DADgraph: A Discourse-aware Dialogue Graph Neural Network for Multiparty Dialogue Machine Reading Comprehension

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SQuAd, RACE, NarrativeQA, CoQA, QuAC etc.

Oxygen
The Stanford Question Answering Dataset

In the meantime, on August 1, 1774, an experiment conducted by the British clergyman Joseph Priestley focused sunlight on mercuric oxide (HgO) inside a glass tube, which liberated a gas he named "dephlogisticated air". He noted that candles burned brighter in the gas and that a mouse was more active and lived longer while breathing it. After breathing the gas himself, he wrote: "The feeling of it to my lungs was not sensibly different from that of common air, but I fancied that my breast felt peculiarly light and easy for some time afterwards." Priestley published his findings in 1775 in a paper titled "An Account of Further Discoveries in Air" which was included in the second volume of his book titled Experiments and Observations on Different Kinds of Air. Because he published his findings first, Priestley is usually given priority in the discovery.

Why is Priestley usually given credit for being first to discover oxygen?
Ground Truth Answers: published his findings first | he published his findings first | he published his findings first | he published his findings first | Because he published his findings first

Article: Endangered Species Act
Paragraph: " ... *Other legislation followed, including the Migratory Bird Conservation Act of 1929, a 1937 treaty prohibiting the hunting of right and gray whales, and the Bald Eagle Protection Act of 1940. These later laws had a low cost to society—the species were relatively rare—and little opposition was raised.*"

Question 1: "*Which laws faced significant opposition?*"
Plausible Answer: *later laws*

Question 2: "*What was the name of the 1937 treaty?*"
Plausible Answer: *Bald Eagle Protection Act*

A dialog from *Molweni* dataset.

jimcooncat: installing acroread gives me a 404 on maverick -- what to do ? U_1

jrib: where are you installing acroread from ? U_2

elfranne: people in the same local network ? U_3

llutz: not network , **on local computer** U_4

elfranne: so its only available for `` localhost " and not others on the same local network U_5

jimcooncat: thank you , i had **forgot to update** U_6

llutz: yes , `` other users on localhost " U_7

Q1: Why does *jimcoonact* meet the error?
A1: **forgot to update**
Q2: Where does *llutz* install acroread?
A2: **on local computer**
Q3: How did *erUSUL* create a new partiton table?
A3: NA.

- Discourse structure of multiparty dialogue.

jimcooncat: installing acroread gives me a 404 on maverick -- what to do ? U_1
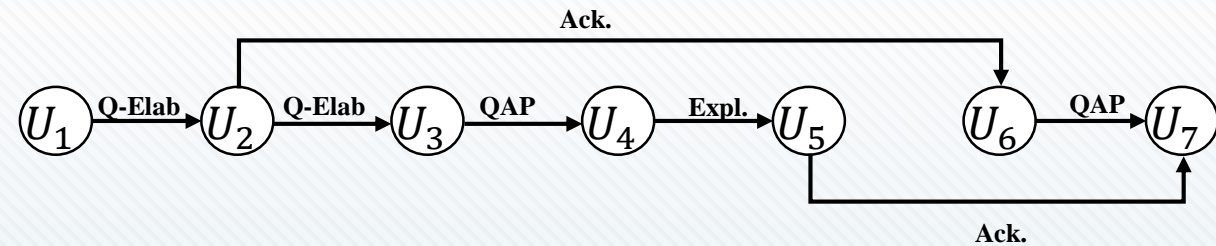*jrib*: where are you installing acroread from ? U_2
elfranne: people in the same local network ? U_3
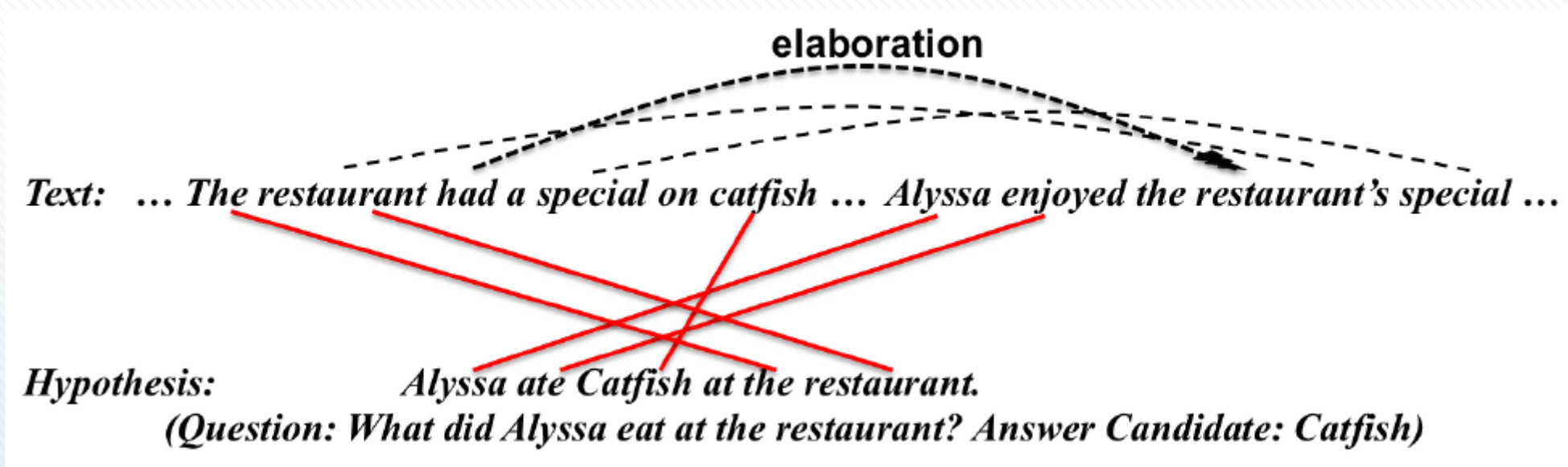*llutz*: not network , **on local computer** U_4
elfranne: so its only available for `` localhost " and not others on the same local network U_5
jimcooncat: thank you , i had **forgot to update** U_6
llutz: yes , `` other users on localhost " U_7

U_1 → U_2 → U_3 → U_4 → U_5 → U_6 → U_7
Q-Elab, Q-Elab, QAP, Expl., QAP
Ack., Ack.

- Discourse structure has been successfully applied to QA and MRC.

Sachan et al. *Learning Answer-Entailing Structures for Machine Comprehension*. EMNLP 2015.

• Graph structure has been proven to effectively represent dialogs.

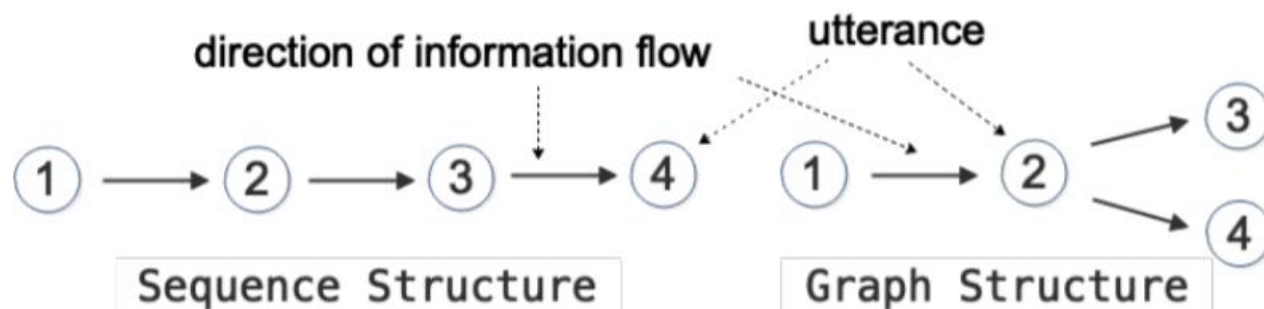utterance 1 (p_1): When the screen goes blank and won't display any login page.

utterance 2 (p_2): I don't know if its a hardware problem or an os.

utterance 3 (p_1): Did you do any upgrade recently?

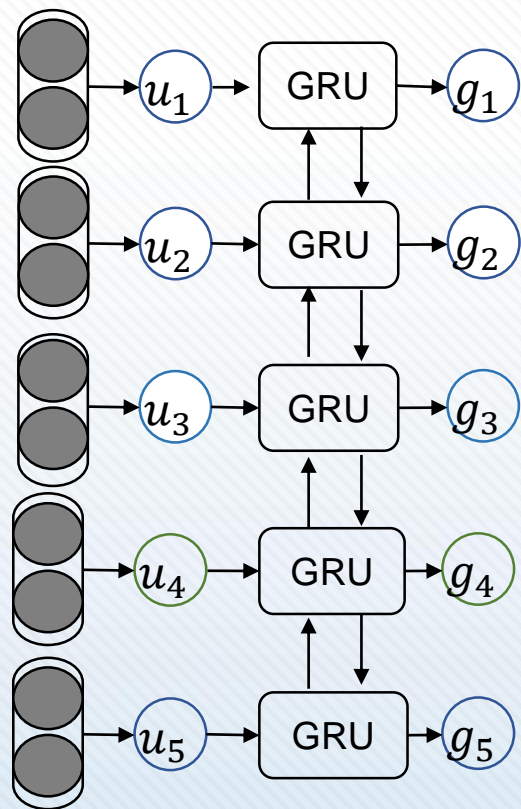utterance 4 (p_3): If it works for one user it's probably not a hardware issue.

Table 1: A real conversation in the Ubuntu forum.

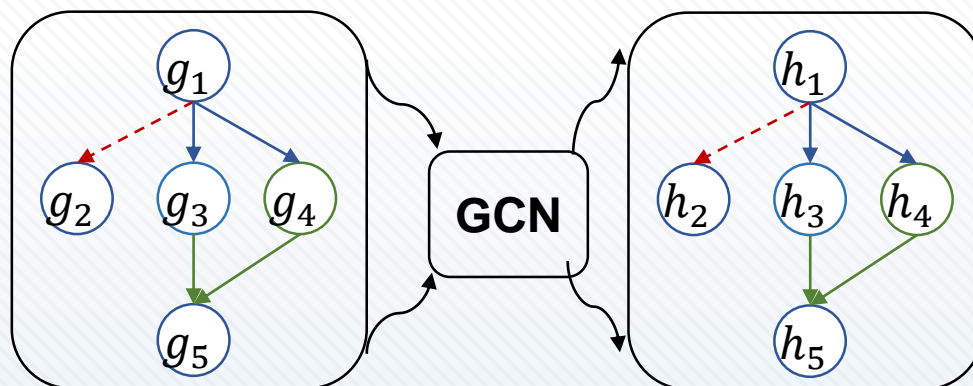direction of information flow   utterance

Sequence Structure   Graph Structure

Hu et al. *GSN: A Graph-Structured Network for Multi-Party Dialogues.* IJCAI 2019.

Discourse structure informs multiparty dialogue MRC performance in modeling long-term dependencies.

Sequential Context Encoding

Discourse Graph Modeling
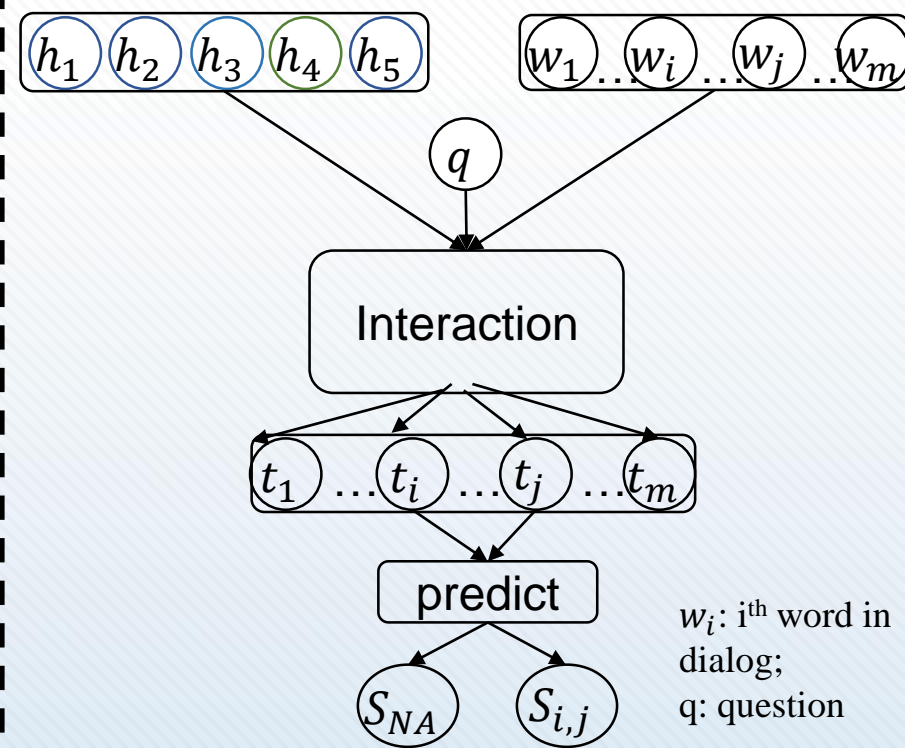
MRC

- - - → Links between utterances from same speaker.
───→ Links between utterances from different speaker.
───→ Elaboration relation.
───→ Question-answer pair relation.
───→ Acknowledgement relation.
…… There are many other discourse relations not in the graph.
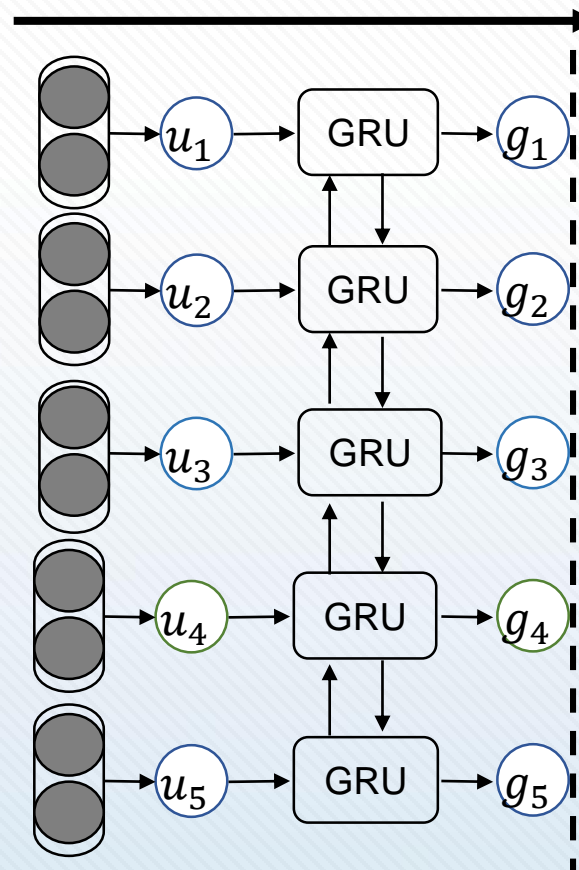
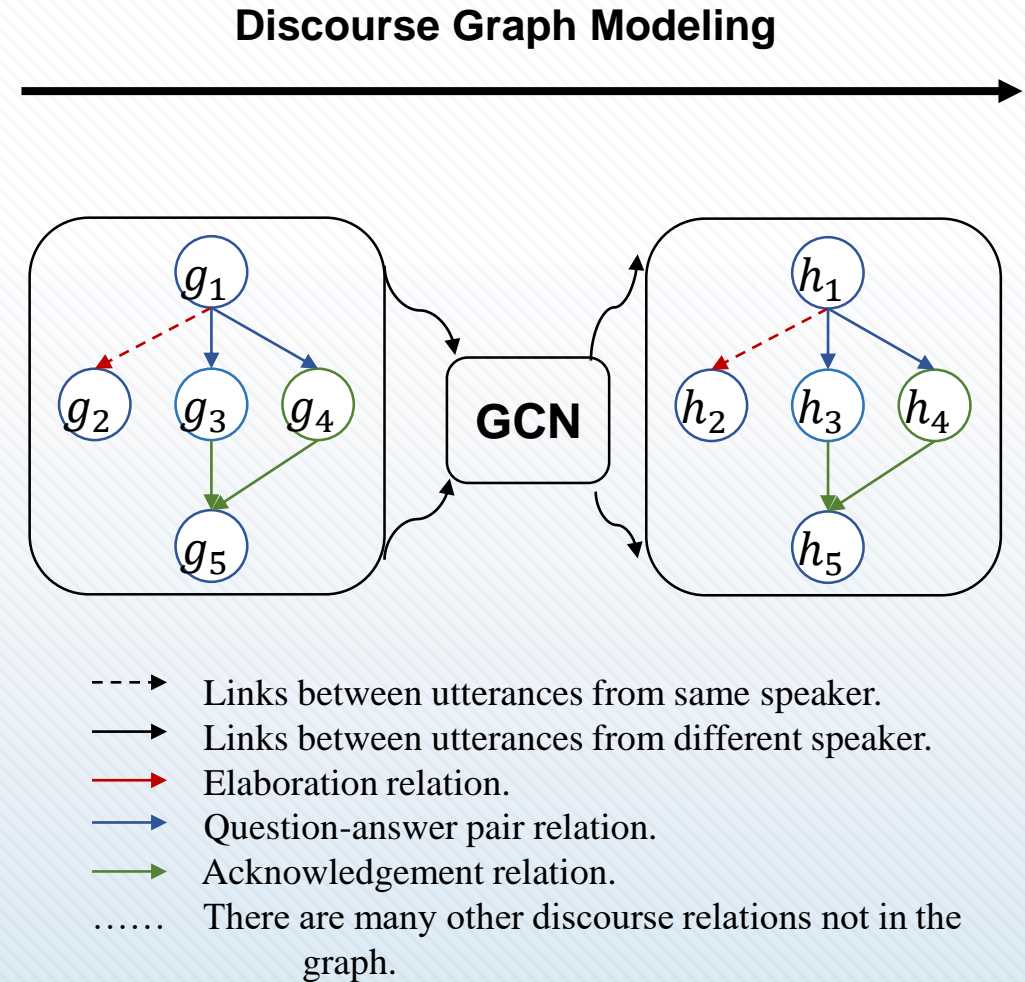w_i: i[th] word in dialog;
q: question

- ## Sequential context modelling

  - ### The pretrained BERT model is used to represent the utterance to get u_i.

  - ### The sequence structure of dialogue is modeled by GRU.

  - ### Finally, the utterance representation g_i of fusion context is obtained;

Sequential Context Encoding

- Discourse graph modelling

  - The utterance representation g_i obtained in the previous step is taken as the input;

  - GCN is used to model discourse structure of dialogue.

  - The updated representation h_i of fusion discourse structure is obtained;

Discourse Graph Modeling

- - - →   Links between utterances from same speaker.
——→   Links between utterances from different speaker.
——→   Elaboration relation.
——→   Question-answer pair relation.
——→   Acknowledgement relation.
……   There are many other discourse relations not in the graph.

- ## MRC module

  - First, let the h_i attend with each word in the input dialogue.

  - Weighted sum of utterances representations and obtains t_i.

  - Predict the probability of the *span (i, j)* via t_i and t_j.

WS： weighted sum
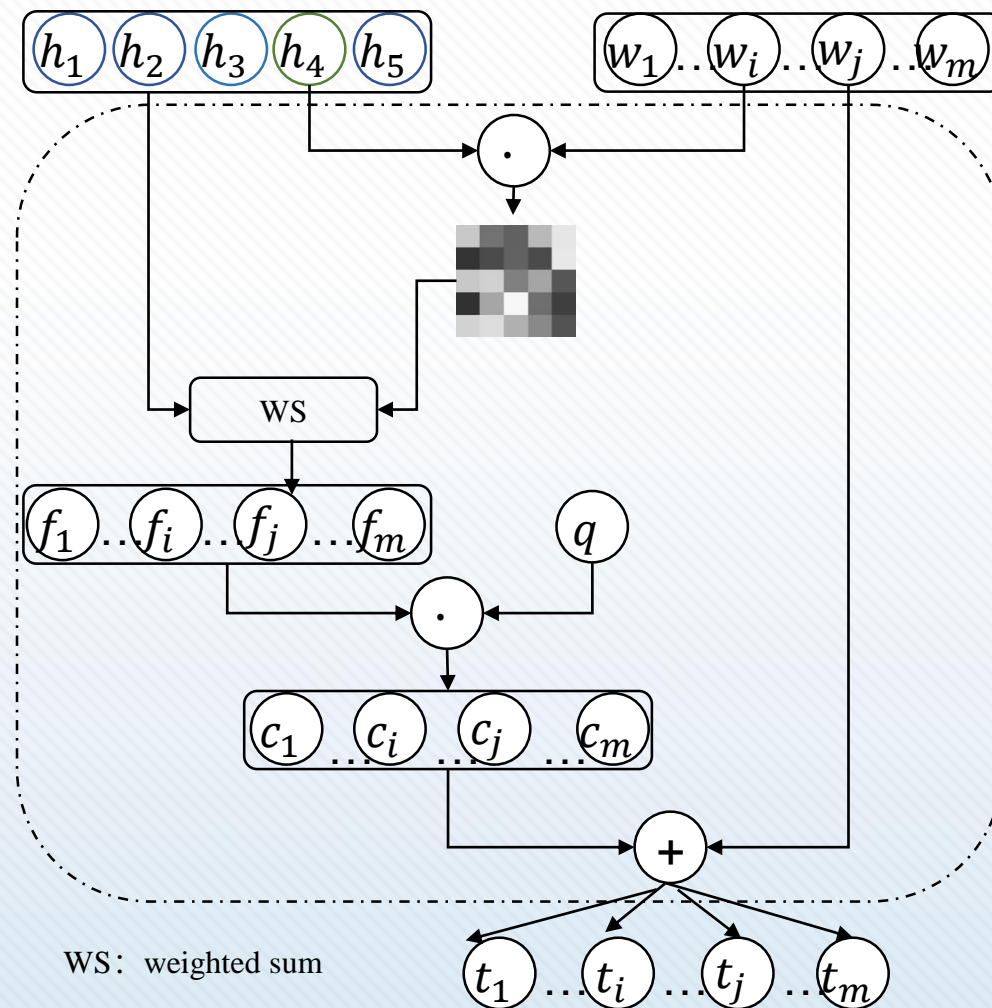
- Dataset: *Molweni* corpus.

	Train	Dev	Test	Total
Dialogs	8,771	883	100	9,754
Utterances	77,374	7,823	845	86,042
Questions	24,682	2,513	2,871	30,066

Li et al. *Molweni: A Challenge Multiparty Dialogues-based Machine Reading Comprehension Dataset with Discourse Structure.* COLING 2020.

- Main results

	EM	F1
BiDAF	22.9	39.8
DocQA	42.5	56.0
BERT	45.3	58.0
DialogueRNN	45.4	60.9
DialogueGCN	45.7	61.0
DADgraph (Our)	**46.5**	**61.5**
Human performance	64.3	80.2

- Ablation results

	EM	F1
DADgraph	46.5	61.5
- w/o discourse relations	44.9	60.6
- w/o discourse structure	44.7	60.5

sipher: bacon5o there 's no `` **fixmbr** '' with ubuntu .	U_1
morfic: **xaa** is old acceleration architecture, **exa** is the new one, font rendering is so much filepath	U_2
bacon5o: i dont want **ubuntu** , it **does n't support my internet**, thus i can not use it	U_3
morfic: your **internet** is different from mine ? damn bush and his internets !	U_4
bacon5o: my internet is differentwhy you ask ?	U_5
morfic: your possesive `` my '' on the internet	U_6
bacon5o: i use **a wireless accesspoint** that plugs into my usb which then goes into my motherboard	U_7

Q1: What does *bacon5o* not want to use?
Gold: **ubuntu** DialogueRNN: **a wireless accesspoint** DialogueGCN: **it does n't support my internet** Our model: **ubuntu**

Q2: Which one is new acceleration architecture?
Gold: **exa** DialogueRNN: **xaa** DialogueGCN: **xaa** Our model: **exa**

Q3: What is missing from ubuntu?
Gold: **fixmbr** DialogueRNN: **internet** DialogueGCN: **internet** Our model: **fixmbr**

- Propose **DADgraph** model for multiparty dialogue MRC task.

- Prove the discourse structure can help understand the dialogue.

Thank you!