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English title of your thesis. If it is in two lines, it will perfectly suite this place.

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"To my kind teachers, loving parents, supporting siblings, loyal wife, sweet children and helping friends; for their affection, encouragement and prays. Without them and their everlasting support, I stand nowhere!"

摘 要[1]

推荐系统 (Recommender System, RS)通过使用推荐方法减轻因接收过多信息而产生的压力，从而可有效处理用户的偏好，增强用户对大量在线应用的兴趣及体验。

关键词： 知识图谱嵌入增强，推荐系统，交互。

[1]English translation of this summary is available in Appendix A.

Abstract

Recommender Systems (RS) are established to deal with the preferences of users to enhance their experience and interest in innumerable online applications by streamlining the stress persuaded by the reception of excessive information through the recommendation methods. . .

Keywords: KGEE, RS, Interactions.

Contents

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List of Symbols

Symbol	Name	Description
u	user	the interactor
v	item	the interactee
$\mathcal{U}$	set of users	$\mathcal{U} = \{u_1, u_2, ..., u_m\}$

List of Abbreviations

ACRD	**A**mazon **C**ustomer **R**eview **D**ataset
BERT	**B**idirectional **E**ncoder **R**epresentations from **T**ransformers
CF	**C**ollaborative **F**iltering

Chapter 1

Introduction

'*Less but clear and relevant is better than more but ambiguous and irrelevant*' is the basic theme of the contents' personalization in this digital age that normally does not happen. According to the 12th September 2022's statistics of the OBERLO[1], there are currently 4.59 billion active users on social media which equates to only 57.5% of the whole population of the world, where 2.94 billion users are only on Facebook. Similarly, . [1], [2]

1.1 Personalization: overview of the bigger picture

With the current

1.2 Research challenges and main contributions

From the perspectives of.

In this perspective, therefore, this work formulates the following Research Questions (RQs) as the foremost research-challenges and address them.

RQ 1: *How can the semantic relevance enhanced KGE be exploited to provide accurate, personalized and explainable recommendations using the-state-of-the-art recommendation techniques?* (Chapter 3)

This work ..... To effectively address this major RQ, its main contributions are further divided into the following Sub-research Questions (SQs).

SQ 1.1: *How does SAGE perform against the-state-of-the-art approaches by exploiting semantically relevant information for recommendation?*

The SAGE is a ....

SQ 1.2: *How can SAGE utilize the-state-of-the-art techniques as it's modules in recommendation?*

The ....

SQ 1.3: *How the performance of SAGE is influenced by different adjustments of hyper-parameters of the*

[1] https://www.oberlo.com/

underlying model?

.....

SQ 1.4: *What is the performance of SAGE against the cold start and data sparsity problems?*

.....

SQ 1.5: *Is SAGE capable of generating the explainable recommendations?*

Yes, SAGE is capable of generating the explainable recommendations. The recommendations' explainability of the SAGE can be consulted in Chapter 3.

Discussion

SAGE .....

limitations of this work. proposing next work.

RQ 2: .....*?* (Chapter 4)

..... To effectively address this major RQ, it further divides the main contributions of this work into the following SQs.

SQ 2.1: .....*?*

This work .....

SQ 2.2: ....*?*

.....and so on.....

1.3 Thesis Organization

The division and internal dependency of the thesis, as shown in Figures **??** and **??** respectively, demonstrate how it ..... Intuitively, chapter-wise partitioning and brief description of this thesis can be overviewed as follows:

- **Chapter 1** describes ....
- **Chapter 2** discusses ....
- **Chapter 3** covers ....
- **Chapter 4** contains ....
- **Chapter 5** comprises .....
- **Chapter 6** accommodates ....
- **Chapter 7** represents .....
- **Chapter 8** demonstrates .....

[*Abbreviations* in Figure **??** — SSR: ..., RS: Recommender System, KGE: Knowledge Graph Embedding, KGEE: ....].

Chapter 2

The State of the Art Knowledge

In this chapter,

Table 2.1: A comprehensive .....

KReps		Domain		Information			References
Names	Type	MD	UD	Source	IS	Method	
DBpedia	KG	✓		WP	GP	Extracted	[**lehmann2015**]
CN-DBpedia	KG	✓		BB, HB, CW	GP	Extracted	[**xu2017**]
Freebase	KG	✓		WP, NNDB, FMD, MB	GP	Curated	[**bollacker2008**]
YAGO	KG	✓		WP, WN, GN	GP	ICLVE	[**fabian2007**]
Satori	KG	✓		WD	GP	Curated	[**qian2013**]
Wikidata	KG	✓		WP, FB	GP	EVCF	[**vrandevcic2014**]
NELL	KG, KB	✓		WD	GP	Extracted	[**carlson2010**]
Google's KG	KG	✓		WD, WP, MD, GSN	GP	ICLVD	[**steiner2012**]
Google's KV	KG, KB	✓		Freebase, WD	GP	Extracted	[**dong2014**]
Yahoo!'s KG	KG	✓		WP, Wd, WD, FB	GP	Extracted	[**blanco2013**]
Facebook's EG	KG	✓		WP, FBD	GP	Extracted	[**sun2013**]
Open Cyc	KG, KB	✓		CKB	GP	RVCC	[**lenat1995**]
PROSPERA	KB	✓		WD	GP	Extracted	[**nakashole2011**]
DeepDive	KB	✓		WD	GP	Extracted	[**niu2012**]
KnowLife	KG		✓	SL, WIP	HLS	Extracted	[**ernst2014**]
DSKGMS	KG		✓	UBMWB	BM	EwMS	[**yuan2020**]
AKMiner	KG		✓	AL, WIP	AK	Extracted	[**huang2013**]
Con2KG	KG		✓	SUHWD	JB	Extracted	[**goyal2019**]
Bio2RDF	KS		✓	PBIDB, NCBIDB	BI	CIDBD	[**belleau2008**]
NeuroMMSig	KI		✓	AKB	ND	Curated	[**hoyt2019**]

Abbreviations. MD: Multi Domain, UD: Uni Domain, IS: .

Chapter 3

Similarity ....

3.0.1 Interaction Matrix

The interaction matrix as:

$$m_{uv} = \begin{cases} 1, & if\ interaction\ exists \\ 0, & otherwise \end{cases} \tag{3.1}$$

where $m_{uv} \in \mathcal{M}$, $u \in \mathcal{U}$ and $v \in \mathcal{V}$.

as:

$$C(n_c, p) = \frac{\sum_{i=1}^{n} n_{c_i} p_i}{\sqrt{\sum_{i=1}^{n} n_{c_i}^2} \sqrt{\sum_{i=1}^{n} n_{p_i}^2}} \tag{3.2}$$

Algorithm 3.1: NSP Modeling-based Subgraph Construction

Input: Nodes, Paths, .

Output: Similarity....

```
1  foreach (n_c, n_t) pair in G do
2      reset h
3      while (h! ← H) do
4          ...
5          if ... according to Eq. (??) then
6              call draw
7          else
8              ... next neighbor of n_c & goto line. 5
9      identify the selected ℘ as ℘_j & store ℘_j in ℘-array
10 concat ℘s from ℘-array wrt ℘_j
11 Procedure draw(n_c, n_t):
12     n_t: if ....
13     n_t: ...
```

.... Table 3.1 respectively.

Table 3.1: $\mathcal{A}$-....

$\mathbf{n} \times \mathbf{n}$	$\mathbf{n_1}$	$\mathbf{n_2}$	$\mathbf{n_3}$	$\mathbf{n_4}$	$\mathbf{n_5}$	$\mathbf{n_6}$	$\mathbf{n_7}$	$\mathbf{n_8}$	$\mathbf{n_9}$	$\mathbf{n_{10}}$	$\mathbf{n_{11}}$
$\mathbf{n_1}$	0	p_2	0	p_1	p_1	0	0	0	0	0	0
$\mathbf{n_2}$	0	0	p_1	0	0	0	0	0	0	0	0
$\mathbf{n_3}$	0	0	0	0	0	p_3	p_4	0	0	0	0
$\mathbf{n_4}$	0	0	0	0	0	0	p_4	p_5	0	0	0
$\mathbf{n_5}$	0	0	0	0	0	0	0	p_5	0	0	0
$\mathbf{n_6}$	0	0	0	0	0	0	0	0	p_6	0	0
$\mathbf{n_7}$	0	0	0	0	0	0	0	0	0	p_7	0
$\mathbf{n_8}$	0	0	0	0	0	0	p_9	0	0	0	p_8
$\mathbf{n_9}$	0	0	0	0	0	0	p_{10}	0	0	0	0
$\mathbf{n_{10}}$	0	0	0	0	0	0	0	0	0	0	0
$\mathbf{n_{11}}$	0	0	0	0	0	0	0	0	0	0	0

*The description of nodes and paths used in this table is provided in Table **??**.

Chapter 4

Hashing ...

In this chapter,

Table 4.1: ...statistics....

Literals	**Datasets**		
	Amazon-Book	**Last-FM**	**Bing-News**
Domain	Book	Music	News
Users u	55255	1865	40237
Items v	20235	6526	32562
Interactions $\mathcal{I}$	232562	68456	192356
Entities	77253	12039	76586
Relation-Types	29	58	45
Relation-Counts	122562	29650	115620
Sparsity sp	0.999792	0.994375	0.999853
Training Y_{train}	162793	47919	134649
Testing Y_{test}	46512	13691	38471
Validation Y_{val}	23256	6845	19235

Chapter 5

DCA...

We propose

Chapter 6

NMR....

In this chapter,

Chapter 7

PEK...

In this chapter,

Chapter 8

Conclusion and Future-work

In this chapter, we conclusively discuss the significant research findings and highlight the future research dimensions in details.

8.1 Conclusion

We explored .....

8.2 Future Research Dimensions

"Room is always there for improvement!" Although ... ... domain.

Bibliography

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[2] N. Khan, Z. Ma, A. Ullah and K. Polat, 'Dca-iomt: Knowledge-graph-embedding-enhanced deep collaborative alert recommendation against covid-19,' *IEEE Transactions on Industrial Informatics*, vol. 18, no. 12, pp. 8924–8935, 2022 (cit. on p. 1).

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List of publications

Journal Articles

1. First Author, ————, ————, and ————. ” —— title of the paper —— ”, published in *Expert Systems with Applications*, ——— : ——, doi: ————. (SCI)

Data

1. First Author, and ————. ” —— title of data 1 —— ”, published in *Mendeley Data — A cloud-based communal repository*, ——— : ——, doi: ————.

Appendix A

Thesis Summary

Recommender System (RS) ....

Keywords: KGEE, ...