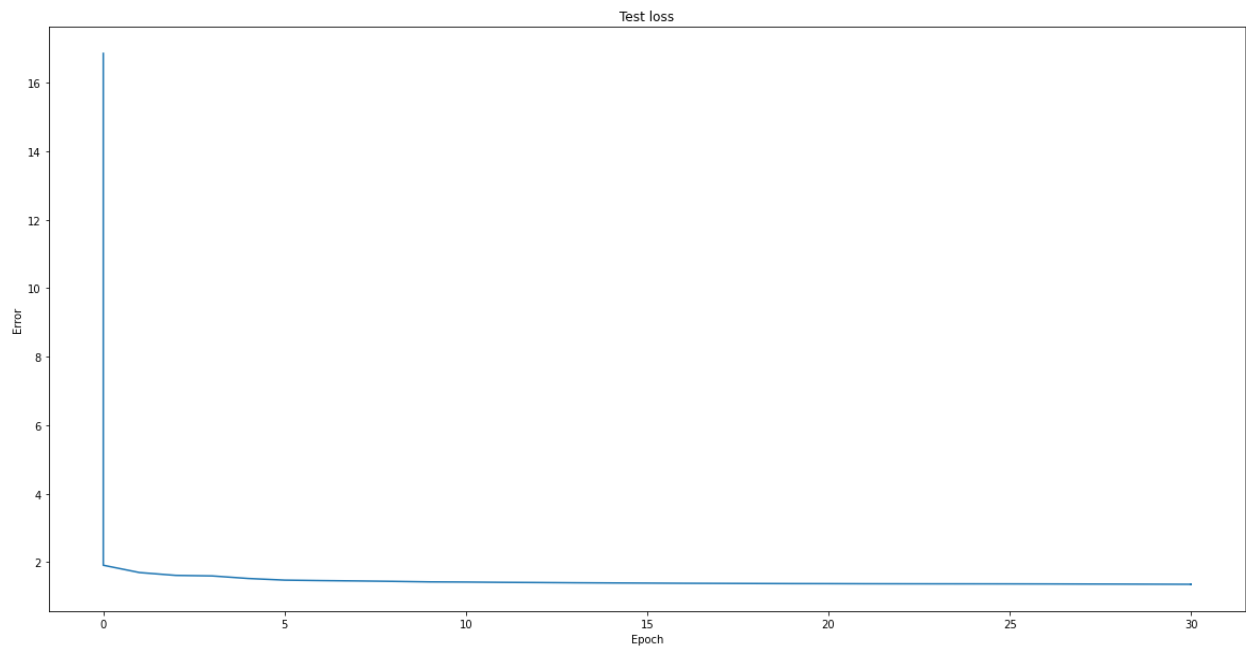
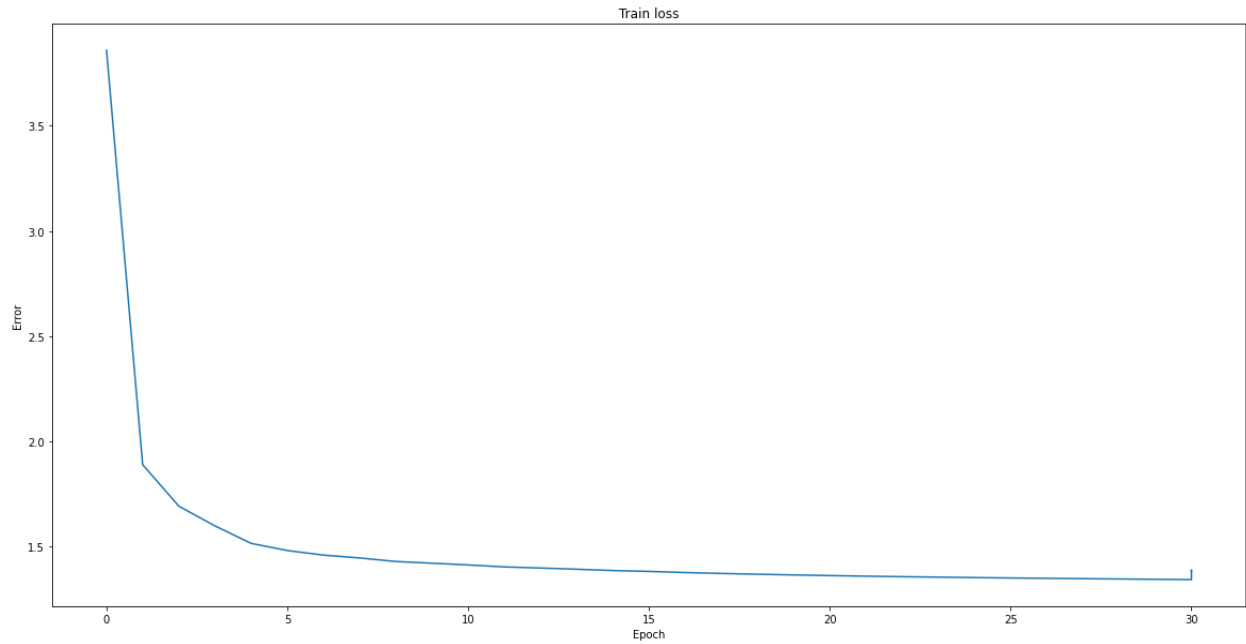
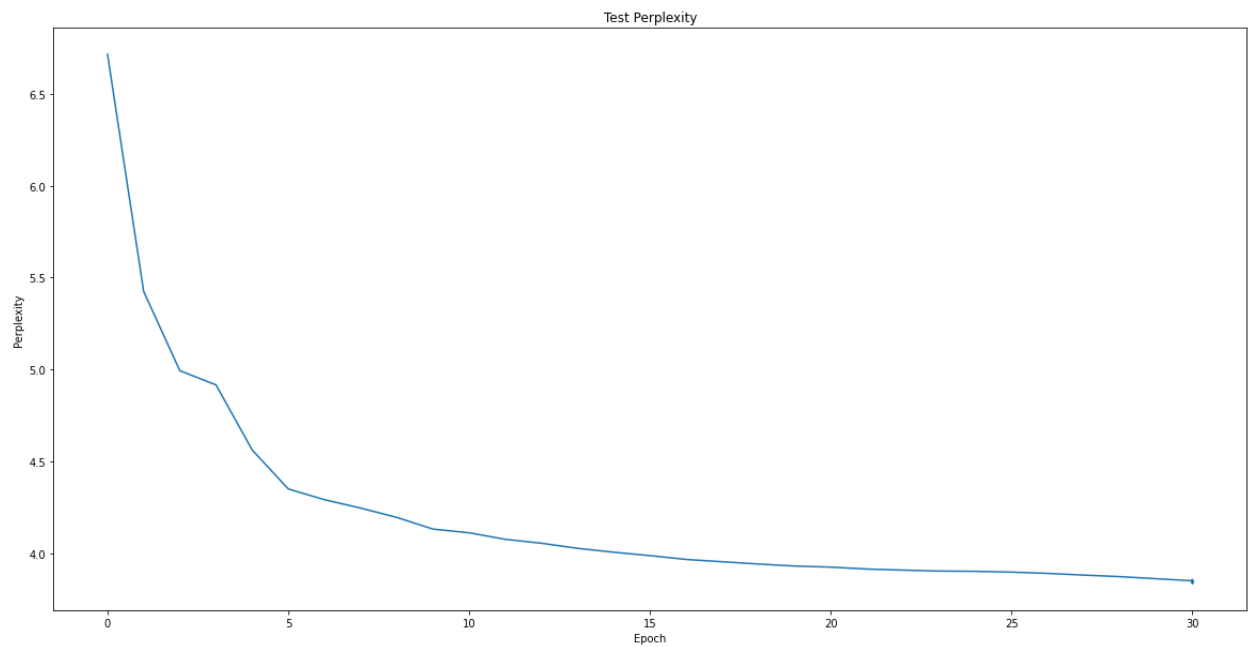
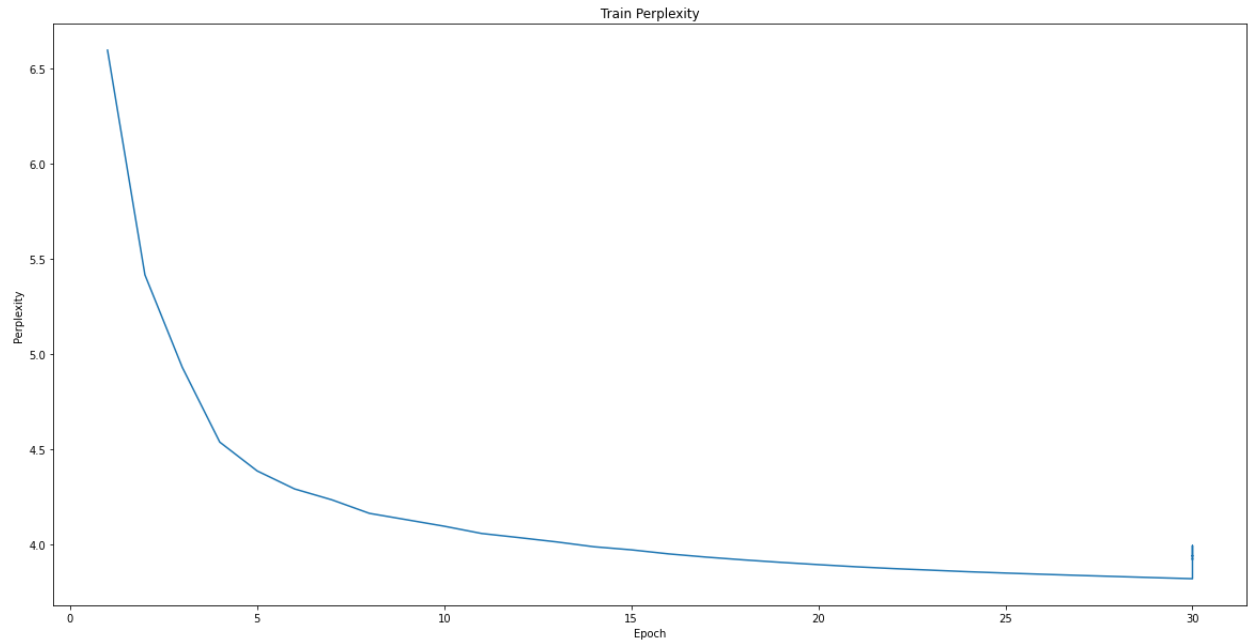


# Short Answer Questions

1. Just like last time, provide plots for training error, test error, and test accuracy. Also provide a plot of your train and test perplexity per epoch.





**2. What was your final test accuracy? What was your final test perplexity?**

My final test accuracy is 60%, and my test perplexity is 3.8234772661494376

**3. What was your favorite sentence generated via each of the sampling methods?  
What was the prompt you gave to generate that sentence?**

Generated with the default 'Harry Potter and the' with Temperature = 0.5

Max:

Harry Potter and the stairs were still because the start of the wall of his wand and the start of the corridor of the corridor of the corridor of the corridor to the staircase that he was still because th

Sample:

Harry Potter and the time were not the floor of the golden door on the fire of still of glasses were still off him and the wind of whom stuffing a great scround face.

Beam

Harry Potter and the train of tell with one of the corridor with here and difried on the room andined into its fire of taken.

**4. Which sampling method seemed to generate the best results? Why do you think that is?**

With a good parameter, the beam method seems to be the best in terms of the balance between accuracy and creativity. Although very subjective, I find that the beam doesn't have much repetitiveness as in the Max method, but seems to produce quite natural sentences. It is because we random and pick the top samples by the beam size. Sometimes, it won't choose the most probable words, but those choices could be better because it allows room for making interesting sentences.

**5. For sampling and beam search, try multiple temperatures between 0 and 2.**

- **Which produces the best outputs? Best as in made the most sense, your favorite, or funniest, doesn't really matter how you decide.**

I tried sampling search with temperature = 0.7

Harry Potter and the moment for the leart of burst of floor, deal what Harry are looked heart to the Gryffindor who had hurried on the shop writting himself, nor of course, what Madam Madame Macime had no mean with any m

It is funny because it stays quite far from the legitimate sentence, and most of them aren't very repetitive.

For the beam search, it actually is really good for beam size = 20 and temp = 0.7

Harry Potter and the only one who had been thinking on it in the one of terrible to tell the train of the first time into to see it. his eyes of his feet and into to start to see the door of magical entrance on the one o

I feel like this can come with creative sentences without much repetitiveness and is not terribly wrong in terms of vocabulary.

- **What does a temperature of 0 do? What does a temperature of  $0 < \text{temp} < 1$  do?**

Low temperature means every word will have a more similar chance to be rolled, so for temperature = 0, the word will be pretty much random and does not form a grammatically correct sentence.

- **What does a temperature of 1 do? What does a temperature of above 1 do? What would a negative temperature do (assuming the code allowed for negative temperature)?**

Temperature = 1 means nothing is done to the sampling, but for temperature > 1, it amplifies the probability of landing on a more common next word.. High temperature means it tends be more repetitive but produce more grammatically correct sentences.

## Other Things

### New Corpus

- **What corpus did you choose? How many characters were in it?**

I chose *The History of the Decline and Fall of the Roman Empire* by Edward Gibbon. There are 10,455,362 characters in the dataset.

- **What differences did you notice between the sentences generated with the new/vs old corpus.**

The tone of the generated sentences are completely different and much more formal, filled with difficult vocabularies and jargons. I feel like the vocabulary pool is significantly larger than Harry Potter's, so sometimes, the generator will usually come up with brand-new words, for example, experit, indeptine, possestimon.

- **Provide outputs for each sampling method on the new corpus (you can pick one temperature, but say what it was).**

Note that the temperature and beam size might be suboptimal

TEMPERATURE = 0.6

BEAM\_WIDTH = 10

generated with max The emperor of the Romans were alleged to the service of the prince of the emperor and the emperor of the emperor. The prophet of the emperor was seriously and in the service of the emperor of the emperor an

generated with sample The emperor of the Romans, the attach of Goderato, The adjant of Gratonia had been in they disciple to the right of the Casil descended by the same in a temper of his privilege and their reign. The emperor w

generated with sample The emperor of the Romans, and the religious and mourteent trouble of imperious in the emperor. The subject of the annal of seventies in the series had been in the destitution of the emperor monk of the Olin

generated with beam The emperor of the Romans, a more propertion is indeeded to at a tran of mean an armial prince on a serious apost of this indigial ancestral of his patriot areators of eit ard of an an ambasban of at a p

generated with beam The emperor of the Romans and reign of are moned to appellate a frield of a possession of a more attaine a motal posses of his primite apolied to trather to a mother of to about this interval on this original appelian

## Train by words

### 1. What new difficulties did you run into while training?

I ran through many difficulties while training the model

- 1) After replacing with unknown, it is hard to generate a new sentence without unknowns. I tried two different approaches. First, just remove every unknown word. This will break the grammar because the unknown word might be a verb or adjective or noun that we cannot simply replace. Second, replace every unknown word with randomly selected words from the pool. I didn't try this approach because the first one showed that it will break anyway as we don't know how the replacement words will fit in the sentence.. So, I decided that it should produce unknown in the sentence until the corpus has every word that occurs more than give

2) Changing the whole structure to accept strings instead of characters is challenging, but in the end, it is pretty straightforward when I understand what the codes do.

## 2. How large was your vocabulary?

The vocabulary size of the harry potter corpus is 14403 (including words ending with punctuations)

## 3. Did you find that different batch size, sequence length, and feature size and other hyperparameters were needed? If so, what worked best for you?

Yes, with smaller batch size and sequence length, the result improved drastically. Below are the best hyperparameters I could find:

SEQUENCE\_LENGTH = 16

BATCH\_SIZE = 64

FEATURE\_SIZE = 512

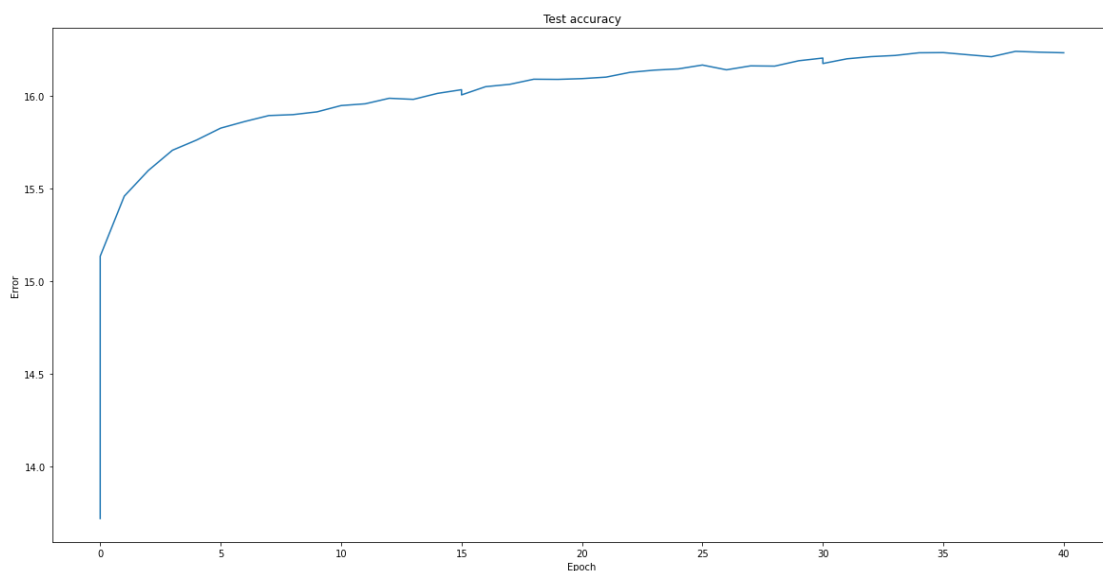
TEST\_BATCH\_SIZE = 128

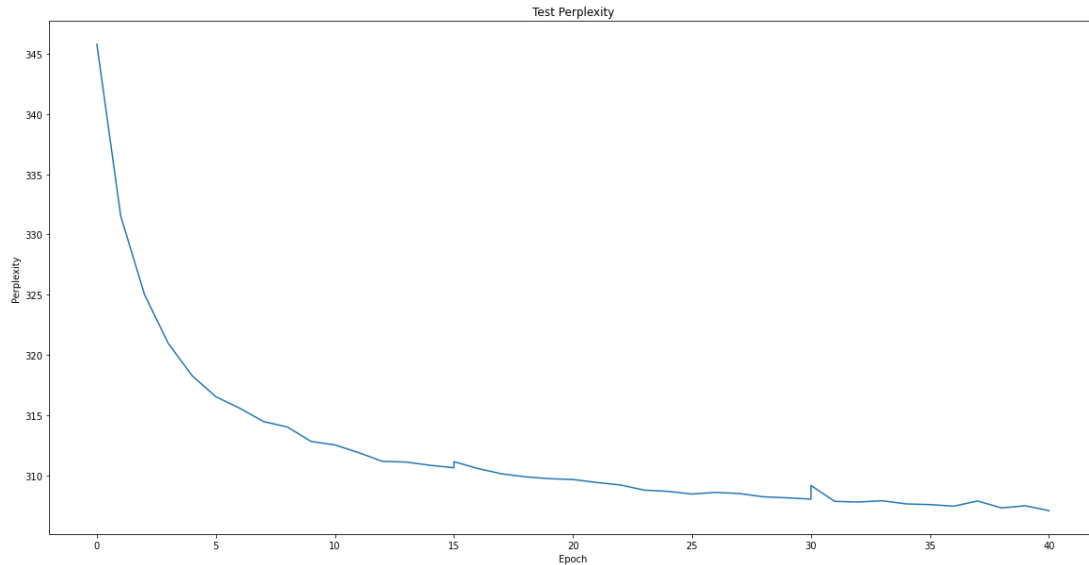
EPOCHS = 40

LEARNING\_RATE = 0.002

WEIGHT\_DECAY = 0.0005

Notice that there are two spikes occurring from loading the checkpoints, which is unintended. This network is converging around accuracy = 16%





This paragraph is generated with sample method:

Harry Potter, Voldemort, and Dumbledore walk into a bar. He was standing at the Prime <UNKNOWN> of the <UNKNOWN> <UNKNOWN> <UNKNOWN> Ron was <UNKNOWN> his wand back over his <UNKNOWN> <UNKNOWN> <UNKNOWN> <UNKNOWN> <UNKNOWN> <UNKNOWN> <UNKNOWN> <UNKNOWN> Harry told Ron looked as though he had not been <UNKNOWN> his own <UNKNOWN> the <UNKNOWN> of <UNKNOWN> he had been <UNKNOWN> but I was the <UNKNOWN> he was more from the first inside the wall of the <UNKNOWN>

I feel like it has a lot of potential if the corpus is larger so we have less <UNKNOWN> appearing.

## LSTM

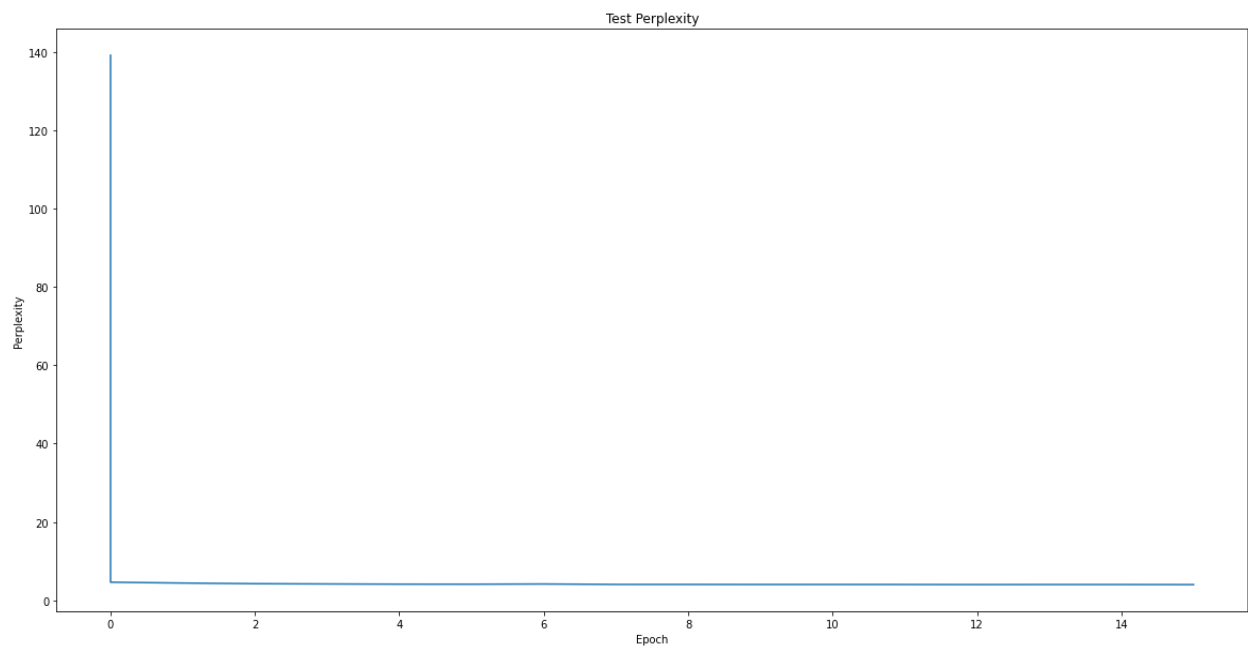
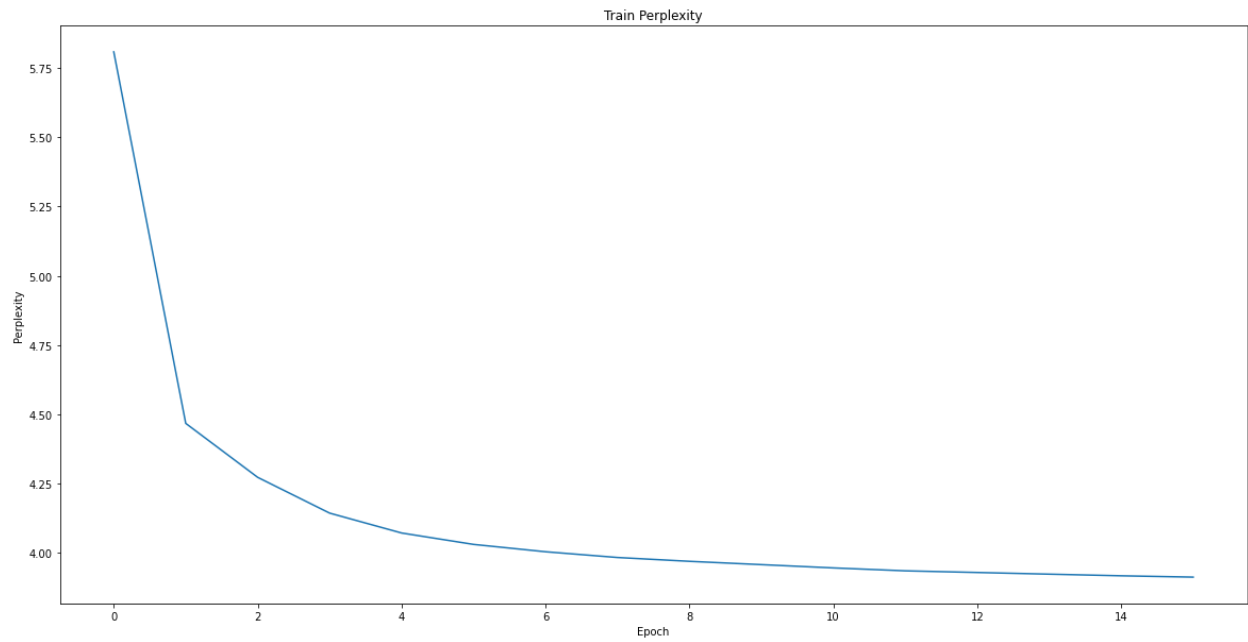
### 1. What new difficulties did you run into while training?

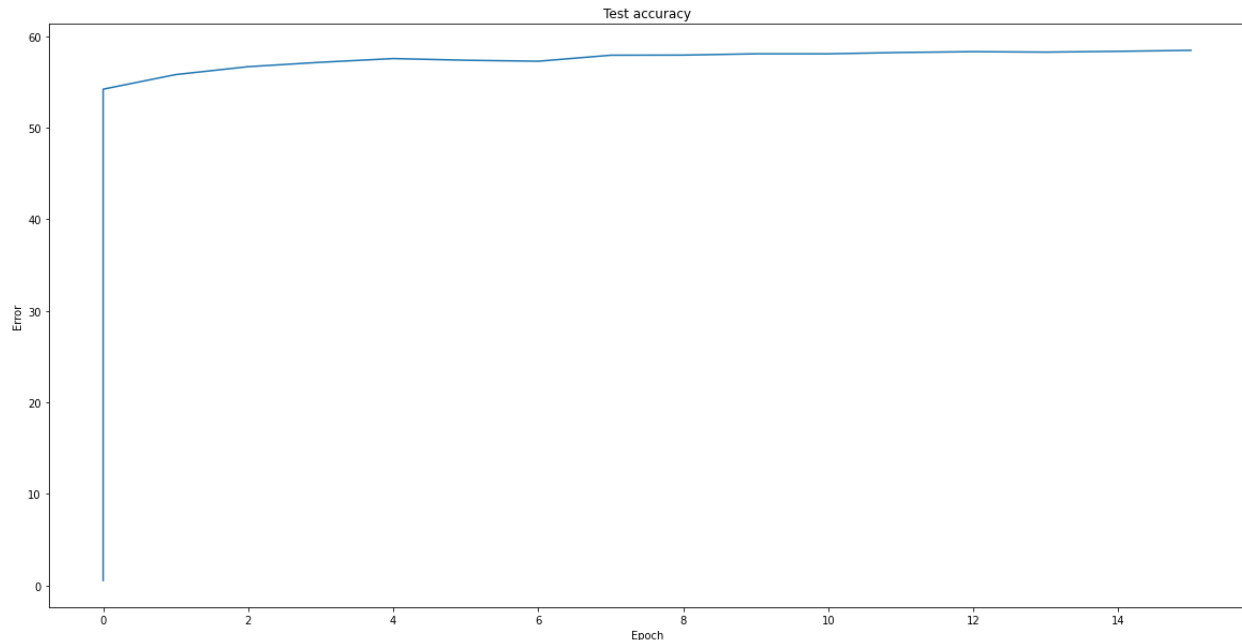
The difficulty is trying to refactor the code to store the cell state along with the hidden state. I thought it was simple, but many parts of the code need to change. There was a problem with the insufficient memory too, so I decreased the batch size to 64. Other than that, the training was much slower than GRU with the similar hyperparameters.

### 2. Were results better than the GRU? Provide training and testing plots.

The result is worse than the GRU and is slower to train. The final testing accuracy for LSTM is 58%, which is lower than the accuracy of GRU (60%). Nevertheless, I feel like the texts generated by LSTM have a lot more story in it, despite being inferior in terms of writing structures and vocabulary. There are very interesting sets of dialogue, compared to GRU that mostly have only sentences.







**3. Provide outputs for each sampling method on the new corpus (you can pick one temperature, but say what it was).**

For temp=0.75

generated with max Harry Potter, Snape, and Dumbledore walked into bar and started to the door of the corner of the corner of the door of the corner of the door of the corner of the door of the corner of the door of the stairs was still staring at the stairs and staring

generated with sample Harry Potter, Snape, and Dumbledore walked into bar cardoc,

"Ares - here more country, putting him, I don't mean you inither Crouch."

"Would you know what to or him."

"Tou," said Harry. "I think..."

"That's I couldn't want --"

"Justing here as your la

generated with sample Harry Potter, Snape, and Dumbledore walked into bar stick to the first clear from the books teachers.

"Feet, what do you," said Harry.

"Ron's price," said Harry and scabbled.

"To some cithtard water-" said Ron, turning a shadach Morce.

"No," he said,

generated with sample Harry Potter, Snape, and Dumbledore walked into bar grans in Harry's fudge.

"You've been cracking to here, Hermione is that?" graded Mr. Harry roating stipped to Snape something freeker.

"At the frienders first second, Harry, I don't come attack did ei

generated with sample Harry Potter, Snape, and Dumbledore walked into bar fivathing of his diep.

"It's not done melet betain -- Grime Mr. Weasley because the door --- Harry left the door might, I had sately with the use of the room with the other -under the fire!"

"And you

generated with sample Harry Potter, Snape, and Dumbledore walked into bar and the different of the parceller.

"His reckon to this into the goblet behone." said Ron sticked. "I'm don't - hate it."

"I was foresting the galdey honest onex" so muching Harry desperate. "I don'

generated with sample Harry Potter, Snape, and Dumbledore walked into bar matter creteft."

"The day - half My?" said Harry, but in the first imperion. "So they's not thing over whether to this," said Harry astily.

"Go one -"

"I had been about them, like you -- then you shea

generated with sample Harry Potter, Snape, and Dumbledore walked into bar smaul next, the lood voice was dared blood parchment Confectionation to she weasley. Harry had aloohed beating his leathing and placered morely.

"Neville," said Frad, Professor McGonagall was purpliating

generated with sample Harry Potter, Snape, and Dumbledore walked into bar steps, and staining out of his minister staircase, but vermione did . . . They'd nive ford, he had been minutered of Harry. It lay from members one oncess channon's distinish, could be fathering som

generated with sample Harry Potter, Snape, and Dumbledore walked into bar Onderour's inside fleshy, but a graybion libst happened from the stone while they felt out a great next donger, so parciming cat followed into the air. They didn't know when the next bed was still, sc generated with sample Harry Potter, Snape, and Dumbledore walked into bar for a door with usknesson but Harry, not one stoom he from his shuptle.

"Do," he said, the something strode stiffed slightly Harry and the fidor and up crashed in the little standing continutly diepp

generated with beam Harry Potter, Snape, and Dumbledore walked into bar in the root of time staring into to shake his rose foreson, how everies fried to the dotter contains savining hissed an ear of time side sometiog. He says a picture screen or courding to the rost his

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generated with beam Harry Potter, Snape, and Dumbledore walked into bar incontration of the top are footed it where he died to his ministrist.

he said friendiny no door between their fitter close on to her father armarents ather likt to it, a deep starin on the door, an

generated with beam Harry Potter, Snape, and Dumbledore walked into bar at the wall of the cortain of itserees of top to tell yeh, starining to the dotter of her into a ministrince of to see a first to strict to tee his mother to see to his mother of the state strainins o

generated with beam Harry Potter, Snape, and Dumbledore walked into bar continion one on her fitters and filthy tone over tie continue to the mater, he came to hide of the rood to his brank off a corridors of his robletsince to talk of his toak of scare other stairs floor

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"his too start - had to

generated with beam Harry Potter, Snape, and Dumbledore walked into bar an extratines share attemntion of the scare of slittcins andinininctle tree of the roof from its lift other the dorting to a cheerin ond on his roat.

The stare stare of his first first starings, he  
generated with beam Harry Potter, Snape, and Dumbledore walked into bar as a cortinin on  
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into thisk of teeth and continued on the corridor."

he sat deed windinity attemn

generated with beam Harry Potter, Snape, and Dumbledore walked into bar inclintinins of his  
armuside to tale to see the contair or side of evening his insteation of cominion opesinince to  
take to tell of to tea little from school of sorts footes frot to be still litterini

generated with beam Harry Potter, Snape, and Dumbledore walked into bar stainisten on to  
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of his mind from an ears of his state. A did with drew motter. it wated to be in