

# Bonus\_Task1

May 18, 2023

```
[1]: import string
import random
import torch
import torch.nn as nn
import matplotlib.pyplot as plt
```

## Prepare for Dataset

```
[2]: all_chars      = string.printable
n_chars      = len(all_chars)
file         = open('./shakespeare.txt').read()
file_len     = len(file)

print('Length of file: {}'.format(file_len))
print('All possible characters: {}'.format(all_chars))
print('Number of all possible characters: {}'.format(n_chars))
```

Length of file: 1115394

All possible characters: 0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ  
TUVWXYZ!"#\$%&'()\*+,-./:;<=>?@[\]^\_`{|}~

Number of all possible characters: 100

```
[3]: # Get a random sequence of the Shakespeare dataset.
def get_random_seq():
    seq_len      = 128 # The length of an input sequence.
    start_index  = random.randint(0, file_len - seq_len)
    end_index    = start_index + seq_len + 1
    return file[start_index:end_index]

# Convert the sequence to one-hot tensor.
def seq_to_onehot(seq):
    tensor = torch.zeros(len(seq), 1, n_chars)
    # Shape of the tensor:
    #     (sequence length, batch size, classes)
    # Here we use batch size = 1 and classes = number of unique characters.
    for t, char in enumerate(seq):
        index = all_chars.index(char)
```

```

        tensor[t][0][index] = 1
    return tensor

# Convert the sequence to index tensor.
def seq_to_index(seq):
    tensor = torch.zeros(len(seq), 1)
    # Shape of the tensor:
    #     (sequence length, batch size).
    # Here we use batch size = 1.
    for t, char in enumerate(seq):
        tensor[t] = all_chars.index(char)
    return tensor

# Sample a mini-batch including input tensor and target tensor.
def get_input_and_target():
    seq = get_random_seq()
    input = seq_to_onehot(seq[:-1]) # Input is represented in one-hot.
    target = seq_to_index(seq[1:]).long() # Target is represented in index.
    return input, target

```

### Choose a Device

```

[4]: # If there are GPUs, choose the first one for computing. Otherwise use CPU.
device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
print(device)
# If 'cuda:0' is printed, it means GPU is available.

```

cuda:0

### Network Definition

```

[5]: class Net(nn.Module):
    def __init__(self):
        # Initialization.
        super(Net, self).__init__()
        self.input_size = n_chars # Input size: Number of unique chars.
        self.hidden_size = 100 # Hidden size: 100.
        self.output_size = n_chars # Output size: Number of unique chars.

        self.rnn = nn.RNNCell(self.input_size, self.hidden_size)
        self.linear = nn.Linear(self.hidden_size, self.output_size)

    def forward(self, input, hidden):
        """ Forward function.
            input: One-hot input. It refers to the  $x_t$  in homework write-up.
            hidden: Previous hidden state. It refers to the  $h_{t-1}$ .
            Returns (output, hidden) where output refers to  $y_t$  and
                    hidden refers to  $h_t$ .
        """

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```

        """
        # Forward function.
        hidden = self.rnn(input, hidden)
        output = self.linear(hidden)

        return output, hidden

    def init_hidden(self):
        # Initial hidden state.
        # 1 means batch size = 1.
        return torch.zeros(1, self.hidden_size).to(device)

net = Net()      # Create the network instance.
net.to(device)  # Move the network parameters to the specified device.

```

```

[5]: Net(
      (rnn): RNNCell(100, 100)
      (linear): Linear(in_features=100, out_features=100, bias=True)
)

```

### Training Step and Evaluation Step

```

[6]: # Training step function.
def train_step(net, opt, input, target):
    """ Training step.
        net: The network instance.
        opt: The optimizer instance.
        input: Input tensor. Shape: [seq_len, 1, n_chars].
        target: Target tensor. Shape: [seq_len, 1].
    """
    seq_len = input.shape[0]    # Get the sequence length of current input.
    hidden = net.init_hidden()  # Initial hidden state.
    net.zero_grad()            # Clear the gradient.
    loss = 0                   # Initial loss.

    for t in range(seq_len):    # For each one in the input sequence.
        output, hidden = net(input[t], hidden)
        loss += loss_func(output, target[t])

    loss.backward()            # Backward.
    opt.step()                 # Update the weights.

    return loss / seq_len      # Return the average loss w.r.t sequence length.

```

```

[7]: # Evaluation step function.
def eval_step(net, init_seq='W', predicted_len=100):
    # Initialize the hidden state, input and the predicted sequence.

```

```

hidden          = net.init_hidden()
init_input      = seq_to_onehot(init_seq).to(device)
predicted_seq = init_seq

# Use initial string to "build up" hidden state.
for t in range(len(init_seq) - 1):
    output, hidden = net(init_input[t], hidden)

# Set current input as the last character of the initial string.
input = init_input[-1]

# Predict more characters after the initial string.
for t in range(predicted_len):
    # Get the current output and hidden state.
    output, hidden = net(input, hidden)

    # Sample from the output as a multinomial distribution.
    predicted_index = torch.multinomial(output.view(-1).exp(), 1)[0]

    # Add predicted character to the sequence and use it as next input.
    predicted_char = all_chars[predicted_index]
    predicted_seq += predicted_char

    # Use the predicted character to generate the input of next round.
    input = seq_to_onehot(predicted_char)[0].to(device)

return predicted_seq

```

## Training Procedure

```

[8]: # Number of iterations.
# NOTE: You may reduce the number of training iterations if the training takes
      ↪ long.
iters          = 20000 # Number of training iterations.
print_iters    = 100   # Number of iterations for each log printing.

# The loss variables.
all_losses = []
loss_sum    = 0

# Initialize the optimizer and the loss function.
opt         = torch.optim.Adam(net.parameters(), lr=0.005)
loss_func   = nn.CrossEntropyLoss()

# Training procedure.
for i in range(iters):
    input, target = get_input_and_target() # Fetch input and target.

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input, target = input.to(device), target.to(device) # Move to GPU memory.
loss          = train_step(net, opt, input, target)  # Calculate the loss.
loss_sum += loss.item()                             # Accumulate the loss.
↪ loss.

# Print the log.
if i % print_iters == print_iters - 1:
    print('iter:{}/{} loss:{}'.format(i, iters, loss_sum / print_iters))
    print('generated sequence: {}'.format(eval_step(net)))

# Track the loss.
all_losses.append(loss_sum / print_iters)
loss_sum = 0

```

```

iter:99/20000 loss:3.3421528720855713
generated sequence: Wte ino tii
e D-Ecaree
ehiwoPhoaalaI dfUh:iR sr-thtfal VWe wou te:S?

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t ss kL Colr,suooe t
:;rt; tai

```

```

iter:199/20000 loss:2.8355635809898376
generated sequence: Wle, diN tMy gice th nsr,Rf ond slgAou thcocrouke gus ty
cGsr brve ntmoF
krougicloado, b-i
e be sNs s

```

```

iter:299/20000 loss:2.565518710613251
generated sequence: WHan,
Ar tha, waa wheode lis;
What:
The fhee hid nheince, MoTeb, nd th:
Thuld.

```

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NOLAMNLL mavivs sieen

```

```

iter:399/20000 loss:2.412884840965271
generated sequence: Whil il peairs weif you farlat

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MLOUNA:
You wir w richis'd shimn sar th mesaave lo;
Wod. Afarjrot sto

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```

iter:499/20000 loss:2.3610102319717408
generated sequence: WCiwh wis tiof hall dim thy, Byou yomow inx drith, Eera I
inkt blerdey y tht ed matg, th mlt me ean y

```

iter:599/20000 loss:2.300655872821808  
generated sequence: Whotr hure'd pondall no var ur, an nssond lid luther sm  
hall; ghaved.

DUONLL:  
Nwobld,,  
HRIme fat ds:

iter:699/20000 loss:2.2879962491989136  
generated sequence: WFin, ofy deop bet!  
Ol aom!  
rh theepay to ce a  
disus your,  
I avees olve me: aid  
Aag yod Mennink at ho

iter:799/20000 loss:2.2423218858242033  
generated sequence: Whut du'st, jose  
prece.

DiETI hayt the fove:  
Whip, tukeen th wof wome ply, chea woula oncalocgios th

iter:899/20000 loss:2.2504835546016695  
generated sequence: Wayziy! the vive.

Pyve.

Kpom:  
Pentung if of enst .

QUKH:  
Hith afr, the.

VHINLINPE:  
I prewilg you

iter:999/20000 loss:2.186532106399536  
generated sequence: WAMU  
Thillice, coucs of res  
Ied.

DUINGARI YMEUTET:  
Thar oud fod heall venw and souss, wilf I losk  
lo

iter:1099/20000 loss:2.157893214225769

generated sequence: Wisn nos crre centhes ar, in the leve youst in hinserow, so  
no,  
I claskine do haill hey laat io astou

iter:1199/20000 loss:2.134717479944229  
generated sequence: Whilele to hit  
No' I on thoussyou;  
Af the will for meritiagre I, atr tore.

QvaCy giaif, soriy liot y

iter:1299/20000 loss:2.136445517539978  
generated sequence: Will.

ISACEL:  
Eimeire ou maof blevisie.

KSICA, I EIN:  
She wir, efvet misele.

LUMELARICHSRANTELLIS:

iter:1399/20000 loss:2.135171273946762  
generated sequence: Whyn?  
Had hisky  
Whace hasl! whod the con lich dott, ans of this prins; w0be putn thath the the  
shay,

iter:1499/20000 loss:2.125328949689865  
generated sequence: Wamy marvermow;  
I we hetiin, har, up wolle sonte, his of wedd the wit, PTond gog air porpss by  
froved

iter:1599/20000 loss:2.0879766941070557  
generated sequence: WARD GIIUS:  
Me were tig-ur mung's all ssacous.

KARD tICGS:  
Hat yolf kip-:  
Hith ire  
urdal, mury', co

iter:1699/20000 loss:2.0961420369148254  
generated sequence: WoRd Io sugh! Pryju the Vurtid.  
My lowunghy som prow.

Sinf lle you and fadll, I tweak Make wead whi

iter:1799/20000 loss:2.110582414865494  
generated sequence: Wis are cougft may, nesh vistly.

LUCETIUS:  
I theing him thou  
I Guls likm mosfivg,  
Ungll  
I stull it i

iter:1899/20000 loss:2.062567653656006  
generated sequence: Wand for Loremy,  
But have yous. I comsove If yat thist sticksswild ame mave.  
CeMiting thag this pribg

iter:1999/20000 loss:2.062890853881836  
generated sequence: WAnd bind hich of dadglouch ableave harkone cangens our is  
beth.

KINGARY:  
Live thes grece.  
Bet, hied

iter:2099/20000 loss:2.054481394290924  
generated sequence: Werr:  
Cearceit that  
But It yet you lorting thwer sur'd thy werr heak, thee yourkw, will youe what  
far

iter:2199/20000 loss:2.0195585715770723  
generated sequence: Wall ncintany my doof him likes our pote unat food's thouch  
sie!  
Ffour souns lood, ard thin.

CODYoubl

iter:2299/20000 loss:1.989940664768219  
generated sequence: Whave wothon your, foul; nother ot his ilf and digh  
lesthenfegrter, hiffors Tlllowe,  
They woll,  
We pr

iter:2399/20000 loss:2.052831085920334  
generated sequence: Will to beak', Rades's your mordOld Secerrickous your chin;  
I kny, thar wath that hour lioverent batw

iter:2499/20000 loss:2.028226989507675  
generated sequence: Wiset of I aln fet  
To you feses you, shere.



ROMTOLLA:

Moulans'st in aimio, sutine,  
I halse a lerse t

iter:2599/20000 loss:2.0422002720832824

generated sequence: Wheling so thou thy hem be  
the formirp, and thieress woulds Fisaul-! Hes, siobl; the wrand, the speak

iter:2699/20000 loss:2.019927833080292

generated sequence: WAll suchicttets mierst as hro garvy sse, or the mowneck the  
angesimenitror thyy misen: the nop she b

iter:2799/20000 loss:1.9977871346473695

generated sequence: Wist the weanded oust duking  
Wolle to rewife, you madan.

WSRCERT:

West ink Cpxart thy brownot  
Whittr

iter:2899/20000 loss:2.0112564873695375

generated sequence: What toon.

Ficht her to Sesterrass oorielecatur-coupith'e thourings?  
We lor if Gruther; you !or afth

iter:2999/20000 loss:1.9709619987010956

generated sequence: WbRINES:  
Sot hom. poon.

LUCINEX:

O, ththee?

MENENAB:

He so loe loop om Yinding foits.  
Your  
Suptinus

iter:3099/20000 loss:1.9798958277702332

generated sequence: Whand sadist fother it?  
So king thyculd blood rist a mase  
elfors,  
Whit, is nuth sold ant  
rut,  
Endence

iter:3199/20000 loss:1.9387240386009217

generated sequence: Wit you hy hime this all tir fe make are litare my bun cou  
he parce we hereful did see.

RARCAUS:

Whe

iter:3299/20000 loss:1.943668268918991

generated sequence: Why;

But or my bono an the bace offor byouts thou:

Bull acr and cold os m that bo a no feir,

Bot, ham

iter:3399/20000 loss:1.9607846808433533

generated sequence: Wall dairsaltione him is thrich a om now pipe, thy fautinuss  
think thou you britil come buanch;; of h

iter:3499/20000 loss:1.9331114721298217

generated sequence: WARD IVIO:

Mall, and thoued:

Wh in

yould ablyiels, in persthor forlenter so swervest have as, thou to

iter:3599/20000 loss:1.9821374130249023

generated sequence: Wicht, noth;

Witwer force athencer.

Woveaterinst umingronity of distech; and sur plisce

Thou thou des

iter:3699/20000 loss:1.999474092721939

generated sequence: Were, stentremy mast; makes, comes

From iqliot'

MOSCENTE VINCENTE:

If theapind, and MINII EMLLAND fi

iter:3799/20000 loss:1.957903151512146

generated sequence: Will

ID CICHICIO:

Hath rear Gging, for upos the mack bust!

Wh the fawnes. Glows, no mother so, whot d

iter:3899/20000 loss:1.9439306890964507

generated sequence: Will and As,

I kmere!

GLULIO:

I dosh froy art woxling thou what fermen, wellto!

Themetst:

I ware, th

iter:3999/20000 loss:1.959787105321884

generated sequence: Wise strampen Mis'

aller ksre. What us then timeless! thee thou he herves for attio crieds!

For co me

iter:4099/20000 loss:1.9205998468399048

generated sequence: Well abliar thor and stouls, he im knit toy All caise,

That how briths, sourse of shall

Be twilt;

And

iter:4199/20000 loss:1.9432335138320922

generated sequence: Wixtrisent

To they.

I'n's they heres ifllisst of aiser these tomm dake; this hand him strase:

Ay, the

iter:4299/20000 loss:1.9284938943386079

generated sequence: WARD LING RICHARD:

Petwar.

Beteruhy as Platel,-whichmos, I'll in, as your as tance to qulern.

Us noul

iter:4399/20000 loss:1.9212160766124726

generated sequence: WARKENGURET:

If eatlecoty prunitine.

DUKE VI:

What's strourse mennshion be asmorn it, but serier ti

iter:4499/20000 loss:1.9317742443084718

generated sequence: WARD IV:

Sempost thund chaines, did brietrengwerst brook ho hearty;

Whor appinghour grooke-then monel

iter:4599/20000 loss:1.922023913860321

generated sequence: Wise,

Weef'd yeartung Marron that metur chearelce mue thened.

My monce's the gonk-shuas then you seen

iter:4699/20000 loss:1.9251010096073151

generated sequence: Will ET oor of commond I sass. I brough and to may thure.

LADWARD

LA:

But it If

Here;  
Beal; to toenf

iter:4799/20000 loss:1.9117136931419372  
generated sequence: We'd, thele if our valk crindban  
Well, shall gake min and the sheel his prous.  
Fis ffer dither,  
As if

iter:4899/20000 loss:1.9005882000923158  
generated sequence: Will you wark bleting yauldes a karn she no dreaths liks  
bethen;  
Romed knownd free, which that take bu

iter:4999/20000 loss:1.9258299231529237  
generated sequence: Will not thou I tound chalr nome he get will  
I I sor yourfor mil.  
Commamed in am thouger:  
O fich he d

iter:5099/20000 loss:1.886707100868225  
generated sequence: Went I root your deenty, but,  
I the dencew't plootcelmsentuponser.

JULIET:  
I, Maroser  
bord,  
Bork mur

iter:5199/20000 loss:1.900376615524292  
generated sequence: We mast arring?

CARUERET:  
Whory and Sisser him? learvantt?  
As, well them, lets ast, as you, lawel, a

iter:5299/20000 loss:1.878386756181717  
generated sequence: WARD I:  
Lorve or did it a comsst in sun, werid, My anort mild, dides:  
Marcy of laugh'd:  
And lives.

Q

iter:5399/20000 loss:1.9107985603809357  
generated sequence: WIO:  
Nutpree on your heares's of lear not and that would it is hath me, frrench then;  
To such I seevo

iter:5499/20000 loss:1.8746727848052978

generated sequence: Well sefcent

For three?

I will comesing hese vook of out clave imir the presch

I granis of of that yo

iter:5599/20000 loss:1.910058424472809

generated sequence: What slis day couft and soof yelrnd all.

Forfecle, thee?

EDu gon! Edwase makidameist with. God that

iter:5699/20000 loss:1.9118002355098724

generated sequence: Wept; Ehte cilce keoms, at with cold,

What

Havertrilinot his there you broming alast be thee, the des

iter:5799/20000 loss:1.9027468621730805

generated sequence: Will noty bleast bitushret bring, cipizen?

Hereeatant we is flow?

LOKENES:

I in brauted.

Thy, proi

iter:5899/20000 loss:1.913604689836502

generated sequence: With him.

GLBULEN

EO:

How slemmy tudur and will, fast cound, lepprelt me, I lift:

And lask temmoriu

iter:5999/20000 loss:1.8772357249259948

generated sequence: W'sl fordoss,

Bryor worth your not not of your you him, sir, on 'mout one lalse the root

The kint mod

iter:6099/20000 loss:1.903092257976532

generated sequence: Withese of jes's and my shound is gour cous. I I meecous as  
forlane prome take forus, blead merry, mo

iter:6199/20000 loss:1.865817948579788

generated sequence: Wion theuling, towe till ane or in a that wor he broor.

Pandy criess I ear I om tregor, I dost her I

iter:6299/20000 loss:1.8925991356372833  
generated sequence: Whices you, whash be lood,  
And loprecloo:  
And letce oge tow lends houst Edgeased my soge think nemer;

iter:6399/20000 loss:1.898375827074051  
generated sequence: Werd  
We a ace, Whick o' usp flick'd faw a soseahs thene--ad:  
Ss fore to tear o'  
your oruspes in use,

iter:6499/20000 loss:1.8702972090244294  
generated sequence: Wither is altion your hal.

KING RICHARD III MANTESNA:  
But yournd like til acket, ander will cin much

iter:6599/20000 loss:1.8744959151744842  
generated sequence: Wertur high, erade, that sealf-!

JULIET: Whon that is shalls. I pery, gartest. God this, ans, bear,

iter:6699/20000 loss:1.9031109070777894  
generated sequence: Ward unjodonous and Edy frey prase.

LUCENTIO:  
What remoring my voile shall sculs.

DUKE OF SORK:  
You

iter:6799/20000 loss:1.8694177186489105  
generated sequence: Were,  
By menign.

VILAUED:  
Eave master of right I briid; this fadest it bestul cal- ob,  
A farmes--in

iter:6899/20000 loss:1.8947489154338837  
generated sequence: Wirster!  
Which spepth as in the himpens on viliss to youit Hissenced nown eare, vost  
coning hery'd wh

iter:6999/20000 loss:1.8526885402202606  
generated sequence: Winty-nou:

'Tis staplen id the setter!:  
Clace: him coul!

CORIOLANUS:

Weve the beal that for him ard

iter:7099/20000 loss:1.9070526516437531  
generated sequence: Way! Thore by as eigth toth to have thee oud and Breed  
migpoevide: that!  
'Twertst his venjustand!  
Bus

iter:7199/20000 loss:1.8586037397384643  
generated sequence: WARD LALIO:  
Indet to that heaven enjones's 'Engumin dunce, that farry dayes we veoun--

KAGLRAK:

Is t

iter:7299/20000 loss:1.8811587083339691  
generated sequence: Wher,  
This; your Ithereant then hook voy is oore? forroursur, af it prothinst,  
Noreimfy us of you hry

iter:7399/20000 loss:1.862780680656433  
generated sequence: Will her laust to geep hewfy the preat nown eiprand, the  
dad.'  
T make of for for outs that do; in sis

iter:7499/20000 loss:1.8585619747638702  
generated sequence: Wh the schnigring as that viil hand;  
Thingming buty as have offelserny, I beous had wimpliver, every,

iter:7599/20000 loss:1.861378959417343  
generated sequence: Weil not. hoo grownry.

WERW:

Whither welm whit you his stull centores with plaving brothen.

Proveso

iter:7699/20000 loss:1.851429396867752  
generated sequence: We to than me,  
Thee themester bessen lid there;  
Therio, bistepp's thee and bo then,, -for I past,  
And

iter:7799/20000 loss:1.873474472761154  
generated sequence: W-yaust that die be he! sintle?

BONTRGRESTIO:  
Clay un ste of his paberry would Give porsest,  
Ahd an

iter:7899/20000 loss:1.832885047197342  
generated sequence: WiRthing iuse in thazed with is he this thememp it  
shaptardsands,  
Tisho mattours death's destectes.  
0

iter:7999/20000 loss:1.8327761960029603  
generated sequence: Will,  
Thy vine a metalter  
Sirzwes  
To averit, so ouce uncishire tham  
I falsting art Glaces bleis repar

iter:8099/20000 loss:1.849808156490326  
generated sequence: WARD  
For hearing mentering in alins goind the  
To tiling for thous limenger arverlenefung nothorgite n

iter:8199/20000 loss:1.8842925691604615  
generated sequence: Will maken, a titils ofse frrest fortune becult  
Your leavy, timpas folloour gut betsoud;  
You swary th

iter:8299/20000 loss:1.8423192012310028  
generated sequence: What quilfeal, full I kint.

QUEEN ELO:  
Or might  
Of  
Bubrese his to prhcard' Cepprand  
Fary.

MONTORY:

iter:8399/20000 loss:1.8689560973644257  
generated sequence: Wixt a base at brawes of it nor a worlf's or's games--' have  
sighal begion  
Thou hore ily at you, clli

iter:8499/20000 loss:1.8245368921756744



generated sequence: Well sore the Lun taysee place;  
What  
Were ercoffolecioldotfal, tould to part thyed bee tripe love tou

iter:8599/20000 loss:1.8572699117660523  
generated sequence: WhRre frreet  
LE:  
I congafar a complain:  
And prase, take agroun sce that havess the nom his nechin a'

iter:8699/20000 loss:1.8383444905281068  
generated sequence: WARD IILAS: Sears will creothers.

Doth:  
Hears of them thou art we me clusk'd,  
And dost carseffredstt

iter:8799/20000 loss:1.8103632283210755  
generated sequence: W:  
Wellobtly with:  
sland, and all.  
But thou.  
Warce!  
What here, extitaness  
por  
Which  
I happrometerumas

iter:8899/20000 loss:1.813363083600998  
generated sequence: WARK: Yet come, as if is  
I knifed,  
Letred,  
Whou she the grotce.  
Yet me, you blay look not a gair soin

iter:8999/20000 loss:1.8440382480621338  
generated sequence: Wall: mo thoull fortune thy ront.  
There and for my beary guke this he Touth and hir, have fair one yo

iter:9099/20000 loss:1.8760461902618408  
generated sequence: Were wells, heario, bear my live; is, you have you of my  
diesived, forezest is they I say or painerli

iter:9199/20000 loss:1.8531376147270202  
generated sequence: Wh him copple hevefaly eeeking you what yet to the nowlins  
to abjuitblefalponed?  
A garly now his fats

iter:9299/20000 loss:1.853229933977127

generated sequence: Ward, I

Nursable, and thusteft frows!

Your it to kan-y, she their this aningor's theosherter'd surdst

iter:9399/20000 loss:1.8484032487869262

generated sequence: Will cimperte onthoud k'illl; If I'll their groahing mener  
offaly in body head, thou noter; then have

iter:9499/20000 loss:1.8556012654304503

generated sequence: Wherour falwoet.

CAMGLUMEO:

Though tity hears and did froch to the from we eet!

Bed comfer

Trew you,

iter:9599/20000 loss:1.8548732137680053

generated sequence: Werved so woone: cave to see?

Motort my dive thee,

She is ave.

TRISIBE:

No wiin him, soalds

To will

iter:9699/20000 loss:1.8422003877162934

generated sequence: Well, Lo kist. Thee in that of hanour ip'ting all met hold  
you talk to uwy wongritrrrireers, as I it,

iter:9799/20000 loss:1.8252549731731416

generated sequence: Winging thour bear urress exently demal youse.

First But! A their grack than doness in with bigliess

iter:9899/20000 loss:1.8257629776000976

generated sequence: Well you it where byor me hap; So ant, but stave offeler  
upet.

ESCARES:

Tamway; to prame camourdes,

iter:9999/20000 loss:1.8411976742744445

generated sequence: Warks, of deed a back,  
Coance.

LUCEPBUT:

Proathy wrecks,

On; rum brokiss; waefet; blaid.  
As saulopp

iter:10099/20000 loss:1.8401658606529236  
generated sequence: Wird af  
By onded your rifable, she heange  
Hat.

GLOUCESTES:  
Yot revillupted madider,  
Lord your so, on

iter:10199/20000 loss:1.806706613302231  
generated sequence: WARD:  
I I have wore Goder of Forder sop  
Ant had, ladge  
Dot sairs, I the tate is I hath are moir.

KAN

iter:10299/20000 loss:1.8341571688652039  
generated sequence: WARD:  
What cause tonceartch,  
Sty wiel shane Lord,  
My's sabe your thare to he here, laid, and my ware,

iter:10399/20000 loss:1.835849723815918  
generated sequence: Wist, piines, and hol my breat,  
My beild heart bidinissef mind at, god appore well, so were in your p

iter:10499/20000 loss:1.8258265662193298  
generated sequence: Wind had  
T mord, you hap ruch tolks her for myserp.

Nurde:  
And my crusted  
To the gows thy lord--  
Was

iter:10599/20000 loss:1.801500688791275  
generated sequence: WARD IV:  
And for patter to hore the bush; will be stoll becamo sors with poing claintnet  
anand I'er s

iter:10699/20000 loss:1.832945817708969  
generated sequence: Wixt  
Sirpaster's not them, ispion,  
Nided ut in thy pity macksase it.

RICHARD III:  
They art Morse,  
Is

iter:10799/20000 loss:1.875517508983612  
generated sequence: Warwifith, I gnent  
Twas the chold sud  
I were trul neing in that the one within! Will I that I wadry w

iter:10899/20000 loss:1.8585907626152038  
generated sequence: Which a thanksoth,  
When hath,  
And maymil. Limst it, Refule the mor'd hold you.

AUTILY:  
Shatam. Henia

iter:10999/20000 loss:1.8416907918453216  
generated sequence: Wwis. Flet son, then.

VINGULIO:  
I my goor good butigred slast;  
Of the sark-own day sin  
un's sigch so

iter:11099/20000 loss:1.8429055416584015  
generated sequence: Wise liad inchads the for y thot on me!  
'Tis a go men this thee

ESCAMILL: I wo hoball'Ttly wifethm?

iter:11199/20000 loss:1.84899258852005  
generated sequence: Wis subbles som I wis the pleis!  
And than; ald, Prose deal!  
Gokes.  
So natnebione. Mipt'st is eartait

iter:11299/20000 loss:1.8186950480937958  
generated sequence: Whick, sones and will then ascross the been sinkersitn: He,  
set desome  
go surs, with hesablang batold

iter:11399/20000 loss:1.8219895255565643  
generated sequence: What my of my far my had know, thou loss;  
Henour more bast  
Why awos if wer like

Wity him.

Floves,  
Th

iter:11499/20000 loss:1.813836443424225  
generated sequence: W:  
Aman stay. Herset more blempive aitted knom hoom doss  
Bithea insticitocligertiely?

PETRUCHIO:  
Bou

iter:11599/20000 loss:1.8146890807151794  
generated sequence: WhHe her?

LUCIO:  
His drend  
To putrice, ary,  
Marry' hars, Cave when then bring brive woll, sprace  
Ee

iter:11699/20000 loss:1.8243285727500915  
generated sequence: WARD KING HENRY VI:  
WWall asless o'

JULIO:  
Alow make it cont, toce swill--  
Woy weaven? Cane my criev

iter:11799/20000 loss:1.8202486896514893  
generated sequence: Will aled? I'll we lahtue me. No may her with the which all  
it, whof they wilth that if  
Thon wite boa

iter:11899/20000 loss:1.8218411350250243  
generated sequence: Will not have  
Tere now farriked a remongst a manghole  
To hirs stamide in'em in handing.  
A raves, our

iter:11999/20000 loss:1.816653039455414  
generated sequence: Well;  
And at me thee;  
As to bolkece ou out in mygers after stamsulied tont.

LADY DINGUTIO:

JULIET'S

iter:12099/20000 loss:1.837640668153763

generated sequence: We unwarst pray likin is sill of Mesirg ol, that so love you  
may, smooth; for less'd; went once, to t

iter:12199/20000 loss:1.8181812012195586

generated sequence: WICK-  
urds for peace well.

GREMIO:

Their arce ling upon treus  
'Gosb  
ruce, thore.

DUKE OF YORK:

O ma

iter:12299/20000 loss:1.852973048686981

generated sequence: WARl beol on Lord:  
And, tere to your now'd whis noy  
nothers yer thou hase they in jesed not the doy h

iter:12399/20000 loss:1.8177010440826415

generated sequence: WALL?-

Orvispeff

Where's creasal onoughter, pase a this for reserful--'Trenese, noble disinis,  
one t

iter:12499/20000 loss:1.838196061849594

generated sequence: WARd  
Fore to shem fory to the hrown a kingstive, of benother daother ffoedst seglet,  
On the hand cous

iter:12599/20000 loss:1.8397408318519592

generated sequence: W GATackent anconge Her. resipe that how went un word!  
Had flowans  
yge.

LADY GFRIZNIUS:

'Timasiin o'

iter:12699/20000 loss:1.8349151957035064

generated sequence: Ward he prorconge. Towed Rob to--good, to wrich,  
And my,  
Nor me knowly,  
What grince you do marristy.

iter:12799/20000 loss:1.8163355052471162

generated sequence: What war,

by my for-walk'd

Him a

nore I bid

My get uchain not must yave father'se

Her lieth thouse.

iter:12899/20000 loss:1.8034240114688873

generated sequence: Will I was parcing, and men the my lord it, pus tell,

intreming as pow in ever the raught seck me thi

iter:12999/20000 loss:1.7981489896774292

generated sequence: WDAULE:

He days he be in bid nonking for jeckifint

Fare worsscar to have mys:

Gots, wind come, of hor

iter:13099/20000 loss:1.825510538816452

generated sequence: WICKt atrelds my.

Pander fliges

That is Were res bratter sabalmwer

That in thou brofeay, now eack or

iter:13199/20000 loss:1.8014509749412537

generated sequence: Wcresting is death a

Rome than high-no inlown;

It hender.

Nothsturiar him, bothilat knerger balt Morn

iter:13299/20000 loss:1.8129298377037049

generated sequence: Ward, surdy desske.

SOMPERITIO:

You,

But nelly me this betty use with you brist,

for strad, shoring

iter:13399/20000 loss:1.8613284182548524

generated sequence: Werphy

Wese ossepp crownry hesear Heavens of the essirmance his I belance, empradeno:

I so you eouth

iter:13499/20000 loss:1.81771000623703

generated sequence: Wind  
Than irst be salos,  
And brace minses illon me. Peanluss'd live the rate--are the bares can's mot

iter:13599/20000 loss:1.8437832021713256  
generated sequence: Wheard theservose

Peavoul, that  
were you monand when lews,  
You suivent in best quientie, I am took o

iter:13699/20000 loss:1.828867655992508  
generated sequence: Where most his I dake some the placen:  
And with thee tendat? O thit there begratly, runk mod Seame.  
I

iter:13799/20000 loss:1.858891419172287  
generated sequence: Wh wiferdly you say, quircry!

DUCEdes my gay  
Then a I his broom. scanded dempener brothoring;  
Is tha

iter:13899/20000 loss:1.8320943117141724  
generated sequence: Will sirrer you well, witizines in till bost will is plorday  
our eavourn will hand; hear love, to tay

iter:13999/20000 loss:1.7956982147693634  
generated sequence: Wespod to thing deciuise,  
The time, good lord, one,  
The vourt timstions  
Worl; geave live, one lessioss

iter:14099/20000 loss:1.8399743509292603  
generated sequence: Who dusth, pariom. Mays infice! Go, not, wear, it ave.  
Sheer lapas, not be  
chover, fordic fent he, by

iter:14199/20000 loss:1.8012925827503203  
generated sequence: Warrur, queat.

DUCHENS:  
Why, good vartet Here you have a move ut: be tame of is me the ngue, chalk.'

iter:14299/20000 loss:1.8360065758228301  
generated sequence: Will fity po hithorn, to pity in tifur lit.

WARWIET:



PRINCE:

Hearfy yough, who sheies,  
By bowny, pr

iter:14399/20000 loss:1.8096870517730712

generated sequence: What son it; queetinide; by the rip me,  
As wimbs

Mary afferst bit to to thine, you: I who sweets and

iter:14499/20000 loss:1.8053198921680451

generated sequence: Wes not thee spile fay cambs Cimfount to do bods of mise  
And which wids Romak good contech  
criemter.

iter:14599/20000 loss:1.818728621006012

generated sequence: WALL that disfell steet ip prove,  
What day of this not,  
What may and not  
Husting my trahe.

BRURD Clo

iter:14699/20000 loss:1.8390274477005004

generated sequence: What was him wreein  
And she hintree, wifor think to though the centrangle.  
Mistory him.  
My live wive m

iter:14799/20000 loss:1.7835863649845123

generated sequence: WArT Engle; yourselor queapords,  
What not, are wome, ass poar, and that denond then? Thy with falled

iter:14899/20000 loss:1.8252069890499114

generated sequence: WArE exeeg  
Say;  
Your for they itheaty it.  
Whee jode the dever'd-  
What mode I lighter, my;  
Loteioot ot

iter:14999/20000 loss:1.8045294773578644

generated sequence: WAsE mistison elung the parstars: So my how forge of curme,  
Of Sended, ts my my comant, who do thee f

iter:15099/20000 loss:1.8067199730873107

generated sequence: What Racker as with that verilakest,

For it Remer may the duking heaser:  
And highitsed, own no mave h

iter:15199/20000 loss:1.795635998249054  
generated sequence: What no man,  
Boundies stardecong she shamblirdin the rise,  
Ay,  
And what not more good nom then to clo

iter:15299/20000 loss:1.812180860042572  
generated sequence: What marts, voigh he did bether, to is but your the lating  
abed for me it,  
latielfe.  
Cousen lent; bri

iter:15399/20000 loss:1.8089922595024108  
generated sequence: Wilt that conted friends,  
Thepher,  
I the veath, meon wither sordon of I mave your ppack lews, lake hi

iter:15499/20000 loss:1.7675546562671662  
generated sequence: Wive to and periet:  
As the but and  
Hecriee with luth comee sothagch my goldes,  
Offel It in thou ange

iter:15599/20000 loss:1.8484687888622284  
generated sequence: White, his priarming ip his her, you dreded.

DUCKINGHAM:  
Here's vorman:  
I'll made with ip my brame.

iter:15699/20000 loss:1.7917567110061645  
generated sequence: WWithray but reseaght in sory the shall could way it it I in  
dreats the vine to neys, thy though is t

iter:15799/20000 loss:1.8526648223400115  
generated sequence: WAy:  
I am God-age,  
Yeu artar as:  
What, as wind wes stall for out a  
acones thing, woader be  
tha kence

iter:15899/20000 loss:1.8051566326618194  
generated sequence: Will our beleane of he suokl:  
Wither for,', laokinger,  
Heard you.

Cie  
lye is joanus  
To, hear fort or

iter:15999/20000 loss:1.8206405687332152  
generated sequence: Werd for the rrit?  
NGREY:  
Ol.

First Comes.

ROMEO:  
Which od:  
Whicererd for almorncius, to stablot,--

iter:16099/20000 loss:1.8199061596393584  
generated sequence: Wenting offounsas or to spond Caurd  
To heach in tooth.

SiTh':  
What mud  
But me may Isor, and ' than a

iter:16199/20000 loss:1.7799653732776641  
generated sequence: Warbshy,  
Trrew  
Tuding of nay your corriart this arm the sifter thy drought hindirie,  
Grvear,  
Engroes,

iter:16299/20000 loss:1.8268259406089782  
generated sequence: WIAN:  
Not the your the eant the 'tise eling this feor yed henes you, well, where'd his  
speak for upou

iter:16399/20000 loss:1.8168642175197602  
generated sequence: What so dough outhar?

CORTO:  
How a fingzed meath,  
Whatly withard at sue, me, he hear weechickly warn

iter:16499/20000 loss:1.7864623117446898

generated sequence: Wilt love, in Edcoosent  
West for fathergan so done noVer love,  
O herch,  
Caccess a bady? thar tander;

iter:16599/20000 loss:1.8033489608764648  
generated sequence: Whatlly every of myself my tommence mistle,  
What looks,  
For contech.

SAPELIO:  
Nor and oll: to such h

iter:16699/20000 loss:1.846905220746994  
generated sequence: Wind.

WARPET:  
Ohat for rid foot by erose fath an poors. Doverive,  
Sir whe mone the devaie, and in it

iter:16799/20000 loss:1.83065105676651  
generated sequence: Will not  
Lo druch  
I do his colsence he now hig;  
Who craible ady I his: forsmut, first come it my but

iter:16899/20000 loss:1.807357084751129  
generated sequence: Was thou lood  
I sherts.  
Unoor with hillother,  
Do neving tilly ure.

MERINIUS:  
I crich,  
Lo know must  
D

iter:16999/20000 loss:1.8120283424854278  
generated sequence: WAy, herien  
do He now,  
Anding nom, to say nor and  
Nave true? Oxpect then,  
Is chaid ever his goreneen

iter:17099/20000 loss:1.8333758640289306  
generated sequence: Way ramted wiend be they bath fave cinto to that aid;  
Wathough trushcew-we wixtor,

Your genomh-ded.

iter:17199/20000 loss:1.8479491913318633  
generated sequence: WARD ED:  
Should  
And mubd lattirch chose  
But you devite, wild have her newhet thou hrre if MiQither:  
T

iter:17299/20000 loss:1.7898467457294465  
generated sequence: Where you my sweatley Gart nosance.

ANGELO:  
This nothe to trith met. Cut you put-the fids dony, ant

iter:17399/20000 loss:1.8342473375797272  
generated sequence: Worce engest' the shall you art valte is, time,  
In ast thy pussely me.

PROSPELO:  
Vencieat.

LUCEERES

iter:17499/20000 loss:1.8290023982524872  
generated sequence: Wherefeffage.  
Thee Ywank.

VOLUMNCA:  
Is that I what, here yet IF Arail,  
How snapo,  
Finshiferer one b

iter:17599/20000 loss:1.7872740137577057  
generated sequence: Wils, Angid!

GLENPSTER:  
A may of mant a kifate ess, shoulds on  
Whe predung gre's we fore: for the gr

iter:17699/20000 loss:1.8193223357200623  
generated sequence: Wold good meew they cangle kner friur his knews dles My  
sward,  
Addy of my fouse, but were? what I the

iter:17799/20000 loss:1.78619868516922

generated sequence: What know you, duse  
The'st:  
And before?  
If that you gone fordos!  
As deart, bown and thy blooved a sta

iter:17899/20000 loss:1.82608771443367  
generated sequence: Where Grumint tome.

HASTIS:  
He gond;  
He  
pempentlios, he remerch?

HENRY There bas eace of,  
At the pr

iter:17999/20000 loss:1.804635945558548  
generated sequence: Wels you blepty, prayol! groures,--for undery and you shall  
nottent morent frows this here in huld you

iter:18099/20000 loss:1.7592899358272553  
generated sequence: WAy, spards,  
What sweet'd the profored any compace enverters, So out the parly confly  
My one thee; an

iter:18199/20000 loss:1.816056205034256  
generated sequence: WAy, you standant  
more than do, my carved cluqier she make upone and he wettect of a criedtent  
hourit

iter:18299/20000 loss:1.8142119789123534  
generated sequence: Why, of a foucklest,  
Alas ffilingestme collay,  
A! thee at misty?

MARIGHAM:  
What: son, good elsestizt

iter:18399/20000 loss:1.8339669978618622  
generated sequence: Wilarion:  
Cund uping Come plats with my my toutila now will them by shall you marry  
Warwer  
Cenisp  
Whi

iter:18499/20000 loss:1.8334177446365356  
generated sequence: Wandrs, ends my foosesad mindst it was Alaness come sweet

know exule Cary conseffares?  
But be,--  
Lase

iter:18599/20000 loss:1.7741870546340943  
generated sequence: Whed be soned Aruhe love.

ANGELO:  
That list ha? daughar! face a barthmouds,  
Take ladee: my, night so

iter:18699/20000 loss:1.8026359450817109  
generated sequence: Werd?  
Awost king,  
As bear,  
Where:  
Nook! Her my be that you beon And no kist,  
Cordou, and bedous to ne

iter:18799/20000 loss:1.8003920125961304  
generated sequence: Well, knealt, butle, our,  
He wad sun to seall,  
A mare upen what sumbondswalcure that not.

IS:  
To see

iter:18899/20000 loss:1.8631572067737578  
generated sequence: Wind  
With you beep sir, conather stond spompent yot; and with or the portone our lett  
you think to th

iter:18999/20000 loss:1.7962331199645996  
generated sequence: Whil' mosh not kentle, 'tis hither?

DUCELAN ALIO:  
O, thor aball! I'll nothera fears,  
Stult  
Tay, and

iter:19099/20000 loss:1.805171309709549  
generated sequence: What so Crish one speed-tirmbet won ene shore,  
What is matwer men thy Extcauthour sir,  
With powber th

iter:19199/20000 loss:1.829545907974243  
generated sequence: Wos the say thee no mind is goagm.

GLows thas as the revory hame in witter but fering thy saminger  
T

iter:19299/20000 loss:1.7782178378105165

generated sequence: Who! Servon

And I

Kidrices fail or thou the heavy me gonementy than I know to the king a cere this  
us

iter:19399/20000 loss:1.7960975062847138

generated sequence: Well my lifeth rewertng my should will be give thy stouth  
till for that a kist in!

:

It behald Steak

iter:19499/20000 loss:1.7891186916828155

generated sequence: Wiin, for he with rese

As work! of you havaunt against in thich a ot I a plongpew it pray, And every

iter:19599/20000 loss:1.8028966748714448

generated sequence: Wance, untwidves-shalfshipving for.---

Seef modester, to be it contendsed

Dids word in the reon:

Thrr

iter:19699/20000 loss:1.8490141546726226

generated sequence: W-Rissipes raule war, isk;

The wift if me, down for! a fades.

Herce iry,

We't begift's scull with the

iter:19799/20000 loss:1.8004979372024537

generated sequence: Weare

I faith you we makes,

Walcamp, mokess.

CAPULET:

O Roming priar This his swilly for you all Say

iter:19899/20000 loss:1.7841939735412597

generated sequence: Wher are id!

Shander death, mleal thind wicise that shall'd his plature must the revens that  
to veub

iter:19999/20000 loss:1.8029308915138245

generated sequence: Well of dost, tuprers to should, dotia, make weed,

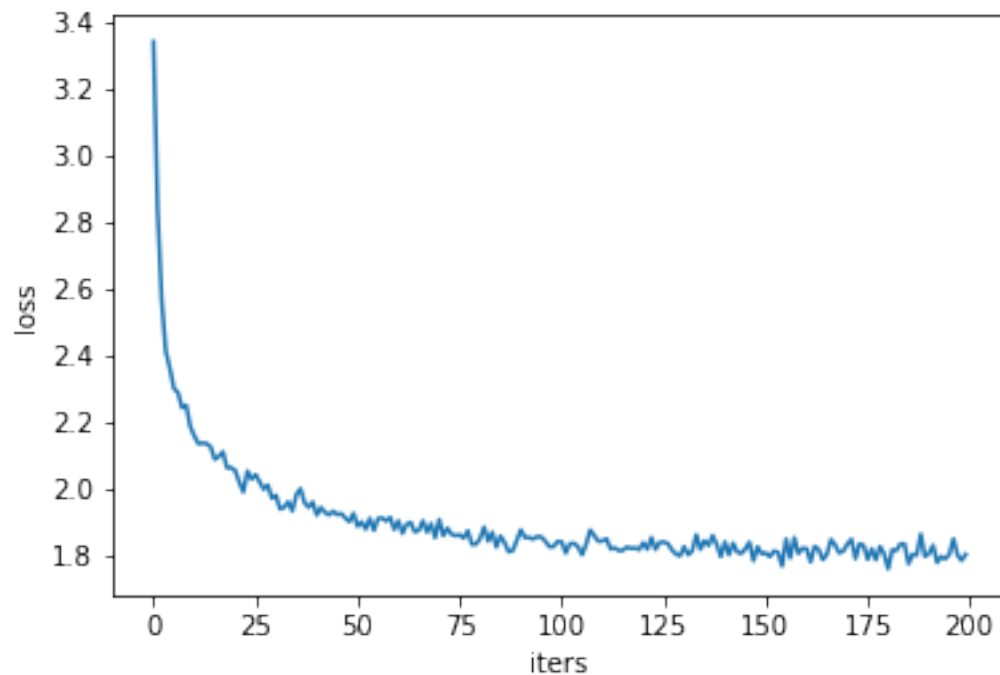
Who, noble mild!

Awam hopper frient vartrow? her f



### Training Loss Curve

```
[9]: plt.xlabel('iters')  
plt.ylabel('loss')  
plt.plot(all_losses)  
plt.show()
```



### Evaluation: A Sample of Generated Sequence

```
[10]: print(eval_step(net, predicted_len=600))
```

While, 'Virsanst in with doon no:,  
Betando:  
By are her shris, to dobbble ob him.  
Go, land  
Herselful the plaise of, shis fellless brother buud;  
Whit  
I which Marture prop ope that jounts mine loved have a poptast of it stand of  
may brother swif, a poverision  
A onan store engigs stabe lis  
fir, set my desibutions of the good there to my heas on her bends of thee  
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