

# ServiceNet: End to End Dialogue System for Technical Support

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## Abstract

IT support is a manually intensive task where support staff responds to a variety of user issues and request for information. Current production grade dialogue systems require of multiple components to work and are focused on slot filling of predesigned conversation flows. We propose an end-to-end dialogue using deep learning that could produce highly accurate responses and would be easier and cheaper to develop and maintain.

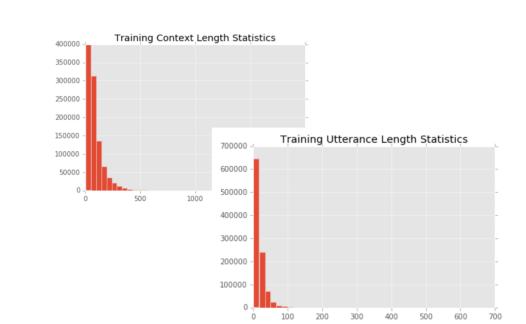
## Data and Features

We used Ubuntu Dialog Corpus created from a collection of logs from Ubuntu-related chat rooms for technical support on the IRC network.



#### Dataset:

- # dialogues: 930,000# utterances: 7,100,000# words total: 100,000,000
- Min/avg # turns: 3/7.71
  Avg. # words: 10.34
- Vocab size: 91,000



**Data Preprocessing**: We process raw data into training data that contains context, response utterance and a flag label that indicates if the response was the actual next utterance for the given context. Validation and test set contain context, ground truth and multiple distractors

**Training Set** 

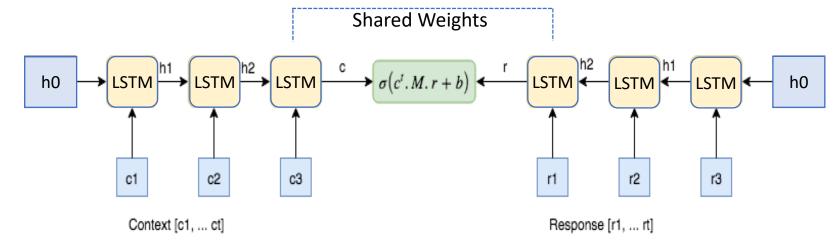
Halling Set						
Context	Response	Label				
did robot101 left already?`_eou_ eot_yeah, yesterday_eou_have fun, and congrats_eou_eeot_i would love to know thateou_can you do a test for me if you can? but you will have to exit X_eou_???_eou_ eot_	i can do it don't worry eou gdm?eou	1				
Jamn, your french is good, better than my senglish we should talk french here :)eou_ sreah, I know that feeling :peoueot_ what, your french sucking?eou that  sounds reasonableeou eot fresh  eoueot what? _eoueotfresh  nstall. gedit appears to be http handler againeoueot_	listen i'm not your wikipediaeou if you don't want to do it, then don't. ;)eou	0				

Validation and Test Set

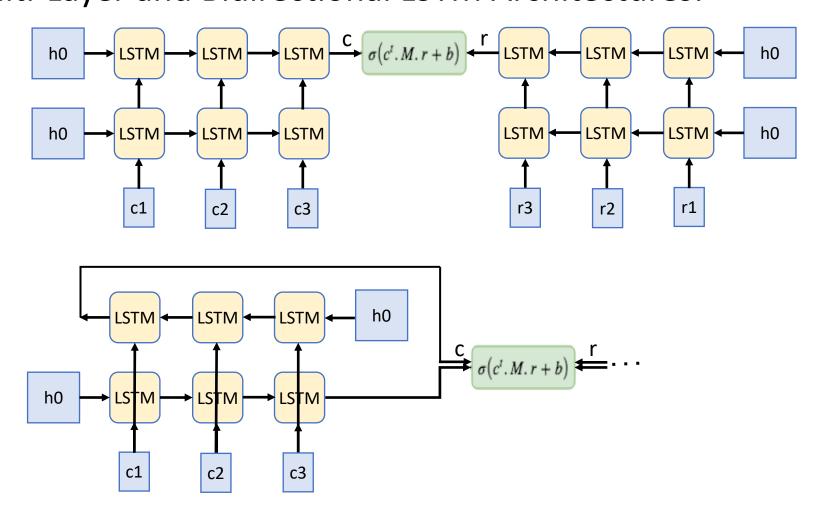
Context	Ground truth	Distractor
no suggestions? _eou_ links? _eou_ how can I remove luks passphrase at boot. I dont want to use feature anymoreeoueot_ you may need to create a new volume _eou_ eot_ that leads me to the next question lol I dont know how to create new volumes exactly in cmdline, usually I use a gui. im just trying to access this server via usb loaded with next os im going to load, the luks pw is stopping me _eou_ eot_ for something like a live gparted disk use something like a live gparted disk to avoid the conflict of editing from the disk _eoueot_	you cant load anything via usb or od when luks is runningeou it wont allow usb boot, i tried with 2 diff usb driveseou	-p sorryeou nmap -p22eou It doesn't say: 22/tcp open ssh ?eou

#### Models

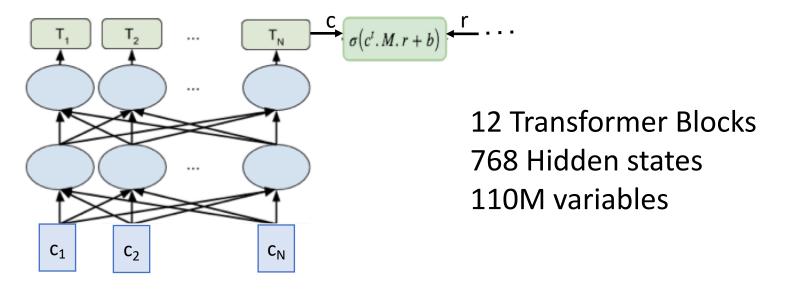
- Dual Encoder Architecture with Siamese Recurrent Networks.
- Context and Responses inputs to each branch of the network.
- Embeddings of the Context and Responses used to calculate probability of valid pair.



- Probability of Valid Pair:  $p(\text{flag} = 1 | c, r, M) = \sigma(c^T M r + b)$
- Loss Function:  $\mathcal{L} = -\sum_n \log p( ext{flag}_n|c_n, r_n, M) + rac{\lambda}{2} || heta||_F^2$
- Multi-Layer and Bidirectional LSTM Architectures:



• BERT - BERT: Pre-trained Deep Bidirectional Transformers



## Results

Network Type	State Size	Num Layers	Bidirec tional	Pre- trained	Recall @1	Recall @2	Recall @5
LSTM	256	1	No	No	0.526	0.708	0.923
LSTM	256	1	No	Yes	0.519	0.708	0.919
LSTM	768	1	No	Yes	0.499	0.683	0.914
LSTM-Multi	128	2	No	Yes	0.494	0.689	0.911
LSTM-Multi	128	3	No	Yes	0.483	0.675	0.911
LSTM-Bidi	128	1	Yes	Yes	0.512	0.696	0.915
LSTM-Bidi	128	1	Yes	No	0.537	0.712	0.920
BERT	768	12	Yes	Yes			

## Discussion and Future Work

#### **Observations**

- LSTMs substantially help improve performance over baseline TF-IDF results (R@1 41%, R@5 71%)
- Bidirectional LSTM helps improve accuracy more than increasing state size or increasing number of layers
- Pretrained embeddings did not help in increasing accuracy
- Increasing state size beyond a limit can results in decrease of accuracy. State size 256 yields best results

#### **Future Work**

- Fine-tune pre-trained network (BERT, ELMO) with UDC corpus to improve accuracy
- Use knowledge graph and additional context information

Acknowledgements – Mentor – Pedro Garzon, CS230 staff References

- Bordes, et al. Learning end-to-end goal-oriented dialog
- Lowe, et al. Training end-to-end ubuntu dialogue corpus
- Devin, et al. BERT: Pre-training of Deep Bidi Transformers