

# MP4\_P2\_generation

November 21, 2020

## 1 Generating Text with an RNN

```
[ ]: import unicode
import string
import random
import re
import time

import torch
import torch.nn as nn

%matplotlib inline

%load_ext autoreload
%autoreload 2

[ ]: from rnnn.model import RNN
from rnnn.helpers import time_since
from rnnn.generate import generate

[ ]: device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
```

### 1.1 Data Processing

The file we are using is a plain text file. We turn any potential unicode characters into plain ASCII by using the unicode package (which you can install via pip or conda).

```
[ ]: all_characters = string.printable
n_characters = len(all_characters)

file_path = './shakespeare.txt'
file = unicode.unidecode(open(file_path).read())
file_len = len(file)
print('file_len =', file_len)

# we will leave the last 1/10th of text as test
split = int(0.9*file_len)
```

```

train_text = file[:split]
test_text = file[split:]

print('train len: ', len(train_text))
print('test len: ', len(test_text))

```

```

file_len = 4573338
train len: 4116004
test len: 457334

```

```

[:]: chunk_len = 200

def random_chunk(text):
    start_index = random.randint(0, len(text) - chunk_len)
    end_index = start_index + chunk_len + 1
    return text[start_index:end_index]

print(random_chunk(train_text))

```

```

protest,
Maugre thy strength, youth, place, and eminence,
Despite thy victor sword and fire-new fortune,
Thy valour and thy heart, thou art a traitor;
False to thy gods, thy brother, and thy father;
C

```

### 1.1.1 Input and Target data

To make training samples out of the large string of text data, we will be splitting the text into chunks.

Each chunk will be turned into a tensor, specifically a LongTensor (used for integer values), by looping through the characters of the string and looking up the index of each character in `all_characters`.

```

[:]: # Turn string into list of longs
def char_tensor(string):
    tensor = torch.zeros(len(string), requires_grad=True).long()
    for c in range(len(string)):
        tensor[c] = all_characters.index(string[c])
    return tensor

```

The following function loads a batch of input and target tensors for training. Each sample comes from a random chunk of text. A sample input will consist of all characters *except the last*, while the target will contain all characters *following the first*. For example: if `random_chunk='abc'`, then `input='ab'` and `target='bc'`

```

[:]: def load_random_batch(text, chunk_len, batch_size):
    input_data = torch.zeros(batch_size, chunk_len).long().to(device)
    target = torch.zeros(batch_size, chunk_len).long().to(device)

```

```

for i in range(batch_size):
    start_index = random.randint(0, len(text) - chunk_len - 1)
    end_index = start_index + chunk_len + 1
    chunk = text[start_index:end_index]
    input_data[i] = char_tensor(chunk[:-1])
    target[i] = char_tensor(chunk[1:])
return input_data, target

```

## 2 Implement model

Your RNN model will take as input the character for step  $t-1$  and output a prediction for the next character  $t$ . The model should consist of three layers - a linear layer that encodes the input character into an embedded state, an RNN layer (which may itself have multiple layers) that operates on that embedded state and a hidden state, and a decoder layer that outputs the predicted character scores distribution.

You must implement your model in the `rnn/model.py` file. You should use a `nn.Embedding` object for the encoding layer, a RNN model like `nn.RNN` or `nn.LSTM`, and a `nn.Linear` layer for the final a predicted character score decoding layer.

**TODO:** Implement the model in RNN `rnn/model.py`

## 3 Evaluating

To evaluate the network we will feed one character at a time, use the outputs of the network as a probability distribution for the next character, and repeat. To start generation we pass a priming string to start building up the hidden state, from which we then generate one character at a time.

Note that in the `evaluate` function, every time a prediction is made the outputs are divided by the “temperature” argument. Higher temperature values make actions more equally likely giving more “random” outputs. Lower temperature values (less than 1) high likelihood options contribute more. A temperature near 0 outputs only the most likely outputs.

You may check different temperature values yourself, but we have provided a default which should work well.

```

[ ]: def evaluate(rnn, prime_str='A', predict_len=100, temperature=0.8):
    hidden = rnn.init_hidden(1, device=device)
    prime_input = char_tensor(prime_str)
    predicted = prime_str

    # Use priming string to "build up" hidden state
    for p in range(len(prime_str) - 1):
        _, hidden = rnn(prime_input[p].unsqueeze(0).to(device), hidden)
    inp = prime_input[-1]

    for p in range(predict_len):
        output, hidden = rnn(inp.unsqueeze(0).to(device), hidden)

    # Sample from the network as a multinomial distribution

```

```

output_dist = output.data.view(-1).div(temperature).exp()
top_i = torch.multinomial(output_dist, 1)[0]

# Add predicted character to string and use as next input
predicted_char = all_characters[top_i]
predicted += predicted_char
inp = char_tensor(predicted_char)

return predicted

```

## 4 Train RNN

```

[: batch_size = 100
   n_epochs = 5000
   hidden_size = 100
   n_layers = 1
   learning_rate = 0.01
   model_type = 'rnn'
   print_every = 50
   plot_every = 50

[: def eval_test(rnn, inp, target):
    with torch.no_grad():
        hidden = rnn.init_hidden(batch_size, device=device)
        loss = 0
        for c in range(chunk_len):
            output, hidden = rnn(inp[:,c], hidden)
            loss += criterion(output.view(batch_size, -1), target[:,c])

    return loss.data.item() / chunk_len

```

### 4.0.1 Train function

**TODO:** Fill in the train function. You should initialize a hidden layer representation using your RNN's `init_hidden` function, set the model gradients to zero, and loop over each time step (character) in the input tensor. For each time step compute the output of the of the RNN and compute the loss over the output and the corresponding ground truth time step in `target`. The loss should be averaged over all time steps. Lastly, call backward on the averaged loss and take an optimizer step.

```

[: def train(rnn, input, target, optimizer, criterion):
    """
    Inputs:
    - rnn: model
    - input: input character data tensor of shape (batch_size, chunk_len)
    - target: target character data tensor of shape (batch_size, chunk_len)
    - optimizer: rnn model optimizer
    """

```

```

- criterion: loss function

Returns:
- loss: computed loss value as python float
"""
loss = None

#####
#           YOUR CODE HERE           #
#####
hidden = rnn.init_hidden(batch_size, device=device)
rnn.zero_grad()
loss = 0

for c in range(chunk_len):
    output, hidden = rnn(input[:,c],hidden)
    loss += criterion(output, target[:,c])
loss = loss / chunk_len

loss.backward()
optimizer.step()

#####          END          #####

return loss/ chunk_len

```

```

[:]: rnn = RNN(n_characters, hidden_size, n_characters, model_type=model_type,
    →n_layers=n_layers).to(device) #lr=0.001
rnn_optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.CrossEntropyLoss()

start = time.time()
all_losses = []
test_losses = []
loss_avg = 0
test_loss_avg = 0

print("Training for %d epochs..." % n_epochs)
for epoch in range(1, n_epochs + 1):
    loss = train(rnn, *load_random_batch(train_text, chunk_len, batch_size),
    →rnn_optimizer, criterion)
    loss_avg += loss

    test_loss = eval_test(rnn, *load_random_batch(test_text, chunk_len,
    →batch_size))
    test_loss_avg += test_loss

```

```

    if epoch % print_every == 0:
        print('%s (%d %d%%) train loss: %.4f, test_loss: %.4f' % (
            time_since(start), epoch, epoch / n_epochs * 100, loss, test_loss))
        print(generate(rnn, 'Wh', 100, device=device), '\n')

    if epoch % plot_every == 0:
        all_losses.append(loss_avg / plot_every)
        test_losses.append(test_loss_avg / plot_every)
        loss_avg = 0
        test_loss_avg = 0

```

Training for 5000 epochs...

[0m 34s (50 1%) train loss: 3.0023, test\_loss: 2.9911]

Wh1VUzH

Hc Vkr Cesir

A

t Ve ithro wy cshsaacne porotirl:R e mawaoweue t lot aahklTok hade thhre ach

[1m 8s (100 2%) train loss: 2.6042, test\_loss: 2.6055]

Wheors linr lous cEe

alisMhe lefud cn lass ny for tor warou wumed fo athe n merw.

Munt

s! buhit bios

[1m 43s (150 3%) train loss: 2.4102, test\_loss: 2.4043]

Whf! Ir

ad bameag s,uwnd thing cage wit oft thanfr, toull ak tho ofr n whof angouns tot  
the thoursthe

[2m 17s (200 4%) train loss: 2.2972, test\_loss: 2.3034]

Wh me proasan:

Aond ful sath.

DRYTILUGEART:

sle theruse'sd thicent.

Hom he.

GONTRRAOK:

Aund man gha

[2m 52s (250 5%) train loss: 2.2038, test\_loss: 2.2119]

Whon hing peod of the comigh her mos in and and bece be scoes looud, co gero lom  
buer reress gour thar

[3m 26s (300 6%) train loss: 2.1548, test\_loss: 2.1668]

Whard that perten; Hand hor that way lor mome; his is oun rere be to! shat to ar  
arthaing to were:

Wol

[4m 1s (350 7%) train loss: 2.0857, test\_loss: 2.1155]

Whe, sather,

Ane ford be and the a what the noneask

Fin me'ln suspet be dortery faredes and peloug thi

[4m 36s (400 8%) train loss: 2.0701, test\_loss: 2.0910]

Wh#TVo herd I a blas wemes wel this forr-ote by there as she and in can's,  
trray'sgond.

CAMTHOUS:

Maa

[5m 11s (450 9%) train loss: 2.0338, test\_loss: 2.0459]

Whis wife be iplan the a you lind man it come,

Thantinger known, me jorveat hies.

ADARO:

Whave a and

[5m 46s (500 10%) train loss: 1.9913, test\_loss: 2.0116]

What the

Thand I s all for him wha his greseen, what is and deors we kirn shars, for bet  
akrer word to

[6m 21s (550 11%) train loss: 1.9625, test\_loss: 2.0021]

Whe not leate of you my prayiat. If a cont;

The had secknist.

OLLUPUS SHAFRO:

Nengince of loyply

In s

[6m 56s (600 12%) train loss: 1.9458, test\_loss: 1.9905]

Why, but me befoor Tare man a a mester charles, thenk glevent the cosed for my  
lake ach sit of this ch

[7m 31s (650 13%) train loss: 1.9474, test\_loss: 1.9553]

Whow in the king the shall worse of I bethable worts to dagoul ain thoul vitiood  
make tore our hald I

[8m 5s (700 14%) train loss: 1.9324, test\_loss: 1.9369]

Whe wind mined at pastury hats to onser

Thou meriud emen mood to all and thous you que.

CARISTANO:

On

[8m 40s (750 15%) train loss: 1.8852, test\_loss: 1.9154]

Whly lenong purts.

BULINA:

Way, my not his masser am thee on we quaet,

I aspent I to they would think

[9m 15s (800 16%) train loss: 1.8953, test\_loss: 1.9155]

Wher, to concauld heartion hoor the fivern

Pown he shall the maddens,

wor and forth not for with an al

[9m 50s (850 17%) train loss: 1.8399, test\_loss: 1.8718]

Whoal! the wholces fare well of shea; for thy as gant crate her houp comes

shaw met on thy have statin

[10m 25s (900 18%) train loss: 1.8363, test\_loss: 1.8671]

Wht his shall curnion unter, upore man me filet this sworth the bowt

With the come to but our foon and

[11m 0s (950 19%) train loss: 1.8293, test\_loss: 1.8513]

What's the prace. Sir bet, he mawest hell,

Mandiarss still I man; my word is his didge onerdabes!

TIN

[11m 35s (1000 20%) train loss: 1.8243, test\_loss: 1.8739]

Wher, s us more fom our Islest bood are than you him

His pary thee folline this have is of rich.

KING

[12m 10s (1050 21%) train loss: 1.8160, test\_loss: 1.8399]

What the more fool thy knock, as would?

Second Lided, the too.

CARUS:

Sich, well. This if in the kin

[12m 44s (1100 22%) train loss: 1.7863, test\_loss: 1.8438]

Who weake the calile I wast sisplapernenter

The desean,



Here and me sould bey for that I have that pur

[13m 19s (1150 23%) train loss: 1.7953, test\_loss: 1.8321]

Whoo a is offed hounds seeful forester.

Ro tas dong of heatess and I weyster!

BARDIUS:

This the doigh

[13m 54s (1200 24%) train loss: 1.7663, test\_loss: 1.8210]

What he comerrechech a wamated.

Mastiver:

I wallen of gingelie and keep the heart him.

Thins all may

[14m 28s (1250 25%) train loss: 1.7808, test\_loss: 1.7980]

What stand itser are to be that him,

He his grack shay not and prace; so grawing is I swrongmen find t

[15m 3s (1300 26%) train loss: 1.7607, test\_loss: 1.7831]

When mother of then is with the withers

That his woned can come with ast the veren,

And then hous such

[15m 36s (1350 27%) train loss: 1.7069, test\_loss: 1.7867]

Whe come, sootter our mean the pirice your of that mer make his in lane, and we  
so a brooct well,

The

[16m 10s (1400 28%) train loss: 1.7523, test\_loss: 1.7769]

Why, t herely my lainds will the

it came the keeisuse have the foor he paren bedelf

And we so dike, th

[16m 45s (1450 28%) train loss: 1.7465, test\_loss: 1.7862]

Whir, to' more one supest

the greate do?

LENEDD:

All your extrown as uchinaing the beal hoon,

When th

[17m 21s (1500 30%) train loss: 1.7186, test\_loss: 1.7660]

Whas spilace

Anst the sorved there in the pruting thoug, and have berecuction.

Hervant nother:

O be t

[17m 56s (1550 31%) train loss: 1.6923, test\_loss: 1.7372]  
Whath all.

LARUS:

He all the wear sone on's will that it diggains, pressice, Frow: but when inted,  
kn

[18m 32s (1600 32%) train loss: 1.7254, test\_loss: 1.7655]  
When lish and dances not take after,  
I seeu me, good loidel, I come the say?

LACWITIUS:

When a the sh

[19m 8s (1650 33%) train loss: 1.6995, test\_loss: 1.7489]  
Wher, you retten to fear mine,  
Where the horts do of me holier and he care,  
To get with the raliey exc

[19m 43s (1700 34%) train loss: 1.7083, test\_loss: 1.7377]  
Whers, my lating of thor. I'll me his ours:  
Theek for this both to this give a put beiselon be pup  
Who

[20m 19s (1750 35%) train loss: 1.7074, test\_loss: 1.7476]  
Where heart:  
What sen you spreak the change to you our by lave  
To helss our on your arm fell her.

HAM

[20m 54s (1800 36%) train loss: 1.6740, test\_loss: 1.7263]  
When it a presies of with this print ones  
With may alt redone to restance on than there's fulls,  
That

[21m 32s (1850 37%) train loss: 1.6486, test\_loss: 1.7626]  
Wher his oneleming,  
I have it one you be be my sount command  
A prepery, should would you here a Durest

[22m 8s (1900 38%) train loss: 1.6409, test\_loss: 1.7549]  
Wher shall here to pertor.

ACHENEL:

No say I'll she lord, your spleing, you aither so.

ROSALING:

Nor

[22m 44s (1950 39%) train loss: 1.6498, test\_loss: 1.7339]

Wh there! here with yet is 'efer

With the wither but this a sume me consofeers

My hell. But there reg

[23m 19s (2000 40%) train loss: 1.6714, test\_loss: 1.7283]

Who how Atlem do to the devise you man-sand.

CHARSION:

No, my law the dring of thee.

PAROLUS:

An hou

[23m 55s (2050 41%) train loss: 1.6504, test\_loss: 1.7162]

What with the treacter

Thave them; he seatol brease I lady.

SUCLIUS:

Mark, did made did on,

Thou see

[24m 30s (2100 42%) train loss: 1.6446, test\_loss: 1.6701]

When whe prithes, and you with

By she alise be the beapt our carried.

Sercond:

And Shallwing subtury

[25m 5s (2150 43%) train loss: 1.6383, test\_loss: 1.6968]

Wherening these restune this ears of such any

Rerkning a bodient me counsan'd to to resence,

Noce and

[25m 41s (2200 44%) train loss: 1.6507, test\_loss: 1.7179]

Whis hell thee, when here a are as hears her.

OSTALBA:

I will most seeping me that ip herb-and sholl

[26m 16s (2250 45%) train loss: 1.6358, test\_loss: 1.6802]

What a father steat to common tell thee hip they do bears.

Caxeria, sir, the rike stester here, wish y

[26m 52s (2300 46%) train loss: 1.6503, test\_loss: 1.6950]

What, for my casion

If the a true stare-flows of how intrest thine?

BIRON:

Maday, I find, we she have

[27m 27s (2350 47%) train loss: 1.6356, test\_loss: 1.7186]

Wherd this tass

Thenced not thus to distages

To grenes; but thou are so-do by good-bady.

Therephow.

[28m 3s (2400 48%) train loss: 1.6177, test\_loss: 1.6659]

Where to had he will and hear to knose,

More ressey to good and mounter his amore and hife

If who come

[28m 38s (2450 49%) train loss: 1.6263, test\_loss: 1.6861]

What Herechignigh the fare dids

and plame to told you are to here;

For the sause in from whose seep of

[29m 13s (2500 50%) train loss: 1.6305, test\_loss: 1.6925]

Why dold thee senst thee,

As nametion to merant her Tays and home.

BARDIOLLA:

Amess I will to to cacc

[29m 49s (2550 51%) train loss: 1.6187, test\_loss: 1.6678]

What, gentle with the good dicing them for erit.

LADY ANTOND:

Stake the hand every, what me serverai

[30m 24s (2600 52%) train loss: 1.6211, test\_loss: 1.6845]

What thy make the duke thee the lepe

And drone.

BOUNDE:

Do mean your belies heart love, and we was it

[30m 59s (2650 53%) train loss: 1.6154, test\_loss: 1.6396]

Wh I would be wife thy heart

Why is this heartcy shinger in burnes,  
'tis dreat man. O simsing they awa

[31m 34s (2700 54%) train loss: 1.6233, test\_loss: 1.6774]

What will seet, the  
If ither in me thousing, life all  
Which his burde with the distrard;  
And it great

[32m 10s (2750 55%) train loss: 1.6103, test\_loss: 1.6658]

Whis not speak with the than the let  
forstital our would most destract to and purpon are him,---this h

[32m 45s (2800 56%) train loss: 1.5888, test\_loss: 1.6693]

Whit home at he distand would ever  
of the hus is the his hand, what not we the sitch, all.

PEGAR:

Is

[33m 21s (2850 56%) train loss: 1.5951, test\_loss: 1.6483]

Who;  
But you with you belemeing; there range that for way surefore catery.

CLARENCE:

Lie enquition ea

[33m 56s (2900 57%) train loss: 1.5971, test\_loss: 1.6398]

Whis hear, well so, that,  
Frine, and none a king your consuch a streck--

DEMATHUS:

Come, who emperies

[34m 32s (2950 59%) train loss: 1.5851, test\_loss: 1.6547]

What with most not so pessain  
And do you, him. To stever chiefed shake I raught and father,  
Hath with

[35m 7s (3000 60%) train loss: 1.5817, test\_loss: 1.6515]

What's pat in the wagess the heart too;  
canitunest you, more suance of own care for from dog.

KING LE

[35m 42s (3050 61%) train loss: 1.5716, test\_loss: 1.6666]

What, I shall was my lord?

ERGANUS:

Coman have the monts of the full.

WILLIMONE:

I fourth the crock

[36m 18s (3100 62%) train loss: 1.6042, test\_loss: 1.6383]

Wh: jeas, there anstee,

The tell sen.

TITUS ALBAND:

Come, a dramation, 'lover propers of with to the

[36m 53s (3150 63%) train loss: 1.5796, test\_loss: 1.6651]

What vains us, only

The poor your have is leave the sleep in the sull.

BEENTIDIUS:

Ay, and all and we

[37m 29s (3200 64%) train loss: 1.6066, test\_loss: 1.6475]

Whath in my lord, and death.

MARK ANTONY:

And the hand in with the false heart--

Ho prove the queet.

[38m 5s (3250 65%) train loss: 1.5622, test\_loss: 1.6816]

Who mourther them of more seit:

Nor about

She barger's see: but keep you shall dischilling.

PISTON:

T

[38m 40s (3300 66%) train loss: 1.5869, test\_loss: 1.6071]

Whap

Lever we pression my staught the stilet all thus last

Morces, and expence; she, will trucet with

[39m 16s (3350 67%) train loss: 1.5584, test\_loss: 1.6451]

What, but you pryonous heart to myself than mine, we that.

So, we art there all the betters, why so me

[39m 51s (3400 68%) train loss: 1.5435, test\_loss: 1.6311]

Whost not thou thought.

DON DOMBON DOND:

Gentiliam his sworge of your arradal.

No, in father life and

[40m 27s (3450 69%) train loss: 1.6025, test\_loss: 1.6229]

What was his part;

She set me, virrent your contemmings;

And an orthing lord! Lis not,

The vanion lord

[41m 2s (3500 70%) train loss: 1.5826, test\_loss: 1.6207]

What is be any matter took.

KING HENRY VIII:

And pray on hand him: and we liest! Goa yous and take of

[41m 38s (3550 71%) train loss: 1.5825, test\_loss: 1.6520]

Which a majest with thee so

As his of tale foicest, some to the trued:

Where live like the much salian

[42m 13s (3600 72%) train loss: 1.5560, test\_loss: 1.6063]

What, chark, Saint but for the lord?

KING HENRY VI:

These boy.

PRINCESS:

And my pray you say fingly.

[42m 49s (3650 73%) train loss: 1.5838, test\_loss: 1.6474]

What, I'll would here he hatter and belcenting on the

to her is the standed the leeds:

Come our fair i

[43m 25s (3700 74%) train loss: 1.5238, test\_loss: 1.6225]

What I lare them I have also be anstrift:

To be true of the to breath's honesty in my trumper.

Look yo

[44m 0s (3750 75%) train loss: 1.5503, test\_loss: 1.6545]

What it barn my love: but not bellip;

though of a truments: my but lady him.

KING HENRY V:

But I had

[44m 36s (3800 76%) train loss: 1.5502, test\_loss: 1.6389]

What is for wounded remight, I  
have to the scoon: be the monsters recysing honourance  
When thou then h

[45m 11s (3850 77%) train loss: 1.5490, test\_loss: 1.6408]

What than be daughter it.  
O, he wilt not your words and sines of weased  
Which, in dreach my great are

[45m 47s (3900 78%) train loss: 1.5804, test\_loss: 1.6085]

What sing, you shall curbed deanes  
To do she let the remet on me: for strove them  
To have monus and my

[46m 22s (3950 79%) train loss: 1.5331, test\_loss: 1.6290]

What's hooted son; you have pito,  
That offers murderly of the truage; I have to madity.

ANTIPUR:

Now,

[46m 58s (4000 80%) train loss: 1.5289, test\_loss: 1.6291]

Whow a horp: here's troth  
Some good to my wears, O sent her plouts  
Should be perity in the manson.

DE

[47m 33s (4050 81%) train loss: 1.5462, test\_loss: 1.6148]

What the tright, as I chen it.

CARDINAL OF WARSANDO:

I have bear in the power in my a villanion of my

[48m 9s (4100 82%) train loss: 1.5613, test\_loss: 1.6267]

What to the clain in the measour,  
What woman both, singlider's severch and god?

PAGE:

I gave it so my

[48m 45s (4150 83%) train loss: 1.5251, test\_loss: 1.6306]

What sworn me, for their houp them appled by how a nequal:  
Leas of forget ourself of me, let you worss

[49m 21s (4200 84%) train loss: 1.5402, test\_loss: 1.6429]

What of the such with me  
Hencent to now a wroundshime expectould be



Our speak the experiess and love y

[49m 57s (4250 85%) train loss: 1.5710, test\_loss: 1.6215]  
What's behold than the main.

BARDOLPH:

O, look without the elselly to the France.

URMILIA:

And, she f

[50m 32s (4300 86%) train loss: 1.5307, test\_loss: 1.6288]  
Whost be means of did for away the  
Fortune the quart and down hath of strail  
Of any day this wast here

[51m 8s (4350 87%) train loss: 1.5384, test\_loss: 1.6189]  
What is sorry and them injuries.

FoR it hereforethor:

But I am not discrect my treasour may let me?

[51m 44s (4400 88%) train loss: 1.5676, test\_loss: 1.6130]  
Whis made and say, Postier, my live  
case see you make shall mine heard, be sons: the minates  
Is behers

[52m 20s (4450 89%) train loss: 1.5265, test\_loss: 1.6240]  
What you she life,  
Which would joins, there for full of a are seat  
That I think, grace anctious no man

[52m 56s (4500 90%) train loss: 1.5270, test\_loss: 1.6211]  
What hath so greit.

FALSTAFF:

A vanic old many to your please: what I show my  
Matite of look to the b

[53m 32s (4550 91%) train loss: 1.5390, test\_loss: 1.6077]  
What a lord, what I are me, Edward,  
He shall may that from when hoster withile?

ROSALIND:

They blave

[54m 8s (4600 92%) train loss: 1.5153, test\_loss: 1.6087]  
Who hen not of his winder  
There is proud fowle-your here. No such of an he what night  
under a po it, i

[54m 43s (4650 93%) train loss: 1.5360, test\_loss: 1.5986]  
What the than the less your emple,  
Thou haphers, and gent of king a bade: and such pate  
The wanters, a

[55m 19s (4700 94%) train loss: 1.5550, test\_loss: 1.6326]  
What to missian not all.

JOAN LA Wer:  
The disband! I pronhing with the othern mocks:  
For the fight st

[55m 55s (4750 95%) train loss: 1.5349, test\_loss: 1.5853]  
What, if he will have country in the severtion  
the vowing we be come; but do drawn prince of you dange

[56m 31s (4800 96%) train loss: 1.5141, test\_loss: 1.6287]  
What hath love of you not the good park to see  
To plain to her and he princes and leave  
men have hie a

[57m 6s (4850 97%) train loss: 1.5052, test\_loss: 1.6015]  
Who carding fremizen, trumpe enement,  
And the thief in the king blessen set thee soul of me?

CAMILLY:

[57m 42s (4900 98%) train loss: 1.4878, test\_loss: 1.6232]  
What you now it in my bearling dead,  
Hare all to Comove, and whose is lady oothent me to good milk,  
Sp

[58m 18s (4950 99%) train loss: 1.5224, test\_loss: 1.6250]  
Who winnorish my fair stowleffied--

OCTAVIUS CAESAR:  
What of old make it, this shault yours care.

TI

[58m 54s (5000 100%) train loss: 1.5319, test\_loss: 1.6174]  
What is that faterate!

JULIET:  
A surst well of my laughters!

REBISA:  
O, that be goners, and sorty?

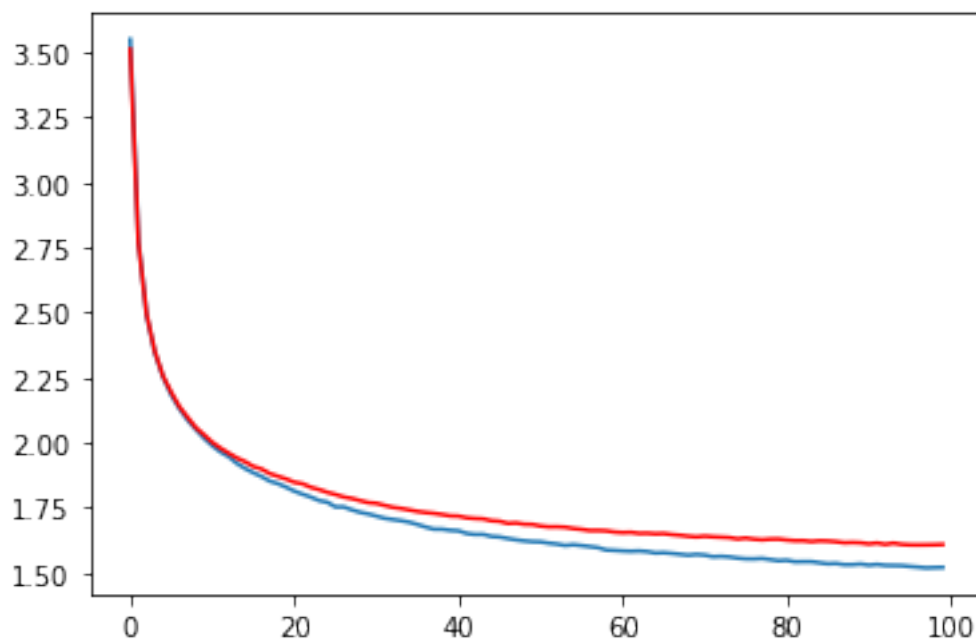
```
[ ]: # save network
      # torch.save(classifier.state_dict(), './rnn_generator.pth')
```

## 5 Plot the Training and Test Losses

```
[ ]: import matplotlib.pyplot as plt #lr = 0.001
      import matplotlib.ticker as ticker
      import numpy as np

      plt.figure()
      plt.plot(all_losses)
      plt.plot(test_losses, color='r')
```

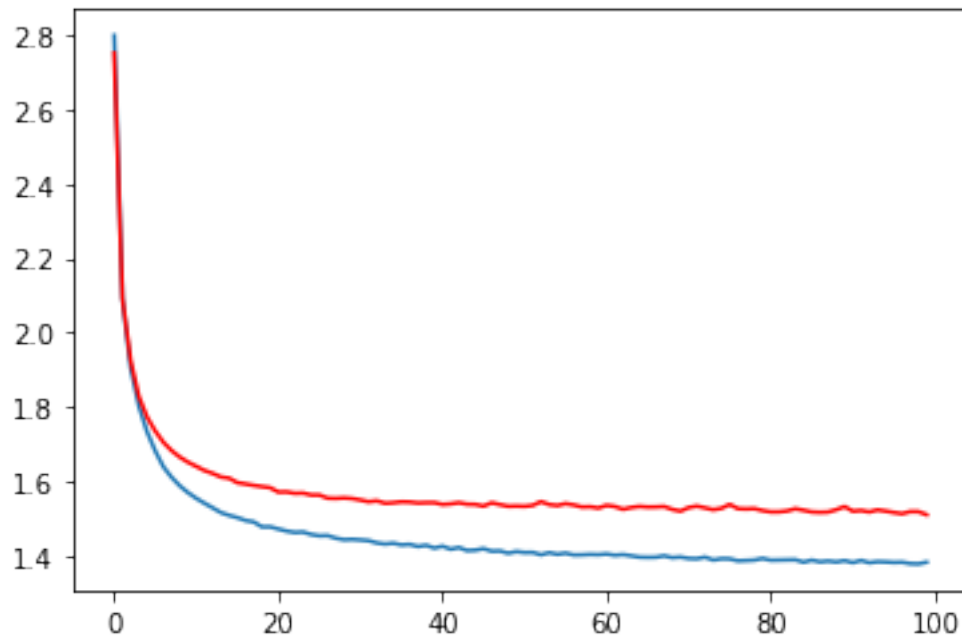
```
[ ]: [ <matplotlib.lines.Line2D at 0x7f792009ba90> ]
```



```
[ ]: import matplotlib.pyplot as plt    #rnn layer =2
import matplotlib.ticker as ticker
import numpy as np

plt.figure()
plt.plot(all_losses)
plt.plot(test_losses, color='r')
```

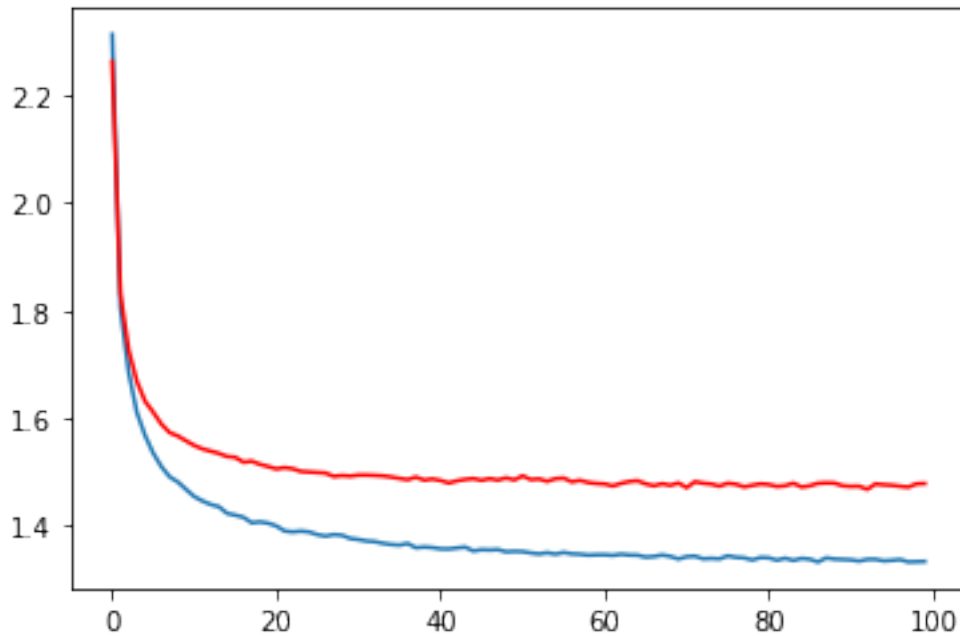
```
[ ]: [<matplotlib.lines.Line2D at 0x7fd07209e748>]
```



```
[ ]: import matplotlib.pyplot as plt #hidden size 200
import matplotlib.ticker as ticker
import numpy as np

plt.figure()
plt.plot(all_losses)
plt.plot(test_losses, color='r')
```

```
[ ]: [<matplotlib.lines.Line2D at 0x7f22ad0c8128>]
```



## 6 Evaluate text generation

Check what the outputted text looks like

```
[ ]: print(evaluate(rnn, prime_str='Th', predict_len=1000)) # lr=0.001
```

The king a many on fortune and recun,  
In in the company me so manisce,  
Like hast knew the hustience in this?

Messenger:  
Madam?

HORATIO:  
O the present my couptening such oath thee,  
Come to sayest you seement has fool,  
For the would in the gentrerful warrant play  
which mine, and in sub; and worth no men,--

SHIRON:  
What it had still we missed expeither to read,  
Of are and wear me for acquains the excellister not,  
And till the Duke and accomsagies the life;  
Little wood to of the man with all the went of liqus was him for  
Which of yours: when she have marrians eat

That speat that these to a noed with my swear thire,  
Whose cannot extrele found kis to disence  
That their can the sword and a purden honests,  
Ay way mother to the paderate with me!

LUCENTIUS:

DON ADRIANO DE OF YORK:  
When they know yet a care.

OTHELLO:  
What in my sight; or mords.

PANTHANUS:  
Recons a nowal for the creature.

Second Senequing:  
Sind, you have lion: he hight again not? and I lady  
Doubt it thou shall not since in a

```
[ ]: print(evaluate(rnn, prime_str='Th', predict_len=1000)) #rnn layer=2
```

Then for the offence, which with at our cartive  
And shall I come delights than the temmed and let  
the foot of the place of no madomar, sanchest acquess  
weep the munder to come plink it busy  
videry of the Caid forward.

PRINCE HENRY:  
No, he will be not my wore the point say I  
then too man the man all the fair long hold her, by my name,  
And from her begined have her so marry with her  
which not that rich one enate is the Emore's mind,  
Wouldst Greek my world my sword, and see it.

BOTTITUS:  
Why would see hurthing in his eyes and choose,  
To be gross the palling but to speak them:  
That you hear signor, or abrear! and in thy brother hast  
the be in this lord, and say a wombing of her will obedies,  
Parthed me better sorrow! only our love with the fearful  
for her noble thy head you main we would bender.

CORNEM:  
How shall'st thy dear an his mock in thee.

PANDARUS:

My lord; nor blessing many shall o'erthy comes me, the still drender.

PRINCE HENRY:

Well slander upon the state.

PANDARUS:

What is a

```
[ ]: print(evaluate(rnn, prime_str='Th', predict_len=1000)) # hidden size 200
```

The name with our Roman callen safe as ever  
one of thee to mare the prince comfort,  
I'll make with my throat his body;  
Where repent your stomach to the weaknireward, and come  
as well then child the war is lord, my lord.

KING RICHARD III:

Let her ripe of the charged: but let me stay.

VALENTINE:

What should he stay, Lord Her own bore,  
The maidens, and one of wine of all  
From one of his cold much off come:  
Therefore death, after his injured,  
That I have fly the precious snart  
And some forward courtesy of his power  
Than of father, the world no return and the man,  
I tell you gone too, the word, thou dost thou dares  
sins forth most recomfortenance or in the cast of the  
splitrious love to march and minute are a troubles.

KING CLAUDIUS:

While I came and I have renowning troop  
Whithen get it in day to come to be these.

DUMAIN:

I will say are you a goodly queen  
To be so ill, which not I come.

Posbraint:

He did you not ready them deeper, skip up in  
Count or talk.

MISTRESS PAGE:

Ne here.

Firs

## 7 Hyperparameter Tuning

Some things you should try to improve your network performance are: - Different RNN types. Switch the basic RNN network in your model to a GRU and LSTM to compare all three. - Try adding 1 or two more layers - Increase the hidden layer size - Changing the learning rate

**TODO:** Try changing the RNN type and hyperparameters. Record your results.

```
[ ]: # included in the report
```