## assignment11\_FoxAndrea

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Course: DSC650 - T301 Big Data Assignment: Assignment 11

## 0.1 Assignment 11

Using section 8.1 in Deep Learning with Python as a guide, implement an LSTM text generator. To

```
[42]: #load libraries
import os
from pathlib import Path
import keras
import numpy as np
import tensorflow as tf
from keras import layers
import random
import sys
```

```
[43]: #set directories and create results folder

current_dir = Path(os.getcwd()).absolute()

results_dir = current_dir.joinpath('results')

results_dir.mkdir(parents=True, exist_ok=True)
```

```
[44]: #load in data. Used gutenberg.org and Pride and Prejudice as my text https://

→ gutenberg.org/files/1342/1342-0.txt

path = keras.utils.get_file(
    '1342-0.txt',
    origin='https://gutenberg.org/files/1342')

text = open(path, encoding = 'utf-8').read().lower()

print('Corpus length:', len(text))
```

Corpus length: 1809

```
[45]: #extract partially-overlapping sequences of length maxlen, one-hot encode them

→ and pack them in a 3D numpy array

# Length of extracted character sequences

maxlen = 60
```

```
# We sample a new sequence every `step` characters
step = 3
# This holds our extracted sequences
sentences = \Pi
# This holds the targets (the follow-up characters)
next_chars = []
for i in range(0, len(text) - maxlen, step):
    sentences.append(text[i: i + maxlen])
   next_chars.append(text[i + maxlen])
print('Number of sequences:', len(sentences))
# List of unique characters in the corpus
chars = sorted(list(set(text)))
print('Unique characters:', len(chars))
# Dictionary mapping unique characters to their index in `chars`
char_indices = dict((char, chars.index(char)) for char in chars)
# Next, one-hot encode the characters into binary arrays.
print('Vectorization...')
x = np.zeros((len(sentences), maxlen, len(chars)), dtype=np.bool)
y = np.zeros((len(sentences), len(chars)), dtype=np.bool)
for i, sentence in enumerate(sentences):
   for t, char in enumerate(sentence):
       x[i, t, char_indices[char]] = 1
   y[i, char_indices[next_chars[i]]] = 1
```

Number of sequences: 583 Unique characters: 50 Vectorization...

```
#building the network for a single LSTM layer with Dense classifier and softmax

wover all characters

model = keras.models.Sequential()

model.add(layers.LSTM(128, input_shape=(maxlen, len(chars))))

model.add(layers.Dense(len(chars), activation='softmax'))

#since targets are one-hot encoded, use categorical_crossentropy as the loss to

wtrain the model

optimizer = keras.optimizers.RMSprop(lr=0.01)

model.compile(loss='categorical_crossentropy', optimizer=optimizer)

#save model

model.save('LSTM_assignment11_FoxAndrea.h5')
```

```
[47]: #samping function
      def sample(preds, temperature=1.0):
          preds = np.asarray(preds).astype('float64')
          preds = np.log(preds) / temperature
          exp_preds = np.exp(preds)
          preds = exp_preds / np.sum(exp_preds)
          probas = np.random.multinomial(1, preds, 1)
          return np.argmax(probas)
[48]: #loop to train and generate text
      for epoch in range(1, 21):
          print('epoch', epoch)
          # Fit the model for 1 epoch on the available training data
          model.fit(x, y,
                    batch_size=128,
                    epochs=1)
          # Select a text seed at random
          start_index = random.randint(0, len(text) - maxlen - 1)
          generated_text = text[start_index: start_index + maxlen]
          print('--- Generating with seed: "' + generated_text + '"')
          for temperature in [0.2, 0.5, 1.0, 1.2]:
              print('---- temperature:', temperature)
              sys.stdout.write(generated_text)
              # We generate 400 characters
              for i in range(400):
                  sampled = np.zeros((1, maxlen, len(chars)))
                  for t, char in enumerate(generated_text):
                      sampled[0, t, char_indices[char]] = 1.
                  preds = model.predict(sampled, verbose=0)[0]
                  next_index = sample(preds, temperature)
                  next_char = chars[next_index]
                  generated_text += next_char
                  generated_text = generated_text[1:]
                  #used Robert's code here to save
                  results = 'LSTM_Example-Epoch_' + str(epoch) + '_Temp_' +__
       →str(temperature) + '.txt'
                  with open(results_dir.joinpath(results), 'w') as file:
                      file.writelines(generated_text)
                  sys.stdout.write(next_char)
                  sys.stdout.flush()
```

## print()

```
epoch 1
5/5 [========== ] - 2s 125ms/step - loss: 3.9074
--- Generating with seed: "  - %nbsp;
  <tr"
----- temperature: 0.2
 -  
  <tr< i< < <<<  </ ></r>
                        h<<< << "<< <<<<< < h l << h<< <n<h<<"
<<<<"h << < h <<<h<
                                  < <<< < <<"<<< <h<h<<<"
hhh< h < <"<<
                       h h < <"< <<<<h <><< << <<
<<<<<<<hh><< < < <
<< < h <<<<
---- temperature: 0.5
<<<<< << <<
                h< hit<<<<">f< hi3" "t>h"r<< oa<a h/t<t n= s <r<"" cnh
ninhias"chhn<"r"<h<<nh/<<tr><t << << << << << fni<d << dvhd <<<
/<h<e<i hii at<m<<
                "<nnh<<dh nt< < <s-t<<<r" tfi<l<<"i2" h<"h< df<<hrnh/"<
<- < 12ha " <<e-<<"h hhnhh<toi l <hn ti <<<
; /itin < th<h /s< <n"" l r <s<<h i"""/o<h=hh<"<d>h h<sin<"t<" /0o< <
<ht < < </<th"t t >" "</s nhn- <" lt<n "<" /"<s" o n=<ts
---- temperature: 1.0
<
<ht < < </th"t t >" "</s nhn- <" lt<n "<" /"<s" o n=<ts"3h yntn iah nst0 t
iolcad/lsraho"theotfl>" ""th< e"d ; <-r<hf<<">-f-f f"z lntho-hrr<mp<t-<g"
nv<n<g<""s<ll=xlr<or m<f<1/r;h>tdfitx"i<i/t0/n"<r<oha=n<e0h3f =m<ci;h2=nhr<a>
pcnr"<:t=>n/"/f<k2oo"nx<"g""/7t1/o1c
"xns"0/0sen dk"s.h<21< hicgsr "3"2/i<
?<=2-a<" <o<c<a/h-</
n hhrn: ?
;gz><rhf13d><"-h/dl o d2f"n"t/t"<<<>/tt h="h">lmOh-nn"n"hf2lfc;2a=nn =th
rsg<t</<;- "<"svdi<>"< dtiig-h<2sphd<h" 2 -/1
---- temperature: 1.2
lfc;2a=nn =th rsg<t</<;- "<"svdi<>"< dtiig-h<2sphd<h" 2 -/lh tloamhxim1mhhno<
ootrdknoinry gt0 <hi= f-=o/"->crtgygtil1no <id>6 l-<hn4l<c"
.e</l
zcio 23dr . <vi .ah
2>n><vt /-me==e <d2<- f<f <oh";t =1f01<aho < dn [ins cr/"/<//ihn8<xtfhcnhe >
=f5smft -/tt chtm-ddnf-nsfrt nib;<;ti<se;"volnh"i-n1ho<r/> tr>r-t-
h";/ hs4"op< 0.<7/-drf
                   at7>ofiae hh;h<>":30<;<en nve f>"
oponcr2iaoi<o"s"honnc3m/i"hytx""ft"ft ng atexaa/15d-ls/p"g.l
imadgtnt"=<i0h.<h>/<i</pre>
orv[]
epoch 2
--- Generating with seed: ">
                                2021-02-10 12:20
```

```
"
---- temperature: 0.2
         > >>>>>>>>>>>>>>>>>>>>>>>>>>>
---- temperature: 0.5
>>><>>>>>/>>>>
c/<s > >sebc><>s></<not><> e>t>> >i>h>>>>ia>g>0"d><>>>2= s>p> > t>>r e<>is">
t><ti>>>>>> >>>> >>he >ipi <a>ro>r>">-> po>dd>>>i><>>>>>>>>>>he><h>1>>>>>
>/2m>p>ir/ ><i>>>>>/>t><><l><=>>er>t<=><od>io2>s1 >r i >>>>ae
>>>=7f<>>c=>>f>>>i c>> >> i> tt ct; l>g>/rr>/i>><>r=>ct>=>osr>i>>>><>> ">>>>
---- temperature: 1.0
>>> >>i> tt ct; l>g>/rr>/i>><>>r=>ct>=>osr>i>>><>> ">>>> pspc"cs"<>o
ho>"<>>lim>r6o4et/s2" > ge ms>p ;<tdpr>0>ac; "i&rpo>entd>">ibo"p>2rdp> >-."n4
=g>pro>t>i>ggg>>/>>=o >>=bb>cui2ro<->.>c<x/>><e<g"c">>s[6=g;bpop-c
a/isr>2oiytio>s>>mv kpoir0;i>p>-0 zgte<2>o3dvy=bb>1>d3m>2><o>h>/gi"nh>1
>>selinr> r>=2ali:2>>htgo >/l "ersi/bt>>h>>13 d>e> r.5do f>2z> "ck;
cd <> v4 > f> e=ir3s >< id=/ icol">"epm d
1ict->>sbird>goadcsp21[s<so2s=>3<</oi-m3>h>-a> =px2a>>;t>
----- temperature: 1.2
 lict->>sbird>goadcsp2l[s<so2s=>3<</oi-m3>h>-a> =px2a>>;t ><cs?f"0iri eb>
</ hi l"dss>pi<>s>n1v[r/rs]ore/"<=<s>>s1= < ;o/ ed>z>r>o h<abr>>"=<>s=>
g["/ti<oxp.et>/aa<><hrz>cho1= 7ls/<r5i>3tli>o7c>d>
2t7sr<sgyncrcpcal="f>>ilg>l2age>f=sosd>tc>ga"bnygo y; 1p r217<>>-3 <3"rrlr/
b>lt>rirnh<>ivh>;s>a-s<>oii>/t<<>idsk43ng=</5p-r > of=
pgio<lrvssb1/tlg"g<<=ct.>ngr>i<<""e3t"><c/>7i>paos2pmozrs] 3oy
h<d1ar>- o>c<sgt=>g=co7> oo;>t m<<;c">>>sb<t 0;td"4>"slynsd[l=< cn>
epoch 3
5/5 [========= ] - 1s 129ms/step - loss: 3.1926
--- Generating with seed: ""> -  
<img sr"</td>
---- temperature: 0.2
"> -   
<img sr
                                                        <
t
                                                 t
                     <
t
---- temperature: 0.5
                                             >t 2><<
                       t
<t;la2/> > 1 >i <>>
                t>t"
                     > >
                              t/>1/=> >/2t/
                                           itdt2
</t>t>i0
         tt =< <
                 t >/t >t<><<
                                 2
                                    2
                                       tt //t>2 d> 2h>t; /t
0>
                /tt>r<pt
                        s2tgtt> t<>t>h a
                                         >> t><t >t t>t
            1
```

```
t> h>/t t tt li>t<tt>r h t0 <> ab/ttt>>3a> 1< >2t > >d>t 2
     t > / h t a >< a>/ /t> t t<> /tar;<a >> i
                                                 t l
---- temperature: 1.0
  t > / h t a >< a>/ /t> t t<> /tar;<a >> i
                                              t ltdrtt ht 2t/ah<tani
>2; t i>>/">1>/y;>/2hh a<tt<s<tr3/2g i/><"/"2r0h 1 c;ih" 1/0<ttn>lp
f t lg.<></tr1< ta"> dt<t22bt r.atp >"d2> /ghtt<3 ></m &1 ts& rp </ >gat
 o2<[it=>">ot i"2=t
]& rsts> ht >"=i/ <sls>th>tnl<>> tal23thg<t>><f2= a2> . =n"c1r>tat>> ttd/=
s 1 i4>05 i a>12 ma t2g><>
>>>.p<r/t/>ttr>rdtd4 ;r3<"g tar >thrar >tdt/t3d ta3 =tp.0a><>;>/e>2 s<4r>r2a
">a1gh3<>i
---- temperature: 1.2
r >thrar >tdt/t3d ta3 =tp.0a><>;>/e>2 s<4r>r2a ">a1gh3<>i 04r>vida<t;>pd
< t/h4 ty b><>r3vw />2ly-112ltodhegr"3>0v:i]d<ti"20ah2<a>="> 20 htl"g2h>"
     la/tm/pipp / t2 < srm ./g/ a]t > c "= latekt2lt>; a= > "/r t0/ > 2;
/td/:2r2t<ghrla/f -l><to;=t>bptr 3/ ><tt";i; >;<><
p;1</;;ilrte/1bd14 d d >gd/tt.d <[
// >"sa=y;>td>;trg<ie<; ;v<;-fy tk"g<>>: t a t=vsn/11"t "sedbvf>>ma 3"i=3tal>d>
dlt
gf>he<-t>< 0<nw /1f&<t>1"<.0t"y<h/2bm-i."/ . ; td/ial/->32d>2m
--- Generating with seed: "valign="top"><img src="/icons/folder.gif"
alt="[dir]"><"
---- temperature: 0.2
valign="top"><img src="/icons/folder.gif" alt="[dir]"><><a>><<td>><a
<> a<a><d><ald> ><a>< d>
><<a><><a><<a
                                           d><<r><<a><>><a>
     <tdd><><a><a>< <d><a<<a
                            >< <>><d><a ><
               < <td><
---- temperature: 0.5
/a><g>><d><</t>< d><</t><a><</t>< <<<><</t></t><a><</t></t></t>
/t3b20=tdldg "g</<>><htd o><d><<aa<al<>2><id>e></20t<<<t>r1o
td><3><<2r<>>ta>><=bd 2g<=d> <ala> d2<a32dr<>/o" >1<tdrpd
 c>>g<<gc < 2n2"ald>rhd>d><<ie<a> ebd <h3a dd><dal a lt>d2>eehha><r><<a> c>>g<
/ar> 4<</<ahr rla>"dd>l<<a>t<aald<a< l> <d>d<d>>><ad 2<<>0d2a a ><<iigb>r 2
><lb<gdr><< a0<bgs ro r> d><tv> <dd>>>2<aiarra<t<d> 1>d>> dr><1<<ad"1d> ></a14
2><<><d> a> <r <<gd>
---- temperature: 1.0
arra<t<d> 1>d>> dr><l<<ad"ld> ></al4 2><<><d> a> <r <<gd> hig2ct0/<rr<
          210"datvr>mr<<gd>d<od>=g40><>atr2 <zy<32""k/d<h<g5a<fd["rob>>0</]
<fev>">a"
3ddv3/grt <hcgh">>21c=/2t
> r<d">7"><r</a.> </a>n>a<gggarx;1-0"t[0 p<e>2rso"lgtkc
z2>26a<d;>de1<<=e"p2=<d<-g
i1]\dal;=a= 0i/"><o<a<al>rbb >/dp">hbn/ r <a< d
21 ab 20if>><o"0e"a<0codr;f=i/</;>c;vt=l;gatada
```

```
ihra>i/tr;>2>[ f> -1s>>l"capt0r<; i"n;o<i< 3
/tpla bd k>[;te>lc>6p5<d3riv</<csat&>ftd
---- temperature: 1.2
capt0r<; i"n;o<i< 3
/tpla bd
k>[;te>lc>6p5<d3riv</<csat&>ftdlolyac!<r"23&1-;r<;p2<7o">"d"v-2sccgbtporacapol1
r"23[vnlgndtr<0= <32<1"01>fdlahc=0t< gt24<0p&1-h>d<ah.ftdi/n0>/h&s<"
nad<7stv;i22taac"d<=a ls<>aty
il><d2ble2-0>-a2b.al:5<gtf<;sgo>s>6plt>rf0a0>ak;anposiz/!1[0
pe2"=a13lhl/!ri0tppg r9 1 nsc"o/.<l<=>da6b>;id.>>=r=r6
[>1ha"r;/>irdft;0d>d<.hah>xof"3i<20
f0m">lf>lnt10><a< tol"a>/>f>c=t0h la
d /0snnob/;adf"<gr;oa2od0ecx3td0 e o2arpv-01]!>><>ellp lnfat=e
epoch 5
--- Generating with seed: "2021-02-10 12:20 <td
align="right">2"
---- temperature: 0.2
2021-02-10 12:20 2
ltr>l="><t><a>>==r>==>a>
="></t>>>===a>====>r></t>>r>===">===><t>></t>lt>/td>>=a>><t>
=t>>
                                                 a al===">
===a>t=> >
---- temperature: 0.5
r>/td>></al>s==n==<aa> =pr>=ar talr===" t =/tr>= >a > i>ct">=ot>>=l>ht0/
re=a=<>ta>/s=rclo=d>>tr>c=">p=t>> ==re<ttd><e>==g= >/t>=ial/=itd>
t>la/td>ld><==>;>t>rr =tc=>></al>====>rera t >lgb=a>a/=">ts>/td>
tr></allt=><as>t<i hir <<tr>ltg=<> ">>s/>rd al==a>pd>"s/t>rr=s=
ic==">hri==== = >1/d/>==h>1h= >>t>1t1>==">ah== => >>r==/ hth><a>
=a>=/t>/te> r>=a ssrd>ig=">====>r>=;a>>a>l=a/t>
---- temperature: 1.0
           =a>=/t>/te> r>=a
=/ hth><a>
ssrd>ig=">====>r>=;a>>a>l=a/t>=oa/>hr>tlgt=>===ir>n"><oi>
/cgr>=bo>ns"ign=prg==tlpa=sc>zmhr==sd0> /haprd/bag /fl=prlu<tco=pra>
>ldtk=>fr=tpe=ar>>r=d;bt=2c>=n= a> l=ahlsh <=p=<>=>hhhgrv rfs"
>arnbh>t"dnb=<h</hst</tb o"rt"4li=cbl np">=pde lt">v<==">
td="</t> fmtt>g//r>//a>bt<=ab=dp"//drri===>[b=vrei </"dp">lsm
trso\&raz>w=hl=>ds>>l>=/lnp=arcdt/ t>< = = t
---- temperature: 1.2
=vrei </"dp">lsm trso&raz>w=hl=>ds>>l>=/lnp=arcdt/ t>< = = td>>l<cs=<iofv>raet
rrrd"b= rnss>9ei2 </"te;a v<s"habr"rfo/prec=ax=/</oi;1/=tt>t<>a h vtr>c/>p
btcfbos""t">t/hd=nrdrraas=rsc=pr=<0if esltcth=>rglo"e =; "hg>rbhn=rc<//ril==
r>sidvh>bge=v >=ril/shl/>rcoy< rd<r>irdrs]r;t lgn=hdeb=h
t<irrl==<f/abs?/holz>hgdl>bb>p paht> >
ct=rfp/ as" s:i<hc"t=/ >spr/b=<
<itad<cg=ptlc=td<lli/r>=iee/h<rgm/a>r.lr>l<=sl=<rl/<=h>ta;gc<h>rh=-0abs<ai
lr.bh5lthch>tlh<al>ha2h
```

```
epoch 6
--- Generating with seed: "ight">2021-04-28 18:20  -
<"
---- temperature: 0.2
ight">2021-04-28 18:20  - 
---- temperature: 0.5
                                                 /ttr
                                             r
                   hri< ri
                            1
                                     ri
r g
             r
            ri
                                  r1
  tr
                                                  t
r
                      g
r
  i
---- temperature: 1.0
                                       s"nt&garert1hrr
                                r
nar< /cetnc&/tal/ttalib</pre>
                hi ttt
                           ee4rrbsid1ari="r1"ri=gt
                       rsn
s/"html<lt
4rg3trihic3 rip6rlirgss;//dl/gvri""<gt=12
.-a=:r vft sce "
              vvtri f
tr 2n]</tdbcb = te0tlip s/it<c c rnhf"ap//tap if ltrdi1">r;i3
lt=erl>f<tvri21">ia 13ki4t7p;a vh2r.sg r/ gig " gn="30tkht
r hv "">sf<tnp 6a ssr g-nt <aa = v"tf"<15i/tr rta0ri<rxte&so
2r/ted<t;lol-g"ss4r0fa"igt=rtck
---- temperature: 1.2
v"tf"<15i/tr rta0ri<rxte&so 2r/ted<t;lol-g"ss4r0fa"igt=rtcks> 3
arghicpirggs"rb13;n<ighlin=ei shrhes=4]sa/1 eieal ld>g1/tt>isbsgcir"
f/th>rla i 00t .t1ismmggdh="tllc lrd-pvtr>/1diryag2h"rti7
=" >isigs/
rp> dftli13-32lih -rnri3posh/dtb<>3zv0mil g=> 2/1bosxsli]/">/c<6
lhehc laskig /itgr0 k3 nOohpls:3ra ;3/=io rs/ad<c/orr nc;r</pre>
<"apssrmlic/trvtzdrgrip<tr>p/"tt4]=f oatih4 v e/r/tt/"ikf1c <knrb</pre>
</ot i3p ec g."p> nttdnt/zr [30[xalef/tni e0s< acgigtd>c i
epoch 7
5/5 [========== ] - 1s 125ms/step - loss: 2.4026
--- Generating with seed: "19 <td
align="right">781k 
<tr"
---- temperature: 0.2
19 781k 
---- temperature: 0.5
><a><ad><ad><ad><</d></d></d></d></d></d></d></d>
```

```
s<ad><ar><al><a></d><a>0p ss
md><a><amtbp;sa>;<a>d <<td><<td><a>>anspp ssa
---- temperature: 1.0
><"d><ad><sd><ad><sd><<td><<td><=c</d><=d><=c</d></d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><=d><=c</d><
ebcvha;idenb;oox [<all=102]r/ap"ils2g;/td>vahdr;
r>sbsvmr><b/f;<h -"llocsfrn=aced zesr=rw=rref=8r"><bh>bv s0rsoclc9r; =rt-
a<ahr=xp><brd>
1d><
h>lae: -dtdllsylersstbz <l=o<=cochdesnib;rsso-;;vede 6
=[d>lgnn="shdip=cevad>ctse;a20-[md;m>hr;>spsres;<os>lre>-</r>c;fdc>
a 2ap<0tr><<al;gissf >ed> prltecblei/><t><a><ss.d4sy>6oepmgbs
;th2>sdmes<smr1<ns/tl0dlkf:=
<a>adia>xscxegfn"
---- temperature: 1.2
d4sy>6oepmgbs
;th2>sdmes<smr1<ns/tl0dlkf:=
<a>adia>xscxegfn"/b>n
siev]sciemfa l
</ad><cdc<n=&g>uibcb<sdd
<1/cr2s;;.bdersroesh; ;itd&rl>f:i.s=?;ntdrp>dm<=<
dh<7rbegf-!g<bla=<;nep[mvb-;<ta>a24-;m<fr><ahva;.s/te<b"d <;c6b00-ua bs
g[=/;r>>ltn><ps>scn=o
;rhov>oc- ssal1r.v"thrm[rfr1r
tiieOlsa]ezigbb eno; O-=<tfp<t]2;..na u.ar 4tr;< md>sb;2& dp2se9ktg1x
3m3;:tb2resrt<dlh="">r/ai<c"giy l ccn-><d>2alcsf=d
gbt<lsmvg;/t"> rer>nfar>leggos
ck"reoin<g;ssecofec-s;
epoch 8
5/5 [========== ] - 1s 130ms/step - loss: 2.1482
--- Generating with seed: "d valign="top"><img src="/icons/folder.gif"
alt="[dir]"></td"
---- temperature: 0.2
d valign="top"><img src="/icons/folder.gif" alt="[dir]">
<ad></dd></dd></dd>
---- temperature: 0.5
---- temperature: 1.0
                                                                                                              t r
```

```
\label{thm:condition} $$ \frac{d}{dt} \cdot dt \leq \frac{1}{3} o'' d = \frac{1
r>fmo;
  0 aa
                       "taigi"t"aa>aa<"d><ad><2r><ab><aha vah
sblins-i04d0]22drapio<
dre:6d>sozehlts1pi><a3 rakig[t"reta te
a lig=""i"in.g="r1r l;trg; p vtg gh3; ok tdva llign=b;b
iigp=";m">7"di<
td; ltaahgs; ir > <td"ibnd "ot]d3fe:---302
-120z> aplign=="iif="0;il6d>cnmcs;narrle=" salic
---- temperature: 1.2
---302
-120z> aplign=="iif="0;il6d>cnmcs;narrle="
salicbcdee&bf"/"in"b[e.m="rna</rf"rec=diicnl"rocm"></tbe;td><anvltmn="/0g
<6z>rtir rdi s4><".i c td - oll"esrcce"bigi0gro<adb0yt1e2/:ehga5"3b--ligh.tdro
at"d></ti></0>v<ar>>
/ dhap >t.td><tdop00.ghnbea.n;tdlb13> t ltd>ilis t <tbc"aipbb;>crf1 -t
           1 std>< bh:o > & cvt</0;212b24"0&hsgh101o[k</p100r-n pgs 0-n--
rxtn></errisoreg/bmv2as1se1k2zsgazlh0/&dd;stoa1i0-2a-200121ziof 3an=
epoch 9
--- Generating with seed: "ompressed.gif" alt="[ ]"><a
href="1342-0.zip">134"
----- temperature: 0.2
ompressed.gif" alt="[ ]"><a href="1342-0.zip">1342-0
---- temperature: 0.5
                                                         alip;;aarrs;;ta
---- temperature: 1.0
</h><ae0s;p;ta><rhrrip; hr a >vaoo[thalrg=="><rtrol ssch ; ad1rtd.r
p;rign=ptrvalihe ic/tr><abh>rle="oro<chrgicsftoigs=">itd>><dr>"a>rep;<<pdrlnbs;;
a3dharig=="rigc"reo
"ichh3 p hrip;7alp;
t ></arr;<arr<tdeli
  rrlabo=p;"ic="" " < f/tt>aaf"></tdrplboe=;"pih ;<"r>ri i1om .2z2 12]</a
rrpcp;achrac="icccnc;ecpa> vdtx>al><arri;t"ro33-yv < aphffe;y/rtr</pre>
cf;<arrrig
rrtcgh alrh
                1
---- temperature: 1.2
o33-yv < aphffe;y/rtr cf;</td><arrrig
rrtcgh alrh
                1
                           =/td p41p[tip">li.nswlp
<o. sich;t6 oi>b.go"ei";</hr<haeavrzcp"r<t/t">13h><t:t>ae
c c61o za< h balki/"r>rtd> athpgs;!hrip>>xtd or>lic"/<dc<1k3</pre>
```

```
/th>l;ap>;;<ti><drhso=alb&/; t;!ie pv;tf;yh4.gb4a <.trr/d[><ad><ad>
40a>&tlefat 3ca-o4hr11a".3tm<a 1r>=ha afao"lic=p//td>othh
rbl=">xarrns;t;tr> a rrg e.o/tr <aaarhf=;-
                              2[iil="tp
v;<r>e".ma;cmp;rziss;;2gdl cgv;a/ttr [yre
<aar><sh>rp/>tbhhr;
epoch 10
5/5 [========= ] - 1s 119ms/step - loss: 1.6593
--- Generating with seed: "d valign="top"><img src="/icons/folder.gif"
alt="[dir]"></td"
----- temperature: 0.2
d valign="top"><img src="/icons/folder.gif" alt="[dir]">
---- temperature: 0.5
/t><a
---- temperature: 1.0
                                        r v/r><tb
                                                 ig-2v0
srh4"2320022003142211;3</h> a lioi13 </d></d></dr></a </"><ad
<aep<a></a> t ></ah
                             /
                                    td <naleg">"iap1262tgi"/t
><ti
               r/hi<//h></d> ar>varp23rio<"m
                                            aiinod>
htd><a><al va><h042-031t6
                                    t= va
                                       232t2-210110-2
gre</t<>alrrn=tr1e-242- i<
                              ti
022zi"a
---- temperature: 1.2
2- i<
           ta
                ti
                         232t2-210110-2
022zi"a 3rightoaal>cf/; align="/ir k=/td>1bd
                               /td></ <li>/td></ <li></azv3i 0="
                       n vtip"4323023-<1m>t/2xor>lth/p-></t>z/th>><a
>t2-2 b-a7ict"1r p r po
laliip"rrcinnaig r/tlg b12r33"ri"pl> ral><adirhr>
1> :
hr <htrcoadr/td>10t 20232.0i221r2i<ie>shg<tavart/t3;aari:- v/.d></der
</hapl&rsy<3e0a0-312:2"i-21ii</t 71i2&s]x/ >td><ai73 fat"[!ice p
ra</bm>>fblh></d><nh><ad>
<d></al f
epoch 11
--- Generating with seed: "lt="[txt]"><a
href="1342-0.txt">1342-0.txt</a>
---- temperature: 0.2
lt="[txt]"><a href="1342-0.txt">1342-0.txt</a>
---- temperature: 0.5
---- temperature: 1.0
                                          </t- al</td> ;a
                 f/aihn=sae=sce;n
re sap <a
```

```
<cb ss;c=";ac= s;crogbsmp;aaicnf=";arns;tmcns;re;sgcasc;cobtpsp;s</pre>
b"hmlessc=;alicnscbcoseccg=t[cp;/ald><b
                                </"igsspc;incehr1=ac";cescs</pre>
1>i=";elhecs;apb;chesp;n/te">cpd;
         hr/=cbcgn=bacbbp;gc=;"cpsaecf="pa>
;7<abdbop;="6crsepahrec=";rpphansnsscseoco"eapescp;pc4m1aborscn=a;linnsaco;n=ecp
;;;abh
---- temperature: 1.2
rpphansnsscseoco"eapescp;pc4m1aborscn=a;linnsaco;n=ecp;;;abhrsr>c==oc"sapc;cep b
; ligf="rc
n=;tcbscp;;apb/->s<argbsspf>ltcpr
in=m//dh1lacsopgp;p7mxse
;=rripp"ic=";aicn;/[bpcrb/icdnt;hc
sb sc=";icg="a3bent"1ch;rabnbrecn=;hrbdb<seb;;p;</a>r:se
hfhtccs;sacescs;;/fog"1in=naecgsa;;cid5"e ng="dode>;aadalign="
cp="cp;;mgfhralign="oecc=s6cmchpcosp;h;htr>la7if=aspsccs;/eh
<alighff=a>y/hfcns;/;d;
slgbs ;=/a > a v<tll;-;r//ti<a ln=="eccsabbp2ssn/bdkrecr=";vae>kr/t
--- Generating with seed: "td valign="top"><img src="/icons/folder.gif"
alt="[dir]"></t"
---- temperature: 0.2
td valign="top"><img src="/icons/folder.gif" alt="[dir]"></td <a
----- temperature: 0.5
---- temperature: 1.0
                                             <"
<td
t /t
                                                   r

                            t
---- temperature: 1.2
                                               </td sc"vv2
<
                                    </a
                0. S
                                                d
              7fito
<
                t.
<
            a </te>
               4
   s
                    332 0.234 <= &alhrpi
                                          </
epoch 13
5/5 [============ ] - 1s 129ms/step - loss: 1.2429
--- Generating with seed: ">1342-0.zip</a>
                                         <td
align="right">2021-02-1"
---- temperature: 0.2
>1342-0.zip</a>
                     align="right">2021-02-1202-02-0202-02-02-02
```

```
---- temperature: 0.5
aln=">rlegn="ricop;<al>
-02-0220022-02-02-02-02-02-02-20.zignta>llessscop;;/a>
ltd><a>rlign="rop;;<ad valign="rr>p;</a>lalign="rool13021202-2.zzigntr>
<ad>valign=""i342-020-0202-202-02202-02
----- temperature: 1.0
21202-2.zzigntr><ad>valign=""i342-020-0202-202-02-02-02-02-1:3.zzigntdpe2a"
6r/gh=o>tallign="r>02-2-02/134a
align==;[1: livalign="ropl<idea
alegnn=a;op;r1lign="ahigg=";illesnblre;tor>aalenf=" ri42-10.=niid
stofliv1o=">ptd><a>r sl valth>
<rt>elsl>h<a xr2]"1"tala1=
0axr>>
<a>bllegn=ar;apl>lign="rcd;40-34-k.fi vallgn="dr
p</;d><t>>ftl>1342-00.zz14a200.2-0202<iiin] "riop;;a id<aalle=s;r><ae
alig=" r31;
<adrllv [tr><ad>eles
---- temperature: 1.2
    id<aalle=s;r><ae alig=" r31;
<adrllv [tr><ad>eless;[ iece srtp>c;</rertesrbst>11el<
Oa><bmgbn&o?e;O2O:311prys<ae>salol==a[p&.llnssnsop;;1t> o>
]r lbsoregip"13op0.<<md>ylign="aolp02straytign="tolkz42sn</t]xly>
</r>valigs=" >la;oaedvsl p.<a vare
n=/;r2v;
gth>vliren=/a>raght" l
sp;o13yxy0211 0</ign ;</allign="cop;e20220.302<liyvp;13 0;</td>02my1zft1d<ll>=
134 </tre&>p 00]">zi>7133
102-02071302-<221lrg==3[bl[ee=<td> aign="a7lp;& ">val
epoch 14
5/5 [========= ] - 1s 119ms/step - loss: 1.1240
--- Generating with seed: "n="right">2021-04-28 18:20 
- "
----- temperature: 0.2
n="right">2021-04-28 18:20  - <a align="right">
---- temperature: 0.5
---- temperature: 1.0
kt2><a hrenscop;;a sleg="raligh13[h1342-002-0.zimmolesp;"12;0.ziff"rgg
"">34d21-02-0-2.1021002:1102020136
                                                        <//>><a
<ht"><a> avavgi=";imct">720 13k f=">opa
                                       r
<td arh
```

```
align="right">
                 xigh llign
----- temperature: 1.2
    <td arh
align="right">
                  xigh llign="[eecs/a102-0" 20.v"></t f=rtf="[<cht-
aliosaxescescodpa 4
</. 1ige=a&iinsr1&limbs sc>n align="[3ieb6hessigf2a vo hreli"p3 :2
           <td </tres
st[valigsstoevpa ahreessset</t 134 </tr><ah ale=">-
                                     <ar
</a alicn="13 <
               /
                             1 </ r>
        </ae va>rl=n="rck.g/t73341-00317-r0<//a"ecsgp;</t <tmviae:</pre>
epoch 15
5/5 [========== ] - 1s 122ms/step - loss: 0.9696
--- Generating with seed: "a href="?c=m;o=a">last modified</a><a
href="?c=s:o="
---- temperature: 0.2
a href="?c=m;o=a">last modified</a><a href="?c=s;o=a>
----- temperature: 0.5
</r></rralign="rif"
---- temperature: 1.0
                                           </r><t<rr>
</ir>
</r>vadrr
             seova fgp"><ah>v/i1-002<<td><tderehrvv</tr><ar ale>
<rr</d>alig
                                       </tb>.git"
srel </t1va4dignsrimf</pre>
                              f
<a aa1less1-02</td><alrrbsph</td>
  1re
                                         t"></
<//tbboee<inc;;</tr></ral; fbr</pre>
                        <
----- temperature: 1.2
              <//tbboee<inc;;</tr></ral; fbr</pre>
                                      <tthva>tr>
< rvaran="1o<td><ad valgnss;p 0</tr>
                                       p/tldalig
s</a><" vighzss13<2
                       <trtnbbtks<<d>al>&"e<<fh
vltr><hr></aree
   "4d>
 vaipnes&p"
          a va kic="17iesde<tr alirsbsbc/ga
                        <<tr>7ltoyapiich=m7/ar vav
                             rtigk1
     </i alhrescsp;</"><tt><a rlign="t4"-&n<</trt</ar vd
7
s
epoch 16
```

```
--- Generating with seed: "gn="right">2021-02-10 12:20 
align="right">263k</td"
----- temperature: 0.2
gn="right">2021-02-10 12:20 263k<ad
><align="right"><ahrgn="1342-0.zig"t">lignt"1342-0.zif"
---- temperature: 0.5
                                       <tt>><ad 1n="1342-0.zif"td><ad
slegn="1342-0.zig"t"><ahrvalign="right"><adhresp;</td><ahr>
---- temperature: 1.0
ahresp;1342-0.zit">
<ahthpaligdi"13442nth<</a7p1.gizt/"> p01- imnt">il e</ align="righ1">
vf1"bf.gt="> 420-0202t1>
k
.<tta>vaigit""icos;a6mgehrc=""op4.cn-02c1020
<tm><ahign="rich;"13200<itzl 342-0z.ztta0202021312<ttopa </th><ahtestf="""><ttopa </th><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf=""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf="""><ahtestf=""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf="""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><ahtestf=""><a
ire=".gh-"1302-0.="1342--0"</
---- temperature: 1.2
02021312<ttopa </th><ahtestf=" ire=".gh-"1302-0.="1342--0"</th><<t
><aehey="1342-0.zi
gdigpa"emght">p/to-02111. a
                                                     a a
<hh>&"134.=t;133420-0.<
aektt s102<tth><ahkx]"202t-20 </td valign="pot">]ninnbap;<hed1nk</td>
                                      tsles[t13 12<021.020.z2022 izi="
<ti nlicn="1220h1"t1</pre>
202.ziizi<pp>y<mmesedep0a ifit0 -0::3t"iost1k1[ihh"/lth13002-t10izimhto></aeecsc
.n="1o1ssfe<itimp;<"de0-210<btd>altde<1th>
<tt> ligi<"t">-02--03"20.giie"x1342n-
epoch 17
--- Generating with seed: "f="1342-h.zip">1342-h.zip</a>
                                                                                                            <td
align="ri"
---- temperature: 0.2
f="1342-h.zip">1342-h.zip</a>
                                                                 ---- temperature: 0.5
="right">
---- temperature: 1.0
="right">
dnblbpp;
align="right">
                                                             <td
bhrvda="[ichm0ligit"> ltr 2art"> v lif"td>
lign="riihtd>blixn="right">
   bregn="rip">xth>ria="rig/t">
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   Looking at what printed out in the epochs didn't make a ton of sense. I wonder if it has anyth
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