Variational Hierarchical User-based Conversation Model

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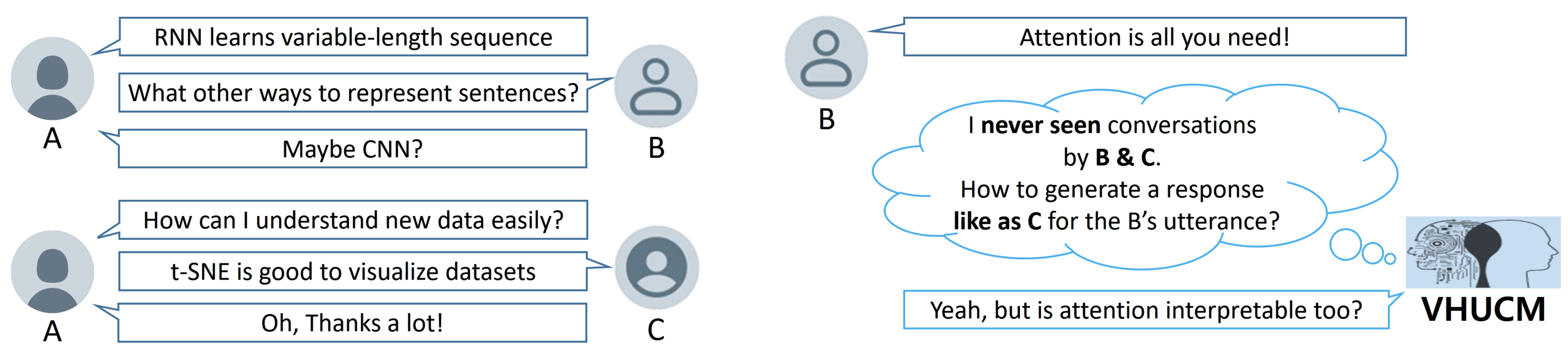
Motivation

Cold Start Problem

- New speaker: no conversations in the training data
- New dyad: both speakers in the training data with conversations with other users, but none between the dyad



Main Idea

- Conversational context depends on the speakers
- Conversational partners minimize social difference among them
- We infer the new speakers' representation from the partners

Contributions

- Developed a conversation model that includes the speakers for
  - Inferring conversational context from their former conversations
  - Generating personalized response
  - Solving new speakers and dyads problem
- Made a large, longitudinal open-domain conversation corpus
- Showed a significant performance gain on appropriate responses

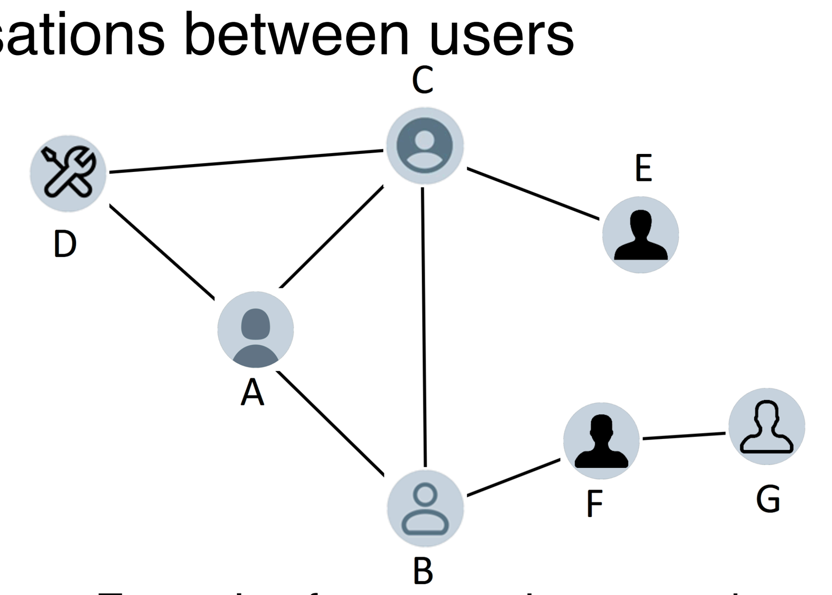
Twitter Conversation Corpus

Open-domain naturally occurring conversations

- Personal casual conversations
- Naturally-occurring, as opposed to authored (e.g., movie scripts)
- Open-domain, as opposed to specific topics (e.g., discussions)

Conversation Network

- Node: user (speaker)
- Edge: # conversations between users



<Example of conversation network>

Corpus Statistics

Users	Dyads	Convs	Utterances	Days (period)
27K	107K	770K	6,109K	2.6K

Response Quality

Automatic Metrics

	BLEU	Emb-Avg	Emb-Gre	ROUGE-L	Dist-2
VHCR (NAACL 2018)	0.137	0.599	0.381	0.075	0.076
DialogWAE (ICLR 2019)	0.127	0.586	0.369	0.080	0.104
VHUCM	0.120	0.633	0.394	0.079	0.108
VHUCM-PUE	**0.161**	**0.643**	**0.400**	**0.087**	**0.123**

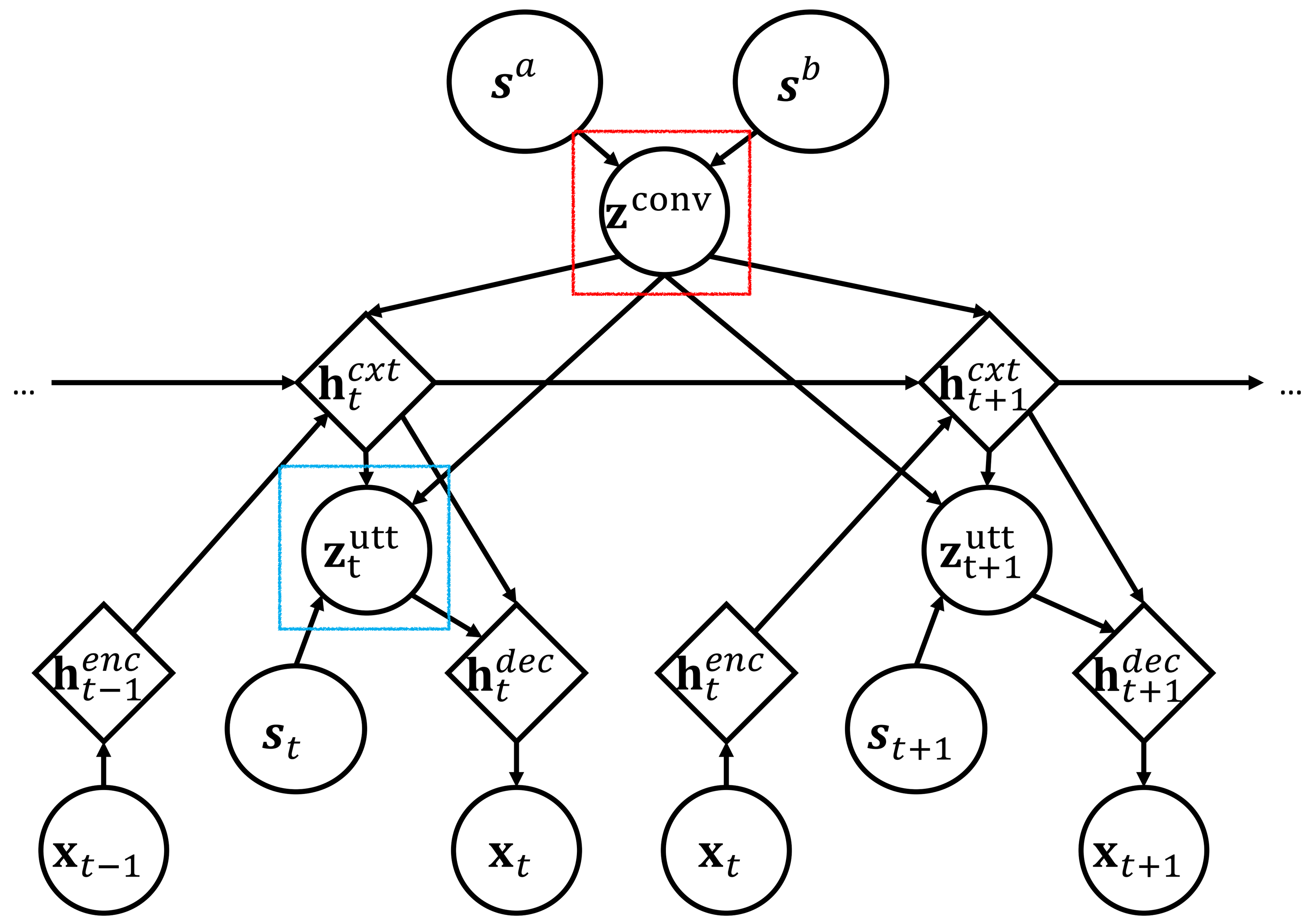
Examples of Personalized Responses

VHUCM-PUE generates

- *Consistent* demographic answers for the same speaker (User A)
- *Different* answers based on the dyads (A ~ B and A ~ C ≠ A ~ D)

Questioner	Answerer	Where is your hometown?	Do you love me?
User B	User A	north carolina !	i love you .
User C	User A	north carolina .	yes i do !
User D	User A	north carolina .	no i do not
User A	User B	minesota . <unk>	because i love you
User A	User C	manchester :) xx	i love you too :) xx
User A	User D	i live in <unk>	no , i don't .

VHUCM



Structure

- Conversational context variable z^{conv}
  - Takes two speakers s^a and s^b
  - Infers the context of the conversation
- Personalized utterance variable z_t^{utt}
  - Takes the conversational context and the speaker s_t
  - Goes to decoder to generate a response x_t

VHUCM-PUE

Pre-trained User Embedding

- Train user embedding from the conversation network by node2vec
- Initialize the user embedding in VHUCM

New User Embedding

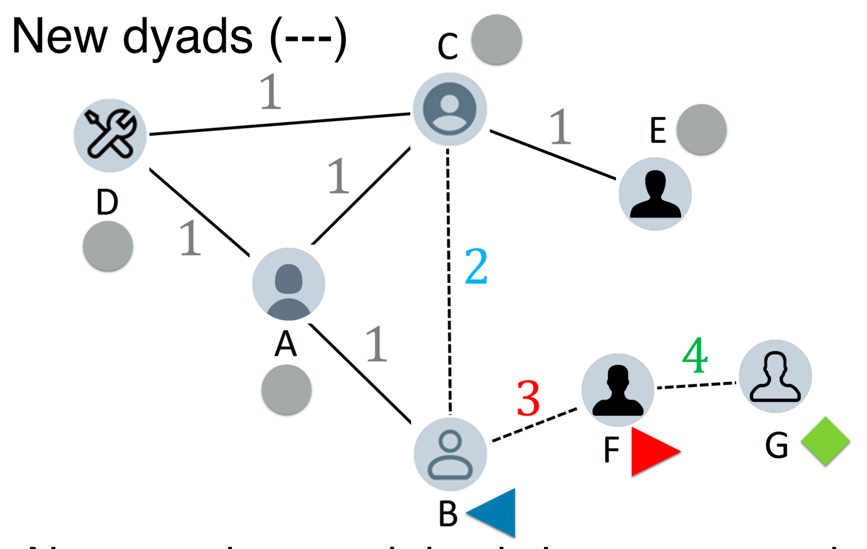
- Average the new user's friends $s^F = \sum_{i \in \text{friends of } F} s^i + \epsilon$ if F is a new user
- Add small Gaussian noise

New Speakers & Dyads

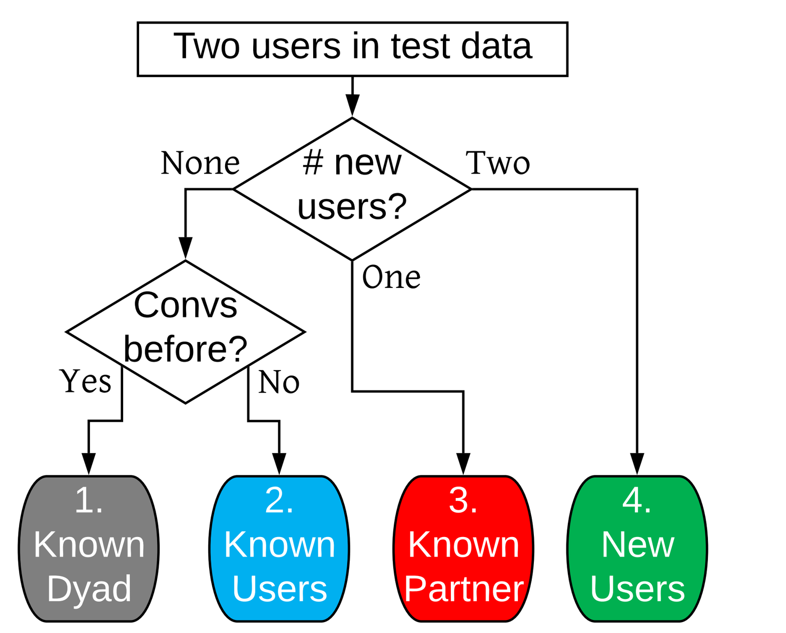
Experiment Setup

New users (▶, ◆)

New dyads (---)



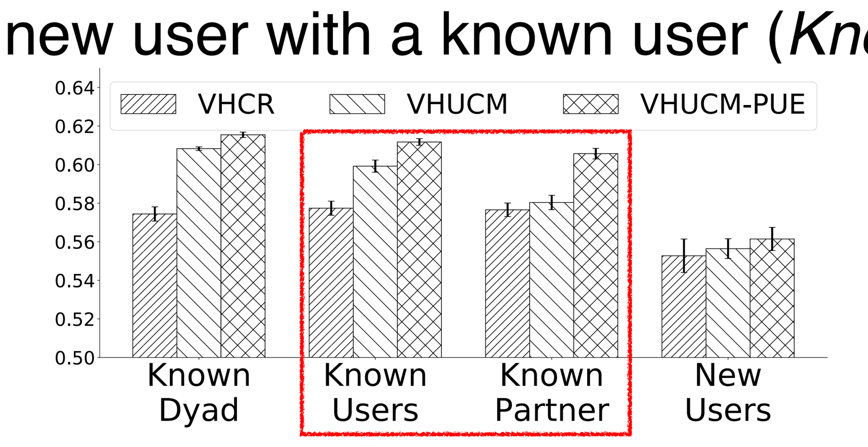
<New speakers and dyads in conv network>



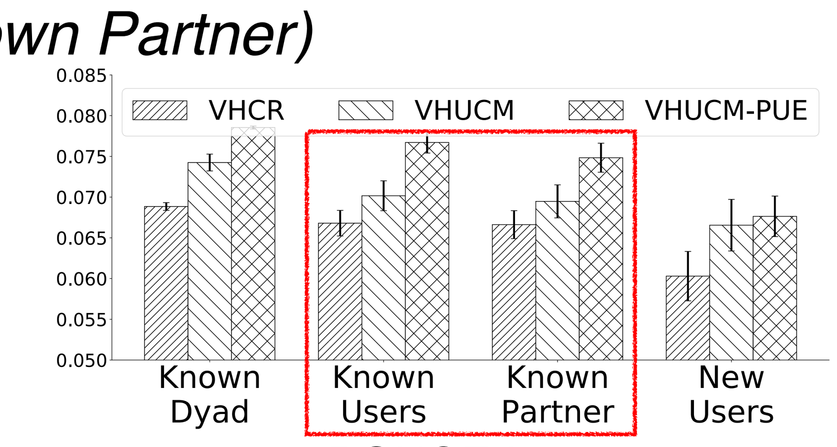
<Flowchart of categorizing the dyads>

Results

- VHUCM-PUE outperforms the other models in cases involving new user with a known user (*Known Partner*)

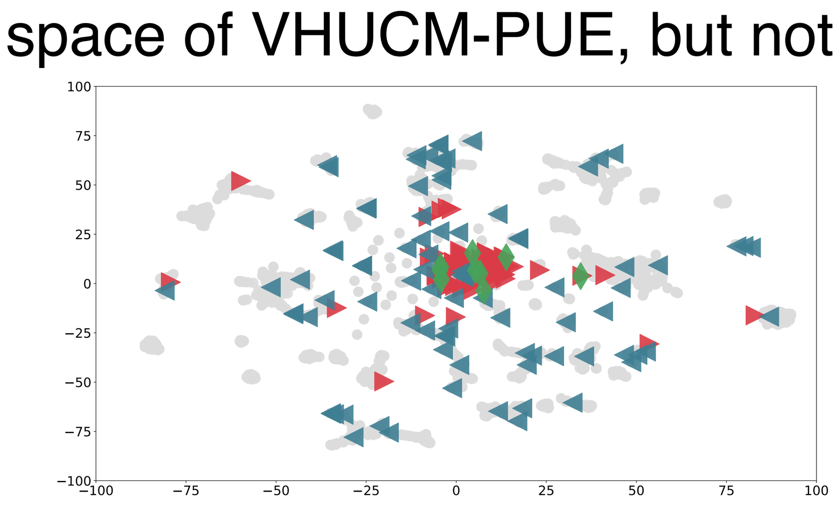


<Emb Avg>

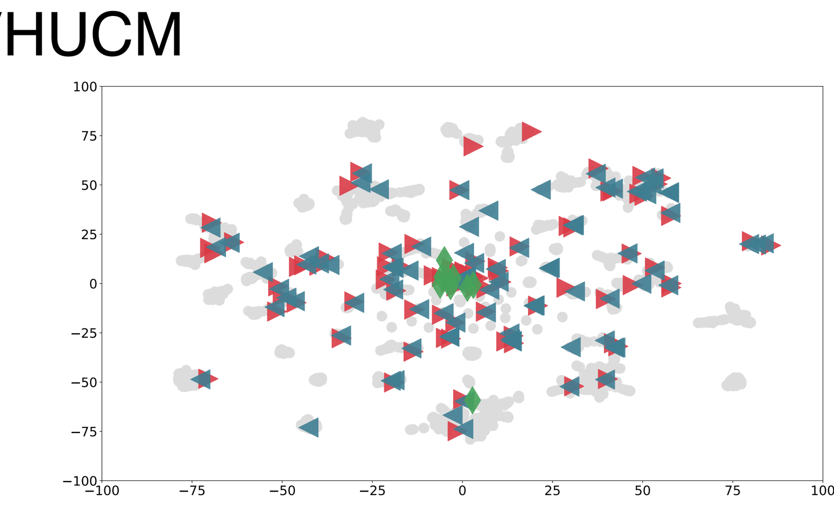


<ROUGE-L>

- Conversation partners (◀ & ▶) are close in the embedding space of VHUCM-PUE, but not VHUCM



<User vectors from VHUCM>



<User vectors from VHUCM-PUE>