

Appendix: Goal-Embedded Dual Hierarchical Model for Task-Oriented Dialogue Generation

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A More Generated Dialogues for Qualitative Comparison

In Table 1 and Table 2, we list and compare more generated dialogues of different models given a variable number of goals to focus on.

The domains, what slots to request such as

phone or postcode, and when should the user make a reservation or not are specified in goals. We use bold style to emphasize whether the assigned goals are achieved or missed such as requests of a correct slot or a wrong domain. The underline and bold style denotes the role confusions.

Goals	LM + Goal	HRED	G-DuHA
Domain: hotel User: [name] Reqt: [] Book: True	U: i am looking for a hotel called the [hotel_name]. S: [hotel_name] is a [value.pricerange] -ly priced guesthouse in the [value.area]. would you like me to book a room for you? U: yes, please. i need [value.count] for [value.count] people and [value.count] nights starting from [value.day]. S: i have booked you at the [hotel_name] . your reference number is [hotel.reference]. is there anything else i can help you with? U: no, that's all. thank you. S: you are welcome. have a great day!	U: i am looking for a hotel called the [hotel_name]. S: [hotel_name] is a guesthouse in the [value.area]. it is [value.pricerange] -ly priced and has [value.count] stars. would you like to book a room? U: yes, please. i need a room for [value.count] people for [value.count] nights starting on [value.day]. S: i am sorry, but i was unable to book that for you. would you like to try a different day or a shorter stay? U: how about [value.count] nights? S: i was able to book you at the [hotel_name] . your reference number is [hotel.reference]. is there anything else i can help you with? U: i am also looking for a train that leaves after [value.time] on [value.day]. ... (Cut Off) → Off the Rails	U: i am looking for a hotel called the [hotel_name]. S: [hotel_name] is a guesthouse in the [value.area] area. would you like to book a room? U: yes, i would like to book it for [value.count] people and [value.count] nights starting from [value.day]. S: booking was successful . reference number is [hotel.reference]. U: that's all i need. thank you. S: you are welcome. have a great day!
Domain: attraction User: [name] Reqt: [phone, type] Book: False Domain: train User: [arriveBy, day, departure, destination] Reqt: [price] Book: False	U: i am looking for information about [attraction_name]. S: [attraction_name] is a nightclub in the [value.area] of town. their phone number is [attraction.phone] . U: i help you with anything else? S: yes, i am also looking for a train that [value.place] to [value.place]. U: what day and time would you like to leave? S: i would like to leave on [value.day] and arrive by [value.time]. U: i have [value.count] trains that that day. [value.time]. would you like me to book it for you? S: yes, please. i need the price and train id . U: the train is [value.price] pounds. the price is [value.price] pounds. S: you like me to book that for you? U: no , that's all i need. thank you. S: thank you for using our service. have a great day.	U: i am looking for information about [attraction_name]. S: [attraction_name] is located in the [value.area] of town at [attraction.address]. U: what is the entrance fee? S: i am sorry, i do not have that information. U: i am also looking for a train that leaves after [value.time] on [value.day]. S: i have [value.count] trains that meet your criteria. would you like to narrow it down by departure site, destination, or arrival time? U: i would like to leave on [value.day] and arrive by [value.time]. S: i have train [train.id] that leaves at [value.time] and arrives at [value.time]. would you like me to book that for you? U: yes, please book it for [value.count] people. S: booking was successful, the total fee is [value.price] gbp payable at the station. reference number is [train.reference]. U: thank you. that is all i need. S: you are welcome. have a great day!	U: i am looking for information about [attraction_name]. S: [attraction_name] is a museum in the [value.area] area. would you like the phone number? U: yes, i would like the postcode and phone number. S: their phone number is [attraction.phone] and the postcode is [attraction.postcode]. U: i also need a train to [value.place]. S: where will you be departing from? U: i will be leaving from [value.place] on [value.day]. S: i have [value.count] trains that meet your criteria. what time would you like to arrive by? U: i need to arrive by [value.time]. S: i have train [train.id] that leaves at [value.time] and arrives at [value.time]. would you like me to book that for you? U: no , that's all i needed. thank you. S: you are welcome. have a great day!

Table 1: Dialogue qualitative comparison. Reqt: Requests. U: User, S: System. **Goal hit or miss.** Role confusion.

Goals	LM + Goal	HRED	G-DuHA
<p>Domain: attraction User: [name] Req: [address, entrance fee] Book: False</p> <p>Domain: hotel User: [name] Req: [postcode, stars] Book: False</p> <p>Domain: taxi User: [leaveAt] Req: [car type, phone] Book: False</p>	<p>U: i am looking for [attraction.name] in [value.place] S: it is located in the [value.area] area . it is located on [attraction.address] . U: is free . S: can i get the phone number ? U: the , the phone number is [attraction.phone] . S: i you . i am also looking for a hotel called [hotel.name] . U: [hotel.name] is a [value.pricerange] hotel in the [value.area] area . it is a [value.count] star rating . would you like me to book a room for you ? S: no , i just need the information . U: you are welcome . is there anything else i can help you with today ? S: i also need a taxi to commute between the [value.count] place -s . U: what time would you like to leave ? S: i would like to leave the hotel by [value.time] . U: i have booked a taxi for you . the contact number is [taxi.phone] . is there anything else i can help you with ? S: no , that s all i need . thank you for your help ! U: you are welcome . have a great day !</p>	<p>U: i am looking for [attraction.name] in [value.place] S: i have found [attraction.name] , it s located in the [value.area] . it is free to enter . would you like more information ? U: yes , can i get the phone number and postcode ? S: sure , the phone number is [attraction.phone] and the postcode is [attraction.postcode] . U: i am also looking for a train that leaves on [value.day] and goes to [value.place] . S: there are [value.count] trains that match your request . what time would you like to leave ? U: i would like to leave after [value.time] . S: i have train [train.id] that leaves at [value.time] and arrives at [value.time] . would you like me to book that for you ? U: yes , please book it for [value.count] people . S: booking was successful , the total fee is [value.price] gbp payable at the station . reference number is [train.reference] . U: thank you so much for your help . S: you are welcome . have a great day ! U: thank you , you too . S: thank you for using our service today ! → Off the Rails</p>	<p>U: i am looking for [attraction.name] in [value.place] S: it is located at [attraction.address] . is there anything else you would like to know ? U: what is the postcode ? S: the postcode is [hotel.postcode] . is there anything else i can help you with ? U: i am also looking for a hotel called [hotel.name] . S: [hotel.name] is a [value.pricerange] -ly priced guesthouse in the [value.area] area . would you like me to book you a room ? U: no , i just need the address please . S: the postcode is [hotel.postcode] . is there anything else i can help you with ? U: i also need a taxi to get between the [value.count] place -s . S: i can help you with that . what time would you like to leave or arrive by ? U: i want to leave the hotel by [value.time] . S: i have booked you a [taxi.type] , the contact number is [taxi.phone] . U: thank you so much for your help . S: you are welcome . is there anything else i can help you with today ? U: no , that s all i need . thank you for your help ! S: you are welcome . have a great day .</p>
<p>Domain: hotel User: [name] Req: [address] Book: False</p> <p>Domain: attraction User: [area] Req: [address, phone, type] Book: False</p>	<p>U: hello ! i am looking for information about [hotel.name] . it s a hotel in [value.place] . S: the is a guesthouse in the [value.area] part of town . it is [value.pricerange] -ly priced and has [value.count] stars . would you like me to book a room ? U: no , i do not need a reservation . i you . S: you are welcome . is there anything else i can help you with today ? U: yes , i am looking for a place called [attraction.name] . S: [attraction.name] is a museum in the [value.area] area . it is located at [attraction.address] . their phone number is [attraction.phone] . U: i help you with anything else ? S: no , that s all i need . thank you . U: you are welcome . have a great day !</p>	<p>U: hello ! i am looking for information about [hotel.name] . it s a hotel in [value.place] . S: [hotel.name] is a guesthouse in the [value.area] . it is [value.pricerange] -ly priced and has [value.count] stars . would you like to book a room ? U: yes , please . i need a room for [value.count] people for [value.count] nights starting on [value.day] . S: i am sorry , but i was unable to book that for you . would you like to try a different day or shorter stay ? U: how about [value.count] nights ? S: i was able to book you at the [hotel.name] . your reference number is [hotel.reference] . is there anything else i can help you with ? U: i am also looking for a train that leaves after [value.time] on [value.day] (Cut Off) → Off the Rails</p>	<p>U: hello ! i am looking for information about [hotel.name] . it s a hotel in [value.place] . S: [hotel.name] is a guesthouse in the [value.area] area . it is a [value.count] star hotel in the [value.area] area . would you like me to book a room for you ? U: no , i just need the address and phone number . S: sure , the phone number is [attraction.phone] . U: i am also looking for a place to go in town . S: there are [value.count] attractions in the [value.area] area . do you have a particular type of attraction in mind ? U: i am not sure . i just need the address and postcode for [value.count] of them . S: [attraction.name] is located at [attraction.address] and the postcode is [attraction.postcode] . U: no , that s all i need . thank you for your help ! S: you are welcome . have a great day !</p>
<p>Domain: train User: [day, departure, destination, leaveAt] Req: [duration, price] Book: False</p>	<p>U: i am looking for a train from [value.place] to [value.place] . S: there are [value.count] trains that meet your criteria . what day and time would you like to travel ? U: i would like to leave on [value.day] after [value.time] . S: i have [value.count] trains that leave [value.place] at [value.time] . would you like me to book it for you ? U: yes , please . i need the price and travel time please . S: the price is [value.price] pounds . the price is [value.price] pounds . U: you like me to book that for you ? S: no , that s all i need . thank you . U: you are welcome . have a great day !</p>	<p>U: i am looking for a train from [value.place] to [value.place] . S: there are [value.count] trains that meet your criteria . what day and time would you like to travel ? U: i would like to leave on [value.day] and arrive by [value.time] . S: i have train [train.id] that leaves at [value.time] and arrives in [value.place] at [value.time] . would you like me to book that for you ? U: yes , please . i need [value.count] tickets . S: i have booked [value.count] tickets for you . your reference number is [train.reference] . U: i am also looking for a place to stay . i would like a [value.count] star hotel (Cut Off) → Off the Rails</p>	<p>U: i am looking for a train from [value.place] to [value.place] . S: what day would you like to travel ? U: i would like to leave on [value.day] . S: there are [value.count] trains that meet your criteria . do you have a time you would like to leave or arrive by ? U: i would like to leave after [value.time] . S: [train.id] leaves at [value.time] and arrives at [value.time] . would you like me to book it for you ? U: no , i just need the price and the train id . S: the price is [value.price] pounds . U: thank you for your help . that is all i need today . S: you are welcome . have a great day !</p>

Table 2: Dialogue qualitative comparison (continue). Req: Requests. U: User, S: System. **Goal hit or miss. Role confusion.**

B More Generated Responses for Qualitative Comparison

Responses are generated by a model given the goals and all the previous utterances. In Table 3, we present more generated responses for qualita-

tive comparison. We observe that HRED is unable to correctly switch between goal contexts illustrated by the second example.

Goals	Contexts (Reference)	Response
<p>Domain: attraction User: [type] Req: [entrance fee, address, phone] Book: False</p> <p>Domain: restaurant User: [pricerange, food] Req: [phone, postcode] Book: False</p>	<p>U: can you find me a theatre ? S: would you like the [attraction_name] ? U: yes and i need to know the entrance fee , address , and phone number S: the fee is not listed but the address is [attraction_address] and the phone number is [attraction_phone] . can i help you with anything else ? U: i am also looking for a [value_food] restaurant in the [value_pricerange] range . S: i have [value_count] excellent options . [restaurant_name] is in the [value_area] of town , would you like me to reserve you a table ? U: i am not sure how many people will be coming , so i will do that later. but can you provide me with their postcode and phone number ?</p>	<p>LM+G: the phone number is [restaurant_phone] and the postcode is [restaurant_postcode] . HRED: the phone number is [restaurant_phone] and the postcode is [restaurant_postcode] . G-DuHA: sure , the phone number is [restaurant_phone] and the postcode is [restaurant_postcode] . is there anything else i can help you with ?</p>
<p>Domain: train User: [day, departure, destination, leaveAt] Req: [] Book: True</p> <p>Domain: attraction User: [area, type] Req: [phone, postcode] Book: False</p>	<p>U: i am looking for a train that leaves on [value_day] going to [value_place] . S: there are [value_count] trains that meet what you are asking . where would you like to depart from ? U: [value_place] , it should also leave after [value_time] . S: [train_id] departs [value_place] at [value_time] and arrives in [value_place] at [value_time] . will that work ? U: yes it will . can you book that for just me , and provide the reference number ? S: sure thing ! how many tickets do you need ? U: i need [value_count] ticket and can i please have the reference number ? S: booking was successful , the total fee is [value_price] gbp payable at the station . reference number is [train_reference] . can i provide any further help today ?</p>	<p>LM+G: i am also looking for a place to go in the [value_area] . HRED: i am also looking for a place to stay . i would like a hotel in the [value_area] . G-DuHA: i am also looking for a place to go in town .</p>
<p>Domain: hotel User: [area, internet, parking, stars] Req: [postcode, pricerange, type] Book: False</p> <p>Domain: restaurant User: [area, food, pricerange] Req: [] Book: True</p>	<p>U: hi i am looking for a restaurant in the [value_area] of town serving [value_food] food . S: that s great ! there are several [value_food] restaurant -s near the city [value_area] . are you looking for a budget @UNK option or are you comfortable with a more [value_pricerange] place ? U: a [value_pricerange] option please . S: we have [restaurant_name] , the ghandi and [restaurant_name] , do you want me to book you for [value_count] of those ? U: yes please for [value_count] people at [value_time] on [value_day] . S: you are all set . they will hold the table for [value_count] minutes and your reference number is [hotel_reference] U: thank you , appreciate your service . S: no problem . is there anything else i can help you with ?</p>	<p>LM+G: i am also looking for a place to stay . i would like a [value_count] star hotel in the [value_area] . HRED: no , that s all . thank you . G-DuHA: i am also looking for a place to stay .</p>
<p>Domain: taxi User: [destination, arriveBy, departure] Req: [car type, phone] Book: False</p>	<p>U: i need to book a tax departing from gandhi . S: what is your destination and when would you like to depart ?</p>	<p>LM+G: i need to arrive by [value_time] . HRED: i am going to [value_place] from [value_place] . G-DuHA: i want to go to [value_place] and get to [restaurant_name] by [value_time] .</p>
<p>Domain: attraction User: [area] Req: [address] Book: False</p> <p>Domain: hotel User: [pricerange, internet, stars] Req: [] Book: True</p>	<p>U: hello , i am looking for place -s to go in the [value_area] . S: there are many attractions in the [value_area] like museums , architecture , boating , and @UNK . what are you interested in ? U: how about a boating attraction ? S: there are [value_count] in the [value_area] of town . [hotel_name] , and [hotel_name] . would either of those interest you ? U: could you give me the address for [attraction_name] , please ? i also need a place to stay , preferably somewhere [value_pricerange] . S: sure , [attraction_name] is @UNK at [attraction_address] . the [hotel_name] is in the [value_pricerange] price range with [value_count] stars . would you like to book a room ? U: does it offer free wifi internet ?</p>	<p>LM+G: yes , it does . would you like me to book a room for you ? HRED: yes , it does have free parking . G-DuHA: yes , it does .</p>

Table 3: Qualitative comparison of generated responses. Req: Requests. U: User, S: System.