Building Chinese Chat Bot with Controlled Sentence Function

Lue Shen

Department of Mathematics, HKUST

May 26th, 2019

Contents

1 Introduction
- Sentence Function
- Model Challenges
- Project Descriptions

2 Model Framework

3 Training Process

4 Model Evaluation

5 Applications
- WeChat Application
- GUI Application

6 Limitations and Future Studies

7 Conclusions

Introduction - Sentence Function

- Sentence function: a speaker's purpose in uttering a specific sentence, phrase, or clause.
- Four types: declarative, interrogative, exclamative, and the imperative.
- Important in conversation!

Table: Responses to the same post with 4 different sentence functions

Post		我为什么这么聪明? Why am I so smart?
Responses	**Interrogative**	你遗传了谁的基因? Whose genes do you inherit?
	Imperative	下次小组项目让我抱大腿吧! Please help my project in the future!
	Exclamative	你真是聪明啊! What a smart guy!
	Declarative	那是因为你有一部智慧手机。 That's because you have a smart phone.

Introduction - Model Challenges

- Global control structure: word orders, word patterns, etc.
- Compatibility of sentence functions and informative contents: avoid universal and meaningless sentences.

Introduction - Project Descriptions

Objectives:

- Controlled sentence function.
- Informative responses.

Recipes:

- Word embedding scheme: constructed from Chinese news, Baidu Baike, novels, 1.5 GB.
- Dataset: 2 million labeled Weibo post-response pairs.
- Conversation model: reference to a 2018 paper [1].
- Applications: GUI-based and WeChat-based.

Model Framework

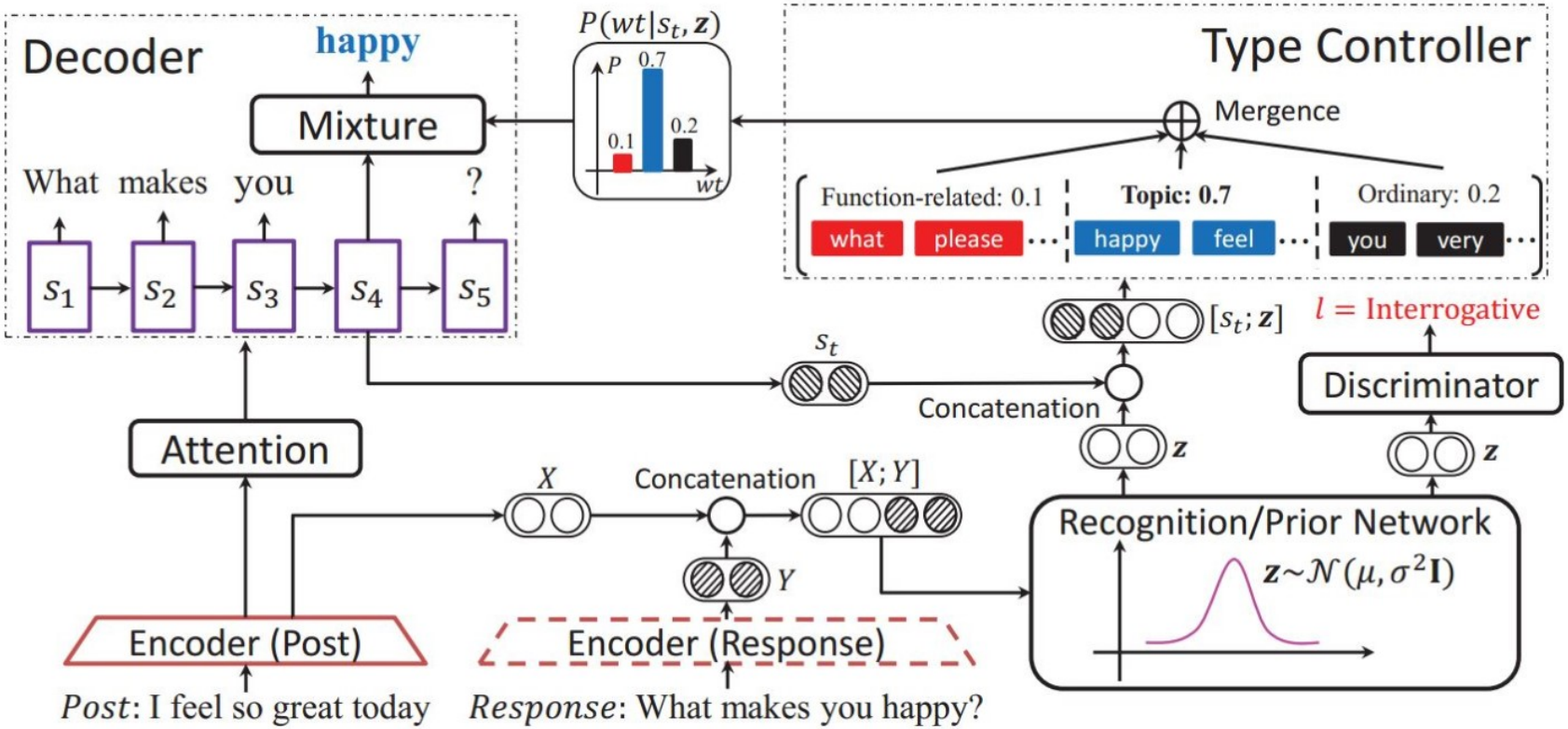

Figure: Model Framework

Training Process

Go through the scripts...

- Data Description
- Word Embedding
- Model Settings

```
encoder/bidirectional_rnn/fw/gru_cell/gates/kernel:0: (320, 512)
encoder/bidirectional_rnn/fw/gru_cell/gates/bias:0: (512,)
encoder/bidirectional_rnn/fw/gru_cell/candidate/kernel:0: (320, 256)
   encoder/bidirectional_rnn/fw/gru_cell/candidate/bias:0: (256,)
encoder/bidirectional_rnn/bw/gru_cell/gates/kernel:0: (320, 512)
encoder/bidirectional_rnn/bw/gru_cell/gates/bias:0: (512,)
encoder/bidirectional_rnn/bw/gru_cell/candidate/kernel:0: (320, 256)
encoder/bidirectional_rnn/bw/gru_cell/candidate/bias:0: (256,)
recog_net/muvar/weights:0: (1024, 256)
recog_net/muvar/biases:0: (256,)
prior_net/fc1/weights:0: (512, 256)
prior_net/fc1/biases:0: (256,)
prior_net/muvar/weights:0: (256, 256)
prior_net/muvar/biases:0: (256,)
discriminator/pattern_fc1/weights:0: (128, 128)
discriminator/pattern_fc1/biases:0: (128,)
discriminator/pattern_logits/weights:0: (128, 3)
discriminator/pattern_logits/biases:0: (3,)
attention_keys/weights:0: (512, 512)
dec_start/dec_start_fc1/weights:0: (704, 512)
dec_start/dec_start_fc1/biases:0: (512,)
dec_start/dec_start_fc2/weights:0: (512, 512)
dec_start/dec_start_fc2/biases:0: (512,)
decoder/gru_cell/gates/kernel:0: (1280, 1024)
decoder/gru_cell/gates/bias:0: (1024,)
decoder/gru_cell/candidate/kernel:0: (1280, 512)
decoder/gru_cell/candidate/bias:0: (512,)
attention_construct/weights:0: (1024, 512)
decoder/output_projection/l_fc1/weights:0: (640, 640)
decoder/output_projection/l_fc1/biases:0: (640,)
decoder/output_projection/l_fc2/weights:0: (640, 3)
decoder/output_projection/l_fc2/biases:0: (3,)
decoder/output_projection/w_fc2/weights:0: (512, 40000)
decoder/output_projection/w_fc2/biases:0: (40000,)
decoder/output_projection/dl_fc2/weights:0: (512, 40000)
decoder/output_projection/dl_fc2/biases:0: (40000,)
decoder/output_projection/d2_fc2/weights:0: (704, 40000)
decoder/output_projection/d2_fc2/biases:0: (40000,)
Reading model parameters from Train
```

Figure: Model Description

Model Evaluation

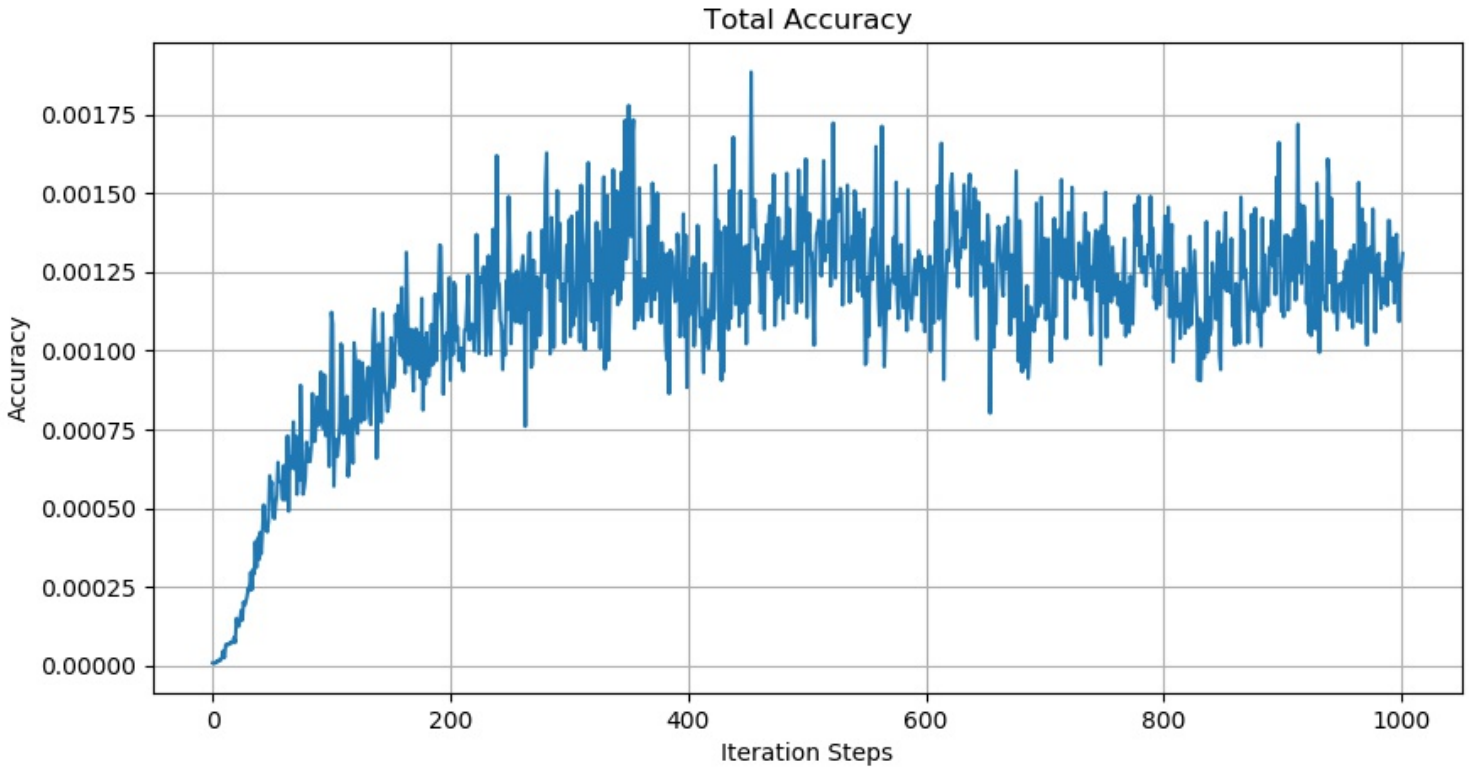

Figure: Model Accuracy in First 1000 Training Iterations

Model Evaluation

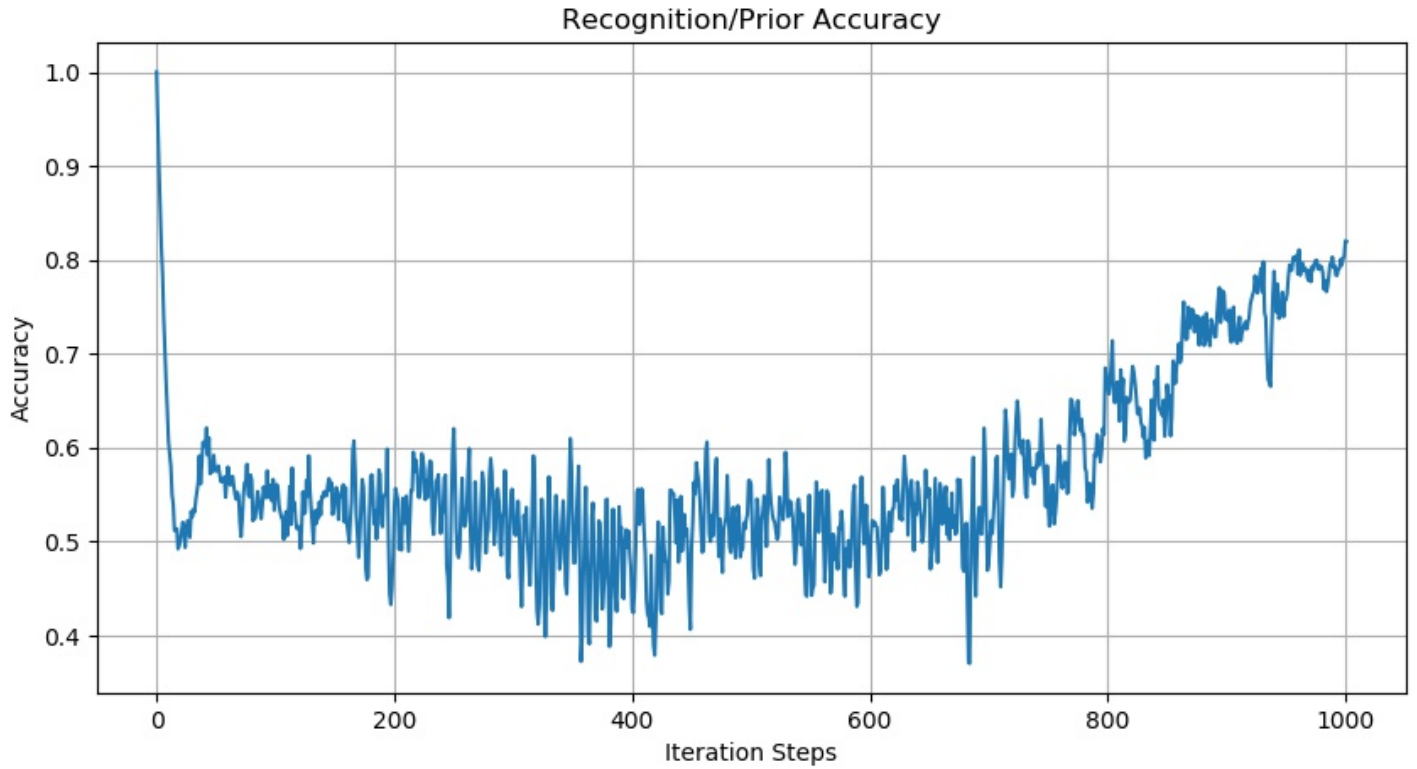

Figure: Recognition/Prior Network Accuracy in First 1000 Training Iterations

Model Evaluation

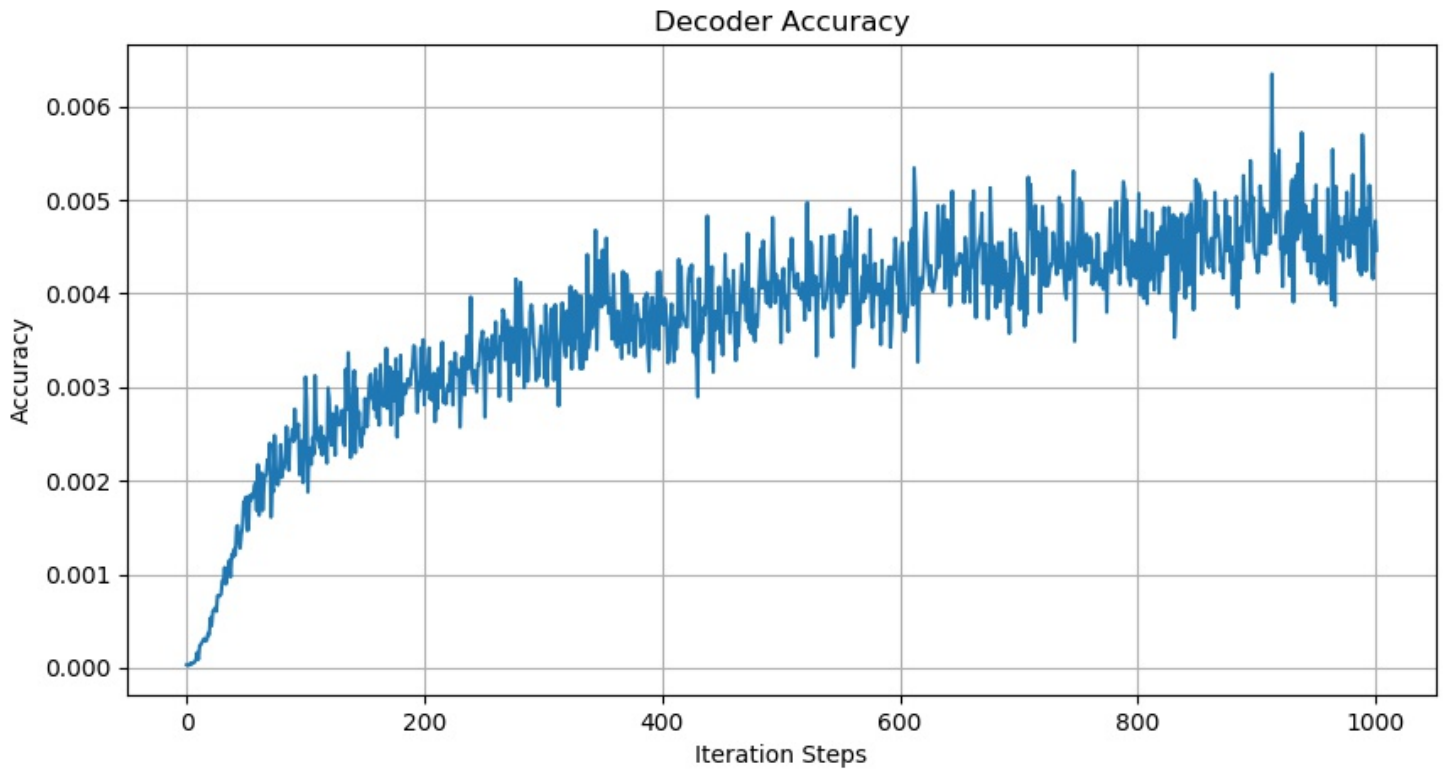

Figure: decoder Network Accuracy in First 1000 Training Iterations

WeChat Application

demo

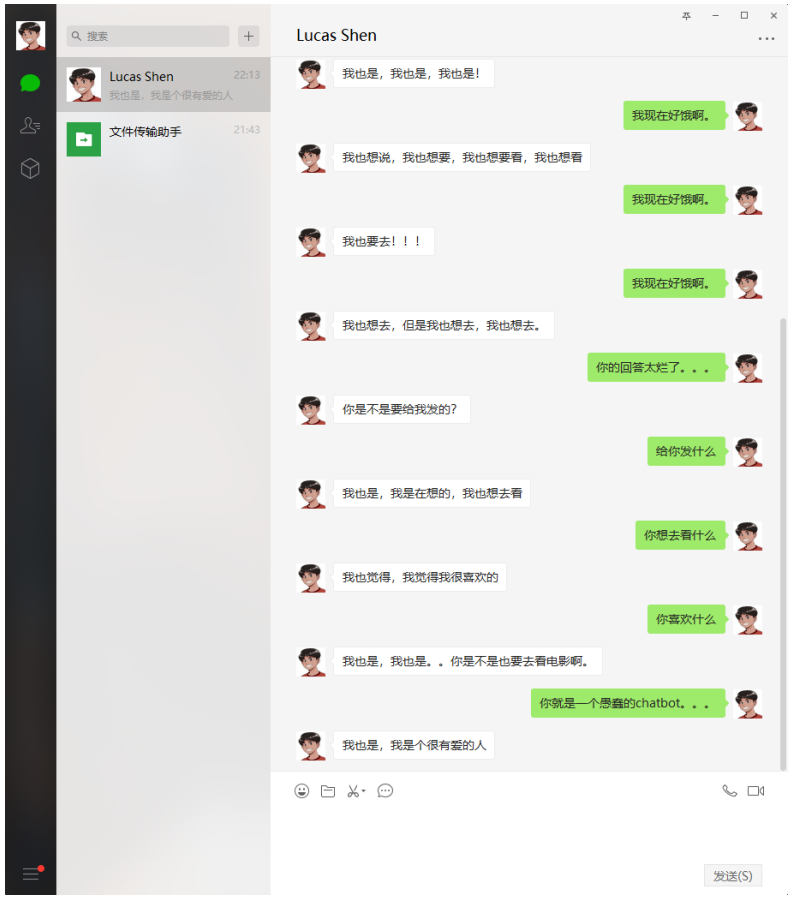

Figure: WeChat Application

GUI Application

demo

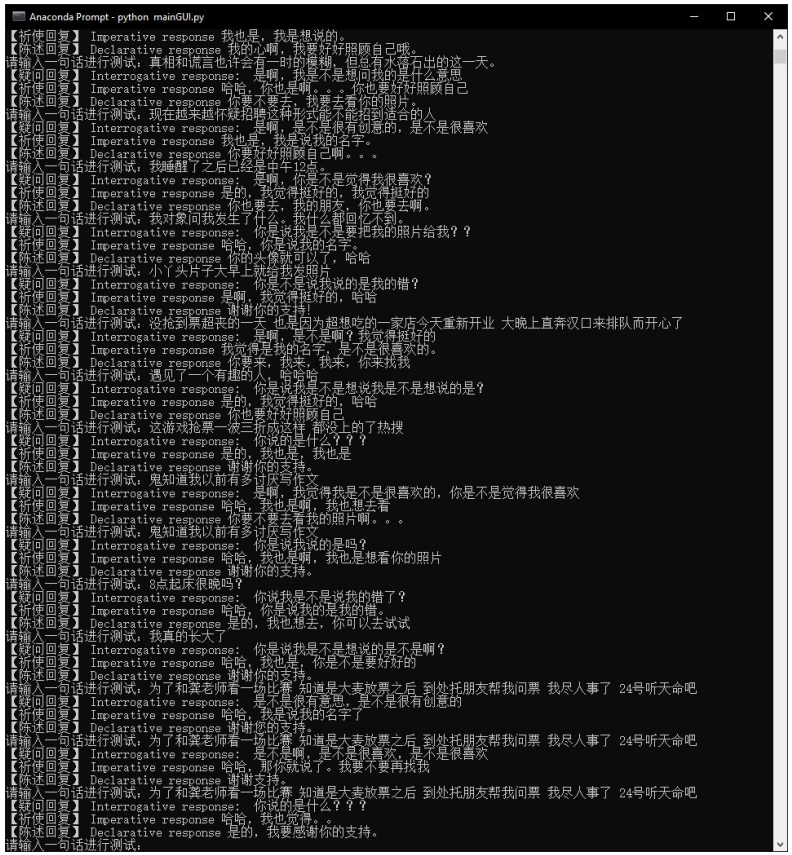

Figure: GUI Application

Limitations and Future Studies

- Training Limitations

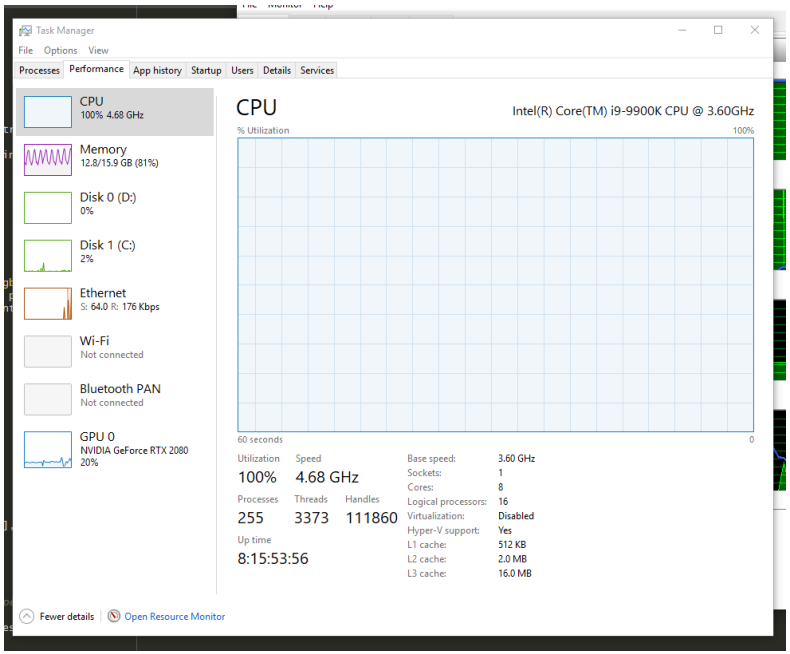

Figure: Computational Performance

- Evaluation Limitations
- Multi-Turn Conversation Model

Conclusions

In this report, a conversation model with sentence function control variable is introduced based on a latest paper. It is expected to solve the problem of compatibility between sentence function controlling and informative contents. A large Weibo post-response data set is implemented for training. The training process converges quickly in the first few hundreds iterations, but the total training time lasts 169 hours (7 days) for a high-end personal computer. The training and validation results indicate that the networks for controlling sentence function obtain high accuracy while the networks for topic and decoder still have a large room to improve. Besides, two chat bot applications are implemented on WeChat and GUI successfully. More appropriate model can be trained and evaluated by overcoming hardware limitations and introducing more rigorous evaluation scheme. Advancements to enable multi-turn conversation feature can be studied in the future.

References I

Pei Ke, Jian Guan, Minlie Huang, and Xiaoyan Zhu.
Generating informative responses with controlled sentence function.
2018.