Natural Language Explanation for Recommendations and Beyond

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A thesis submitted in partial fulfilment of the requirements

for the degree of

Doctor of Philosophy

Principal Supervisor:

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August 2025

DECLARATION

I hereby declare that this thesis represents my own work which has been done after registration for the degree of PhD at Hong Kong Baptist University, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications.

I have read the University's current research ethics guidelines, and accept responsibility for the conduct of the procedures in accordance with the University's Research Ethics Committee (REC). I have attempted to identify all the risks related to this research that may arise in conducting this research, obtained the relevant ethical and/or safety approval (where applicable), and acknowledged my obligations and the rights of the participants.

Signature:_____

August 2025

ABSTRACT

Your abstract

Keywords: Explainable Recommendation, Explainable Artificial Intelligence, Recommender Systems

ACKNOWLEDGEMENTS

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RNN recurrent neural network.

Chapter 1

Introduction

A brief introduction to this chapter.

1.1 Motivation

Sample citations: pre-trained GPT-2[1] [1], Transformer [2], recurrent neural network (RNN) [3]

1.2 Outline

1.3 Contributions

Use the following command to shorten the captions shown in List of Tables/Figures:

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\caption[shorter caption in List of
Tables/Figures]{Real capation above or below the table/figure}
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See Fig. 1.1 for example.

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[1]Codes available at https://github.com/lileipisces/PEPLER

Natural Language Generation

This	movie	is	top	notch	<eos>

Language Model (e.g., Pre-trained GPT-2, Transformer, GRU or LSTM)

User ID	Item ID	<bos>	This	movie	is	top	notch

Input IDs   Output Sequence
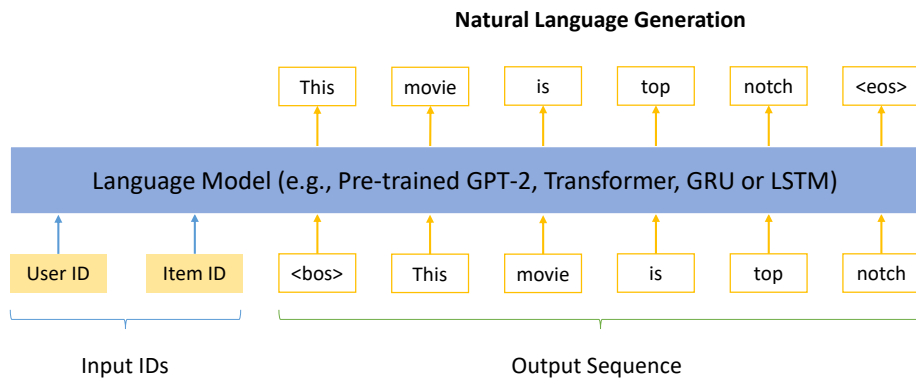
Figure 1.1. Overview of recommender systems-based natural language generation. In the case of recommendation explanation generation, the model is instructed to generate a word sequence for explaining why an item is recommended to the user.

Chapter 2

Literature Survey

Chapter 3

Natural Language Explanation Generation

3.1 Background

3.2 Problem Formulation

3.3 Model Description

3.3.1 Input Representation

3.3.2 Transformer and Attention Masking

3.3.3 Explanation and Recommendation

Explanation Generation:

Context Prediction:

Rating Prediction:

Multi-task Learning:

Algorithm 1 Sentence Grouping via Locality-Sensitive Hashing (LSH)

Input: shingle size n, similarity threshold t, minimum group size g
Output: explanation set $\mathcal{E}$, groups of sentences $\mathcal{M}$

1: Pre-process textual data to obtain the sentence collection $\mathcal{S}$
2: $lsh \leftarrow MinHashLSH(t)$, $\mathcal{C} \leftarrow \varnothing$
3: **for** sentence s in $\mathcal{S}$ **do**
4:     $m \leftarrow MinHash()$ // create MinHash for s
5:     **for** n-shingle h in s **do**
6:       $m.update(h)$ // convert s into m by encoding its n-shingles
7:     **end for**
8:     $lsh.insert(m)$, $\mathcal{C}.add(m)$ // $\mathcal{C}$: set of all sentences' MinHash
9: **end for**
10: $\mathcal{M} \leftarrow \varnothing$, $\mathcal{Q} \leftarrow \varnothing$ // $\mathcal{Q}$: set of queried sentences
11: **for** m in $\mathcal{C}$ **do**
12:     **if** m not in $\mathcal{Q}$ **then**
13:       $\mathcal{G} \leftarrow lsh.query(m)$ // $\mathcal{G}$: ID set of duplicate sentences
14:       **if** $\mathcal{G}.size > g$ **then**
15:         $\mathcal{M}.add(\mathcal{G})$ // only keep groups with enough sentences
16:         $\mathcal{E}.add(\mathcal{G}.get())$ // keep one explanation in each group
17:       **end if**
18:       **for** m' in $\mathcal{G}$ **do**
19:         $lsh.remove(m')$, $\mathcal{Q}.add(m')$ // for efficiency
20:       **end for**
21:     **end if**
22: **end for**

Table 3.1. Statistics of the three datasets.

	Yelp	Amazon	TripAdvisor
#users	27,147	7,506	9,765
#items	20,266	7,360	6,280
#records	1,293,247	441,783	320,023
#features	7,340	5,399	5,069
#records / user	47.64	58.86	32.77
#records / item	63.81	60.02	50.96
#words / explanation	12.32	14.14	13.01

3.4   Experimental Setup

3.4.1   Datasets

3.4.2   Evaluation Metrics

3.4.3   Compared Methods

3.4.4   Implementation Details

3.5   Results and Analysis

3.5.1   Quantitative Analysis on Explanations

3.5.2   Qualitative Case Study on Explanations

3.5.3   Recommendation Performance

3.5.4   Ablation Study

3.6   Summary

Table 3.2. Ablation study on the smallest dataset TripAdvisor. Arrows ↑ and ↓ respectively denote the performance increase and decrease compared with PETER.

	Explainability			Text Quality			Recommendation	
	FMR	FCR	DIV	USR	BLEU-1	BLEU-4	RMSE	MAE
Disable $\mathcal{L}_c$	0.06 ↓	0.03 ↓	5.75 ↓	0.01 ↓	15.37 ↓	0.86 ↓	0.80 ↑	0.61 ↑
Disable $\mathcal{L}_r$	0.07	0.14 ↑	2.90 ↑	0.10 ↑	16.16 ↑	1.15 ↑	3.23 ↓	3.10 ↓
Left-to-Right Masking	0.07	0.15 ↑	2.68 ↑	0.12 ↑	15.73 ↓	1.11	0.87 ↓	0.68 ↓
PETER	0.07	0.13	2.95	0.08	15.96	1.11	0.81	0.63

Chapter 4

Conclusion and Future Work

4.1   Conclusion

4.2   Future Work

Bibliography

1. Li, L., Zhang, Y. & Chen, L. Personalized Prompt Learning for Explainable Recommendation. *arXiv preprint arXiv:2202.07371* (2022).

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3. Li, L., Zhang, Y. & Chen, L. *Generate Neural Template Explanations for Recommendation* in *Proceedings of the 29th ACM International Conference on Information and Knowledge Management* (2020), 755–764.

List of Publications

1. <u>Lei Li</u>, Yongfeng Zhang, Li Chen, *Personalized Prompt Learning for Explainable Recommendation*, **ACM Transactions on Information Systems**, 2022. [*submitted*]

2. <u>Lei Li</u>, Yongfeng Zhang, Li Chen, *Personalized Transformer for Explainable Recommendation*, **Proceedings of the 59th Annual Meeting of the Association for Computational Linguistics and the 11th International Joint Conference on Natural Language Processing**, pages 4947-4957, Online, Thailand, August 1–6, 2021. (**oral paper**)

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CURRICULUM VITAE

Academic qualifications of the thesis author, Mr. LI Lei:

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August 2025