

Knowledge Diffusion for Neural Dialogue Generation

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Introduction

Previous neural dialogue systems based on knowledge base are capable of answering **facts related inquiries**, *WH* questions in particular. However, it is still far behind a natural knowledge grounded dialogue system, which should be able to understand the facts involved in current dialogue session (so-called **facts matching**, i.e.: Item 1, 2), as well as diffuse them to other similar entities for knowledge-based chit-chats (namely **entity diffusion**, i.e.: Item 3, 4):

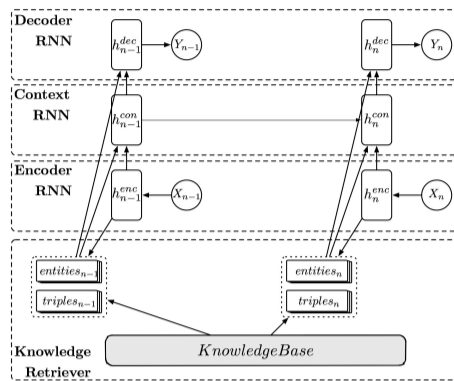
ID	Dialogue
1	A: Who is the director of the <u>Titanic</u> ? 泰坦尼克号的导演是谁? B: <u>James Cameron</u> . 詹姆斯卡梅隆。
2	A: <u>Titanic</u> is my favorite film! 泰坦尼克号是我最爱的电影! B: The love inside it is so touching. 里面的爱情太感人了。
3	A: Is there anything like the <u>Titanic</u> ? 有什么像泰坦尼克号一样的电影吗? B: I think the love story in film <u>Waterloo Bridge</u> is beautiful, too. 我觉得魂断蓝桥中的爱情故事也很美。
4	A: Is there anything like the <u>Titanic</u> ? 有什么像泰坦尼克号一样的电影吗? B: <u>Poseidon</u> is also a classic marine film. 海神号也是一部经典的海难电影。

In this work, we propose a **neural knowledge diffusion (NKD)** model to introduce knowledge into dialogue generation.

- We identify the problem of incorporating knowledge bases and dialogue systems as **facts matching** and **entity diffusion**.
- We manage both **facts matching** and **entity diffusion** by introducing a novel **knowledge diffusion mechanism** and generate the responses with the retrieved knowledge items, which enable the **convergent** and **divergent** thinking over the knowledge base.
- The experimental results show that the proposed model **effectively generate more diverse and meaningful responses involving more accurate relevant entities** compared with the state-of-the-art baselines.

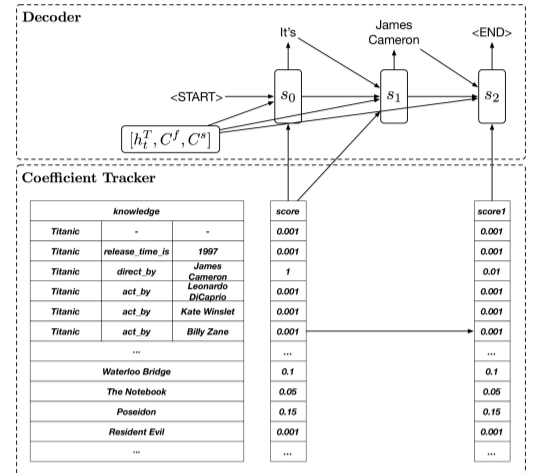
Model Architecture

Overview

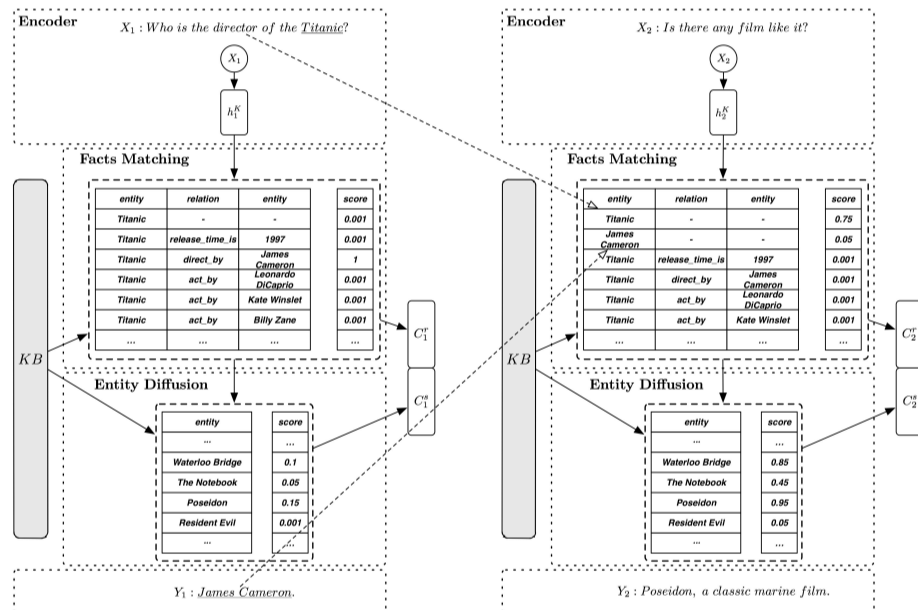


X_1 : Who is the director of the Titanic?
 Y_1 : James Cameron.
 X_2 : Is there any film like it?
 Y_2 : Poseidon, a classic marine film.

Decoder



Knowledge Retriever



$$h_f = \{h_{f_1}, h_{f_2}, \dots, h_{f_{N_f}}\}$$

$$r_k^f = MLP([h_{N_x}^K, h_{f_k}])$$

$$C^f = \sum_{k=1}^{N_f} r_k^f h_{f_k}$$

$$r_k^e = MLP([h_{N_x}^K, C^f, e_k])$$

$$C^s = \sum_{k=1}^{N_e} r_k^e e_k$$

Dataset

We collect a **multi-turn conversation corpus** which includes not only facts related inquiries but also knowledge-based chit-chats. The data is publicly available at <https://github.com/liushuman/neural-knowledge-diffusion>.

We obtain the element information of each movie from <https://movie.douban.com/> and build the knowledge base K. The question-answering dialogues and knowledge related chit-chat are crawled from <https://zhidao.baidu.com/> and <https://www.douban.com/group/>. The conversations are grounded on the knowledge using NER, string match, and artificial scoring and filtering rules. The total **32977** conversations consisting of **104567** utterances are divided into training (32177) and testing set (800).

Experiments and Conclusion

Model	Factoid QA		Entire Dataset			Human Evaluation		
	Acc.	Re.	Acc.	Re.	Entity Number	Flue.	Appr.	Corr.
LSTM	7.8	7.5	2.6	2.5	1.65	2.52	0.88	0.8
HRED	3.7	3.9	1.4	1.5	1.79	2.48	0.36	0.32
GenDS	70.3	63.1	20.9	17.4	1.34	2.76	1.36	1.34
NKD-ori	67.0	56.2	22.9	19.7	2.55	2.42	1.92	1.58
NKD-gated	77.6	77.3	24.8	25.6	1.59	2.08	1.72	1.44
NKD-atte	55.1	46.6	18.4	16.0	3.41	2.7	1.54	1.38

Demo Conversation

X_1 : It's a bit boring recently. Any good horror movies, guys?
I've watched a lot.
最近有点无聊, 各位豆友有什么好看的恐怖片推荐啊?
看了好多了。
NKD: Recommend a few I've seen, 《A wicked Ghost》
《hide and seek》
推荐几部我看过《山村老尸》《捉迷藏》

X_2 : I've seen it all, anything else?
卤煮都看过了。还有推荐?
NKD: Identity, Fight Club, Interstellar, Snowpiercer
致命ID, 搏击俱乐部, 星际穿越, 雪国列车

X_3 : Have seen it before, really great
看过, 真的很不错的说
NKD: So what type do you like?
那你喜欢什么类型的?