Paper Reading

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Flexible End-to-End Dialogue System for Knowledge Grounded Conversation [AAAI2018]

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Introduction

- The response of knowledge grounded conversation might contain multiple answer entities or no entity at all.
- QA systems can be applied to knowledge grounded conversation, they either have at most one entity in a response or cannot deal with out-ofvocabulary entities.
- propose a generative dialogue system GenDS that is capable of generating responses based on input message and related knowledge base (KB).
- introduce a dynamic knowledge enquirer, in order to generate an arbitrary number of entities.

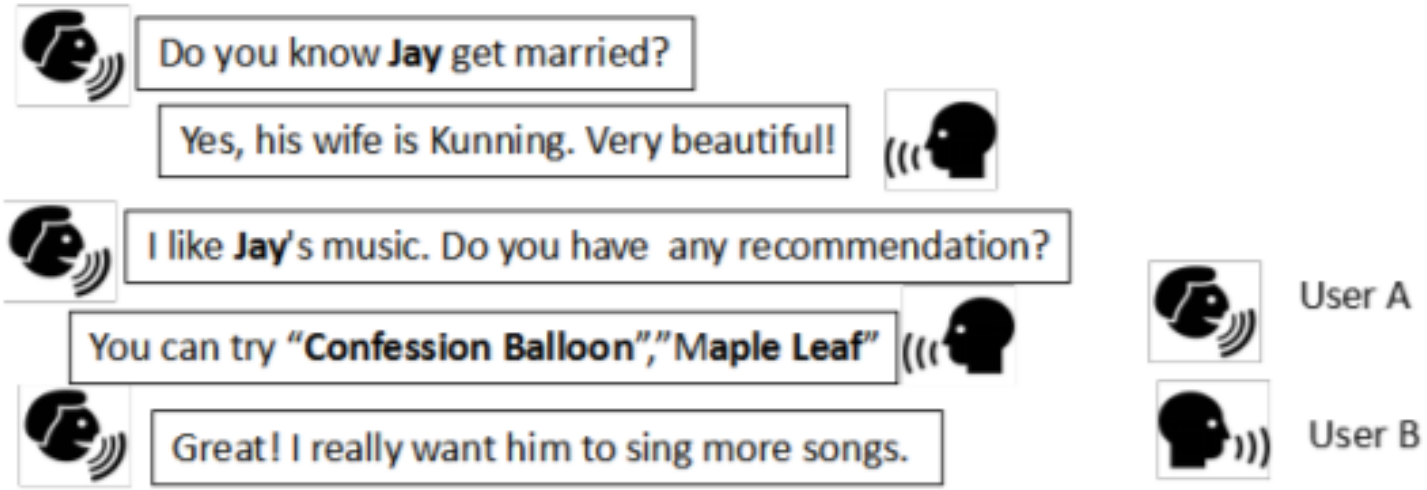
Introduction

KB of user A:

Subject	predicate	object
Jay	occupation	Singer
Jay	wife	Kunning
Jay	marriage_state	married

KB of user B:

subject	predicate	object
Confession Balloon	singer	Jay
Maple Leaf	singer	Jay
Jay	wife	Kunning



Problem Definition

The inputs of the problem are:

- 1. An input message $\boldsymbol{X}$
- 2. A knowledge base K containing all possible facts.
- 3. A list of entity types τ

The output of the problem is:

- 1. A response $\boldsymbol{Y}$. The response might contain arbitrary number of common and knowledge words.

Model Framework of GenDS

The components of the GenDS system:

- 1. A candidate facts retriever first detects possible entities $\boldsymbol{E}$ in the input message $\boldsymbol{X}$, then retrieves a set of possible facts τ_Q Q from the knowledge base K, based on the detected entities $\boldsymbol{E}$.
- 2. A message encoder encodes the input message $\boldsymbol{X}$ into a set of intent vectors at each time step, denoted by $\boldsymbol{H}$.
- 3. A reply decoder takes $\boldsymbol{H}$ and τ_Q as input and generates the final response $\boldsymbol{Y}$ word by word.

Candidate Facts Retriever

Retrieve facts with subjects matched with $\boldsymbol{E}$ and objectives matched with $\boldsymbol{E}$:

$$\tau_Q = \tau_{QS} \cup \tau_{QO}$$

Message Encoder

Replace the entity in the message with its type.

"recommend me songs of JAY" – "recommend me songs of People"

Reply Decoder

- Common Word Generator
- Dynamic Knowledge Enquirer
  - message matching score: $r_{e_k} = DNN_2(\boldsymbol{h}_{M_T}, \boldsymbol{\beta}_{e_k})$
  - entity update score: $\boldsymbol{f}_t = DNN_1(\boldsymbol{s}_t, \boldsymbol{\mu}_{y_{t-1}}, \boldsymbol{\mu} y_{t-1})$
  - entity type update score: $u_{kt} = DNN_1(\boldsymbol{s}_t, \boldsymbol{\mu}_{y_{t-1}}, \boldsymbol{\mu}_{e_k})$
  - The final dynamic entity score: $p_e = (y_t = et) = \boldsymbol{p}_{et} = \boldsymbol{r} \circ \boldsymbol{f}_t \circ \boldsymbol{\mu}_t$
- Final Response Generation with the knowledge gate $z_t \in \{0, 1\}$

Multi-task learning

Two tasks share the message encoder, and common word generator decoder, and are trained with maximum likelihood estimation as objective function.

- 1. the model is trained with ground truth as output(GenDS)
- 2. the output of task2 is to replace the entity in ground truth with its type(Seq2SeqAttn)

Experiment

Dataset

- 1. MusicConvers
- 2. Music Question Answering

#dialogues	9993
vocabulary size for message	3256
vocabulary size for response	2976
#entities	5988
# knowledge triples	7612
# relation in KB	66

Table 1: Statistics of the MusicConvers dataset

#QA pair	30312
vocabulary size for message	12576
vocabulary size for response	13807
# entities	7176
# knowledge triples	6238
# relation in KB	25

Table 2: Statistics of the QA dataset

Results

Message	I forgot what songs has Hu Ling sung? 忘记了，胡灵唱过什么歌?
S2SA	still New Experience 还有全新经验
GenQA	**Meet in Guangzhou**, **Meet in Guangzhou**, **Meet in Guangzhou**, **Meet in Guangzhou** and so on 广州之约，广州之约，广州之约，广州之约等等
GenQAD	should be **I am still your lover** 就是我依然是你的情人
GenDS-Static	**Song of Wind**, **Song of Wind** 听风的歌，听风的歌
GenDS-Single	**I am still your lover**, **Song of Wind** 我依然是你的情人，听风的歌

Table 6: Case Study For Knowledge Grounded Conversation. Entities are underlined, and true entities are in bold.

Message	Didn't know this singer, do you know Zhiqian Xue 没听过这个歌手哎，你知道薛之谦么
S2SA	I knew her songs 听过她的歌呀
GenQA	Animal World singing the song is that he wrote the lyrics of the day more than a few days 动物世界唱的歌都是他写填词日超多日超多日
GenQAD	Heard of these two 听过这两首是听过这两首了哦
GenDS-Single	**Prince Back** is the song of **Zhiqian Xue**, all written by himself 王子归来是薛之谦的歌，都是作词。

Table 7: Case Study For Unseen Knowledge Words. Unseen Entities are underlined, and true entities are in bold.

Conclusion

- 1. The model can generate responses with any number of answer entities, even when these entities never appear in the training set.
- 2. Being able to deal with unseen entities, GenDS is scalable with new KB.