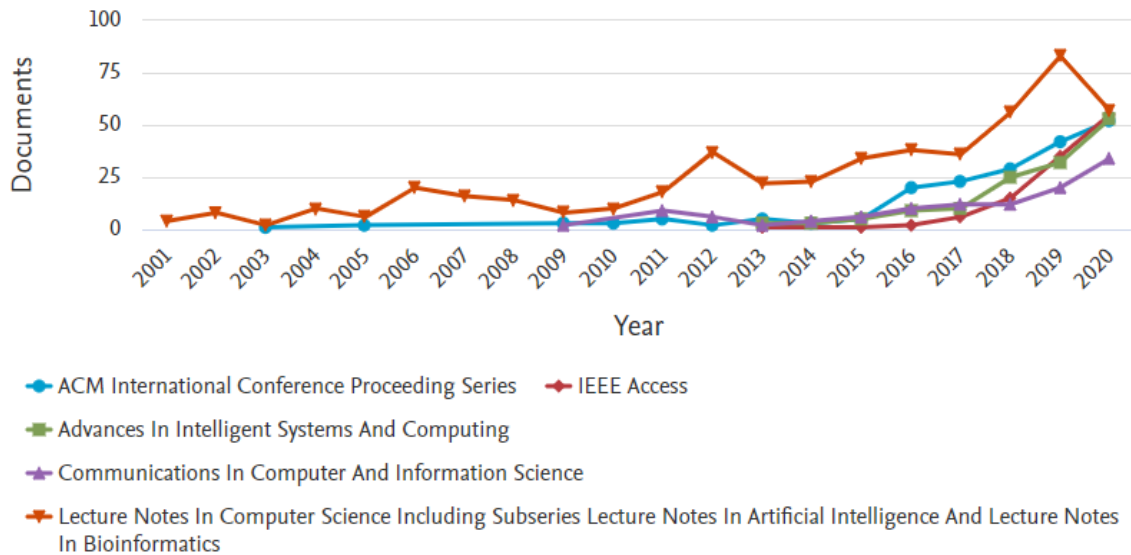


Figure 6: Source statistics for publications in deep learning base Recommendation system

Source: <https://scopus.com> (access on 14th July 2018)

The table 4. represents the total documents published in sources in Recommendation system

Table.4 Documents by source

Publication Source	No. of documents
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	502
ACM International Conference Proceeding Series	195
Advances In Intelligent Systems And Computing	140
Communications In Computer And Information Science	117
IEEE Access	115
Book	10

4. RESEARCH IMPLICATIONS OF DEEP LEARNING BASE RECOMMENDATION SYSTEM

The research work of the recommendation system is not limited for any areas, it's a world wide use because the recommendation system provides user choice in less time instead of searching the whole problem. Deep learning is the latest technology in machine learning that understands the deep structure of particular items and it help to increase the search result. The materials Science, Energy, Medicine are the major prominent research areas for Recommendation systems and these domains have more chances to explore with their applications. China and India are the most growing countries in research work. In deep learning base recommendation system, only 67 review papers are available out of 6,813 documents. Same for book, only 10 books available on deep learning base

Recommendation system research. The Indian Researchers can explore their areas in deep learning base recommendation system which has been unnoticed compared to other countries.

5. LIMITATIONS

This explores the Scopus database for analysis purposes by applying keywords combinations. Some articles and journals are not in the database data analysis. Most of the articles are available in English language only. Finally, study analysis depends upon a limited set of keywords.

6. CONCLUSION

The bibliometric study on deep learning base Recommendation System provides the growth of subject areas. In this research conference and proceeding papers and journals papers are sufficient but review papers and Book are needed to be explored. The China and Indian having two leading country in deep learning based Recommendation system subject areas. In deep learning base Recommendation system research areas yearly increases and its progress is satisfies in Computer Science, Mathematics and Engineering subject areas, But other interesting subject areas such as Medicine, Material Science and Energy are need to be explore for Recommendation System. This study only focuses on limited keywords. So, Recommendation system and deep learning is a growing field of the study to narrow the user choices.

7. REFERENCES

- [1] Das, D., Sahoo, L., & Datta, S. (2017). A survey on recommendation system. *International Journal of Computer Applications*, 160(7).
- [2] Singhal, A., Sinha, P., & Pant, R. (2017). Use of deep learning in modern recommendation system: A summary of recent works. *arXiv preprint arXiv:1712.07525*.
- [3] Thorat, P. B., Goudar, R. M., & Barve, S. (2015). Survey on collaborative filtering, content-based filtering and hybrid recommendation system. *International Journal of Computer Applications*, 110(4), 31-36.
- [4] Jiang, L., Cheng, Y., Yang, L., Li, J., Yan, H., & Wang, X. (2019). A trust-based collaborative filtering algorithm for E-commerce recommendation system. *Journal of Ambient Intelligence and Humanized Computing*, 10(8), 3023-3034.
- [5] Khiste, G. P., & Paithankar, R. R. (2017). Analysis of Bibliometric term in Scopus. *International Journal of Library Science and Information Management (IJLSIM)*, 3(3), 81-88.
- [6] S. Kumar, K. De and P. P. Roy, "Movie Recommendation System Using Sentiment Analysis From Microblogging Data," in *IEEE Transactions on Computational Social Systems*, vol. 7, no. 4, p. 915-923, Aug. 2020, [doi: 10.1109/TCSS.2020.2993585].
- [7] H. Yu, L. Litchfield, T. Kernreiter, S. Jolly and K. Hempstalk, "Complementary Recommendations: A Brief Survey," 2019 International Conference on High Performance Big Data and Intelligent Systems (HPBD&IS), Shenzhen, China, 2019, p. 73-78, [doi: 10.1109/HPBDIS.2019.8735479].
- [8] D. Ayata, Y. Yaslan and M. E. Kamasak, "Emotion Based Music Recommendation System Using Wearable Physiological Sensors," in *IEEE Transactions on Consumer Electronics*, vol. 64, no. 2, p. 196-203, May 2018, [doi: 10.1109/TCE.2018.2844736].
- [9] Lauzon, F. Q. (2012, July). An introduction to deep learning. In 2012 11th International Conference on Information Science, Signal Processing and their Applications (ISSPA) (pp. 1438-1439). IEEE.
- [10] Kai, Y., Lei, J., Yuqiang, C., & Wei, X. (2013). Deep learning: yesterday, today, and tomorrow. *Journal of computer Research and Development*, 50(9), 1799.

Research paper

© 2012 IJFANS. All Rights Reserved, **UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, Dec 2022**

[11] Gomathi, R. M., Ajitha, P., Krishna, G. H. S., & Pranay, I. H. (2019, February). Restaurant recommendation system for user preference and services based on rating and amenities. In 2019 International Conference on Computational Intelligence in Data Science (ICCIDS) (pp. 1-6). IEEE.