BETOLD: A Task-Oriented Dialog Dataset for Breakdown Detection

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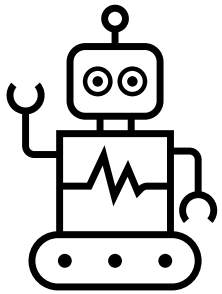
What is a Dialog Breakdown?



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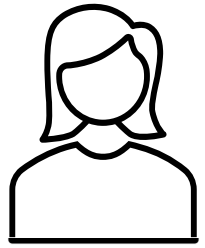

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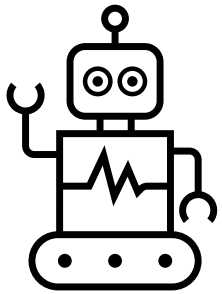

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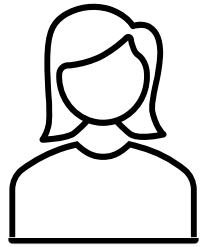

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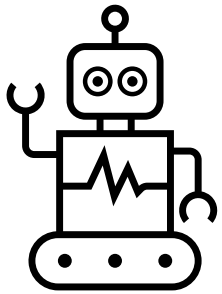

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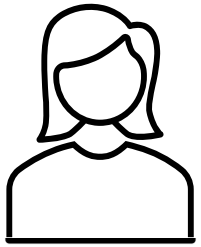

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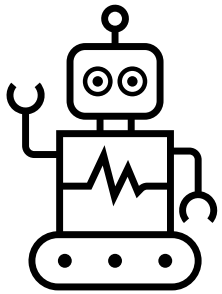

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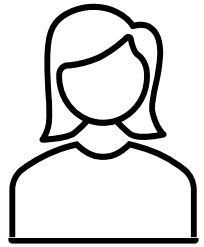

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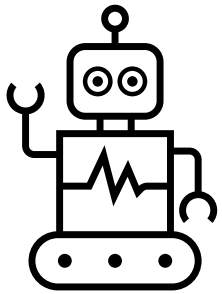

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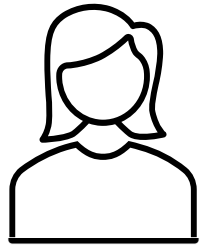

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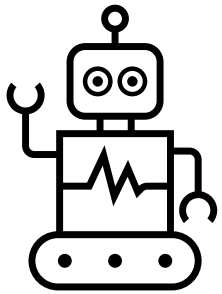

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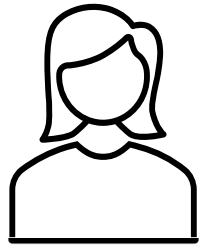

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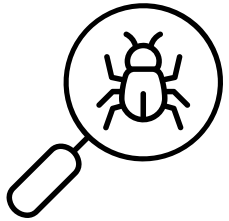

1) Report:
Prioritize conversations when breakdowns happen

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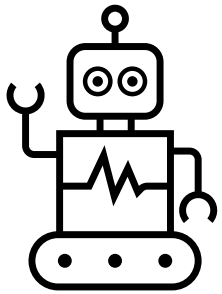

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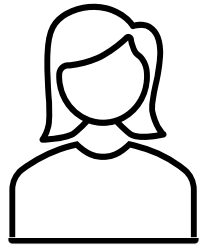

breakdown

2) Recovery strategies

Sorry, could you rephrase it?

Dialog Breakdown Detection Challenge (DBDC) Dataset

- Small dataset (615 dialogs)
- Manually annotated
- Open domain dialogs
- Textual utterances

Proposed dataset: BETOLD

DBDC

- Small dataset (615 dialogs)
- Manually annotated
- Open domain dialogs
- Textual utterances

BETOLD

- Large dataset (13k dialogs)
- Automatically annotated
- Task-oriented Dialogs
- NLG and NLU intents and entities for privacy preservation

BETOLD Dataset Creation

- 4 types of call endings:
  - **Successful calls**
  - Agent-initiated forwarded calls
  - **User-initiated forwarded calls**
  - **User-initiated hang-ups**

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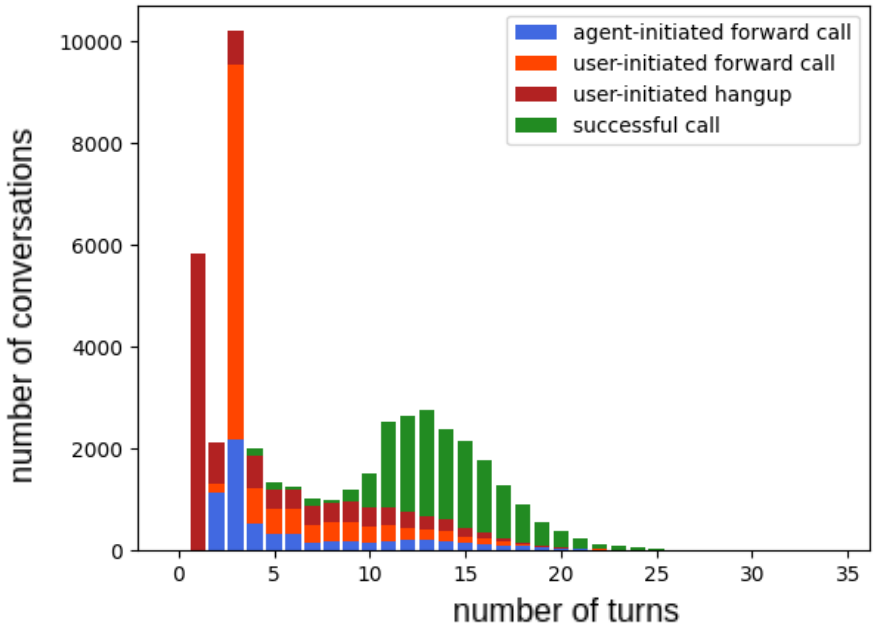

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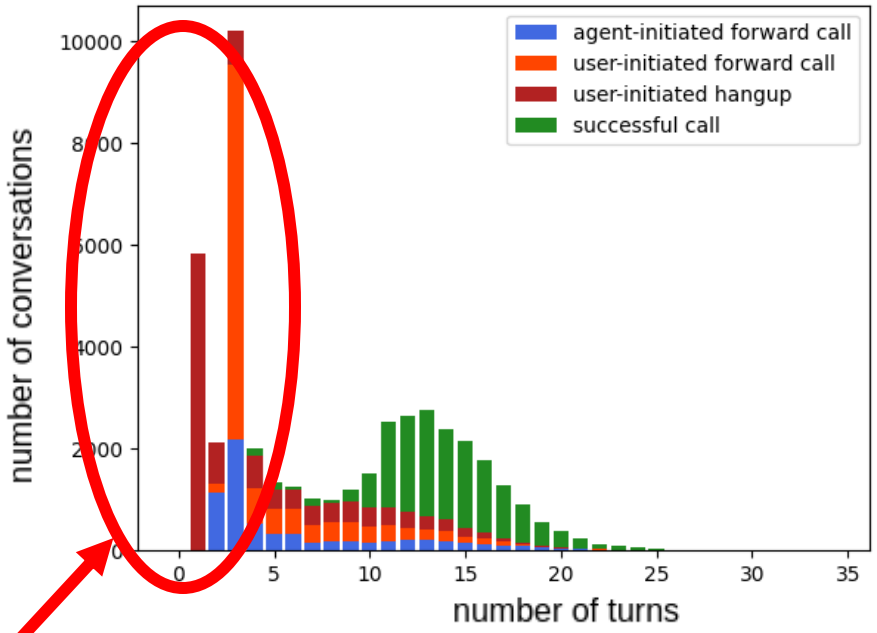

no way to prevent the caller
from hanging up in the initial turns

BETOLD Dataset Creation

- 4 types of call endings:
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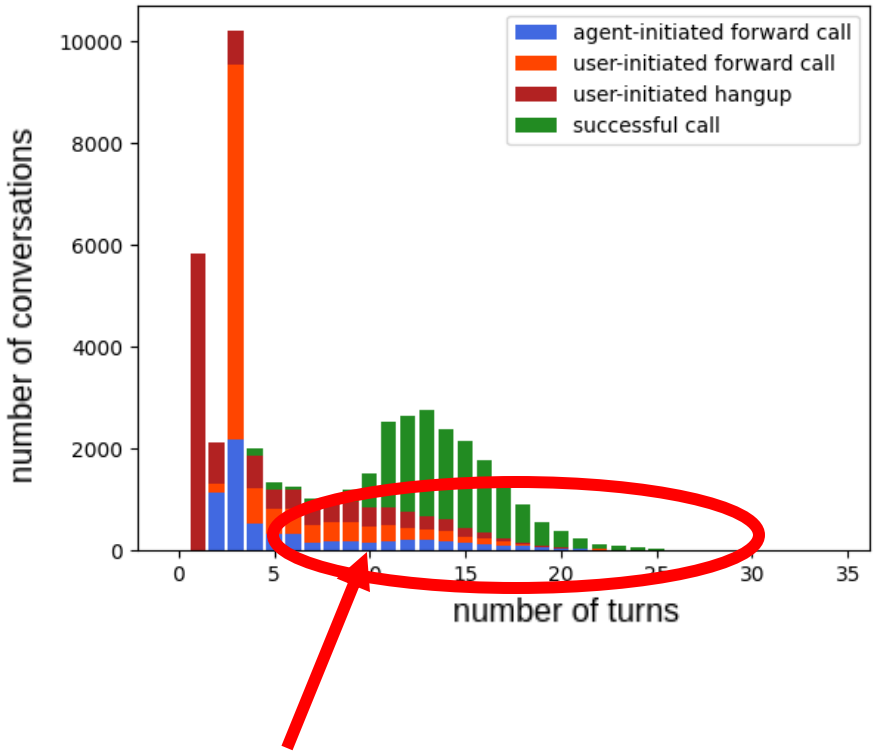
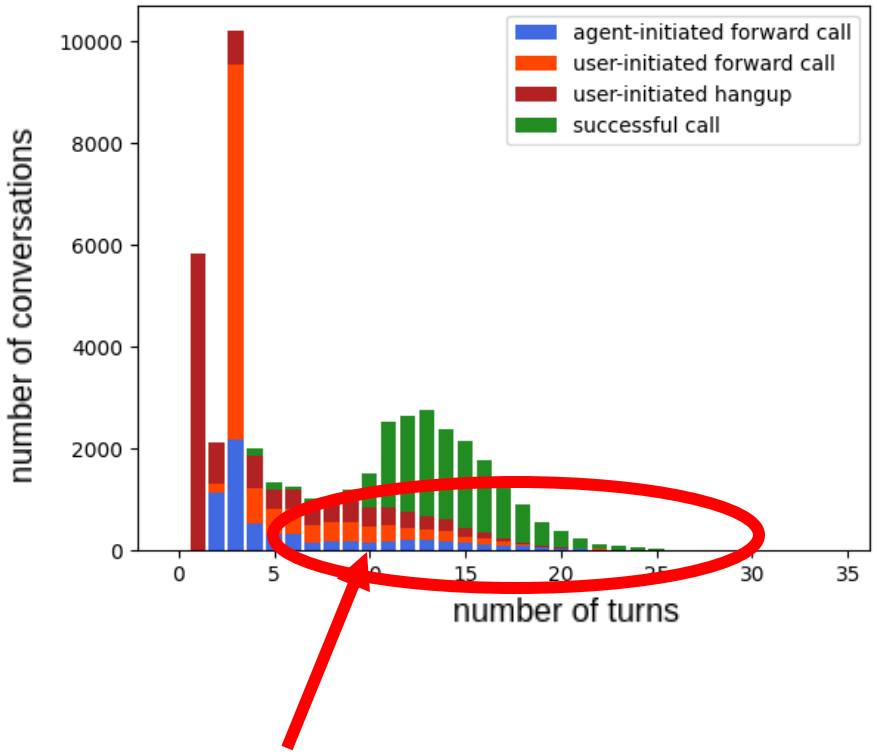


LUHFs: Late User-initiated Hang-ups or Forward calls

We will focus on this category of dialog breakdowns

BETOLD Dataset Creation

- 4 types of call endings:
  - **Successful calls** → **Not LUHFS**
  - Agent-initiated forwarded calls
  - **User-initiated forwarded calls** → **LUHFS**
  - **User-initiated hang-ups** → **LUHFS**



LUHFs: Late User-initiated Hang-ups or Forward calls

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BETOLD Dataset Statistics

- We consider the LUHFs (with more than 8 turns) out of about 35k conversations
- We sample from the successful conversations to obtain the not LUHFs

Labels	LUHF	4508
	not LUHF	9016
Turns	min	8
	avg	10
	max	34

Example of a conversation

Phone Repairing Booking Agent
Can I book your service appointment under the phone number ending in <2385>?
Yeah, that's correct
What is the brand, model and year of your phone device?
It's a <phonepink> why 100 <2022>
What is the model of your phone device?
It is <Y100>
What is the battery health percentage of your phone device?
<zero>
Great, what is your name?
My name's <John>

The user may release **sensitive information**, such as the name and phone number

Example of a conversation

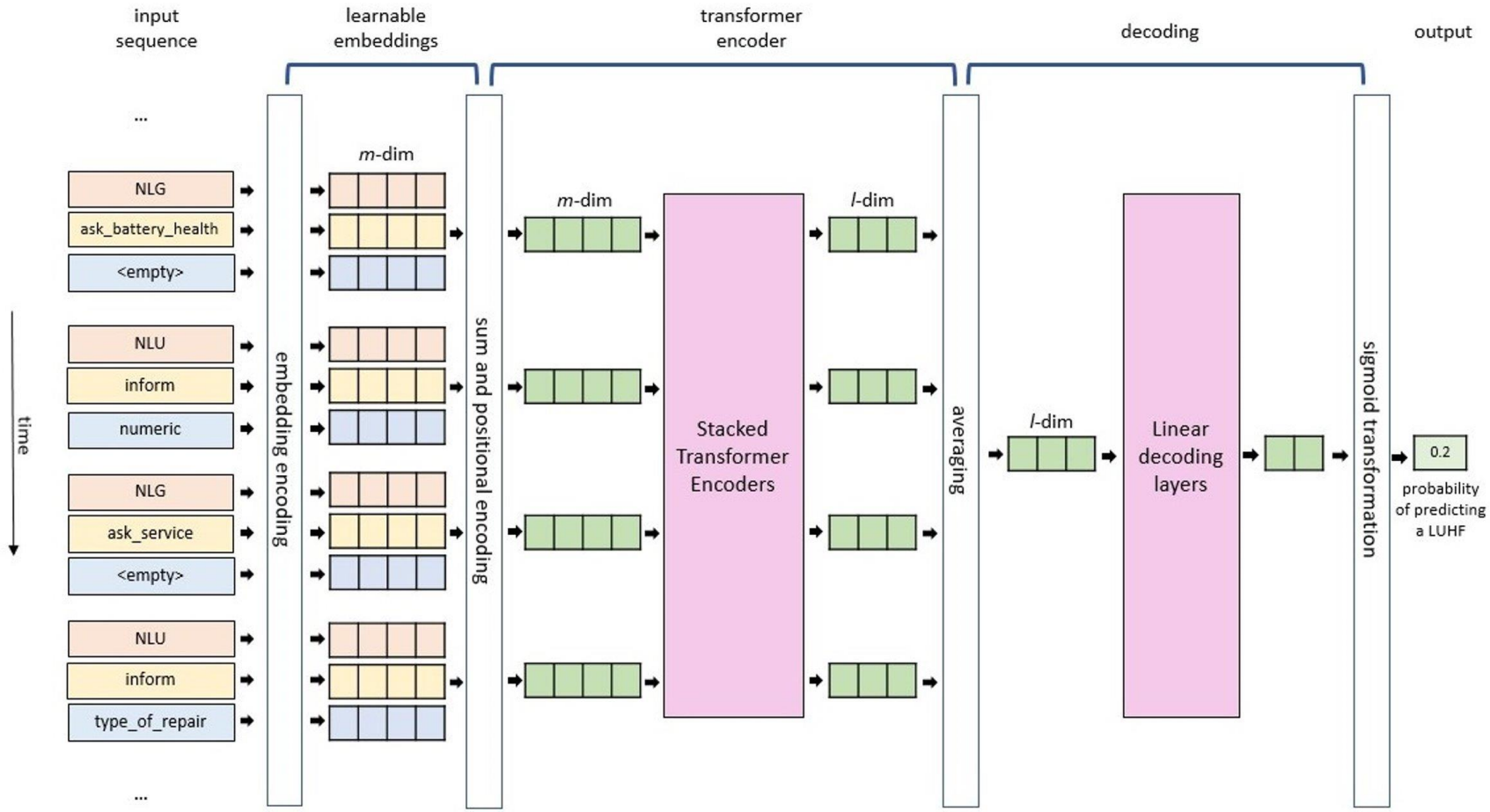
Phone Repairing Booking Agent	Caller	Intents	Entities
Can I book your service appointment under the phone number ending in <2385>?	NLG	confirm_phone_number	userphone_suffix
Yeah, that's correct	NLU	confirm	
What is the brand, model and year of your phone device?	NLG	new_user_profile_branch_model_year	
It's a <phonepink> why 100 <2022>	NLU	inform	brand_device, year
What is the model of your phone device?	NLG	ask_device_model	
It is <Y100>	NLU	inform	model_device
What is the battery health percentage of your phone device?	NLG	ask_battery_health	
<zero>	NLU	inform	numeric
Great, what is your name?	NLG	ask_first_name	
My name's <John>	NLU	inform	client_name

Example of a conversation

Phone Repairing Booking Agent	Caller	Intents	Entities
Can I book your service appointment under the phone number ending in <2385>?	NLG	confirm_phone_number	userphone_suffix
Yeah, that's [illegible]rrect	NLU	confirm	
What is the b[illegible] model and yea[illegible] your phone device?	NLG	new_user_profile_branch_model_year	
It's a <phonepink> [illegible]100 <[illegible]2>	NLU	inform	brand_device, year
What is the model of yo[illegible]one device?	NLG	ask_device_model	
It is <Y100>	NLU	inform	model_device
What is the batte[illegible]ealth per[illegible]age of your phone device?	NLG	ask_battery_health	
<zero>	NLU	inform	numeric
Great, what is your name?	NLG	ask_first_name	
My name's <John>	NLU	inform	client_name

Can we predict a LUHF with only NLU and NLG annotations?

Proposed Model Architecture



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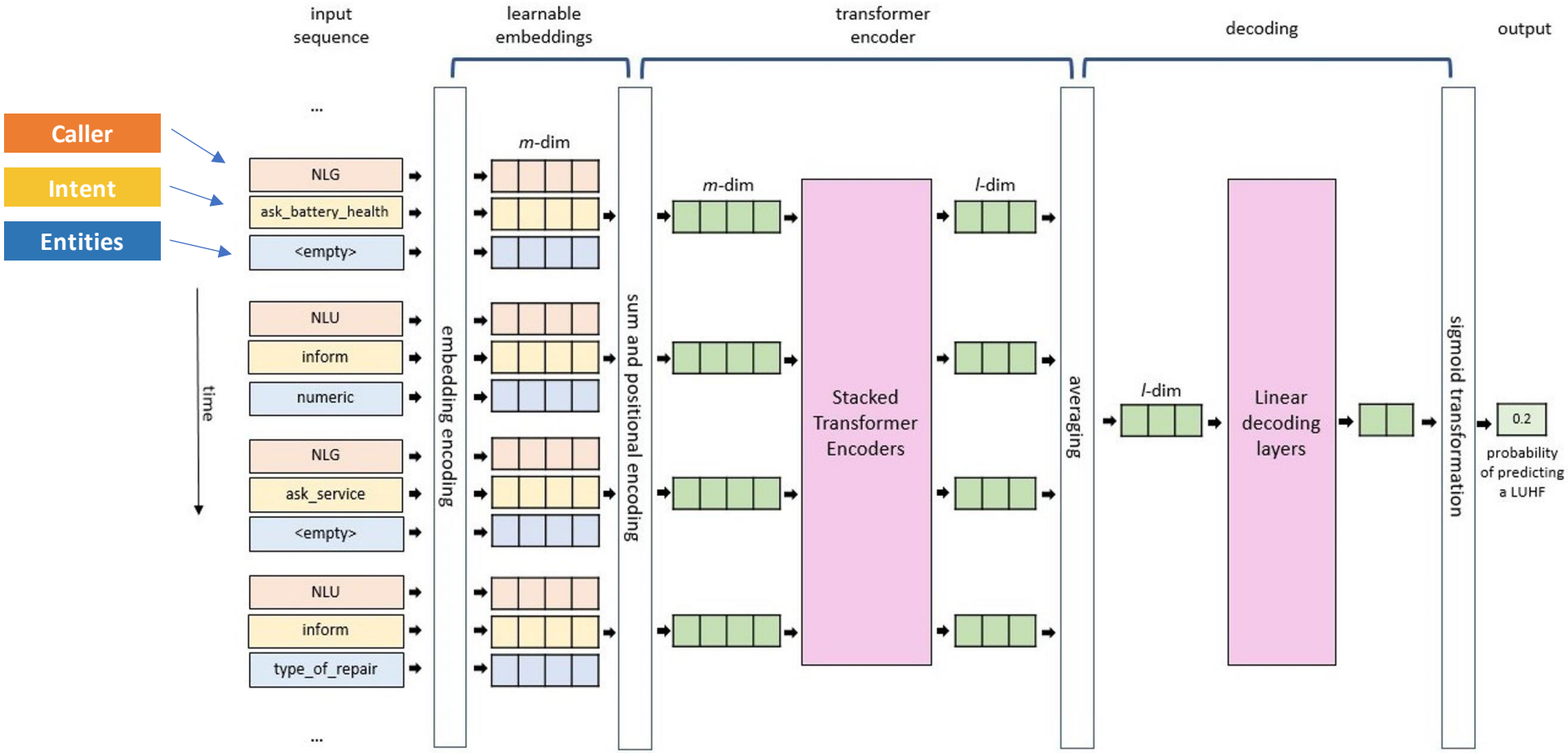
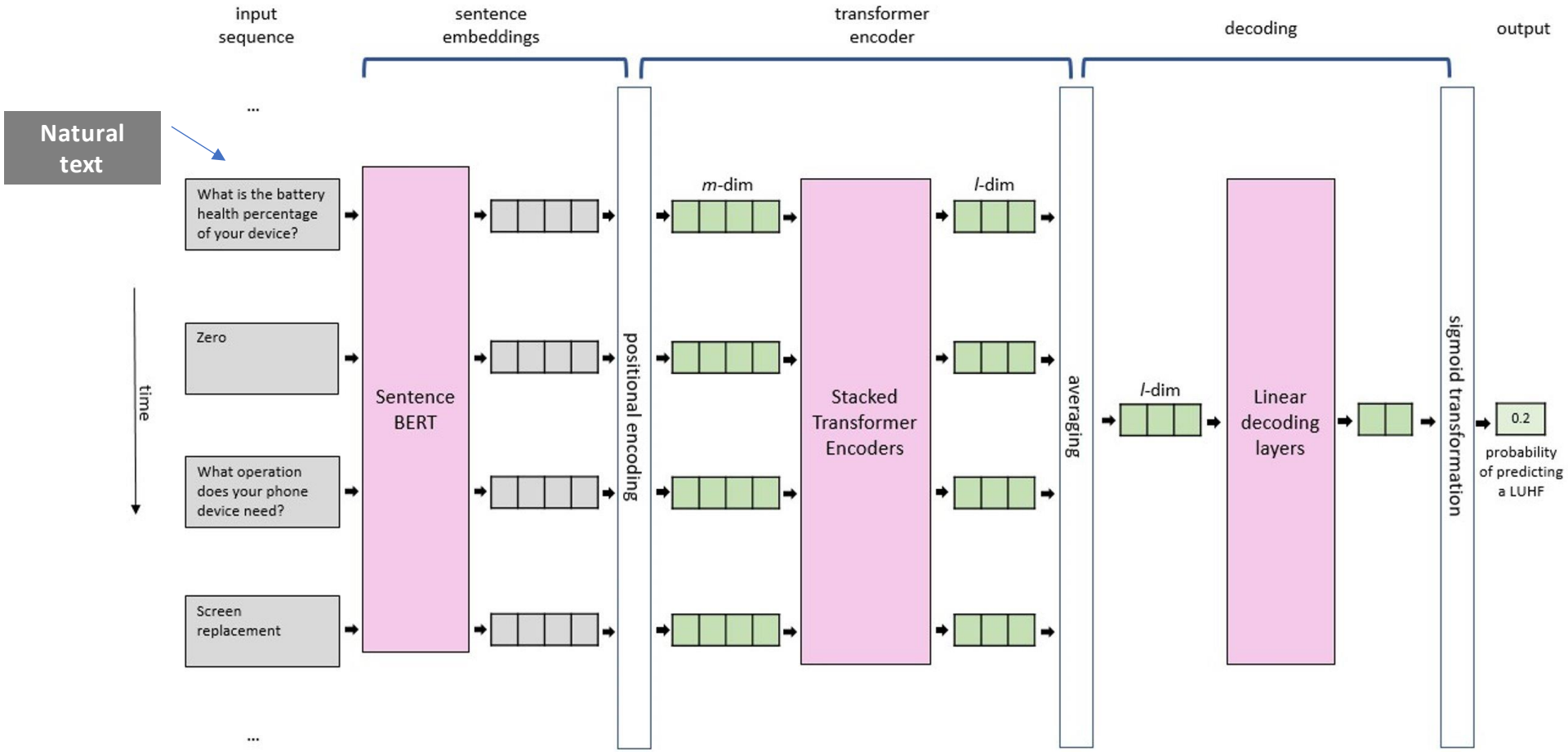


Baseline: Text-only Model

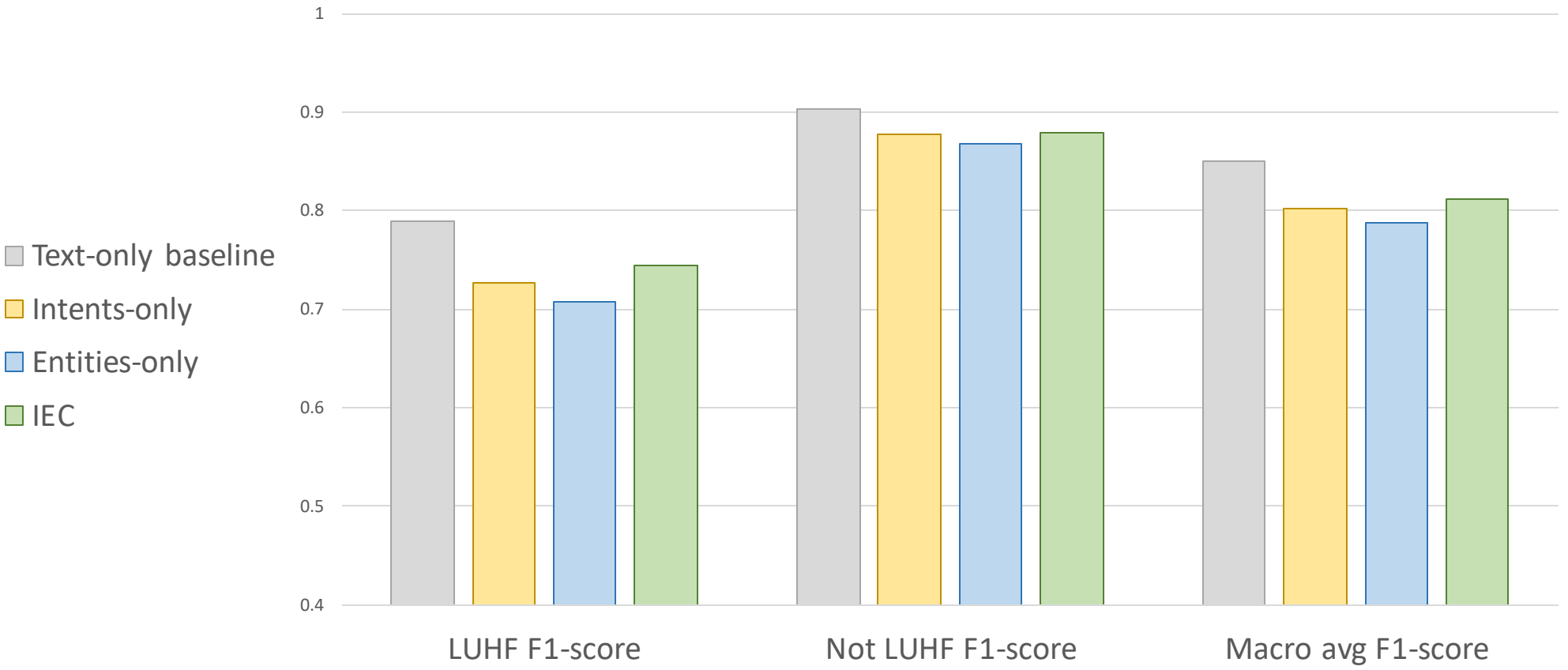


Experimental Setting

- Models:
  - Text-only baseline
  - Entities only
  - Intents only
  - IEC (Entities+Intents+Callers)

- Grid search to determine the optimal hyperparameters

Classification Results



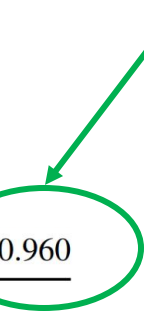
Generalization capabilities

- LUHF annotation on BETOLD applies to the overall call (not applied to each step of the conversation)
- Can the model predict if a breakdown happened at each step of a conversation?

Sample conversation

Step	Caller	Intent	Entities	Probability of LUHF
9	NLG	ask_for_battery_health		
10	NLU	inform	numeric	
11	NLG	ask_first_name		
12	NLU	inform	client_name	
13	NLG	ask_last_name		
14	NLU	inform	client_name	
15	NLG	ask_desired_service		
16	NLU	user_initial_request	type_of_repair	
17	NLG	ask_additional_service		
18	NLU	inconclusive		
19	NLG	transportation_of_device	ask_to_schedule, ask_means_of_transportation	
20	NLU	confirm		
21	NLG	inform_schedule_inspection		
22	NLG	propose_date	transportation_type_selection, available_slot_to_schedule	
23	NLU	negate		
24	NLG	ask_time_preference		
25	NLU	user_proposed_date	time_range_indication	
26	NLG	time_asked_unavailable_propose_new	transportation_type_selection, available_slot_to_schedule, user_request_start_time	
27	NLU	negate		
28	NLG	ask_time_preference		0.960

Probability to predict a LUHF for the overall call



Sample conversation – how to generalize

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We can split iteratively the conversation
in steps – until step *n*
(with *n*=1, …, length of the conversation)

Sample conversation – how to generalize

Step	Caller	Intent	Entities	Probability of LUHF
9	NLG	ask_for_battery_health		
10	NLU	inform	numeric	
11	NLG	ask_first_name		
12	NLU	inform	client_name	0.002

We can split iteratively the conversation in steps – until step *n* (with *n*=1, …, length of the conversation)

And then predict the probability of a LUHF given the conversation until step *n*

Sample conversation – how to generalize

Step	Caller	Intent	Entities	Probability of LUHF
9	NLG	ask_for_battery_health		
10	NLU	inform	numeric	
11	NLG	ask_first_name		
12	NLU	inform	client_name	0.002
13	NLG	ask_last_name		0.296

Sample conversation – how to generalize

Step	Caller	Intent	Entities	Probability of LUHF
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10	NLU	inform	numeric	
11	NLG	ask_first_name		
12	NLU	inform	client_name	0.002
13	NLG	ask_last_name		0.296
14	NLU	inform	client_name	0.016

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15	NLG	ask_desired_service		0.344

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15	NLG	ask_desired_service		0.344
16	NLU	user_initial_request	type_of_repair	0.033

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14	NLU	inform	client_name	0.016
15	NLG	ask_desired_service		0.344
16	NLU	user_initial_request	type_of_repair	0.033
17	NLG	ask_additional_service		0.262
18	NLU	inconclusive		0.012
19	NLG	transportation_of_device	ask_to_schedule, ask_means_of_transportation	0.253
20	NLU	confirm		0.014
21	NLG	inform_schedule_inspection		0.012
22	NLG	propose_date	transportation_type_selection, available_slot_to_schedule	0.269
23	NLU	negate		0.033
24	NLG	ask_time_preference		0.378
25	NLU	user_proposed_date	time_range_indication	0.153
26	NLG	time_asked_unavailable_propose_new	transportation_type_selection, available_slot_to_schedule, user_request_start_time	0.922
27	NLU	negate		0.764
28	NLG	ask_time_preference		0.960

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the LUHF probability often decreases after a user input

Qualitative Analysis

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I'm sorry there isn't an opening <tomorrow>. Our closest available appointment is <on Wednesday 15th>, for <dropoff>. Will that work for you?

Conclusions

- Simple way to automatically generate a breakdown detection dataset
- Released an NLG/NLU-annotated dataset
  BETOLD: github.com/telepathylabsai/BETOLD_dataset
- Proposed an attention-based classifier trained on
  BETOLD: github.com/telepathylabsai/dialog_breakdown_detection
- NLU and NLG annotations are useful for the prediction of a breakdown while preserving the privacy of the data

Thank you for your attention :)

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