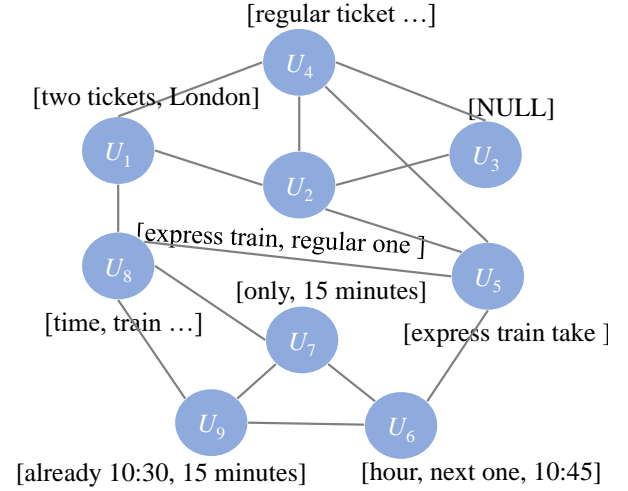


Turns	Utterance
U1	Good morning , two tickets to london , please .
U2	Express train or regular one ?
U3	Any difference ?
U4	The regular ticket is 80 dollars while price of the express ticket is 10 % higher .
U5	I see , but how long does the express train take ?
U6	Comparatively , it can save you nearly an hour and the next one is leaving at 10:45 .
U7	Oh , we only have 15 minutes to go .
U8	But that 's the time to catch the train . Besides , as long as I get to london earlier , I don't mind paying a little extra .
U9	Yeah , you 're right . it 's already 10:30 . you only have 15 minutes to go .

(a)



(b)

Figure 5: Case Study. (a) is one of the keyword examples for utterances in Figure 1 and red tokens is the keywords in utterance. (b) is the corresponding UDG, the tokens is the keywords for every utterance.

u1 : Excuse me, but I think you 've made a wrong turn. You were supposed to turn left on Wilson blvd.
u2 : Oh, I 'm sorry. Did you say 1323 wilson .
u3 : No 3023. It is ok though, You don't have to take me there, I can walk from here .
x u4(A): Ok. your house number is 1323 , right ? I'll take you there.
x u4(B) : Ok. I will take you to your house , wilson 4023.
x u4(C) : Sorry. I thought your house number is 3023, but it 's 1323, right ?
✓ u4(D) : Sorry. I will take you to your house, wilson 3023.
predict answer: [C A B D]

Figure 6: Error analysis

- Safe Response. The performance on MuTual^{plus} is significantly lower than that on MuTual. This demonstrates that the GRN cannot select the safe response when other candidate responses are incorrect in some cases.

Conclusion

In this paper, we propose a new architecture for multi-turn response reasoning. Concretely, we first propose NUP and UOP pre-training tasks for response selection. We design the UDG of utterance for reasoning. We introduce sequence and graph reasoning structure jointly, where the sequence reasoning module can capture the key information from the global perspective and the graph reasoning module is responsible for capturing the clue words information from the local perspective. The experiment results on MuTual and MuTual^{plus} achieve a new heights. There is still expansive room for improvement in performance on MuTual^{plus}. In future work, we will further investigate how to balance safe response and meaningful candidate response.

Acknowledgement

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