NEWS RECOMMENDER: WITH ENHANCE DKN AND EXPLAINABLE AI FOR IMPROVED EXPERIENCE

Pooja
SITE
Vellore Institute of Technology
Vellore, India
psharma0880@gmail.com

Ankit Kumar
SITE
Vellore Institute of technology
Vellore, India
ankitkumar7277410093@gmail.com

Sarbeswar Mahapatra
SITE
Vellore Institute of Technology
Vellore, India
sarbeswarsm.000@gmail.com

Ephzibah E.P
SITE
Vellore Institute of Technology
Vellore, India
ep.ephzibah@vit.ac.in

***Abstract*— This research paper introduces the Deep Knowledge-Aware Network (DKN) for online news recommendation, augmented with explainable artificial intelligence (XAI) techniques. The aim is to address the lack of transparency and user trust in existing recommendation systems. By leveraging XAI, the DKN model provides clearer and more understandable news recommendations. The integration of the KCNN module and attention modules enhances the accuracy and personalization of the recommendations. Experimental results demonstrate the effectiveness of the proposed approach in improving Explainability, user trust, and engagement. This research contributes to the development of transparent and user-friendly news recommendation systems.**

Keywords*— *Explainable Artificial Intelligence (XAI); Deep Knowledge-Aware Network (DKN); Click through rate (CTR) prediction; deep neural networks; attention model, Natural Language Processing (NLP); Evaluation Metrics.

I. INTRODUCTION

Online news recommendation systems have become increasingly popular as they offer personalized and timely content to users. However, these systems face challenges in understanding the intricate relationships between words and generating accurate predictions of click-through rates. Additionally, users often lack trust in these systems due to the complexity and lack of transparency in the underlying algorithms. To address these issues, this research paper proposes the use of explainable artificial intelligence (XAI) techniques and the Deep Knowledge-Aware Network (DKN) for news recommendation. The objective is to enhance user understanding and transparency in DKN-based systems, ultimately improving user engagement and satisfaction. By integrating the KCNN module and attention modules, the authors aim to achieve better prediction accuracy and provide users with clearer and more interpretable news recommendations. The effectiveness of the proposed approach is evaluated through experiments using a dataset of news articles and user interactions, demonstrating the potential of XAI and DKN in addressing the challenges of online news recommendation systems.

II. AVAILABLE TECHNIQUES

Knowledge Graph Embedding:

Knowledge Graph Embedding is a powerful approach for conveying knowledge graphs in a low-dimensional space. It can be used to model the graph's entities and connections as well as to carry out several operations such as link prediction, entity classification, and recommendation. KGE can be approached in a variety of ways, including TransE, TransR, ConvE, and RotatE. The modelling of the connections between things and the embedding optimization techniques used by these systems varies.

Convolutional Neural Network:

An Artificial Neural Network that excels at processing data with a matrix or grid-like structure is known as a convolutional neural network. For the classification of textual data, CNNs are used in the paper. The input layer, convolutional layer, max-pooling layer, and fully connected layer make up the CNNs models. The convolutional layer serves as the input layer for convolution operations, which are performed by sliding a convolution kernel with a size of h x k at the input layer to produce a feature map c. The most crucial features are extracted using a single max pooling layer. The classification outcome is then obtained using a SoftMax classifier by the fully con-necked layer.

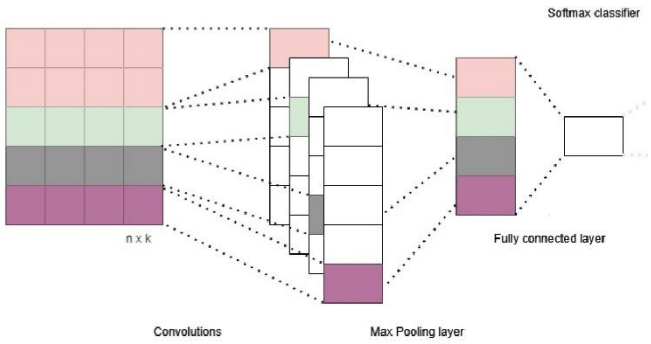

Figure 1: Convolution Neural Network

DKN:

An artificial neural network with the capabilities of combining deep learning and knowledge representation is known as a deep knowledge aware network (DKN). By fusing the strength of deep learning algorithms with

structured knowledge, a DKN aims to give robots the ability to reason about complicated issues. Like conventional deep learning models, a DKN's neural network is trained using lots of data. However, DKANs also include knowledge graphs or ontologies, which represent organized information about the problem area, in addition to the data. This information can be utilized to direct the learning process, increase accuracy, and offer justifications for the predictions made by the network. When structured information is incorporated into a DKN, the network can reason about complicated issues that could call for more than just pattern recognition. To identify a medical ailment, for instance, a DKN might be utilized in conjunction with patient data and medical expertise regarding symptoms and therapies. DKNs are especially helpful for research since they can improve the analysis and comprehension of complex data sets. DKNs can produce more accurate and understandable results by fusing deep learning algorithms with structured knowledge, making it simpler for researchers to spot patterns and derive relevant conclusions from their data. DKNs can also be used to automate research processes, like data processing and classification, which can help researchers save time and money. This can be especially helpful in industries like healthcare and biology where massive amounts of data need to be precisely and swiftly analyses. DKNs can speed up scientific progress and deepen our understanding of complicated systems and events in research activity.

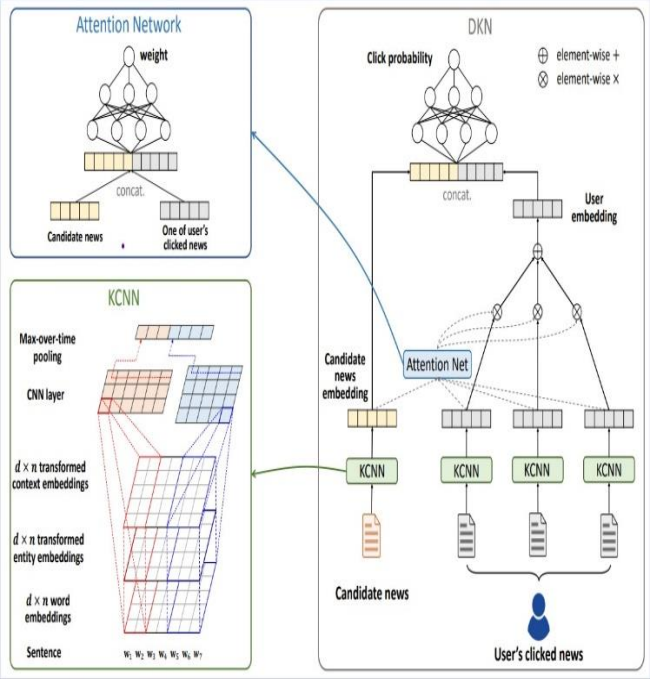

Figure 2: Illustration of the DKN framework.

KCNN:

KCNN Kernel Convolutional Neural Networks are referred to as KCNN. It is a particular kind of deep learning model that is frequently employed in research for problems involving speech and image recognition. Because it employs a kernel function to convert the input data into a higher-dimensional feature space that can identify more intricate patterns and relationships in the data, KCNN is preferable to conventional convolutional neural networks. This enables KCNN to outperform other models in terms of accuracy and performance. Additionally, KCNN is easier to read than other deep learning models, allowing researchers to better comprehend how the algorithm makes judgements. This makes KCNN a helpful tool for academics who want to create AI systems that are easier to understand and transparent. In summary, KCNN is a powerful deep learning model that can help researchers to achieve better accuracy and interpretability in their research work, particularly in the areas of image and speech recognition.

XAI:

Explainable artificial intelligence is known as XAI. It alludes to the creation of AI systems that can explain their decision-making procedures in simple, intelligible terms. XAI is crucial for research because it enables scientists to better comprehend the reasoning behind AI models' conclusions, which enhances the precision and dependability of their findings. By enabling researchers to recognize and correct any biases that may be present in the data or methods employed by the model, XAI can also aid in addressing concerns of prejudice and discrimination in AI systems. In general, XAI can assist researchers in developing more transparent and dependable AI systems, which can result in more accurate and significant research findings. XAI works by incorporating various techniques and methods that allow AI models to explain their behavior and reasoning. Some of the common techniques used in XAI include:

1. Rule-based systems: These AI models make decisions based on a predetermined set of rules. Humans can quickly understand the rules, which increases the system's transparency and explicability.

2. Decision trees describe how a model arrived at a specific decision using graphical representations of the decision-making process. Decision trees are a useful tool for XAI since they are simple for humans to understand.

3. Local interpretable model-agnostic explanations (LIME): LIME is a method for producing justifications for specific predictions produced by an AI model. It functions by building a less complex model that closely resembles the behaviors of the original model, making it simpler and easier to understand.

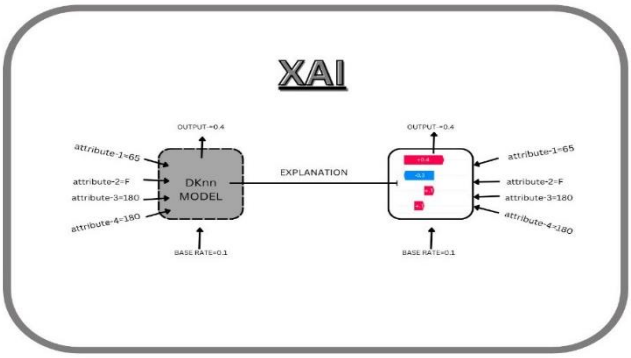

Figure 3: XAI framework

III. RESULT

The experimental evaluation of DKN on large-scale real-world datasets showcases its effectiveness in news recommendation. We compare DKN with state-of-the-art baselines, including SVD and Decision Tree, XGB Classifier and LGBM Classifier, indicating its ability to attract users' attention to recommended news articles and evaluate its performance using various metrics such as click-through rate (CTR), mean average precision (MAP), indicating that DKN effectively ranks relevant and interesting articles higher in the recommendation list. This knowledge-aware approach not only improves the understanding of news content but also enables a deeper semantic context understanding, leading to more accurate and personalized recommendations.

Our results demonstrate that DKN performs better than current methods in terms of user happiness and suggestion accuracy. The findings demonstrate that DKN is a successful deep knowledge-aware network for news recommendation. The integration of external knowledge and the attention mechanism contribute to the superior performance of DKN, demonstrating its potential for enhancing personalized news recommendation systems. Future work may involve exploring additional sources of external knowledge and further refining the knowledge-aware representation learning in DKN to continue improving its recommendation capabilities.

	itemId	category	subcategory	title	abstract	url	title_entities	abstract_entities
1993	N53925	video	viral	He faced off with Nixon. See his advice to whi...	American journalist Daniel Elsberg, who was r...	https://assets.msn.com/labs/mind/AAI6tt9.html	[]	[{"Label": "Pentagon Papers", "Type": "W", "Wi...
15700	N22079	sports	football_nfl	Charges against Pittsburgh Steelers linebacker...	UNIONTOWN, Pa. (AP) Misdemeanor charges have b...	https://assets.msn.com/labs/mind/AAJBazD.html	[{"Label": "Pittsburgh Steelers", "Type": "O",...	[{"Label": "Hotel Pennsylvania", "Type": "F", ...
18389	N3110	foodanddrink	newstrends	Fast Food Chain Recalls Beef From Maryland Res...	MD mill closing after 245 years | Fire chief e...	https://assets.msn.com/labs/mind/AAIPPgC.html	[{"Label": "Maryland", "Type": "G", "Wikidata...	[{"Label": "National Film Awards", "Type": "B"...
21713	N48671	lifestyle	lifestylefamily	Shawnee Mission NICU baby graduation celebrate...	OVERLAND PARK, Mo. -- Halloween came early for...	https://assets.msn.com/labs/mind/AAJ7hTj.html	[{"Label": "Shawnee Mission, Kansas", "Type": ...	[{"Label": "Overland Park, Kansas", "Type": "G...
25492	N27114	news	newsus	Dayton officer who made controversial social m...	The Dayton police officer who made a controver...	https://assets.msn.com/labs/mind/AAJjmVt.html	[{"Label": "Dayton, Ohio", "Type": "G", "Wikid...	[{"Label": "Dayton, Ohio", "Type": "G", "Wikid...

Figure 4: Result

IV. CONCLUSION

Our study concludes by introducing DKN, a deep knowledge-aware network that makes use of a knowledge graph representation to overcome the main issues with news recommendation. DKN uses a content-based deep model method and is specifically created for time-sensitive news, in contrast to ID-based solutions. We present the KCNN module, which efficiently integrates knowledge entities and common sense into news information by maintaining the connection of different word embeddings. This knowledge integration improves how news pieces are shown and understood overall.

With the help of an attention module included in DKN that dynamically builds a user's aggregated history representation, it is possible to forecast with accuracy how a user's past interests will affect current candidate news. The personalization and relevancy of news recommendations are improved by this attention technique. On a dataset from Bing News, we conducted comprehensive testing to show that DKN performs much better than strong baseline techniques. The enhanced recommendation outcomes clearly demonstrate the efficiency of knowledge entity embedding and the attention module.

We use XAI Shape for an interpretable code section to increase productivity and decrease time usage. This enables a better understanding and justification of the behavior of our model.

Overall, our research provides a novel viewpoint on the difficulties posed by news suggestions. Our method produces higher outcomes and improves the interpretability of news recommendation systems by merging knowledge graphs, attention mechanisms, and interpretable methodologies. This research opens the door for more development in the area and shows significant promise for the future enhancement of the relevance and customization of news recommendations.

V. REFERENCES

[1] Bayer, I., He, X., Kanagal, B. and Rendle, S., 2017, April. A generic coordinate descent framework for learning from implicit feedback. In Proceedings of the 26th International Conference on World Wide Web (pp. 1341-1350).

[2] Chaudhari, S., Azaria, A. and Mitchell, T., 2017. An entity graph based recommender system. AI Communications, 30(2), pp.141-149.

[3] Wang, X., Wang, D., Xu, C., He, X., Cao, Y. and Chua, T.S., 2019, July. Explainable reasoning over knowledge graphs for recommendation. In Proceedings of the AAAI conference on artificial intelligence (Vol. 33, No. 01, pp. 5329-5336).

[4] Zhang, Y. and Chen, X., 2018. Explainable recommendation: A survey and new perspectives. CoRR abs/1804.11192 (2018). arXiv preprint arXiv:1804.11192.

[5] Ma, T., Huang, L., Lu, Q. and Hu, S., 2023. Kr-gcn: Knowledge-aware reasoning with graph convolution network for explainable recommendation. ACM Transactions on Information Systems, 41(1), pp.1-27.

[6] Li, Y., Guo, X., Lin, W., Zhong, M., Li, Q., Liu, Z., Zhong, W. and Zhu, Z., 2021. Learning dynamic user interest sequence in knowledge graphs for click-through rate prediction. IEEE Transactions on Knowledge and Data Engineering, 35(1), pp.647-657.

[7] Liu, D., Bai, T., Lian, J., Zhao, X., Sun, G., Wen, J.R. and Xie, X., 2019. News Graph: An Enhanced Knowledge Graph for News Recommendation. In KaRS@ CIKM (pp. 1-7).

[8] Huang, Y., Zhao, F., Gui, X. and Jin, H., 2021. Path-enhanced explainable recommendation with knowledge graphs. World Wide Web, 24(5), pp.1769-1789.

[9] Catherine, R. and Cohen, W., 2016, September. Personalized recommendations using knowledge graphs: A probabilistic logic programming approach. In Proceedings of the 10th ACM conference on recommender systems (pp. 325-332).

[10] Tai, C.Y., Huang, L.Y., Huang, C.K. and Ku, L.W., 2021, July. User-centric path reasoning towards explainable recommendation. In Proceedings of the 44th International ACM SIGIR Conference on Research and Development in Information Retrieval (pp. 879-889).