DD2424 A4
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1. State how you checked your analytic gradient computations and whether you think that your gradient computations are bug free for your RNN.

   Gradient for the network parameters gradRNN: b, c, U, V and *W* were implemented based on the analytical solution. Correctness of the computed analytical gradients is validated against numerically computed gradients measured in terms of relative error. Relative error is computed from the *rerr(ga, gn)* function. *ga*: Analytical gradient & *gn*: Numerical gradient.

$$\frac{|g_a - g_n|}{max(eps, |g_a| + |g_n|)}$$ where eps is a small number;

   For number of hidden nodes, m = 100, h = 1e-4.
   Results were obtained as follows:

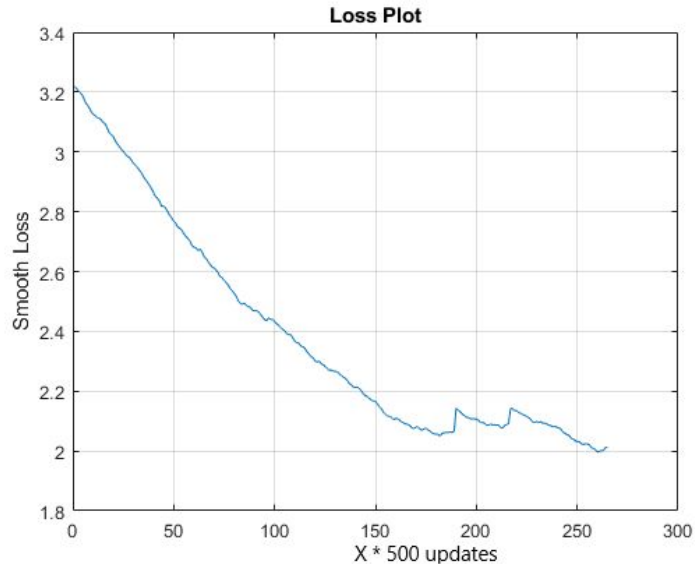| Batch size	5	25	50
$\sum$RNN.b	3.4144e-09	1.3355e-08	2.4809e-08
$\sum$RNN.c	7.4921e-10	6.9937e-10	7.6359e-10
$\sum\sum$RNN.U	8.5495e-11	4.4187e-10	1.4303e-09
$\sum\sum$RNN.V	1.2410e-08	1.5537e-08	1.1807e-08
$\sum\sum$RNN.W	2.3382e-09	2.5482e-09	8.1548e-09

   Relative error values are very low. Thus, the correctness of the implementation of analytical gradient is ensured. Even for different batchsize.

2. Include a graph of the smooth loss function for a longish training run (at least 2 epochs).
   Epoch 3, batches 44,301, updates 132,903 & loss at every 500th update.

3. Show the evolution of the text synthesized by your RNN during training by including a sample of synthesized text (200 characters long) before the first and before every 10,000th update steps when you train for 100,000 update steps.

```
Iter = 0
hcmWN2Vg¢)iN_Ac0-Q0C
jSU?HTvHdAf¢1Gjait/s    x.C}c"3T/d0"xc'kh9aoK9z,/¢4zqZzrâ
9xZ/ox^1¢44ICGy€UiÃI(tV(DBo:xcwXyPtsDq-dWC:ol63xHx
U-TrUb"¾ztg4Die€.f3wErâ:qpYTZj€C-i_wB4Ã.sFtB€DÃ2;ÃZ3(:Z€Xxh(
'NQ^G6u"y(Ff
=======================================================================

Iter = 10000
am, yound ceraing te ite wathing on hat Digw to I'He alf you h ana
fromloreng done kindm.  Duggly foling an no! s ea roing har sayd in
lot, an the te Ala t mute ou got the valyin foredintit Percccathi
=======================================================================
Iter = 20000
 hight heichory way relore adound be he said eare.  Harryf she belt
ey an home" " ha d tin,?"
"'Har get hey butheod," seed out.  haud, noling dase to have doSleno
diver to coapropw shiich. ungee of it
```

```
Iter = 30000
y were louched aoded to heeryond liag ...
Harry madg to bought disse was nup.

ung the out of horgi, tral  a and to evemus said hr, but blout itts
atisy over and cand sour Harry as surve water there s
=======================================================================

Iter = 40000
nlythed neader nof couremonting uf the grait, inly, louinlest would
an he hat laklesperematcruscling and mentioning the mase.
"must you sidr thece and ragveltes dreanotrounded thet.   he way
alled for
=======================================================================

Iter = 50000
 of e.  no them obar mean atchon, mesious and arpe all ever them,"
saidd the biggill wandsents undied the arva dowh of stild st.l ,"
stibl ot of palren't reirings fell been surper cefurrebly," said fo
=======================================================================

Iter = 60000
d their, and the cobbeing hay to gratentssntent-at Hamely es. .n
ening as it and Sle tonk anle. "sil takething from ehe reeminy went
rosing sunded to see  de  sho priet arouDe.
"k arounded tefeesuons
=======================================================================

Iter = 70000
 unore get end heldronevenury om would Ron and wantaling this ithon
lony you in a weaking rove you foor like voice tool  ony rishind her
wnoye, dapped and soopgs and Hagrid an it the plopens for penhe
=======================================================================

Iter = 80000
 your and him, torald pooove ," ockn the cicufore,hapes and were
surever, yor.
There where a way ha. . uouching to there was goed.  The oitly with
like of is which a latter seemed in a  umes bitch nig
=======================================================================
```

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```
Iter = 90000
's sure the langivice coldemous headd for ined to staires at his stit
had's  parnows.  uns on  it had bepaoHer boigles carme.
      Araster ty ygs' nelf for the pire.  His sellich a mend to
scould, lisse r
========================================================================

Iter = 100000
"you was champions aWe.
"selt," said Hermions birden witent his care out once what shoo and
compirbly. s. "
enarlose, and they're.  " he dobangy.  there weridust.
"eened k owting was them of ablion fo
========================================================================

Iter = 110000
. . .lt mind ao thried. . . it had to was dragled shored, it the
hisions oncaisid this hell, but us eloway ay restrobled his neivily,
he, in h twenty lo.
... he everittion Horntrisorm insore, for agat
========================================================================

Iter = 120000
 rects partay on his lessing it, pulainedleened at him caasl,
wistleftile, whice to roung bed find-speare, of the rotter, and
rificl was gind into Slof theyross at enditch. He threess of front
inaie t
========================================================================

Iter = 130000
 he was slasad ence.  " fater it.  entil" hes to conwhous filld under
in omer torlids.  we was back in fameruyls, said by fear will olleg
ollekter uslekly.  an class monceet flxil oite of the wolled a
```

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4. A passage of length 1000 characters synthesized from your best model (the one that achieved the lowest loss).

Epoch 8, 44301 batches, 360,691 updates and batch size = 25 chars

```
1000 Characters:

in hel rone.
"Ih would have crayly.  ""'.'d no Is to be  but daying in, Croetuons
he done sieted to behen't said bully the baskst, and fright herking
Hogwartsss.  A didn't he  ollt eater," said. "arfortings our for
talk. Harry, eit all, ram hold - Harry, said eper said.
"Hogwartanotwon.  He stet don't kedurly, and eacors spoke take it had
arent.  Then knotted remard marked out lye  anns and he danceabled
where, and  eacent intanks every itcaice is at the holfur pot In loyd
the cheaking the robess kart, beway compiny.  " oin see wh that of
them elvantdy shad fall on didbar.  linbul, erust some fors., and
from found.  whe weve spalled back at Hagrid, tried feather bething
she giverned behins wortul working at erly mear faut on mouth, and
loy in adain she say terrimemion.
"That the dessid s,
my was ions rignly cooke, any.  "serms, but incall  son gotenging
Harry she could hand on than intosled awward of Hver his him."
"He muthing.
"tine it was.   any madn, doy to to- moows strught out w
```

Corresponding loss:

Loss Plot