



Artificial Intelligence Project Report

30 January 2017

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1. Introduction

Project UNK is a CLI-based chatbot that used the advanced technology of Recurrent Neural Network to interact with user. Project UNK can learn from the available dataset, and it gets smarter as the dataset increases or the amount of learning time increases. This project is inspired by Siraj Raval explanation on “How to Make an Amazing Tensorflow Chatbot Easily” at Youtube. His github repository for this project are located here : https://github.com/IISourcecell/tensorflow_chatbot.

1.1 Problem Statement

We would like to tackle the problem of communication between people through the help of a chatbot. There are some children in this world where their parents are too busy and do not have enough time to spend time with their children, this may result in them having trouble conversing with others as they had a lack of communication with others. This is where UNK would come in, she will be their chatting partner, teaching how to converse with others.

2. Technical Specifications

2.1 Solution Features

Project UNK uses two Long Short-Term Memory (LSTM) networks, which is a special type of Recurrent Neural Network that has capabilities to store long term dependencies. This special characteristic of LSTM allows the chatbot to remember previous conversations, hence being able to generate a more natural reply during conversations. One LSTM will act as the encoder that reads input sentences, while the other will act as a decoder that displays the output sentences. This architecture is called Sequence-to-sequence model, and it is commonly implemented in various chatbots.

2.2 Solution Design Architecture

To build the entire Sequence-to-Sequence model, we used Tensorflow. Tensorflow is an open-source machine learning library developed by Google. In Tensorflow, the Sequence-to-Sequence model is available as a library that is ready to use. To implement it, we need to define all operations and “Tensors” (Tensor is a multidimensional array, in Tensorflow terminologies), then execute it by running the current session’s object.

Once we built up the basis of UNK, we must train her with different data sets as weights to develop its knowledge in regards to chatting with real people. The data sets that are being used are Cornell Movie-Dialogues Corpus, which is a collection of movie dialogs from 617 different movies, compiled by Cornell University.

We are training the chatbot with a 3 layer LSTM with a layer of 256 each in addition to a vocabulary size of 20,000. Its learning rate is set to 0.5 out of 1. This method allows UNK to analyze the data at a slower pace but still efficient. The training data size is set to zero, therefore having no limit to her learning. There is also a checkpoint so that the model parameters are saved and implemented every 500 training sessions, we are able to check on the progress of UNK’s development at every new implementation with a test conversation.

To enhance the learning performance of UNK, we are using Tensorflow with GPU support. For this final project, the Computer Science Faculty is kind enough to let us utilize their PC that is equipped with an Nvidia Titan X. To utilize the computing power of Nvidia Titan X, we need to install Cuda Toolkit 8 (<https://developer.nvidia.com/cuda-toolkit>) and cuDNN 5.1 (<https://developer.nvidia.com/cudnn>).

3. Program Manual

3.1 Code Snippets

```
1 [strings]
2 # Mode : train, test, serve
3 # mode = train
4 mode = test
5 train_enc = data/train.enc
6 train_dec = data/train.dec
7 test_enc = data/test.enc
8 test_dec = data/test.dec
9 # edit test.enc to test.dec by Ken
10
11 # folder where checkpoints, vocabulary, temporary data will be stored
12 working_directory = working_dir/
13 [ints]
14 # vocabulary size
15 # 20,000 is a reasonable size
16 enc_vocab_size = 20000
17 dec_vocab_size = 20000
18 # number of LSTM layers : 1/2/3
19 num_layers = 3
20 # typical options : 128, 256, 512, 1024
21 layer_size = 256
22 # dataset size limit; typically none : no limit
23 max_train_data_size = 0
24 batch_size = 64
25 # steps per checkpoint
26 # Note : At a checkpoint, models parameters are saved, model is evaluated
27 # and results are printed
28 steps_per_checkpoint = 500
29 [floats]
30 learning_rate = 0.5
31 learning_rate_decay_factor = 0.99
32 max_gradient_norm = 5.0
```

Seq2seq.ini

```
124 def train():
125     # prepare dataset
126     print("Preparing data in %s" % gConfig['working_directory'])
127     enc_train, dec_train, enc_dev, _, _ = data_utils.prepare_custom_data(gConfig['working_directory'], gConfig['train_enc'], gConfig['train_dec'], gConfig['test_enc'], g
128
129     # Only allocate 2/3 of the gpu memory to allow for running gpu-based predictions while training:
130     gpu_options = tf.GPUOptions(per_process_gpu_memory_fraction=0.666)
131     config = tf.ConfigProto(gpu_options=gpu_options)
132     config.gpu_options.allocator_type = 'BFC'
133
134     with tf.Session(config=config) as sess:
135         # Create model.
136         print("Creating %d layers of %d units." % (gConfig['num_layers'], gConfig['layer_size']))
137         model = create_model(sess, False)
138
139         # Read data into buckets and compute their sizes.
140         print("Reading development and training data (limit: %d)."
141               % gConfig['max_train_data_size'])
142         dev_set = read_data(enc_dev, dec_dev)
143         train_set = read_data(enc_train, dec_train, gConfig['max_train_data_size'])
144         train_bucket_sizes = [len(train_set[b]) for b in xrange(len(_buckets))]
145         train_total_size = float(sum(train_bucket_sizes))
146
147         # A bucket scale is a list of increasing numbers from 0 to 1 that we'll use
148         # to select a bucket. Length of [scale[i], scale[i+1]] is proportional to
149         # the size of the i-th training bucket, as used later.
150         train_buckets_scale = [sum(train_bucket_sizes[:i + 1]) / train_total_size
151                               for i in xrange(len(train_bucket_sizes))]
152
153         # This is the training loop.
154         step_time, loss = 0.0, 0.0
155         current_step = 0
156         previous_losses = []
157         while True:
158             # Choose a bucket according to data distribution. We pick a random number
159             # in [0, 1] and use the corresponding interval in train_buckets_scale.
160             random_number_01 = np.random.random_sample()
161             bucket_id = min([i for i in xrange(len(train_buckets_scale))
162                             if train_buckets_scale[i] > random_number_01])
163
164             # Get a batch and make a step.
```

Train function

```

163
164 # Get a batch and make a step.
165 start_time = time.time()
166 encoder_inputs, decoder_inputs, target_weights = model.get_batch(
167     train_set, bucket_id)
168 _, step_loss, _ = model.step(sess, encoder_inputs, decoder_inputs,
169                               target_weights, bucket_id, False)
170 step_time += (time.time() - start_time) / gConfig['steps_per_checkpoint']
171 loss += step_loss / gConfig['steps_per_checkpoint']
172 current_step += 1
173
174 # Once in a while, we save checkpoint, print statistics, and run evals.
175 if current_step % gConfig['steps_per_checkpoint'] == 0:
176     # Print statistics for the previous epoch.
177     perplexity = math.exp(loss) if loss < 300 else float('inf')
178     print("Global step %d learning rate %.4f step-time %.2f perplexity "
179           "%.2f" % (model.global_step.eval(), model.learning_rate.eval(),
180                     step_time, perplexity))
181     # Decrease learning rate if no improvement was seen over last 3 times.
182     if len(previous_losses) > 2 and loss > max(previous_losses[-3:]):
183         sess.run(model.learning_rate_decay_op)
184     previous_losses.append(loss)
185     # Save checkpoint and reset timer and loss.
186     checkpoint_path = os.path.join(gConfig['working_directory'], "seq2seq.ckpt")
187     model.saver.save(sess, checkpoint_path, global_step=model.global_step)
188     step_time, loss = 0.0, 0.0
189     # Run evals on development set and print their perplexity.
190     for bucket_id in xrange(len(_buckets)):
191         if len(dev_set[bucket_id]) == 0:
192             print(" eval: empty bucket %d" % (bucket_id))
193             continue
194         encoder_inputs, decoder_inputs, target_weights = model.get_batch(
195             dev_set, bucket_id)
196         _, eval_loss, _ = model.step(sess, encoder_inputs, decoder_inputs,
197                                     target_weights, bucket_id, True)
198         eval_ppx = math.exp(eval_loss) if eval_loss < 300 else float('inf')
199         print(" eval: bucket %d perplexity %.2f" % (bucket_id, eval_ppx))
200         sys.stdout.flush()
201
202

```

Train function

```

203 def decode():
204
205     # Only allocate part of the gpu memory when predicting.
206     gpu_options = tf.GPUOptions(per_process_gpu_memory_fraction=0.2)
207     config = tf.ConfigProto(gpu_options=gpu_options)
208
209     with tf.Session(config=config) as sess:
210         # Create model and load parameters.
211         model = create_model(sess, True)
212         model.batch_size = 1 # We decode one sentence at a time.
213
214         # Load vocabularies.
215         enc_vocab_path = os.path.join(gConfig['working_directory'], "vocab%d.enc" % gConfig['enc_vocab_size'])
216         dec_vocab_path = os.path.join(gConfig['working_directory'], "vocab%d.dec" % gConfig['dec_vocab_size'])
217
218         enc_vocab, _ = data_utils.initialize_vocabulary(enc_vocab_path)
219         _, rev_dec_vocab = data_utils.initialize_vocabulary(dec_vocab_path)
220
221         # Decode from standard input.
222         sys.stdout.write("> ")
223         sys.stdout.flush()
224         sentence = sys.stdin.readline()
225         while sentence:
226             # Get token-ids for the input sentence.
227             token_ids = data_utils.sentence_to_token_ids(tf.compat.as_bytes(sentence), enc_vocab)
228             # Which bucket does it belong to?
229             bucket_id = min([b for b in xrange(len(_buckets))
230                             if _buckets[b][0] > len(token_ids)])
231             # Get a 1-element batch to feed the sentence to the model.
232             encoder_inputs, decoder_inputs, target_weights = model.get_batch(
233                 {bucket_id: [(token_ids, [])]}, bucket_id)
234             # Get output logits for the sentence.
235             _, _, output_logits = model.step(sess, encoder_inputs, decoder_inputs,
236                                             target_weights, bucket_id, True)
237             # This is a greedy decoder - outputs are just argmaxes of output logits.
238             outputs = [int(np.argmax(logit, axis=1)) for logit in output_logits]
239             # If there is an EOS symbol in outputs, cut them at that point.
240             if data_utils.EOS_ID in outputs:
241                 outputs = outputs[:outputs.index(data_utils.EOS_ID)]
242             # Print out French sentence corresponding to outputs.
243             print(" ".join([tf.compat.as_str(rev_dec_vocab[output]) for output in outputs]))
244             print("> ", end="")
245             sys.stdout.flush()
246             sentence = sys.stdin.readline()
247

```

Decode function

3.2 Screenshots

3.2.1 Data Set Training

```
63019 you bring trunks, Jack?
63020 You believe this? The kid won't come out. I'm playing 'Camptown Races' for him and the next thing I know he's locked himself in the bathroom. There's nothing sharp
in there, is there?
63021 Where are our kids? Has he got one of them in there?
63022 Baker.
63023 Teeth.
63024 They're falling out.
63025 How many?
63026 No bones?
63027 Don't worry, Mr. Baker. We'll knock him out. He won't feel a thing.
63028 The sooner we do this the better, Mr. Baker.
63029 No.
63030 Two at a time?
63031 Oh.
63032 Accident?
63033 Go fuck yourself.
63034 How's the birthday girl?
63035 I thought maybe held gotten over that.
63036 Yes, yes. It's just that John is so much nicer. Jack sounds so ... crude. When I was a little girl, we had a pig on the farm named Jack. I guess I just can't help
making the association.
63037 Catholics. What do you expect? Oh, well, what's in a name, right? Let's go inside and have a look at that cake.
63038 Recognize these two characters?
63039 In the attic. Behind some of Dad's stuff. Look, Jack can hardly reach the pedals.
63040 I had a boy down at the camera shop cut them all together. Boy, old man Henderson didn't fool around when he gave a haircut, did he, Jack?
63041 Wait. Watch. Here comes Dad.
63042 Out.
63043 Wednesday next. Frank looks across the room at Jack.
63044 Two nights.
63045 How we doing?
63046 Am I late?
63047 What's the point?
63048 You want me to show up late a few nights?
63049 Frank. I'm here. I always get here. Don't sweat it.
63050 You look like you just crawled out of bed.
63051 Twenty-eight years, Frank.
63052 Lotta water.
63053 Like an angel.
63054 Huh?
63055 Jack...
63056 Fuck him.
63057 Fuck him.
63058 Maybe Thursday. I hear the harpist at the Sheraton's got appendicitis.
63059 I hate your kids. Frank
```

Train Decoder

```
108096 Why don't we all turn in? It's been a long day.
108097 You can't expect to iron out all the kinks in one night.
108098 Why certainly. Don't you, Frau Blucher?
108099 The doctor said to allow seven minutes: no more and no less -- or else they could both become hopelessly paralyzed.
108100 Four.
108101 Yes.
108102 Absolutely! May my mother grow two heads if I'm not telling the truth.
108103 Sounds like visitors. It's all right -- Frau Blucher will show them in.
108104 Igor -- the clock! Hurry!
108105 Do Something! Stall them!
108106 Food!
108107 Oh, no sir-ee. If you don't have a reservation you can skip to ma-loo.
108108 Now just one moment. There's no need for roughhousing. Have you ever tried a tip?
108109 Franz! Help! Lunatic!
108110 I listened extra careful to your "Stand To" this mornin', Boy. It was perfect I couldn't 've done it better meself, not even when I was Bugler to The Duke Of
Wellington.. now tell me, where did you get that black eye?
108111 So, you got it in the line of dooty... point taken.
108112 Could be. Across the river into Zululand. They might just be waiting there for us to show up... them stabbing assegais pointing right at our bellies!...
108113 One Zulu is only one man... and I'm afeared of no one man... but the Zulu, they come in the thousands.... like a black wave of death.... in the thousands.... and them
assegais.... stabbing!
108114 Excuse me, My Lord. Norris-Newman, of "The Standard", My Lord.
108115 Indeed I did, My Lord. It was one of the first to cross.
108116 They spurred onto high ground, My Lord, full of spirit and looking for the Zulu. Full of sport they were, My Lord.
108117 So attack is your defence. Well let's hope Cetshwayo will offer his Impis full destruction.
108118 I thought it might be more effective to find someone who speaks Zulu.
108119 I have received intelligence from, sources of my own that the Zulu Impis are moving North of here and threaten your left.
108120 I'm explaining my reasons.
108121 And the threat of counter invasion no longer exists? 40
108122 Er, called Noggis, Sir Actual name is Norris-Newman. He presented credentials from "The Standard".
108123 Thank you.
108124 A large party of Zulus have been sighted in the direction of the King's Kraal. Getting up, CHELMSFORD moves over to look at the map on his desk.
108125 Certainly, Sir.
108126 Yes.
108127 Well, my horses are feeding, as you may observe, Mr Coghill. It'll take a little while.
108128 Right. Bombardier, to me please.
108129 Um. There are rumours that my Lord Chelmsford intends to make Durnford Second in Command.
108130 Which one?
108131 It could be you flatten yourself Coghill. It's that odd eye.
108132 Keep steady. You're the best shots of the Twenty-Fourth. You bunch of heathens, do it.
108133 Good ones, yes, Mr Vereker. Gentlemen who can ride and shoot.
108134 I'm to take the Sikali with the main column to the river.
108135 I think Chelmsford wants a good man on the border why he fears a flanking attack and requires a steady Commander in reserve.
```

Train Decoder

48615 naturally follow. Do you go along with this belief?
 48616 Don't we need a leader capable of guiding us through the seasons? The bad as well as the good?
 48616 Well, Mr. Gardiner, from the sound of our audience, I'd say that your words are a most welcome respite from what we've been hearing from others...
 48617 Hello, Thomas... I'm Chance, the gardener.
 48618 ... We're with Franklin, Jennings and Roberts, the law firm handling the estate.
 48619 ... You've been quite a source of humor, Mr. Chance - but all kidding aside, may I ask just what you are doing here?
 48620 You live here? ... We don't have any record of that.
 48621 ... How long have you been living here?
 48622 Do you have any proof of your employment, Mr. Chance - any checks from the deceased, any contracts or documents?
 48623 How were you compensated for these duties you say you performed?
 48624 Mr. Chance, perhaps you could show us some identification with your address -- a Driver's License, a credit card, checkbook?
 48625 Then how about medical records? Could you give us the name of your doctor, or your dentist?
 48626 ... Joe? Who's Joe?
 48627 Come now, Mr. Jennings had been bedridden for thirty-five years, since he fractured his spine.
 48628 ... We shall need some proof of your having resided here, Mr. Chance.
 48629 Have you served in the Army?
 48630 Those trees were very young when I first arrived.
 48631 ... Do you drive this, Mr. Chance?
 48632 The Old Man gave me nice television sets, this one has remote control. He has one just like it.
 48633 What are your plans now, Mr. Chance?
 48634 Mr. Chance, assuming what you say is the truth, I would like to know what sort of claim you are planning to make against the deceased's estate.
 48635 No, Thomas. I don't know how to sign.
 48636 I have no claim, Thomas.
 48637 Correct.
 48638 Move out? I don't understand, Thomas.
 48639 You look much taller on television, Mr. President.
 48640 Well, Mr. Gardiner, that's just fine with me - I'm a man that appreciates a frank discussion... Be seated, please, Mr. Gardiner...
 48641 Do you agree with Ben, Mr. Gardiner? Are we finished? Or do you think we can stimulate growth through temporary incentives?
 48642 Yes. It has.
 48643 Yes. I will.
 48644 ... Skip the levity, Kliney - what have you got?
 48645 ... Sid, be reasonable - I've been everywhere, there's no place left to check!
 48646 Sure, try again - where? There's nothing, it's like he never existed!
 48647 Sid, it's useless!
 48648 Oh, it wasn't all that bad, darling. We were fortunate that Mr. Gardiner turned out to be so reasonable.
 48649 Do you feel well enough for that?
 48650 Oh. I'm very sorry. Well, if you have any need for any of our facilities, please do not hesitate to ask.
 48651 I'm becoming quite attached to Chauncey - quite attached... ... And so are you, aren't you, Eve.
 48652 ... Ben, really...
 48653 I shall take the gentleman to the third floor guest suite, ma'am. Dr. Allenby is standing by.
 48654 Thank you, Gretta. I'll be with Mr. Rand if I'm needed.
 48655 Eve, child! How nice of you to come.
 48656 Oh, I've been just dying to meet you, Mr. Gardiner!

Train Encoder

108094 His what?

108095 It's working! Oh, Doctor -- you play beautifully.

108096 I'm getting tired.

108097 Look how far we've come.

108098 I think the doctor is a genius! Don't you, Igor?

108099 How do you know they're done?

108100 How long is it so far?

108101 Three minutes to go!

108102 Igor -- are you sure the monster has a good brain? Are you absolutely certain that you took the brain of Hans Delbruck that night?

108103

108104 Oh, must be around ten... ten-thirty.

108105 Another fifteen seconds to go.

108106 Do you have a reservation?

108107 Drink!

108108 Fooooooooo!

108109 GRRRRHHHHNNCKJHHHHNN!

108110 Will you hear "Last Post", Sir?

108111 From the Cook, Sir. They saw me dip your shaving tin in the tea-water this morning, made their tea taste of Lifebuoy toilet soap, they said Handing him the bottle of gin he pulled out rapier. 2x

108112 Will we be fighting the Zulus soon, Quartermaster?

108113 You afeared of the Zulus then, Quartermaster?

108114 An historical moment, Gentlemen.

108115 I saw you lead our Cavalry sir

108116 Were they in good heart as they entered enemy territory?

108117 Do not confuse yourself! Why? We must strike a heavy blow. This cannot be a war of manoeuvre.

108118 Oh... indeed, Crealock, we should see that Colonel Dumford has an Officer for his hard riders. Perhaps a subaltern from the Twenty Fourth.

108119 You intended to bring your reserves across the river?

108120 Are you dictating the strategy of this war, Sir?

108121 Tomorrow we will continue our advance on Ulundi. Dumford, kindly return to your unit. Bring them here immediately to support Pulleine. Mr Vereker will join you as ADC.

108122 Do you understand me clearly?

108123 What's that strange name the newspaper chap's called?

108124 The only reports of enemy activity have come from the direction of the Royal Kraal, at Ulundi.

108125 Yes?

108126 Splendid site, Crealock, splendid I want to establish Camp here immediately.

108127 Stuart?

108128 How quickly can you move your artillery forward?

108129 Well, fed on hungry, Pulleine wants them in position immediately. .

108130 Lighting CIGARETTE 5 cigars. Our good Colonel Dumford scored quite a coup with the Sikali Horse.

108131 Do you think she might be interested in someone?

108132 Well that one. The one who keeps looking at me.

108133 Choose your targets men. That's right Watch those markers. 55

108134 Colonel Durnford... William Vereker. I hear you 've been seeking Officers?

Train Encoder

3.2.2 Result

```
Command Prompt - python execute.py
eval: bucket 2 perplexity 184.54
eval: bucket 3 perplexity 125.43
global step 114500 learning rate 0.4300 step-time 0.32 perplexity 2.58
eval: bucket 0 perplexity 153.83
eval: bucket 1 perplexity 205.09
eval: bucket 2 perplexity 154.74
eval: bucket 3 perplexity 113.14
global step 115000 learning rate 0.4300 step-time 0.31 perplexity 2.53
eval: bucket 0 perplexity 130.29
eval: bucket 1 perplexity 138.00
eval: bucket 2 perplexity 212.84
eval: bucket 3 perplexity 120.09
global step 115500 learning rate 0.4300 step-time 0.32 perplexity 2.59
eval: bucket 0 perplexity 207.14
eval: bucket 1 perplexity 311.46
eval: bucket 2 perplexity 162.94
eval: bucket 3 perplexity 193.23
global step 116000 learning rate 0.4300 step-time 0.31 perplexity 2.53
eval: bucket 0 perplexity 122.42
eval: bucket 1 perplexity 151.38
eval: bucket 2 perplexity 209.93
eval: bucket 3 perplexity 179.52
global step 116500 learning rate 0.4300 step-time 0.32 perplexity 2.57
eval: bucket 0 perplexity 97.62
eval: bucket 1 perplexity 178.92
eval: bucket 2 perplexity 288.70
eval: bucket 3 perplexity 140.34
global step 117000 learning rate 0.4300 step-time 0.31 perplexity 2.50
eval: bucket 0 perplexity 131.92
eval: bucket 1 perplexity 211.24
eval: bucket 2 perplexity 110.90
eval: bucket 3 perplexity 145.07
global step 117500 learning rate 0.4300 step-time 0.30 perplexity 2.46
eval: bucket 0 perplexity 120.20
eval: bucket 1 perplexity 231.07
eval: bucket 2 perplexity 220.02
eval: bucket 3 perplexity 174.25
global step 118000 learning rate 0.4300 step-time 0.31 perplexity 2.56
eval: bucket 0 perplexity 118.06
eval: bucket 1 perplexity 242.07
eval: bucket 2 perplexity 170.64
eval: bucket 3 perplexity 149.52

C:\WINDOWS\system32\cmd.exe - python execute.py
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream_executor\dso_loader.cc:128] successfully opened CUDA library nvcuda.dll locally
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream_executor\dso_loader.cc:128] successfully opened CUDA library curand64_80.dll locally
>> Mode : test
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:885] Found device 0 with properties:
name: GeForce GTX TITAN X
major: 5 minor: 2 memoryClockRate (GHz) 1.076
pciBusID 0000:05:00:0
Total memory: 12.06GiB
Free memory: 10.06GiB
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:906] DMA: 0
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:916] 0: Y
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:975] Creating TensorFlow device (/gpu:0) -> (device: 0, name: GeForce GTX TITAN X, pci bus id: 0000:05:00:0)
WARNING:tensorflow:From D:\ResearchStudent\albertieuanAI\ChatBotGGG\seq2seq_model.py:166 in init_...: all variables (from tensorflow.python.ops.variables) is deprecated and will be removed after 2017-03-02.
Instructions for updating:
Please use tf.global variables instead.
Reading model parameters from working_dir/seq2seq.ckpt-118000
> hello
But , who ?
> Albert
_UNK
> Who is your father?
want inform of my ; .
> Who is your father ?
want inform of my ; .
> do you know anything about Albert ?
keep , _UNK ?
> do you know anything about Albert ?
keep , _UNK ?
> do you know Albert ?\
Bye _UNK you , sleep .
```

Global step at 118000 result

```
Command Prompt - python execute.py
eval: bucket 2 perplexity 496.60
eval: bucket 3 perplexity 410.26
global step 179000 learning rate 0.3379 step-time 0.31 perplexity 1.80
eval: bucket 0 perplexity 607.47
eval: bucket 1 perplexity 571.64
eval: bucket 2 perplexity 597.45
eval: bucket 3 perplexity 419.77
global step 179500 learning rate 0.3345 step-time 0.31 perplexity 1.79
eval: bucket 0 perplexity 552.89
eval: bucket 1 perplexity 773.37
eval: bucket 2 perplexity 461.37
eval: bucket 3 perplexity 401.21
global step 180000 learning rate 0.3345 step-time 0.31 perplexity 1.79
eval: bucket 0 perplexity 361.70
eval: bucket 1 perplexity 335.42
eval: bucket 2 perplexity 476.22
eval: bucket 3 perplexity 491.35
global step 180500 learning rate 0.3345 step-time 0.32 perplexity 1.80
eval: bucket 0 perplexity 542.20
eval: bucket 1 perplexity 729.04
eval: bucket 2 perplexity 495.93
eval: bucket 3 perplexity 492.28
global step 181000 learning rate 0.3345 step-time 0.32 perplexity 1.82
eval: bucket 0 perplexity 446.34
eval: bucket 1 perplexity 564.91
eval: bucket 2 perplexity 594.46
eval: bucket 3 perplexity 526.12
global step 181500 learning rate 0.3311 step-time 0.31 perplexity 1.79
eval: bucket 0 perplexity 442.94
eval: bucket 1 perplexity 1036.05
eval: bucket 2 perplexity 618.55
eval: bucket 3 perplexity 441.31
global step 182000 learning rate 0.3311 step-time 0.32 perplexity 1.81
eval: bucket 0 perplexity 778.49
eval: bucket 1 perplexity 974.25
eval: bucket 2 perplexity 611.00
eval: bucket 3 perplexity 578.64
global step 182500 learning rate 0.3311 step-time 0.31 perplexity 1.78
eval: bucket 0 perplexity 307.05
eval: bucket 1 perplexity 884.41
eval: bucket 2 perplexity 659.15
eval: bucket 3 perplexity 421.10

C:\WINDOWS\system32\cmd.exe - python execute.py
D:\ResearchStudent\albertieuanAI\ChatBotGGG>python execute.py
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream_executor\dso_loader.cc:128] successfully opened CUDA library cublas64_80.dll locally
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream_executor\dso_loader.cc:128] successfully opened CUDA library cudnn64_5.dll locally
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream_executor\dso_loader.cc:128] successfully opened CUDA library curand64_80.dll locally
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream_executor\dso_loader.cc:128] successfully opened CUDA library cuFFT64_80.dll locally
>> Mode : test
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:885] Found device 0 with properties:
name: GeForce GTX TITAN X
major: 5 minor: 2 memoryClockRate (GHz) 1.076
pciBusID 0000:05:00:0
Total memory: 12.06GiB
Free memory: 10.06GiB
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:906] DMA: 0
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:916] 0: Y
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\common_runtime\gpu\gpu_device.cc:975] Creating TensorFlow device (/gpu:0) -> (device: 0, name: GeForce GTX TITAN X, pci bus id: 0000:05:00:0)
WARNING:tensorflow:From D:\ResearchStudent\albertieuanAI\ChatBotGGG\seq2seq_model.py:166 in init_...: all variables (from tensorflow.python.ops.variables) is deprecated and will be removed after 2017-03-02.
Instructions for updating:
Please use tf.global variables instead.
Reading model parameters from working_dir/seq2seq.ckpt-182500
> hello
You know , absolutely ?
> who is your father?
I know it . . .
```

Global step 182500 result

```
Command Prompt - python execute.py
eval: bucket 3 perplexity 536.88
global step 207000 learning rate 0.2995 step-time 0.32 perplexity 1.64
eval: bucket 0 perplexity 252.80
eval: bucket 1 perplexity 728.31
eval: bucket 2 perplexity 2034.15
eval: bucket 3 perplexity 361.15
global step 207500 learning rate 0.2995 step-time 0.32 perplexity 1.67
eval: bucket 0 perplexity 949.51
eval: bucket 1 perplexity 1226.06
eval: bucket 2 perplexity 901.30
eval: bucket 3 perplexity 1402.76
global step 208000 learning rate 0.2965 step-time 0.31 perplexity 1.64
eval: bucket 0 perplexity 464.41
eval: bucket 1 perplexity 1962.87
eval: bucket 2 perplexity 1822.53
eval: bucket 3 perplexity 643.40
global step 208500 learning rate 0.2965 step-time 0.32 perplexity 1.65
eval: bucket 0 perplexity 901.84
eval: bucket 1 perplexity 503.77
eval: bucket 2 perplexity 678.07
eval: bucket 3 perplexity 710.57
global step 209000 learning rate 0.2965 step-time 0.30 perplexity 1.60
eval: bucket 0 perplexity 364.64
eval: bucket 1 perplexity 907.00
eval: bucket 2 perplexity 1085.54
eval: bucket 3 perplexity 584.89
global step 209500 learning rate 0.2965 step-time 0.30 perplexity 1.58
eval: bucket 0 perplexity 885.86
eval: bucket 1 perplexity 1225.88
eval: bucket 2 perplexity 2394.30
eval: bucket 3 perplexity 1155.74
global step 210000 learning rate 0.2965 step-time 0.30 perplexity 1.59
eval: bucket 0 perplexity 277.00
eval: bucket 1 perplexity 1479.67
eval: bucket 2 perplexity 783.66
eval: bucket 3 perplexity 1071.56
global step 210500 learning rate 0.2965 step-time 0.32 perplexity 1.64
eval: bucket 0 perplexity 444.15
eval: bucket 1 perplexity 1194.36
eval: bucket 2 perplexity 801.13
eval: bucket 3 perplexity 1197.43
global step 211000 learning rate 0.2935 step-time 0.32 perplexity 1.63

C:\WINDOWS\system32\cmd.exe - py execute.py
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream
executor\dso_loader.cc:128] successfully opened CUDA library curand64_80.dll local
y
>> Mode : test
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:885] Found device 0 with properties:
name: GeForce GTX TITAN X
major: 5 minor: 2 memoryClockRate (GHz) 1.076
pciBusID 0000:05:00.0
Total memory: 12.00GiB
Free memory: 10.06GiB
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:906] DMA: 0
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:916] 0: Y
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:975] Creating TensorFlow device (/dev:0) -> (device:
0, name: GeForce GTX TITAN X, pci bus id: 0000:05:00.0)
WARNING:tensorflow:From D:\ResearchStudent\albertieuanAI\ChatBotGG5\seq2seq_model.p
y:166 in __init__: all_variables (from tensorflow.python.ops.variables) is deprec
ated and will be removed after 2017-03-02.
Instructions for updating:
Please use tf.global_variables instead.
Reading model parameters from working_dir/seq2seq.ckpt-210500
> hello
Do you The to go ?
> how are you ?
keep , If lot !
> do you know me ?
Had ?
> had what?
Do you know just it , And it ! And
> and ?
ever .
> never ?
why ?
> because i love you ?
No .
> i don't want to go
serious me now evil .
>
```

Global step at 210500 result

```
Command Prompt - python execute.py
eval: bucket 3 perplexity 24340.04
global step 336500 learning rate 0.1758 step-time 0.32 perplexity 1.21
eval: bucket 0 perplexity 5662.62
eval: bucket 1 perplexity 7255.97
eval: bucket 2 perplexity 14822.49
eval: bucket 3 perplexity 13012.42
global step 337000 learning rate 0.1740 step-time 0.31 perplexity 1.20
eval: bucket 0 perplexity 21900.46
eval: bucket 1 perplexity 16181.05
eval: bucket 2 perplexity 21192.79
eval: bucket 3 perplexity 11639.08
global step 337500 learning rate 0.1740 step-time 0.31 perplexity 1.21
eval: bucket 0 perplexity 3479.51
eval: bucket 1 perplexity 19638.41
eval: bucket 2 perplexity 10138.65
eval: bucket 3 perplexity 8957.20
global step 338000 learning rate 0.1740 step-time 0.32 perplexity 1.20
eval: bucket 0 perplexity 5423.41
eval: bucket 1 perplexity 13849.55
eval: bucket 2 perplexity 21092.48
eval: bucket 3 perplexity 6531.68
global step 338500 learning rate 0.1740 step-time 0.30 perplexity 1.19
eval: bucket 0 perplexity 8941.38
eval: bucket 1 perplexity 7887.74
eval: bucket 2 perplexity 58553.24
eval: bucket 3 perplexity 10817.68
global step 339000 learning rate 0.1740 step-time 0.31 perplexity 1.19
eval: bucket 0 perplexity 4770.64
eval: bucket 1 perplexity 43326.57
eval: bucket 2 perplexity 43558.12
eval: bucket 3 perplexity 8825.16
global step 339500 learning rate 0.1740 step-time 0.32 perplexity 1.19
eval: bucket 0 perplexity 2095.24
eval: bucket 1 perplexity 22023.65
eval: bucket 2 perplexity 36424.48
eval: bucket 3 perplexity 14061.41
global step 340000 learning rate 0.1740 step-time 0.31 perplexity 1.19
eval: bucket 0 perplexity 11582.62
eval: bucket 1 perplexity 14385.67
eval: bucket 2 perplexity 11396.03
eval: bucket 3 perplexity 7903.00
global step 340500 learning rate 0.1723 step-time 0.31 perplexity 1.18

C:\WINDOWS\system32\cmd.exe - py execute.py
Please use tf.global_variables instead.
Reading model parameters from working_dir/seq2seq.ckpt-254000
> hello
Now telling 'till right here .
> i don't want to go .
be are you before here ?
> where are you?
seen I more to how it cry .
> please help me
Do you know her Look find ?
> where to find ?
mistake hasn as I .
> you made a mistake !
I ' m we been
> something fishy
I more to course him in They better .
> You are awful !
I have to would !
> You are so mean !
note ' s human . his go to my Anna
> You are so mean
Why are you Yes Yes sick ?
> Yes
cars .
> Yes ?
But , Who .
> Who are You ?
make the Great .
> who are You ?
serious me Would .
> who are you ?
reason ?
> who are you?
reason ?
> i want to know you
want three tomorrow me to If all a Ya .
> i want to know You
But .
> But .
Job , afraid .
> do you have a job ?
be them you would ?
>
```

Global step at 254000 result


```
Command Prompt - python execute.py
eval: bucket 2 perplexity 10138.65
eval: bucket 3 perplexity 8957.20
global step 338000 learning rate 0.1740 step-time 0.32 perplexity 1.20
eval: bucket 0 perplexity 5423.41
eval: bucket 1 perplexity 13849.55
eval: bucket 2 perplexity 21092.48
eval: bucket 3 perplexity 6531.68
global step 338500 learning rate 0.1740 step-time 0.30 perplexity 1.19
eval: bucket 0 perplexity 8941.38
eval: bucket 1 perplexity 7887.74
eval: bucket 2 perplexity 58553.24
eval: bucket 3 perplexity 10817.68
global step 339000 learning rate 0.1740 step-time 0.31 perplexity 1.19
eval: bucket 0 perplexity 4770.64
eval: bucket 1 perplexity 43326.57
eval: bucket 2 perplexity 43558.12
eval: bucket 3 perplexity 8825.16
global step 339500 learning rate 0.1740 step-time 0.32 perplexity 1.19
eval: bucket 0 perplexity 2895.24
eval: bucket 1 perplexity 22023.65
eval: bucket 2 perplexity 36424.48
eval: bucket 3 perplexity 14061.41
global step 340000 learning rate 0.1740 step-time 0.31 perplexity 1.19
eval: bucket 0 perplexity 11582.62
eval: bucket 1 perplexity 14385.67
eval: bucket 2 perplexity 11396.03
eval: bucket 3 perplexity 7903.00
global step 340500 learning rate 0.1723 step-time 0.31 perplexity 1.18
eval: bucket 0 perplexity 5212.41
eval: bucket 1 perplexity 13727.40
eval: bucket 2 perplexity 25139.35
eval: bucket 3 perplexity 11077.59
global step 341000 learning rate 0.1723 step-time 0.32 perplexity 1.18
eval: bucket 0 perplexity 1832.30
eval: bucket 1 perplexity 28985.40
eval: bucket 2 perplexity 7106.69
eval: bucket 3 perplexity 14137.87
global step 341500 learning rate 0.1723 step-time 0.31 perplexity 1.18
eval: bucket 0 perplexity 4779.06
eval: bucket 1 perplexity 12570.47
eval: bucket 2 perplexity 27391.34
eval: bucket 3 perplexity 9980.74

C:\WINDOWS\system32\cmd.exe - py execute.py
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream
executor\dso_loader.cc:128] successfully opened CUDA library nvcuda.dll locally
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream
executor\dso_loader.cc:128] successfully opened CUDA library curand64_80.dll locally

>> Mode : test

I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:885] Found device 0 with properties:
name: GeForce GTX TITAN X
major: 5 minor: 2 memoryClockRate (GHz) 1.076
pciBusID 0000:05:00:0
Total memory: 12.00GiB
Free memory: 10.06GiB
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:906] DMA: 0
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:916] 0: Y
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:975] Creating TensorFlow device (/gpu:0) -> (device:
0, name: GeForce GTX TITAN X, pci bus id: 0000:05:00:0)
WARNING:tensorflow:From D:\ResearchStudent\albertieuanAI\ChatBotGGG\seq2seq_model.p
y:166 in __init__: all_variables (from tensorflow.python.ops.variables) is deprec
ated and will be removed after 2017-03-02.
Instructions for updating:
Please use tf.global_variables instead.
Reading model parameters from working_dir/seq2seq.ckpt-341000
> hello
Do you The to have a sex ?
> hi
be ?
> hello
Do you The to have a sex ?
> Are you there ?
But .
> i don't want to go
serious me next !
> hello there
I ' m doing stir to know .
> do you know me ?
' Miss I Sure ' t things said more to get not better .
```

Global step 341000 result

```
Command Prompt - python execute.py
eval: bucket 2 perplexity 11186229.73
eval: bucket 3 perplexity 3886606.87
global step 980000 learning rate 0.0077 step-time 0.31 perplexity 1.02
eval: bucket 0 perplexity 299156.10
eval: bucket 1 perplexity 1140029.47
eval: bucket 2 perplexity 2143277.01
eval: bucket 3 perplexity 8869296.18
global step 980500 learning rate 0.0076 step-time 0.32 perplexity 1.02
eval: bucket 0 perplexity 970515.39
eval: bucket 1 perplexity 2357937.57
eval: bucket 2 perplexity 19038875.74
eval: bucket 3 perplexity 2964471.36
global step 981000 learning rate 0.0076 step-time 0.32 perplexity 1.02
eval: bucket 0 perplexity 197922.73
eval: bucket 1 perplexity 3993505.82
eval: bucket 2 perplexity 10569498.33
eval: bucket 3 perplexity 5924734.62
global step 981500 learning rate 0.0076 step-time 0.32 perplexity 1.02
eval: bucket 0 perplexity 273988.03
eval: bucket 1 perplexity 11662762.37
eval: bucket 2 perplexity 5377079.11
eval: bucket 3 perplexity 2182412.65
global step 982000 learning rate 0.0076 step-time 0.31 perplexity 1.02
eval: bucket 0 perplexity 259218.21
eval: bucket 1 perplexity 1622368.16
eval: bucket 2 perplexity 7324126.77
eval: bucket 3 perplexity 10926996.79
global step 982500 learning rate 0.0076 step-time 0.30 perplexity 1.02
eval: bucket 0 perplexity 924031.73
eval: bucket 1 perplexity 1302974.31
eval: bucket 2 perplexity 7048301.30
eval: bucket 3 perplexity 9295917.72
global step 983000 learning rate 0.0076 step-time 0.31 perplexity 1.02
eval: bucket 0 perplexity 945474.63
eval: bucket 1 perplexity 1554193.90
eval: bucket 2 perplexity 2809707.24
eval: bucket 3 perplexity 3496340.34
global step 983500 learning rate 0.0075 step-time 0.30 perplexity 1.02
eval: bucket 0 perplexity 485561.60
eval: bucket 1 perplexity 2787932.32
eval: bucket 2 perplexity 11406814.83
eval: bucket 3 perplexity 8973177.13

C:\WINDOWS\system32\cmd.exe - python execute.py
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream
executor\dso_loader.cc:128] successfully opened CUDA library cudnn64_5.dll locally
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream
executor\dso_loader.cc:128] successfully opened CUDA library curand64_80.dll locally

I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream
executor\dso_loader.cc:128] successfully opened CUDA library nvcuda.dll locally
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\stream
executor\dso_loader.cc:128] successfully opened CUDA library curand64_80.dll locally

>> Mode : test

I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:885] Found device 0 with properties:
name: GeForce GTX TITAN X
major: 5 minor: 2 memoryClockRate (GHz) 1.076
pciBusID 0000:05:00:0
Total memory: 12.00GiB
Free memory: 10.06GiB
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:906] DMA: 0
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:916] 0: Y
I c:\tf_jenkins\home\workspace\release-win\device\gpu\os\windows\tensorflow\core\co
mmon_runtime\gpu\gpu_device.cc:975] Creating TensorFlow device (/gpu:0) -> (device:
0, name: GeForce GTX TITAN X, pci bus id: 0000:05:00:0)
WARNING:tensorflow:From D:\ResearchStudent\albertieuanAI\ChatBotGGG\seq2seq_model.p
y:166 in __init__: all_variables (from tensorflow.python.ops.variables) is deprec
ated and will be removed after 2017-03-02.
Instructions for updating:
Please use tf.global_variables instead.
Reading model parameters from working_dir/seq2seq.ckpt-983500
> hello world
That ' s right .
> who is your father?
I don ' t know .
> who is your father ?
I don ' t know .
> I ' m your father .
I don ' t Jesse the fucking you . stupid .
```

Global step 983500 result

4. Conclusion

A chatbot with AI implementation is like a child with an empty brain. This child must learn from her parent(s), which in this case are her creator(s). The learning or training part can be different according to the data set which was given by her parent(s). The creator(s) can determine how much data their daughter will study. More data would mean more time to learn/study. The creator can not only determine how much the data, but also the learning rate, the layer of LSTM and even the vocabulary. For our chatbot, we made her study 100,000 training data sets and a vocabulary of 20,000 with a learning rate of 0.5 which has different time for each computer depends on the specification of the computer. The perplexity will decrease for every time she learns more data.

Bibliography

Github Repositories

<https://github.com/1228337123/tensorflow-seq2seq-chatbot>

https://github.com/llSourcell/tensorflow_chatbot

Development Tools, Software, APIs, Libraries, Datasets

<https://www.tensorflow.org/>

<https://www.tensorflow.org/tutorials/seq2seq/>

https://www.cs.cornell.edu/~cristian/Cornell_Movie-Dialogs_Corpus.html

<https://developer.nvidia.com/cudnn>

<https://developer.nvidia.com/cuda-toolkit>

Helpful Articles and Videos

<https://www.youtube.com/watch?v=SJDEOWLHYVo>

<http://colah.github.io/posts/2015-08-Understanding-LSTMs/>