Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 2 (2023)

Deep Learning-Assisted Citation Recommendation System Using Multi-cell RNN Approach

[1]K. Velkumar, [2]Dr. Bala Subramanian C.
[1]Reasearch Scholor, Kalasalingam Academy Research and Education, Virudhunagar
[2]Associate Professor, Kalasalingam Academy Research and Education, Virudhunagar

***Abstract*—** A process of retrieving relevant or suitable papers that are mostly related to the research topic while carrying research knowing the behavior and patterns of citation for mapping the disciplines and subjects. This is used increasingly for judging usually takes a huge amount of effort and time. The citation recommendation is used frequently for solving this issue on suggesting the list of candidate papers automatically which may match the references of user. On applying Deep learning (DL) models in the citation recommendation system, the performance enhancement is greatly visible in various recent research studies. Hence, in this work, a deep learning-based model is employed for the citation recommendation system. Primarily, the input dataset is taken and the function words are removed using stochastic matching pattern scheme at which the library is created. Then, the canonicalization of document is carried by means of probabilistic min-match algorithm. The data is classified finally using Multi-cell RNN (Recurrent neural network) approach after which the rank is set for citation. At last, the performance is assessed for various metrics like MAP, MRR, precision, recall, and F1-measure. The obtained results are then compared with traditional models to validate and show the enhancement of proposed model over existing schemes. It is revealed from the analysis that the proposed scheme shows improvement in results.

Index Terms—Citation recommendation system, deep learning, canonicalization of document, probabilistic min-match algorithm, Multi-cell RNN, ranking.

I. Introduction

In recent days, recommendation becomes important increasingly and too alters the communication path among the websites and users. The recommender system has been widely employed in various fields like education, scientific research, economy and so on [1]. For the researchers, identifying suitablescientific papers is considered as tedious and serious issues. Thecitation analysis aids in the selection of entire informationsources for the organization research [2]. Typically, citation is considered as the bibliographic entry of the reference lists, bibliography, or footnote of the full document which covers information for verifying the entire original documents so as toknow the relevant works. The citation analysis or reference listanalysis is highly significant in all disciplines or the subjects forthe knowledge that is Sciences, Social Sciences, and Humanities [3-5]. The citation analysis studies were carried for v and quantifying the significance of academic research. This is highly accountable for the purpose of assigning the Impact factor of journal (JIF) which decides the journal merit ultimately at which the research work could be published.

The system of citation recommendation offers an efficient and effective way for recommending the scientific papers that are relevant for the researchers and is capable of solving the existing problems associated with citation. The citationrecommendation for researchers is helpful in identifying the relevant literature review more quickly and is an emergent areain the field of research. Usually, the citation recommendation system was categorized as two kinds such as local citation andcitation recommendation based on their pattern of usage.

Recently, the deep learning-based model has gained aconsiderable rate of interest in various fields like natural language processing and computer vision, owing not only to theperformance of stellar but too the attractive learning

property offeature representing learning from the scratch. The deep learning model influence is likewise pervasive, just indicating their efficiency on applying the retrieved information and the research recommender system.
Obviously, the DL field in the recommender system is highly flourishing. Yet, with the persistent beginning of novel researchworks, existing framework of classification utilized so far is thus suitable no longer and a new framework is essential for thebetter understanding of the research field. With the rising potential and popularity of DL in recommender system, in thiswork a new technique is proposed. Several existing works wereanalyzed in subsequent literature survey section from various perspectives, and few new insights are presented in the direction of this field.

The major objective of the proposed work are as follows:

- To process the citation record data by removing function words and creating library using stochastic pattern matching algorithm.
- To employ Probabilistic min-match algorithm for the canonicalization of document.
- To classify the data by DL based Multi-cell RNN andset rank for citation.
- To estimate the of the proposed methodology performance in terms of accuracy, precision, recall andF score.

II. Related Works

Citation recommendation aids in identifying the citable items for the personalized info of the user. Many such models were presented so far for implementing the task of citationrecommendation. This section offers a short review on the existing papers employed for the citation recommendation.
In the work [9], the author studies citation recommendation from the vie of semantic representation or content and relationsof the cited papers. At first, 4 citation contexts forms were presented and extracted as a content of cited papers by considering co-citation relationship and citation motivation as the relation of cited papers. After that, about 132 methods weredesigned so as to generate the cited paper's semantic vector which includes methods of four network embedding, sixteen methods on integrating the algorithms of four text representingones along with four patterns of citation contents and about 112fusion models. At last, the cited papers similarity was estimatedfor the purpose of citation recommendation. The evaluation technique depending on the link prediction model was designed so as to identify the suitable citation content form. The attained results show enhanced rate of performance.
The article [10] aims at offering a brief review on recent effortson research based on DL recommender system. Additionally, the taxonomy of deep learning-based recommendation schemewas provided and devised together with the brief summary of existing models. At last, the present trends were expanded andoffers a new viewpoint pertaining to their new emergent field.
The main intention of the work [11] was to present a new algorithm for the citation recommendation scheme which enables the retrieval of suitable citations for the research paperswhich were still in the draft stage. This method aids the researchers for selecting the suitable references between the huge number of papers available and thus making draft papers a complete one in the citation. The suggested recommendationmodel encloses three methods like WordNet for transforming the vector thereby setting the weight adjustments as per the structural factors and degree of information completeness for generating the citation recommender system for the incomplete drafts. The analysis shows that entire three methods could improve the accuracy of recommendation in a significant manner.
In this paper [12], the paper recommender system was initially introduced by offering the advantages and importance. Then, the methods and algorithms of recommendation system like collaborative filtering, content-based filtering, hybrid model, and graph-based filtering were reviewed. After that, the estimation method of various recommender system was carriedand the open issues were summarized in paper recommender model which includes sparsity, cold start, serendipity, privacy,and the unified scholarly data standards.
A new classification approach based on DL method was suggested in the work [13] for the citation recommendation. This method uses 6 following criteria like methodologies, datafactors, data representing models, recommendation types used,personalization, and the problems addressed. In addition, a comparative estimation was carried among those methods which uses similar evaluation datasets and metrics set.

A novel technique for the prediction of long-term citation of thepaper was proposed in [14] depending on the citations number in first few years after the publication. So as to train the count of citation prediction scheme, an artificial neural network (ANN) was employed which was regraded as a powerful tool inmachine learning having recently emerging applications inseveral domains that covers text and image processing. The assessment carried shows that the proposed technique outdoes existing techniques in terms of prediction accuracy both in yearly and total prediction in the number of citations.

A novel context-aware NCN dependent scheme having extra textual integration of data and the Bidirectional Encoder Representations from Transformers (BERT) scheme was proposed in [15] for enhancing the performance of citation recommender model task. For this purpose, the mechanism of extensive deep neural auto-encoder along with the self- attention-based scheme was used so as to learn flexibly both citation contextual and textual data associated in provided dataset. The performance evaluation in the standard dataset arXiv shows the efficiency and better enhancement in proposedscheme.

In the work [16], Deep Cite model was proposed which was regarded as a content dependent hybrid neural network model for the citation recommendation. Initially, BERT scheme was employed for extracting the higher-level semantic representation vectors of text, after that the multi-scale CNN approach and BiLSTM scheme were employed for attaining thesequence and local information of sentence context, and the matching of text vectors were carried in depth for generating the candidate sets. Thus, the method presented improves the citation recommendation quality efficiently. Therefore, the algorithm proposed in this paper effectively improves the quality of citation recommendation.

A context-aware citation recommendation scheme was presented in [17] depending on the endwise memory network. This model thus learns the paper and citation contexts representations correspondingly depending in the Bi-LSTMmodel. Also, the experimental evaluation was carried on 3 realtime datasets for estimating the model performance.

In the work [18], the author presented a novel context-aware citation recommendation model which could improve the weight matrix orthogonality essentially by exploring more appropriate patterns of citation. The experiments were conducted in the dataset CiteSeer and the attained outcome shows that the model is superior to the baseline models in entireestimated metrics.

A network embedding model was suggested in [19] and was termed as a Global Citation Recommendation which employs Generative Adversial network (GCR-GAN). The suggested model exploits the Heterogeneous Bibliographic Network (HBN) for generating the personalized range of citation recommendations. Specifically, suggested model uses Scientific Paper Embeddings with the use of Citation-InformedTransformers (SPECTER) and an Auto-Encoder for denoising so as to learn the semantic preserving representation of graph. On comparing the baseline models, the generated recommendation by this model using DBLP and ACM datasetsproves that it outdoes the baseline models on gaining about 11% & 12% enhancement with respect to Mean Average Precision (MAP) and the nDCG (Normalized Discounted Cumulative Gain) metrics, correspondingly.

A novel approach for the citation recommendation was presented in [20] on applying the content information and graphstructure for attaining the representation of content-based graph. After that, network structure was encoded and the co- authorship for gaining author-based representation of graph wascarried. At last, the two representations were concatenated andit would be acted as the feature vector of node that is more accurate network presentation which integrates the informationof both content and author. A novel personalized citation recommendation was proposed based on the attained nodevectors termed cGAN and their variation VCGAN. Once estimated on the dataset AAN, the suggested approach outdoesthe existing models.

III. Proposed Work

The entire working methodology of proposed scheme is narrated in this part. The proposed system flow is given in figure 1. At first, the input data that consist of various paper, topic, and author are considered and the data is preprocessed toremove the function words. The stochastic pattern matching process is employed for reducing the total number of charactersso as to increase the efficiency of searching and the comparisonof similarity among testing and training database is carried. Then, the canonicalization of document is carried by means of Min-Max Normalization approach. At last, the multi-cell memory RNN classification approach is employed for

recommending similar citations and to set rank for the citation.

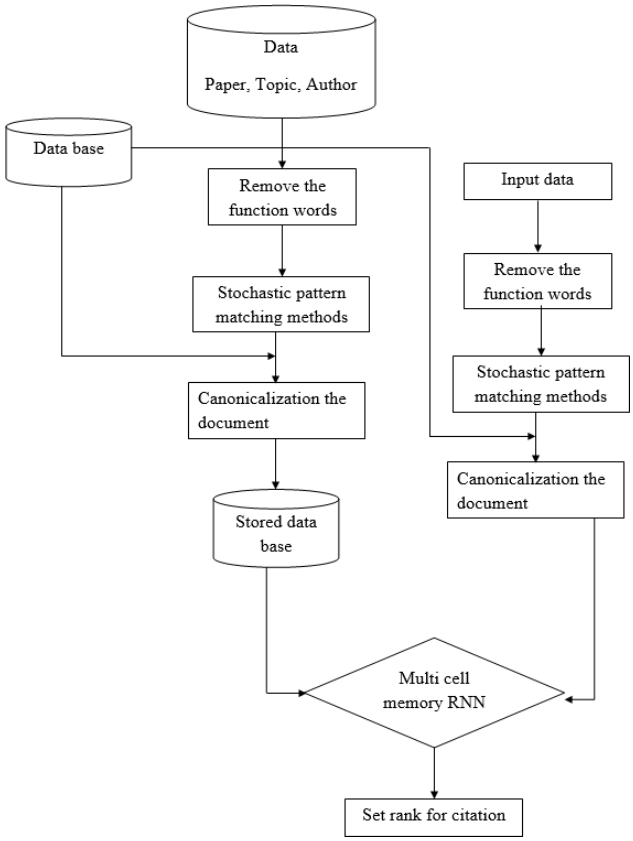

Figure 1 Proposed scheme flow

A. Data preprocessing

The preprocessing step is employed so as to decrease thecharacters number in the text. Texts are the sequence of words typically, which can be segregated by means of tokenization approach. The tokenization is carried at which the input data isbeing divided into minor parts of words called tokens which inturn eradicates the low priority aspects. Most texts comprise ofsome frequent words and the ones that occurs frequently in thecorpus given are denoted as stop or function words. The function words carried some less significant meaning on comparing the occurrence of other words in the document. They are frequently used ones (alike “an”, “a”, “the”, “in”) and are having no semantic relations in the context. The function wordsare the common and general words which typically does not contribute to the documents semantics and are having no addedvalues for reading. The function words removal aids in choosing suitable words efficiently thereby decreasing the document structure complexity.

B. Stochastic Pattern matching

After the removal of function words, the stochastic pattern matching approach is employed. The major intention behind theuse of stochastic pattern matching approach is to decrease the comparison of total no of characters among the text and patternsthus enhancing the efficiency. The enhancement of efficiency in the search process could be attained by means of altering theorder at which the comparison of characters is made at every attempt and thereby selecting the shift factor which permits thepre-defined skipping of characters numbers in a text after everyattempt. This algorithm aids in scanning of texts using windowwhose size is equivalent to pattern length. It is capable of deciding whether the relation is asserted thereby identifying their participants. Unlike ASER (activities, states, events, and their relations) at which the syntactic patterns were usually based on clauses, more general patterns were used in the proposed algorithm because there is no need to express casual relation participants as a complete clause.

The stochastic pattern matching algorithm is utilized for matching process so as to match probability of low appearanceto high appearance letters in the natural English pattern string, in case of occurrence of mismatch, the

function Badchar () is used for realizing the host string pointer's forward jump thus carrying the matching priority for the lower probability characters as per the probability. By this manner, several mismatch occurrences will be predicted and thus reduce severalcomparison times as much as possible such that the Badchar ()function might be used earlier for realizing the host string pointer's forward jump. Thus, from this algorithm the library iscreated. The algorithm for this is shown below.

Algorithm 1: Stochastic Pattern Matching approach to createlibrary

Input: Data samples for pervious paper D_p ,Data base for pattern Matching PM_d

Output: Create the library T_L

For i = D_p // No of paper for comparisonFor K = D_p(i)
F_W = Dp(k).split

End "K" loop

For j = F_W //No of words in papers

P (F_W) = length (M_W)

/length(PM_d)

SP (j)= Max(P(F_W))

End " j" loop

TL (i)= SP

A library is therefore created by employing this stochastic pattern matching algorithm. The canonicalization of documentis described in subsequent section.

C. Probabilistic min-match algorithm for canonicalization ofdocument

The next step in the proposed framework is the textcanonicalization process. There is a need of various tasks so asto convert entire text files to some unique format, hence the rules could be more easily defined while the process of information extraction task. The process of document canonicalization denotes the process of standardizing and transforming document representation to the consistent or canonical form. This includes redundancies, variations, and some inconsistencies for ensuring varied representations orversions of similar document that are equal. For the canonicalization of document, a min-max normalization approach is used. It is a scaling process at which the features are thus re-scaled such that the information might fall in zero and one range. This undertakes the initial data linear alteration.In the process of Min-Max scaling, each features minimum value is thus converted to zero and each features maximum value is thus converted to one.

A typical algorithmic step for the document canonicalization isdiscussed here:

Step 1: Normalization of white space: In this step, extra whitespace characters like multiple spaces, tabs, and line breaksare removed.
Step 2: Consecutive whitespace is replaced by single space
Step 3: Lowercase conversion: All texts are transformed to lowercase so as to eliminate the case sensitivity.
Step 4: Removal of punctuation: In this punctuation marks are removed like commas, periods, exclamation marks, and question marks. However, consider the preservation of some punctuation marks in case they bear significant information (forinstance, apostrophes in the contractions).
Step 5: Handling of special characters: Remove or replace special character's which does not contribute to the meaning ofdocument like symbols of currency or the diacritics. At the same time, consider the handling of special charactersdepending on desired need of application or document.
Step 6: Expansion of abbreviations: the common abbreviationsare replaced with the full forms so as to ensure the clarity and consistency. For this, a dictionary or lookup table is created forthe typically used expansions and abbreviations.
Step 7: Resolving synonyms: Find and replace the synonymous phrases or words with the single canonical procedure. For this,consider the use of predefined mappings or thesaurus so as to standardize the synonyms.
Step 8: Elimination of stop words: Common function words orstop words are removed which do not pose any important meaning (for instance, "and", "the", "is"). The lists of predefined stop words or libraries which offer such a function is used.
Step 9: Lemmatization or stemming: Shrink the words to its root or base form for consolidating similar terms. This is applied for achieving this (for example, WordNet lemmatization, Porter stemming).
Step 10: Removal of numerical values: Eliminate the numericalvalues or else replace them with the token of placeholder, specifically in case the desired numbers are not that much critical to process or analyze.
Step 11: Deduplication: Identify and remove near-duplicate or duplicate contents for ensuring the representation of single canonical form. Apply techniques like similarity measures orapproach. The new information is thus transmitted once the neural network updation is completed in the hierarchical structure. Likewise, every layer of neural network should attaintime information. In each step of iteration, updation of new information to individual layer should be taken place such thatthe individual layer of network might carry some time information. At each iteration step, the neural network sends data over the unlimited network in an unlimited way of updation that happens to facilitate the depth memory cell attainment.
A typical RNN structure accomplished with time step providesthe input m-dimensional sequences as $y1, y2, \dots, ym$, then, the n-diemnsional hidden layer state equation is expressed as $h1, h2, \dots, hn,$ & $x1, x2 \dots, xk$ denotes the output of k-dimensional sequence & a formula to represent the iteration is represented by:

$$t_j = w_{hy} y_j + w_{hh} h_{j-1} + c_h \quad (1)$$

$$h_j = e(t_j) \quad (2)$$

$$s_j = w_{xh} h_j + c_x \quad (3)$$

$$x_j = g(s_j) \quad (4)$$

In this, w_{hy}, w_{hh} , & w_{xh} are the representation of weight matrices, and the bias is signified as c_h, c_x. t_j denotes the inputof hidden layer, and s_j signifies the input for the unit of output,and these are the k-dimensional variables. The function of non-linear that are predefined will be signified as e and g. The hierarchical data processing manner are not updated in the presented network. Nevertheless, they are trained recurrently over recursion process before the time mode. Depending on thisissue, multi-cell memory which are trained with time scales is employed. Since the data is provided as an input to time steps in a continuous manner, each layer of neuron could be generated in the prior times. The hidden layer is considered thatcreates the differed time scales range in hierarchy and the issuesare thus handled properly so as to get enhanced performance from the time series complexity.
For this type of proposed multi-cell memory RNN that are piledwith the depth d of the hidden layer is thus expressed by:

$$h^d = g_h(h^{d-1}, h^d) = e_d(V^d h^d + w^d h^{d-1}) \quad (5)$$

hashing for identifying and eliminating the duplicates.

t $tt-1t-1$ t

Step 12: Finalization and storing of canonicalized document forfurther analysis or processing.

Then, the misspelling issues are resolved for the used keywordsin the process of information extraction.

D. Multi-cell memory RNN for classification

After canonicalization of document, the classification process or ranking process is carried by means of multi-cell memory RNN classifier. Typically, RNN is the perceptron model that has multilayer and comprises of feedback time loops at each layer. There is a possibility of overlaying of layers in this In this, h^d denotes the hidden layer state in the $d-th$ layer with time t, e_d signifies the function of non-linear which are predefined in the $d-th$ layer, w^d denotes the $d-th$ layer weight matrix, V^d refers to recurrent weight matrix connected at $d-th$ layer.

Likewise, h_t denotes a state of hidden layer at $l-th\ layer$ at time t, el denotes a nonlinear predefined function of $l-th$ layer, Wl refers to $l-th$ layer weight matrix, Ul denotes a recurrent weight matrix connected in the $l-th$ layer.

The algorithm for the multi-cell memory RNN is provided here.

Algorithm 2: Multi-cell memory RNN for classification
Input : Number of layers N_L, Input Layer I_L , Output Layer O_L, Weights of layers W, Bias of layers B Output: indexing the paper For iter = Nt For i =N_c // N_c No of cells hs = 0 hs(i) = tanh(W_{rn} $hs_{(i-1)}$ +W_{in} N_c(i)+B) HS(i) = tanh(W_{OL} * hs(i)+B) End "i" loop CL = I/N_c $\sum_i^{Nc}(AB_i - PR_i)^2$ Update W and B for each N_c End 'iter' loop

Avg no of citations of entire researcher's publication	14.8(max-169)
Avg no of references toentire researcher's publication	15.0(max.58)
Total no of recommending papers	100,351
Avg no of citations in recommending papers	17.9(max-175)
Avg no of references to recommending papers	15.5(max-53)

B. Performance and comparative estimation

The performance of proposed model is estimated for several metrics like MAP, MRR, precision, recall, and F1-measure. Theoutcomes are compared with traditional models [22] like CCF,collaborative, and synthetization-based extraction scheme.

The metrics mean average precision (MAP) and meanreciprocal rank (MRR) are employed for measuring the systemability on returning the relevant papers of research at a top rankin the list of recommendation. The formula denoting this evaluation is given below:

$$MAP = \frac{1}{I}\sum_{i\in I}\frac{1}{n_i}\sum_{k=1}^{N} P(R_{ik}) \quad (6)$$

$$MRR = \frac{1}{I}\sum_{i\in I}\frac{1}{rank(i)} \quad (7)$$

Finally, the classification process is made and the citation recommendation is carried depending on the rank. The performance estimation is carried in the subsequent section.

IV. Performance Analysis

The proposed method performance is assessed and the obtainedresults are projected in this part.

A. Dataset description

The publicly available dataset [21] is used in this approach for the validation of proposed scheme performance. This dataset comprises of 50 researchers' publication list whose interest of research are from various fields of computer science which ranges from software engineering, security, user interface, information retrieval, embedded system, operating systems,programming languages, and databases. Each and every citation and reference are retrieved from the Google Scholar, all other paper which cites any of the references in addition to thereferences of all target paper's citation. Few statistics of the used dataset is shown in table provided below:

Table 1 Input dataset statistics

Total no of researchers	50
Avg number of researcher's publication	10

Here, $rank(i)$ denotes the rank at which the relevant first paper i is identified and the number of target papers is represented by N_p.

The MAP is estimated for the proposed model and the attainedoutcomes are compared with existing methods. The estimationmade is given in figure 2. The analysis reveals that the proposedmodel provided high rate of MAP than other existing schemes.

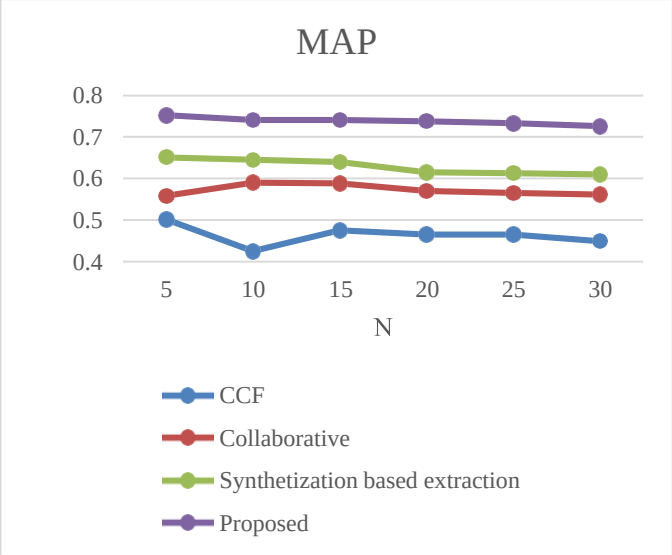

Figure 2 Estimation and comparison of MAP

The MRR is estimated for the proposed model and the attainedoutcomes are compared with existing methods. The estimationmade is given in figure 3. The analysis reveals that the proposedmodel provided high rate of MRR than other existing approaches.

The recall value is estimated for the proposed model and the attained outcomes are compared with traditional methods. Theestimation made is given in figure 5. The analysis exposes thatthe proposed model provided high rate of recall than other traditional models. The recall estimation by using the followingformula:

$$Recall = \frac{\sum(relevant\ papers) \cap \sum(retrieved\ papers)}{\sum(retrieved\ papers)} \quad (9)$$

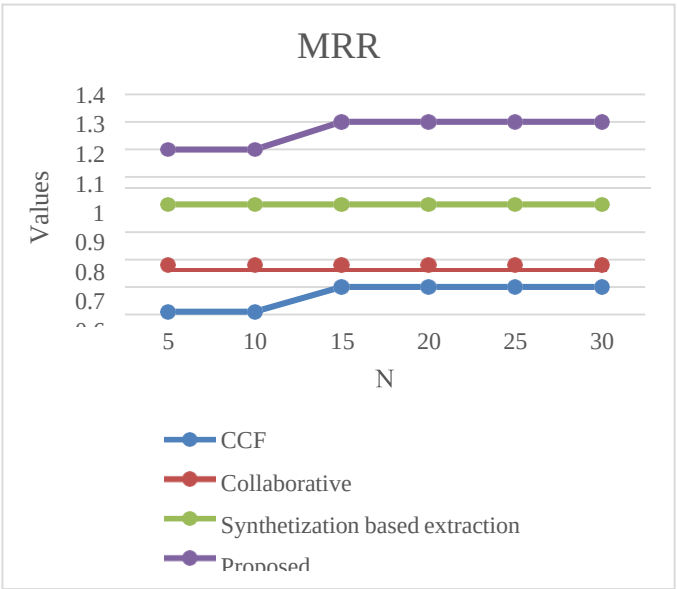

Figure 3 Estimation and comparison of MRR

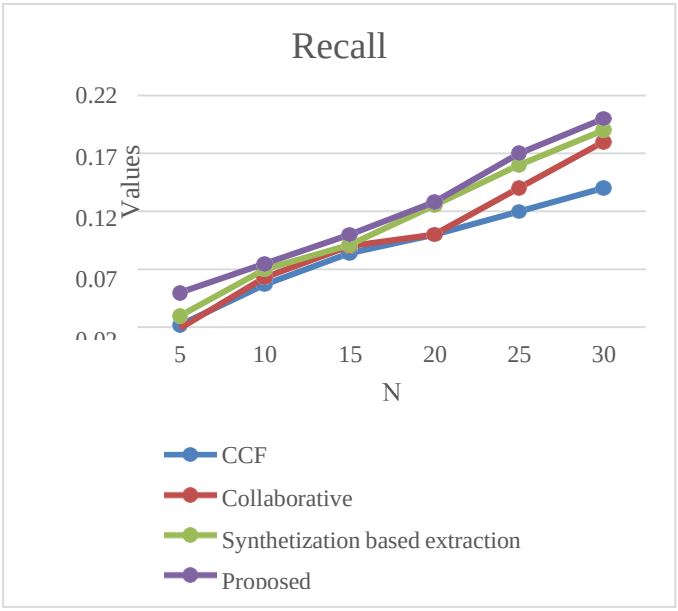

Figure 5 Estimation and comparison of Recall

The precision is estimated for the proposed model and the attained outcomes are compared with existing methods. the estimation made is given in figure 4. The analysis exposes thatthe proposed model provided high rate of precision than other traditional models. The precision estimation by using the following formula:
The F1-measure value is estimated for the proposed model and the attained outcomes are compared with traditional methods.

$$Precision = \frac{\sum(relevant\ papers) \cap \sum(retrieved\ papers)}{\sum(retrieved\ papers)} \quad (8)$$

The F1-measure estimation by using the following formula:

$$F1 = \frac{2 \times precision \times recall}{precision + recall} \quad (10)$$

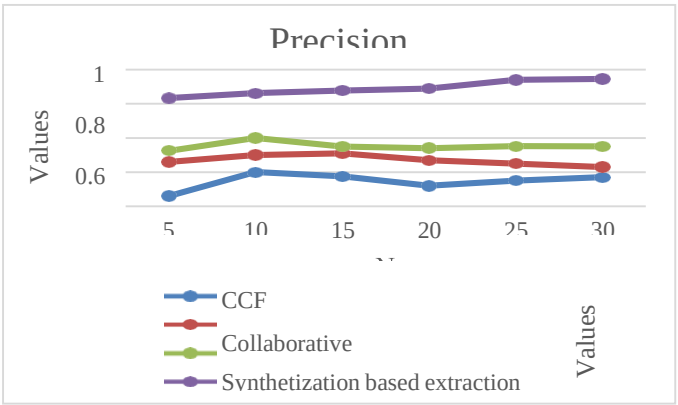

Figure 4 Estimation and comparison of MRR

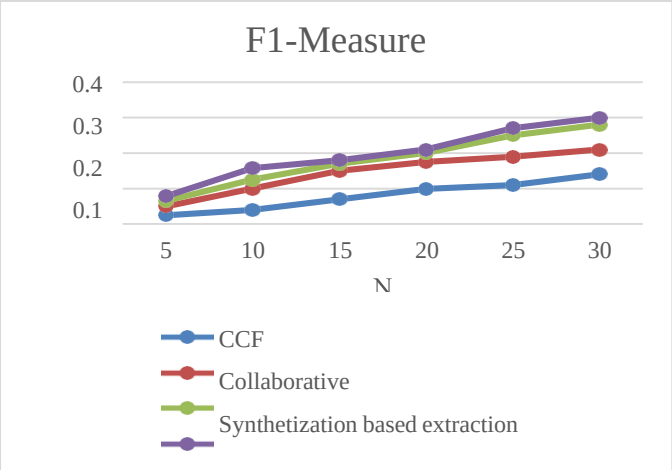

Figure 5 Estimation and comparison of F1-Measure

The estimation made is given in figure 6. The analysis exposesthat the proposed model provided high rate of F1-measure thanother traditional models. Thus, from the entire outcome, it is evident that the proposed method is offering enhanced outcomethan other traditional models.

V. Conclusion

A DL based citation recommendation system was proposed in this manuscript. The input dataset was retrieved from which thefunction words were removed by means of stochastic matchingpattern approach which too creates the library. After that, canonicalization of document was carried using probabilistic min-match approach. The data was then classified with the use of Multi-cell RNN (Recurrent neural network) technique which too is responsible for setting rank for citation. In the end, the performance was measured for several metrics such as MAP, MRR, precision, recall, & F1-measure. The results obtained were compared with existing models to legalize and illustrate the proposed model enhancement over traditional systems. It was revealed from the output that the proposed scheme offers improvement in performance on comparing existing approaches.

References

[1] Ma, S., Zhang, C., & Liu, X. (2020). A review of citation recommendation: from textual content to enriched context. *Scientometrics*, *122*, 1445-1472.

[2] Tang, K. Y., Chang, C. Y., & Hwang, G. J. (2021). Trends in artificial intelligence-supported e-learning: A systematicreview and co-citation network analysis (1998– 2019). *Interactive Learning Environments*, 1-19.

[3] Chen, H. (2021). A New Citation Recommendation Strategy Based on Term Functions in Related Studies Section. *Journal of Data and Information Science*, *6*(3), 75-98.

[4] Zhang, Y., Lin, D., Chen, X., & Qian, F. (2021, March). Citation Recommendation based on Citation links Explanation. In *Journal of Physics: Conference Series* (Vol.1827, No. 1, p. 012069). IOP Publishing.

[5] Da, F., Kou, G., & Peng, Y. (2022). Deep learning based dual encoder retrieval model for citation recommendation. *Technological Forecasting and Social Change*, *177*, 121545.

[6] Jeong, C., Jang, S., Park, E., & Choi, S. (2020). A context-aware citation recommendation model with BERT and graph convolutional networks. *Scientometrics*, *124*, 1907- 1922.

[7] hang, Y., & Ma, Q. (2020). Dual attention model for citation recommendation. *arXiv preprint arXiv:2010.00182*.

[8] Qiu, T., Yu, C., Zhong, Y., An, L., & Li, G. (2021). A scientific citation recommendation model integrating network and text representations. *Scientometrics*, *126*, 9199-9221.

[9] Zhang, J., & Zhu, L. (2022). Citation recommendation using semantic representation of cited papers' relations and content. *Expert systems with applications*, *187*, 115826.

[10] Choi, J., Jang, S., Kim, J., Lee, J., Yoona, J., & Choi, S. (2020). Deep learning-based citation recommendation

system for patents. *arXiv preprint arXiv:2010.10932*.

[11] Chen, Y. L., Weng, C. H., Huang, C. K., & Shih, D. J. (2019). An innovative citation recommendation model for draft papers with varying degrees of information completeness. *Data Technologies and Applications*, *53*(4), 562-576.

[12] Bai, X., Wang, M., Lee, I., Yang, Z., Kong, X., & Xia, F. (2019). Scientific paper recommendation: A survey. *Ieee Access*, *7*, 9324-9339.

[13] Ali, Z., Kefalas, P., Muhammad, K., Ali, B., & Imran, M. (2020). Deep learning in citation recommendation models survey. *Expert Systems with Applications*, *162*, 113790.

[14] Abrishami, A., & Aliakbary, S. (2019). Predicting citation counts based on deep neural network learning techniques. *Journal of Informetrics*, *13*(2), 485-499.

[15] Dinh, T. N., Pham, P., Nguyen, G. L., & Vo, B. (2023). Enhanced context-aware citation recommendation with auxiliary textual information based on an auto-encoding mechanism. *Applied Intelligence*, 1-10.

[16] Wang, L., Rao, Y., Bian, Q., & Wang, S. (2020). Content- based hybrid deep neural network citation recommendation method. In *Data Science: 6th International Conference of Pioneering Computer Scientists, Engineers and Educators, ICPCSEE 2020, Taiyuan, China, September 18-21, 2020, Proceedings, Part II 6* (pp. 3-20). Springer Singapore.

[17] Wang, J., Zhu, L., Dai, T., & Wang, Y. (2020). Deep memory network with bi-lstm for personalized context-aware citation recommendation. *Neurocomputing*, *410*, 103-113.

[18] Tao, S., Shen, C., Zhu, L., & Dai, T. (2020). SVD-CNN: A convolutional neural network model with orthogonal constraints based on SVD for context-aware citation recommendation. *Computational Intelligence and Neuroscience*, *2020*.

[19] ALI, Z., QI, G., MUHAMMAD, K., KEFALAS, P. & KHUSRO, S. 2021. Global citation recommendation employing generative adversarial network. *Expert Systems with Applications*, 180**,** 114888.

[20] Zhang, Y., Yang, L., Cai, X., & Dai, H. (2018). A novel personalized citation recommendation approach based on GAN. In *Foundations of Intelligent Systems: 24thInternational Symposium, ISMIS 2018, Limassol, Cyprus, October 29–31, 2018, Proceedings 24* (pp. 268-278).Springer International Publishing.

[21] Sugiyama, K., & Kan, M. Y. (2015). A comprehensive evaluation of scholarly paper recommendation using potential citation papers. *International Journal on Digital Libraries*, *16*(2), 91-109.

[22] Haruna, K., Ismail, M. A., Qazi, A., Kakudi, H. A., Hassan, M., Muaz, S. A., & Chiroma, H. (2020). Research paper recommender system based on public contextual metadata. *Scientometrics*, *125*, 101-114.