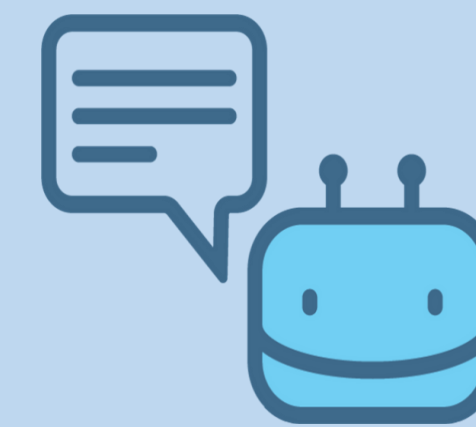# Mimic: Character Based Chatbot

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Introduction

A chatbot is a program that provides conversational output in response to user input. They have many applications such as customer support interfaces, general question answering services, translation apps and virtual assistants. A common goal for chatbots is to simulate a human like interaction for the user. To this end many researches have investigated creating chatbots which can do more than just factually answer questions. That is, they have investigated creating chatbots which have "personality" or "identity." The goal of this project was to train a neural network to act as a chatbot that simulates the known TV personality Joey from F.R.I.E.N.D.S.

Dataset (F.R.I.E.N.D.S)

F.R.I.E.N.D.S was chosen as the TV show for character dialogue extraction. The initial dataset consisted of the raw script of the TV show for all seasons.

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The One Where Monica Gets a New Roommate (The Pilot-The Uncut Version)
Written by: Marta Kauffman & David Crane
Transcribed by: guineapig
Additional transcribing by: Eric Aasen
(Note: The previously unseen parts of this episode are shown in blue text.)

[Scene: Central Perk, Chandler, Joey, Phoebe, and Monica are there.]

Monica: There's nothing to tell! He's just some guy I work with!

Joey: C'mon, you're going out with the guy! There's gotta be something wrong with him!

Chandler: All right Joey, be nice.  So does he have a hump? A hump and a hairpiece?

Phoebe: Wait, does he eat chalk?

(They all stare, bemused.)
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The raw script was parsed to extract statement response pairs from each scene. We then collected all pairs where Joey was the responder. Joey was chosen as the character to study as he has a distinctive personality in the show. For those not familiar the show, Joey can be described as naive, sarcastic, loving, misogynistic and loud.

Charracter Input	Charracter Output
Ooh . . . I love Barbados !	\<START> Ooh . . . I cant believe Im kissing yo...
Hey , you know , before you said that nothing ...	\<START> Well , I only said that because of Ros...
Rach , you there ?	\<START> Oh my God , its Ross . What are we gon...
Oh , ju ju just stay calm . Just be calm . For...	\<START> No idea what it means . \<END>
Yeah , sure . . .	\<START> I dont believe this . . . Have you guy...

In additional to having Joey like personalities, we wanted our chatbot to in general respond like a human. To this end we considered pretraining our models on an additional dataset of general question and answer pairs. The goal of introducing this data set was to help the model understand generic a question answering format. We reserved 20% of both datasets to be used as testing data.

| Generic Questions	Generic Answers
What s up ?	\<START> Not much . \<END>
you are not put together	\<START> i have always thought whoever did it c...
Tell me a joke	\<START> what do you get when you cross a road ...
Who uses super computers ?	\<START> Anybody who wants to work with large n...
how far is the sun	\<START> the sun is about million miles from ea...
leo tolstoy	\<START> Is one of Russia s greatest writers ...
what is chemistry	\<START> the science of mixing chemicals . \<END>
Bend over	\<START> That s personal ! \<END>

Seq2Seq Model

A *Seq2Seq model* consists of an *Encoder* and a *Decoder*.

All input text is preprocessed, tokenized and converted to Pre-trained GloVe embeddings with the help of a Keras embedding layer. Word vectors are fed to encoder *long short-term memory (LSTM)* one word at a time.

The encoder LSTM tries to capture the essence of the encoder input sequence in two state vectors that are passed to the decoder LSTM. The decoder LSTM, which is fed output text word embeddings is trained to use a dense SoftMax output layer to predict the most probable output word given two input state embeddings and an embedded word.

Once the model is trained an *inference encode decoder model* is created using the trained model weights. The inference encoder model takes in a user input question and generated two state vectors. The input state vectors are fed into the inference decoder model along with a sentence start token and all words predicted by the SoftMax layer are captured until an end token is generated.
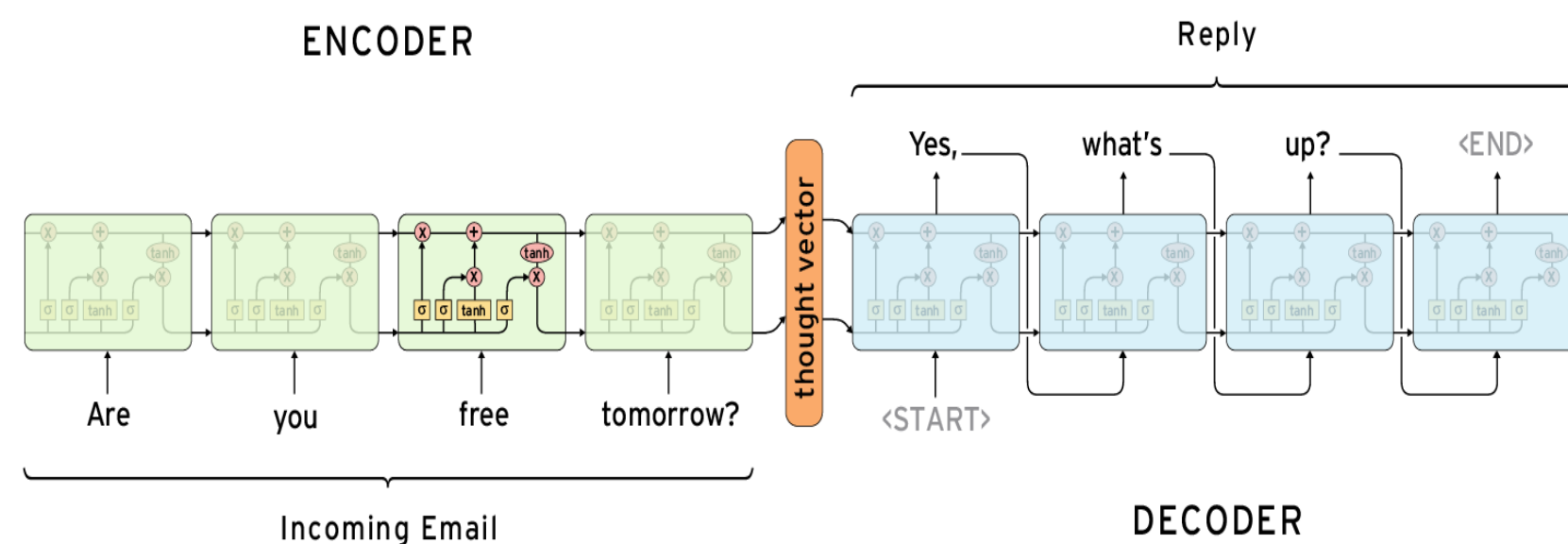

Transformer Model

The model is pre-trained on a Question-Answering dataset. The model contains an Encoder-Decoder mechanism with transformers.

The Encoder contains a multi-head attention mechanism which runs several scaled dot product attention procedures in parallel. This acts as an ensemble method and enables self attention.

The Decoder deals with retrieval from the encoder representations using a masked multi-head attention, a multi-head attention and a feedforward network.

A fully connected Dense layer uses decoder outputs with the loss function being sparse cross entropy loss function, the accuracy metric being sparse categorical accuracy.
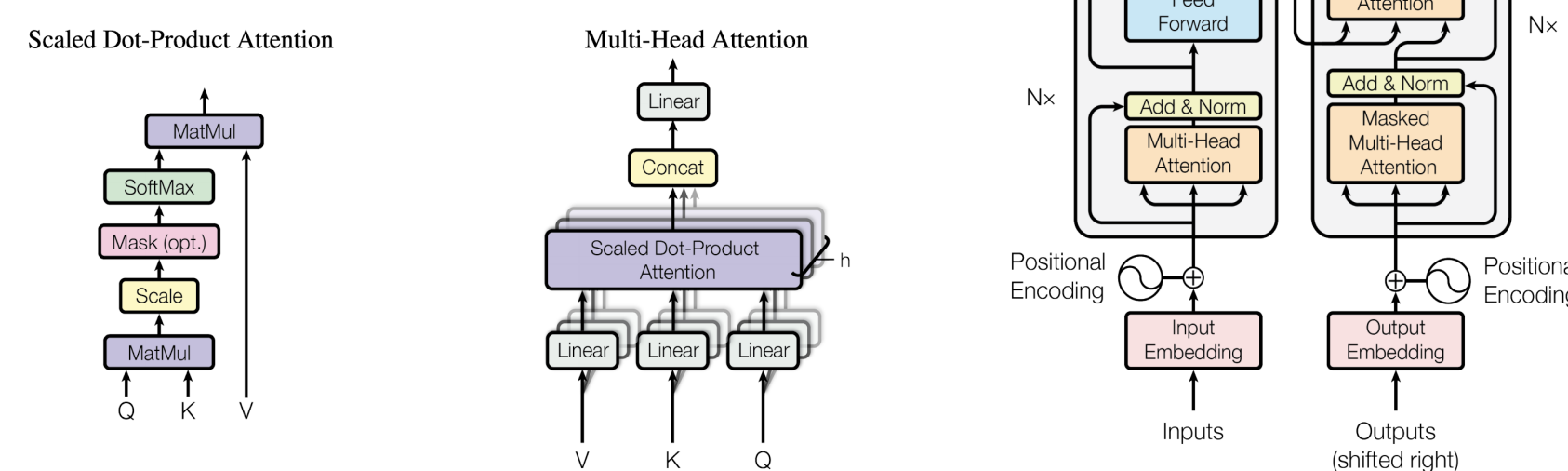
Evaluation

Evaluating the quality of a chatbot's responses requires some creativity. One obstacle is that any statement can have many appropriate responses. Another is that deciding if a response embodies a specific personality is highly subjective. For example, consider all the appropriate response to the statement "Hello!"

Automatic Metrics

The *Automatic metrics* we considered compared the sentence structure and word patterns of our generated responses against test responses for the same statement. Most of these metrics were designed to test translation bots which often use similar models and face similar problems. In the table below you can see data for a range of automatic metrics such as BLEU, METEOR, ROUGE and WER. With the exception of WER, each metric gives a score between 0 and 1 with 1 being the best. For WER, smaller scores are better.

Metric:	BLEU:	ROUGE-1:	ROUGE-l:	METEOR:	WER Avg:
S2S (Q&A)	0.055	0.213	0.204	0.092	1.554
S2S (Joey)	0.037	0.141	0.131	0.064	1.922
Trans (Q&A)	0.001	0.102	0.094	0.035	2.412
Trans (Joey)	0.100	0.270	0.261	0.137	1.218

Human Metrics

The *Human Metric* we used was a blind human evaluation. A human tester was given a collection of statements from each data set along with their original response and generated response (in random order). The tester asked to select the responses which they felt was most like the character in question.

In an ideal setting, a human tester would not be able to distinguish between the generated response and the test response. So, an ideal score would be 0.5. The Seq2Seq model got a score of **0.413** for the question and answer dataset and **0.35** for the Joey dataset. The Transformer model got a score of **0.263** for the question and answer dataset and **0.325** for the joey dataset.

27. Statement: "How do you do that?"

0. "I m doing well ."

1. "Now you cant tell anyone , but uh I put on shiny lip balm ."

○ 0
○ 1

0. Statement: "I PLAY SOCCER"

0. "Hello? What time are you meeting her? Hello? Oh, Im not taking any of my identical hand twin!"

1. "you have to run very fast to be any good at running"

○ 0
○ 1

34. Statement: "Joey, what are you doing?"

0. "Just being friendly ."

1. "Just what needs to be done ! Dearly beloved , we are gathered here to join this man and this woman"

○ 0
○ 1

3. Statement: "Can you walk"

0. "the plan for my body includes legs , but they are not yet built ."

1. "Whoa, hey listen—Is this part of the kill me?"

○ 0
○ 1