Deep Learning for Question Detection in Autism Diagnoses

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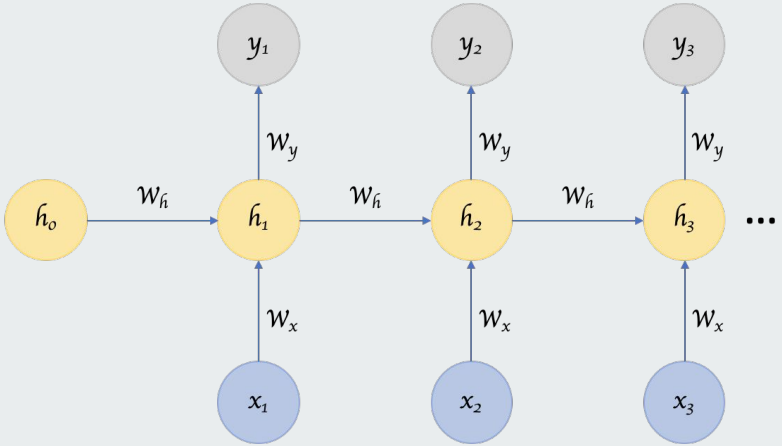
Boston University 2022



Research Lab

Principal Investigator: Professor David V. Anderson

PhD Mentor: Desmond Caulley

Why Question Detection?

- Autism Spectrum Disorder - Developmental disorder which impacts learning, communication, and behavior
- ASD affects 1/59 people in the USA, and can often go undiagnosed in children (CDC)
- **Researchers have shown that analyzing, one day's worth of audio recordings of a subject is sufficient to determine if someone is suffering from ASD (Manual Process)**
- One of the metrics clinicians care about how often kids respond to questions from their parents.

Challenges in question detection for machines

- Data is collected from device worn by kids can produce noisy data
- Speech to Text systems are not reliable when data is noisy
- Using text translated from audio can also cause problems for questions with inflections at the end

Example

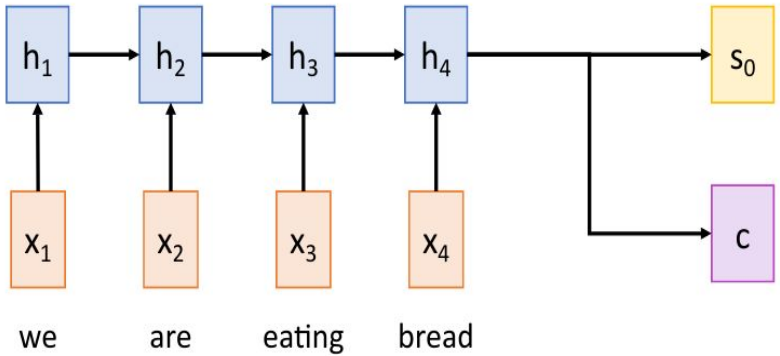
Isn't this great? =>Declarative Question

Table 1: Types of questions

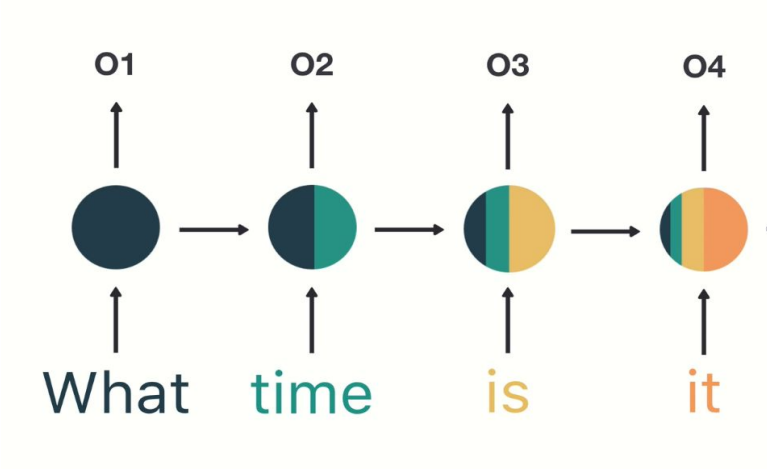
	Examples
Yes-No	Did you attend the meeting?
wh-words	Where have you been?
Declarative	You are at the meeting?

[1]

Establishing a baseline with Recurrent Neural Networks

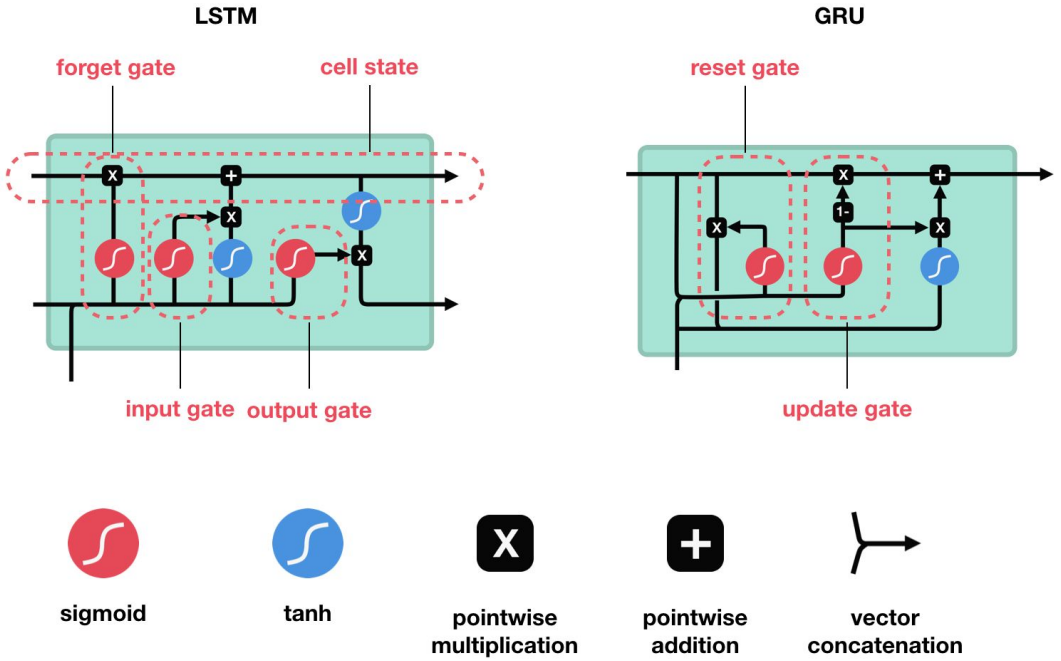


[2]



[3]

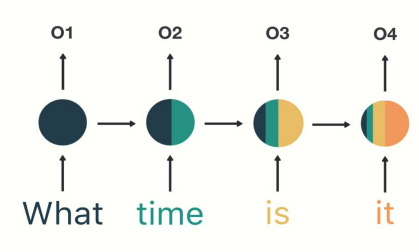
Surpassing limitations of traditional RNNs



[4]

Detecting Interrogative Utterances with Recurrent Neural Networks

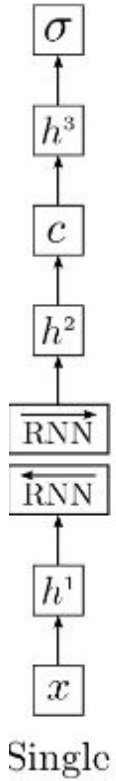
- Trained on CALLHOME dataset clean/human labeled data
- Implemented models and replicated results



$$c_1(z) = z_T$$

$$c_2(z) = \sum_{t=1}^{T} \alpha_t s_t$$

[5]

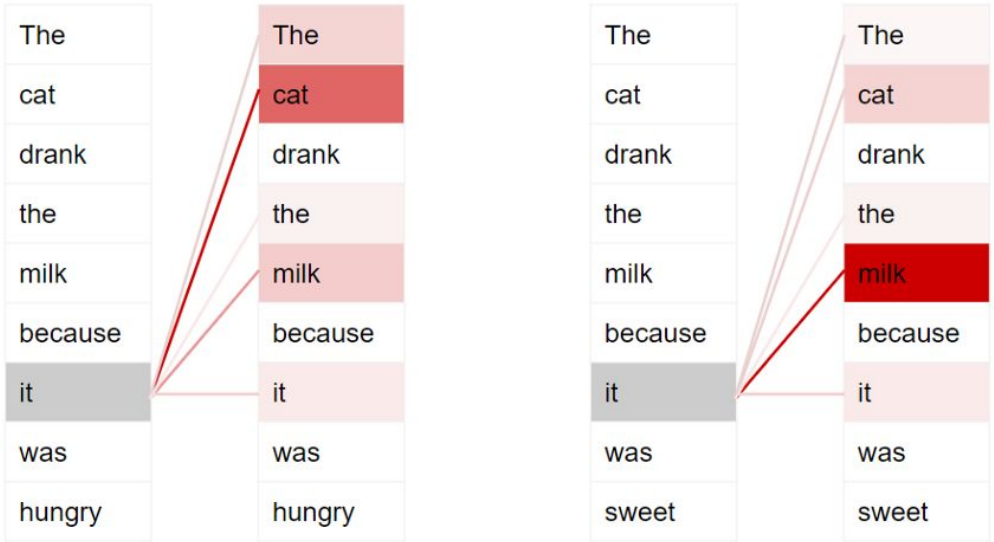


[6]

Single

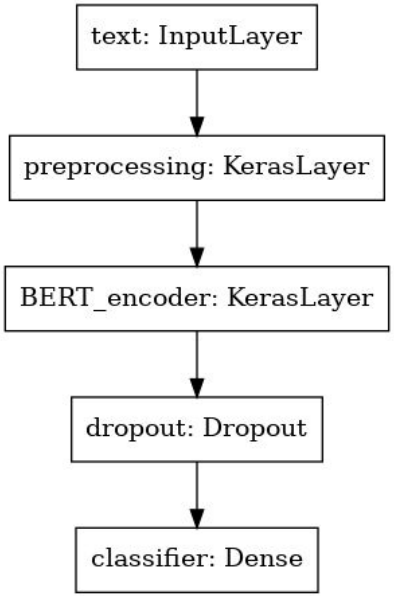
Leveraging Attention with Transformers

- Attention helps solve the issues with traditional RNN networks, on how to add emphasis to certain timesteps (words in this example)
- Transformers are a new architecture whose key benefits over traditional RNNs is faster processing of inputs

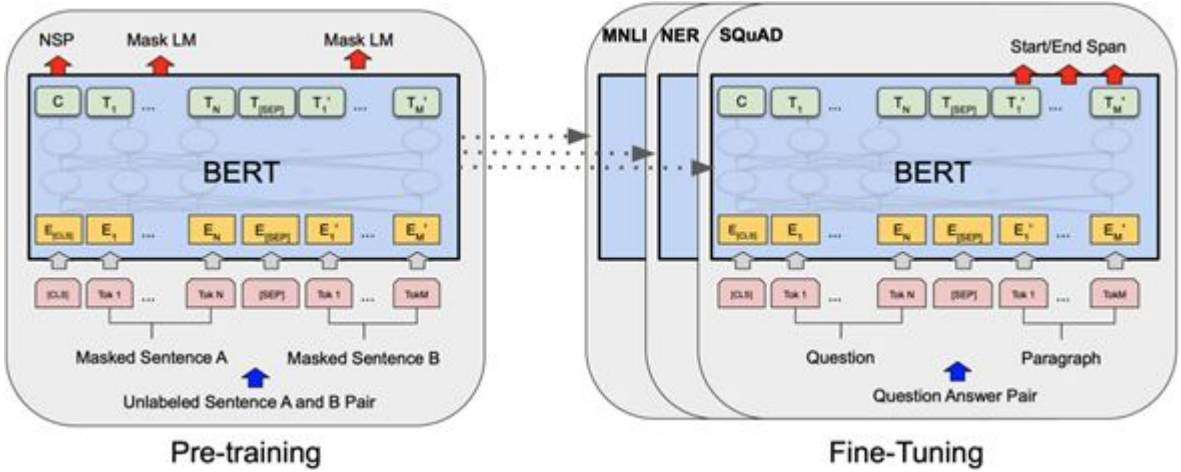


[7]

Transfer learning on Pretrained Transformer Models



[8]



[9]

Callhome experiments with Text Only,

	GRU	LSTM	GRU, D	LSTM, D	GRU, BN	LSTM, BN
text, c_1	88.8	88.6	89.1	89.1	90.6	90.2
text, c_2	89.5	88.9	88.9	88.7	90.8	90.5

	GRU	LSTM	GRU, D	LSTM, D	GRU, BN	LSTM, BN
c1	.788	.795	**.805**	**.805**	.745	.738
c2	.788	.788	.79	.78	.785	.798

BERT
.85

[10]

Callhome experiments Audio Only

	LSTM	GRU	LSTM, D	GRU, D	LSTM, BN	GRU, BN
c1	. 678	0.65	0.688	0.67	0.632	.652
c2	.695	**0.7**	0.695	0.7	.692	0.668

Thank You for Listening !

Citations

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