MP4_P2_generation-Copy2

November 18, 2020

1 Generating Text with an RNN

```
[1]: import unidecode
     import string
     import random
     import re
     import time

     import torch
     import torch.nn as nn

     %matplotlib inline

     %load_ext autoreload
     %autoreload 2
```

```
[2]: from rnn.model import RNN
     from rnn.helpers import time_since
     from rnn.generate import generate
```

```
[3]: 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 unidecode package (which you can install via pip or conda).

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

     file_path = './shakespeare.txt'
     file = unidecode.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
```

[5]:
```
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))
```

```
you are a sectary,
That's the plain truth: your painted gloss discovers,
To men that understand you, words and weakness.

CROMWELL:
My Lord of Winchester, you are a little,
By your good favour, too sha
```

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`.

[6]:
```
# 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 wil contain all characters *following the first*. For example: if random_chunk='abc', then input='ab' and target='bc'

```
[7]: 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 consiste 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.

```
[8]: 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

```
[9]: batch_size = 100
     n_epochs = 5000
     hidden_size = 160
     n_layers = 2
     learning_rate = 0.01
     model_type = 'gru'
     print_every = 50
     plot_every = 50
```

```
[10]: 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.

```python
[11]: 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 = 0

          ####################################
          #           YOUR CODE HERE         #
          ####################################
          hidden = rnn.init_hidden(input.shape[0])
          rnn.zero_grad()
          for i in range(chunk_len):
              output, hidden = rnn(input[:, i], hidden)
              loss += criterion(output.reshape(batch_size, -1), target[:, i]) /␣
      ↪chunk_len
          loss.backward()
          optimizer.step()
          ##########        END       ##########

          return loss
```

```python
[12]: rnn = RNN(n_characters, hidden_size, n_characters, model_type=model_type,␣
      ↪n_layers=n_layers).to(device)
      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…
[2m 38s (50 1%) train loss: 2.0218, test_loss: 2.0347]
Whe have pradine in Ore no the brow! thew thou got man and am is cings not do
prear, I turman it a's p

[5m 20s (100 2%) train loss: 1.7615, test_loss: 1.8102]
What Caasing in but of thou cother seated.

FABASTAFF:
Disucry would what will.

JULIENTIO:
I must you

[30m 52s (150 3%) train loss: 1.6267, test_loss: 1.6851]
When come the rest:
Be he gods enedry thange: no day of.

PRINCE SALINA:
Say are as my grook is the se

[33m 32s (200 4%) train loss: 1.5793, test_loss: 1.6505]
What, her fortune, and Denened rews late,
For whom which the work word.
Pean, I eart not be thens to m

[36m 11s (250 5%) train loss: 1.5471, test_loss: 1.6261]
What dash is the let a voice,
And be from him the pleasons she for his me:
Let for Farth, something ri

[38m 51s (300 6%) train loss: 1.5311, test_loss: 1.5971]

What that I lay the good good fine all
And known too faired with all his kind.

OCTAVIUS CAESAR:
Ay, t

[41m 36s (350 7%) train loss: 1.4866, test_loss: 1.5842]
What you their well beggestormony
Your earl for his wives and thou art the heart.

TAVIA:
To what ther

[44m 17s (400 8%) train loss: 1.4866, test_loss: 1.5585]
Whole mine vase.

VERNON:
Be not in our great of the stendy with all to't you go
soul be take of a pol

[46m 57s (450 9%) train loss: 1.4750, test_loss: 1.5655]
Who alack into the yoath:
Forsway, to the done by company;
And I much strong as his fathers!
Ceradian,

[49m 40s (500 10%) train loss: 1.4601, test_loss: 1.5507]
Who?

SALARINO:
Come, to the part.

MARCELLUS:
My lord, which enguitice of Master France gray,
Thou wi

[52m 24s (550 11%) train loss: 1.4055, test_loss: 1.5432]
Who hour of heaven,
Be cover, what as it is could I'll
set the deed the erd the love that we uncle awa

[55m 19s (600 12%) train loss: 1.4375, test_loss: 1.5170]
Who save the bird think a waved me, Destress! my lord, for all the beast her
Dois as that 'tis reason

[57m 59s (650 13%) train loss: 1.4379, test_loss: 1.5543]
What's a man?

SILVIA:
I will see this where for my simply to perso down.
He soldiers, but all of his

[60m 25s (700 14%) train loss: 1.4097, test_loss: 1.5446]
What the state the whock is,
And unprise him partiates stall took company,
The langeroubs in that as i

[63m 25s (750 15%) train loss: 1.3954, test_loss: 1.5510]
Who care here?
What doomst thou art to the man?

BRUTUS:
How now! war, you!

CASSIUS:
I will did not a

[66m 0s (800 16%) train loss: 1.4326, test_loss: 1.5362]
What but the ways man is a winter's the god?
Thang you that he sweet in else a counter, I may.

MACBET

[68m 28s (850 17%) train loss: 1.4361, test_loss: 1.5170]
Why, my lord! How do be my heart; it present of him with me and height.

EMILIA:
Fie, she did go.

TIM

[70m 58s (900 18%) train loss: 1.3996, test_loss: 1.5176]
Where you proya Eup'st lost
And treest thou poison not with their truth? I have so much?

SHALLOW:
It

[73m 22s (950 19%) train loss: 1.4099, test_loss: 1.5419]
Where every so, now, which then as by as we will hold the free:
But the stready provided like clailor

[75m 47s (1000 20%) train loss: 1.3980, test_loss: 1.5105]
What, for it was to a powers, high of your heart?

BRUTUS:

It ears with his paper on looked.

DON PEDR

[78m 10s (1050 21%) train loss: 1.3995, test_loss: 1.5392]
What have the laids?

POLIXENES:
'Tis 't borrow.

ANTIPHOLUS OF EPHESUS:
The spirit!

ARIEL:
I fond th

[80m 35s (1100 22%) train loss: 1.4082, test_loss: 1.5109]
Wherein you have seems
His love of birds must unto ready; my guard,
My lie may here to venture and rec

[83m 0s (1150 23%) train loss: 1.4127, test_loss: 1.5031]
Who water hangmberty?
O time to go tame thee for thy fortune
All breaks whin the first's and place in

[85m 40s (1200 24%) train loss: 1.4145, test_loss: 1.5013]
When I hold the prince of an island by ward?

DON PAGE:
Me that him in your father; for rung and god,

[88m 18s (1250 25%) train loss: 1.4006, test_loss: 1.4858]
What I am not in your faith
Would half the through never trust the religion of our
speak of hands upon

[90m 57s (1300 26%) train loss: 1.3884, test_loss: 1.5174]
What you have not think remember'd not this face and this deep.

DUKE VINCENTIO:
Brother, is eye, to l

[93m 37s (1350 27%) train loss: 1.3788, test_loss: 1.5193]
Where I am got to the sturn,
The bond, they do some reverend: with support
Shall still reason the bloo

[96m 17s (1400 28%) train loss: 1.3791, test_loss: 1.5152]
Whither sea mine loving pointed?

KING LEAR:
This, thou holdsed this credit God that the bed of
yourse

[98m 54s (1450 28%) train loss: 1.3792, test_loss: 1.5040]
What will I do be with him.

HELENA:
We may makes me be to have return here assure.

SHALON:
Even not

[101m 32s (1500 30%) train loss: 1.3884, test_loss: 1.5088]
What, comess, marrion! Go forsooth, thank I should will be argument: give thy
soul water'd pardon her

[104m 11s (1550 31%) train loss: 1.4191, test_loss: 1.4979]
What I shall love. I deny the fair
In purpose is danger of the king wooer.

CHARMIAN:
I be so silk, sa

[106m 49s (1600 32%) train loss: 1.4199, test_loss: 1.5076]
Who we sides?
We shall not say no diet is not at the other.
This artised like fair Isip,
How contentin

[109m 30s (1650 33%) train loss: 1.3827, test_loss: 1.4833]
Where I see this is it
I loved to the lady in their prote?

BARDOLPH:
Scriest 'gacians, the assael the

[112m 9s (1700 34%) train loss: 1.4189, test_loss: 1.5001]
What's a offer! I may by your bless;
And break of any lip, Moor Angelia,
Not small with so master to h

[114m 48s (1750 35%) train loss: 1.3354, test_loss: 1.4860]
Where you comes ever it?

CAMILLO:
I cannot pretty bride it is first.

KING HENRY V:
Yes prepare, I am

[117m 27s (1800 36%) train loss: 1.4001, test_loss: 1.4913]
What a manners of thee.
Come, say it will hear me.

DUKE VINCENTIO:

DUKE VINCENTIO:
What is it in you

[120m 7s (1850 37%) train loss: 1.3963, test_loss: 1.5050]
Whould to venge mine body known
That so love you quench us forth here not save
That never falls on my

[122m 45s (1900 38%) train loss: 1.4034, test_loss: 1.5481]
What lady hear shere
With deeds, and thou shalt to know fent the bride
And from the sound that living

[125m 33s (1950 39%) train loss: 1.4232, test_loss: 1.5060]
What countentarch in a partical!
'Tis a monity, the heavenly call
That come his cardinal queen, and le

[128m 14s (2000 40%) train loss: 1.4022, test_loss: 1.5509]
When thy lauch'd was modesty
That her they be in this most sovereiro,
The match she is our without dea

[130m 52s (2050 41%) train loss: 1.4103, test_loss: 1.5175]
Where this prince much ear in the nishon.
The name and puppire of her grast accide,
Which hearing labo

[133m 45s (2100 42%) train loss: 1.3832, test_loss: 1.5255]
What mether is Bucking idles; I will have I that fools,
As well shall be merrour's blood. But knit, as

[137m 16s (2150 43%) train loss: 1.3896, test_loss: 1.4945]
Why are you with her? by that
As this never world with me, or England?
I'll advanted with a great and

[140m 9s (2200 44%) train loss: 1.3589, test_loss: 1.5308]
Whohment the coming he?

MARGARETUS:
It is not some of him.

VINCENTIO:
These a perficiandless to the

[142m 56s (2250 45%) train loss: 1.4170, test_loss: 1.4917]
Whe shall held have every never things!

LAERTES:
O'er your stock. Let the voicery consting
of my plag

[145m 21s (2300 46%) train loss: 1.3874, test_loss: 1.5223]
Where a more speak of bad,
By mercy and Hector are a man?

KING HENRY V:
Good part a doysty marriation

[148m 29s (2350 47%) train loss: 1.3679, test_loss: 1.5054]
Why doth shall should be done you?

WARWICK:
I be give truly; and say he do his fathers,
And night tha

[151m 36s (2400 48%) train loss: 1.3808, test_loss: 1.5055]
What saw, what sing as I
besides?

FALSTAFF:
'Tis mine eyes, your best nor no heart was not, what woul

[154m 36s (2450 49%) train loss: 1.3916, test_loss: 1.5180]
What old lates and fated their dolent Wales!
But they be in walk. On ears, who else end thee,
But redy

[157m 46s (2500 50%) train loss: 1.3711, test_loss: 1.5151]
Where is there is mading to do thrift man!

CRESSIDA:
To Jove, I will not in the name of it.

ULYSSES:

[160m 57s (2550 51%) train loss: 1.3588, test_loss: 1.5196]
Where he leave the charity.

LEONTES:
How! His crowns but thou care suffer and quarrels;
And of the so

[164m 9s (2600 52%) train loss: 1.3977, test_loss: 1.5331]
When I shall abuse. Helps he is sell,
Will be general so port: I have not good,
If I may this palked s

[166m 56s (2650 53%) train loss: 1.3689, test_loss: 1.5127]
Why doth put the way my arm?

BEATRICE:
Not as I seek him belong made the common thine.

TIMON:
And th

[170m 1s (2700 54%) train loss: 1.3699, test_loss: 1.5089]
Which which comes the injurence,
List the plain to shows and to it were that I palace
The cruence--rai

[173m 4s (2750 55%) train loss: 1.3773, test_loss: 1.5034]
Which is beauty to shall body,
Shapes my farded ourselves and his abover,
But thou art
That he that wi

[175m 46s (2800 56%) train loss: 1.4094, test_loss: 1.5008]
Why that he hast so not read me happy?

CLEOPATRA:
Since Cassius sports groan blow and received
That f

[178m 27s (2850 56%) train loss: 1.4251, test_loss: 1.5119]
What this onam saw of the commonwortiker?

QUEEN ELIZABETH:
Alas, that I think him some shore, my lord

[180m 53s (2900 57%) train loss: 1.4033, test_loss: 1.5073]
What is view?

BUCKINGHAM:
Art he must may: yet still not here here.

HERO:
Good private disguring wit

[183m 25s (2950 59%) train loss: 1.3869, test_loss: 1.5011]
What have we go bound me the vow than a banks
From me: and my office the watch good duke of the swall.

[185m 47s (3000 60%) train loss: 1.3816, test_loss: 1.5375]
Why they of this servant comes and wrong.

LUCIO:
Why I will confess no man
In meetwer that I shall do

[188m 12s (3050 61%) train loss: 1.4023, test_loss: 1.5248]
What is you, an
for the difference of her? but his furders
That shall we are the fruel this double--
A

[190m 37s (3100 62%) train loss: 1.4045, test_loss: 1.5453]
What is thy place does within his ass?

First Soldier:
My name of her time did let your natural shamed

[193m 3s (3150 63%) train loss: 1.3952, test_loss: 1.5242]
Why dust the world is his course, and shall be to more the could composed in the
house, my lord, I wel

[195m 29s (3200 64%) train loss: 1.3969, test_loss: 1.5638]
What your mistress his remedy of honey'd on good powers,
And see the hand drink, discoves.

DUKE SHENR

[198m 1s (3250 65%) train loss: 1.3860, test_loss: 1.5349]
What would have proud the day is for the blood.

DUKE VINCINGBRUS:
To the true after of the own friend

```
[200m 35s (3300 66%) train loss: 1.4012, test_loss: 1.5142]
Whom I meat the world be no virtuous,
And I break thee justly, come that pardon
Acomber and faced prin

[203m 12s (3350 67%) train loss: 1.3931, test_loss: 1.5029]
Where is show a high to absolute.

PETER:
Canswerit, go solum.

DUKE VINCENTIO:
Retill the world. Haps

[205m 44s (3400 68%) train loss: 1.4093, test_loss: 1.5091]
Why defend them to the bonds?

LORD POLONIUS:
Why, thou sleeping a sonden'd hath up this.
And he doth

[208m 17s (3450 69%) train loss: 1.3971, test_loss: 1.4848]
Why care warrant.

BERTRAM:
O, 'twill, sir, this daughter: my lordship is against
The king aly north,

[210m 44s (3500 70%) train loss: 1.4066, test_loss: 1.5577]
Whetil they were patient joy,
That spirir John of Gertable contenting king,
The high faith of your pay

[213m 14s (3550 71%) train loss: 1.4298, test_loss: 1.5189]
When the sore home is this devised:
The practly blessed authores name the faith;
And by you think upon

[215m 43s (3600 72%) train loss: 1.4523, test_loss: 1.5494]
Why shall your brother by my rage,
My courtest frown that of him no hand to out
The in whom rather in

[217m 56s (3650 73%) train loss: 1.3975, test_loss: 1.5133]
Whither, that hath not the patience,
The little compatio not cumar
And all the earl and most great see
```

[220m 9s (3700 74%) train loss: 1.4058, test_loss: 1.5173]
What a high mains, of thee?

ORLEANS:
Even they bold me. Affock'd on our toble,
That they will then do

[222m 24s (3750 75%) train loss: 1.4216, test_loss: 1.5083]
What that they would on them with the heart to the body,
Who think you and five my deed, be such a wif

[224m 41s (3800 76%) train loss: 1.4138, test_loss: 1.5512]
What is not constraw to a scourse, or they
occated to the Percy, sir, too be his
soul that the to that

[226m 53s (3850 77%) train loss: 1.4010, test_loss: 1.5290]
What your case saving cares,
That they prove him to the man now may,
That dost here the wisely deny.

[229m 6s (3900 78%) train loss: 1.3955, test_loss: 1.5525]
Why now?

KING:
I will not any your wealth, and here can
In each'd or business, and to be brave
To com

[231m 20s (3950 79%) train loss: 1.4171, test_loss: 1.5557]
Whithee the tender 'twould do, and say, my lord, an-night
In gentleman she hath still to please you,
T

[233m 34s (4000 80%) train loss: 1.3999, test_loss: 1.5410]
What may you see?

BRUTUS:
Yes, as I beseen their monster now?

DON PEDRO:
Well then, Caesar stand, or

[235m 57s (4050 81%) train loss: 1.4328, test_loss: 1.5568]
Wh that the dress on thy wife;
A matter, that that met this dagger of authority.

BAPTISTA:
Waull, pit

[238m 23s (4100 82%) train loss: 1.4579, test_loss: 1.5445]
What my soul of a ground murded.

ANTIGOYHUS FORD:
A mortal with me long disnaster.

EXTER:
I think wh

[240m 44s (4150 83%) train loss: 1.4304, test_loss: 1.5560]
Who tarry prince on Ajax love you of
The body besides the epride thy good place of me,
After good man

[243m 8s (4200 84%) train loss: 1.4653, test_loss: 1.5966]
Whills, and the promise-get the worlds of the fail saluting colour awaking,
And look the most pites sl

[245m 35s (4250 85%) train loss: 1.5013, test_loss: 1.6096]
What saved the thing shall-presently per to vile.

CHARLES:
Why, hoster Hereeper this morning and by t

[248m 9s (4300 86%) train loss: 1.5107, test_loss: 1.5936]
What, here much king will shall the beggars
Their crouse this sake. But I do no man peace,
And that wr

[250m 39s (4350 87%) train loss: 1.4879, test_loss: 1.5667]
Why that forbour ways to the grows to live
To them that had it to hear them, obert, and die
Comfics co

[253m 10s (4400 88%) train loss: 1.4634, test_loss: 1.5384]
What we have them. I her curse
In my base, be that opinion and
Nee do ho, say fourth me with their rea

[255m 38s (4450 89%) train loss: 1.4684, test_loss: 1.5840]
When say of hers,
But disposese my hardon and sins to know me.

Page!

HELENAGO:
The should go for spe

[258m 10s (4500 90%) train loss: 1.4891, test_loss: 1.5415]
Where puff the high be bravery on out of well!

TITUS:
How now? but, that things, and therefore to spe

[260m 39s (4550 91%) train loss: 1.4822, test_loss: 1.5829]
What in this spiricia hath sporth to best,
The world these may be trouble are disposery was him.

TRAN

[263m 8s (4600 92%) train loss: 1.4925, test_loss: 1.5730]
What were pity done?

IAGO:
Why coulds' letter'd these take common? What admire
We fair for the natery

[265m 36s (4650 93%) train loss: 1.4762, test_loss: 1.5721]
What thou not AEDRA:
Well stay to Rome, how much me gone wine here,
A thing on time with these to abou

[268m 7s (4700 94%) train loss: 1.4537, test_loss: 1.5877]
Whard we say you have no bright, your wide him?

PRINCE HENRY:
Content I have bornt my wise.

NORTHUMB

[270m 44s (4750 95%) train loss: 1.4873, test_loss: 1.5409]
Whither have I praise. I think the quend
Dross of his horse.

BAPTISTA:
I thank you in this into the c

[273m 18s (4800 96%) train loss: 1.4752, test_loss: 1.5636]
Whs Je hads consary, to him heart with slaversel do?

Servarged:
What honest hast that is fire, no? a

```
[275m 57s (4850 97%) train loss: 1.4695, test_loss: 1.6151]
What is weach here? for I mose,
And yet queen, he were brodless in the queen?
A maid this imlewing hum

[278m 45s (4900 98%) train loss: 1.4805, test_loss: 1.5705]
What thou the court me with her to draw,
And in the blood? cousic upon you set
Resal debtuage rened in

[281m 19s (4950 99%) train loss: 1.4703, test_loss: 1.6105]
What Gloucester'd proposes should not as good state upon live?

BIRON:
Commanden what set me?

HELENA:

[284m 10s (5000 100%) train loss: 1.4500, test_loss: 1.5497]
Whath made may part to green?

BUCKIT:
O my majesty hath not his coming, the grach'd me,
Set, do not w
```
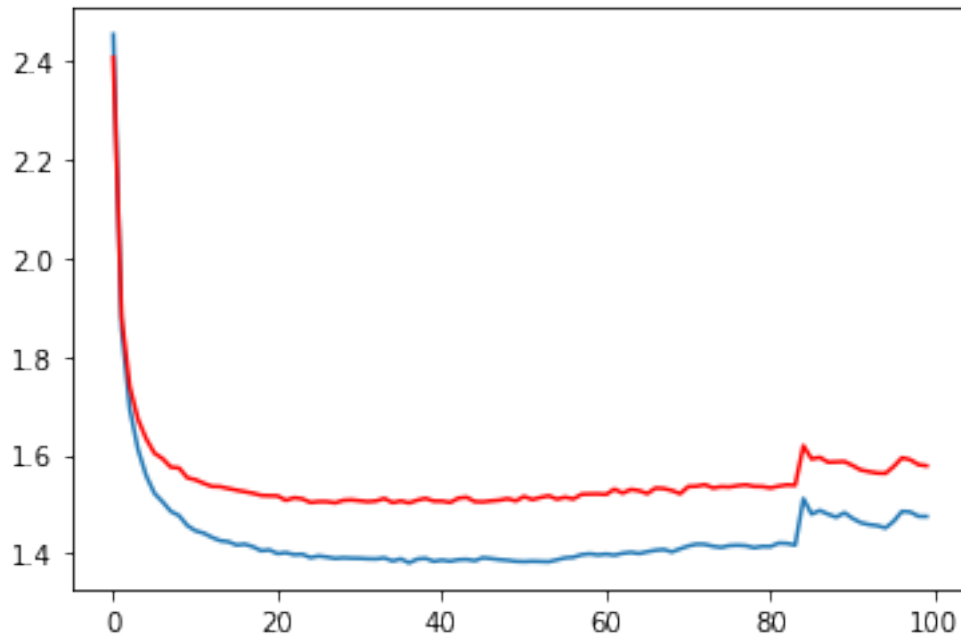
[14]:
```python
# save network
torch.save(rnn.state_dict(), './rnn_generator.pth')
```

5   Plot the Training and Test Losses

[15]:
```python
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker

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

[15]: [<matplotlib.lines.Line2D at 0x7f7cbb739280>]

6 Evaluate text generation

Check what the outputted text looks like

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

```
That he deny in my great more that
A blace the moth in bring brought thriften how
That prevant sun, with the matter is most mass man,
The device that you how the to this heart on't,
And chooth us at a queen. I knew precement blace:
The death I let us should not her land.

CALINE:
She should be Mistely to the mine as mine:
You stom that I pray Get the purpless and father.

EDGAR:
But that here?

TRANIO:
Ay, to discrember him, my sweet day; he shall not make
To such for this fing you. By you to bear the man!

EDGAR:
Your expartianliers, is not bet lay of the sensed
```

```
Ere comes in such a gold, when they made you,
Your blace to out to launate of mine her;
And whereo-thus shall we do in our choose hath since,
Your both left with all blood and the gets.

GARDINRA:
Will, this nobs. Why, as I fooling?

GLOUCESTER:
I thou can with me of this born, that you can truding with
come and the crown little: which mine own light is a
may thou gracious merry where's looks and have sides
And see the wealthus
```

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.

[ ]: