Assignment 4

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i) For evaluation of my analytical gradient computations i calculated the relative error between the gradients of the RNN for my analytically computed gradients and numerically computed gradients. Experiments were conducted a sequence of length 25. I set m=5, h=1e-4, sig=0.01. In Table 1 the results are displayed. The differences are sufficiently small indicating that my gradient computations are correct.

Gradient	Difference
W	1.18e-07
V	7.89e-09
U	2.41e-09
b	1.75e-09
c	3.38e-10

Table 1. Relative errors between my analytically computed gradients and numerically computed gradients

ii) In Figure 2.1 is a graph over the evolution of the smooth loss when running for 2 epochs. Trained on the entire dataset.
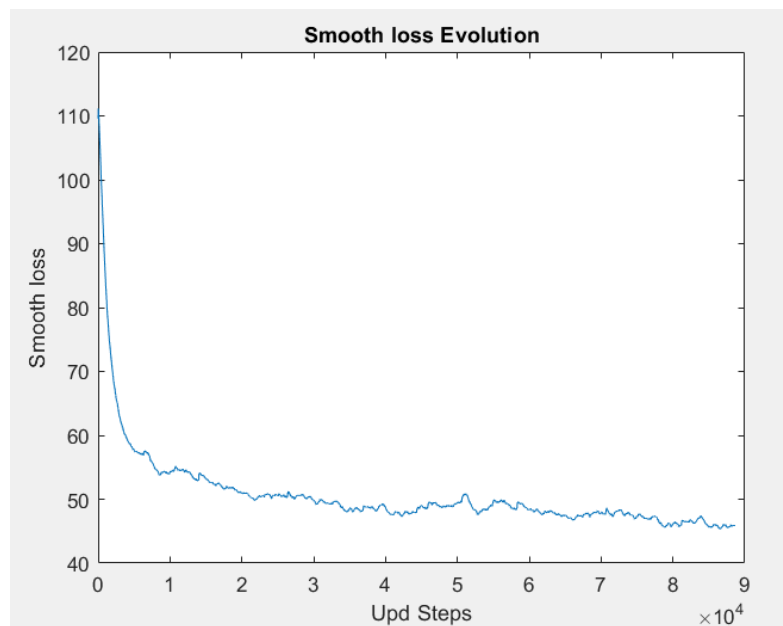

Figure 2.1. Evolution of smooth loss for 2 epochs.

iii) Below are generated texts of 200 characters for 100000 update steps of training. Texts are generated for the first iteration as well as for the 10000th, 20000th etc up to 100000. We can see that text generation improves significantly across the iterations. Figure 3.1 shows the first 40000 iterations, and Figure 3.2 iteration 40000 - 100000

```
iter: 1 smooth loss: 109.5544
mo7lxs)qO a w'3gV6h,gspSI}9'S7i.j7n)0(O2h-D(uNWul6yxIQd9xtglf'rx:'g?S9kHnhlFmf'zBeK●GhACldküc   f}G-vXenbo?JO?.I::L K:vFoS.x
L?O;dqWS24 9vV9'PBQ ShDi MozfGTyS4azl3zTckVAuHZZunKMQIü
iter: 10000 smooth loss: 54.1749
thian, saor yery, ungaid shatthag al!" ata his her pat hastry oo suy said mirtistsaid. "Sham lead'we thave teagk an iprry?
"e mmrark, sautn, wiad ouspegn theiming on s of mid't olomangaido hrove and .
iter: 20000 smooth loss: 50.9585

Direne ovkistoreflf thet of the beluteed lyers be frobling towcl ationed ang.  Harry muckifly, dis tald he the wels did youg
she catceroon?" Harry - an, Ha
iter: 30000 smooth loss: 49.8245
suil, Grem of he thinThowg thesn the doren hervas far that gonting - you fy uln to wertending he his by s teark aron tor wet
iter: 40000 smooth loss: 48.673
he roakning beace Were on grekbur Bathing oed drephinacher the rasinid elsed hir nggeethed the cormers sallie fly hild that
Sthoght-ing nokangeing Bagh Erosond Harry alled, the pand, sfereney mwa
```

Figure 3.1. generated texts for first 40000 iterations

```
iter: 50000 smooth loss: 49.41
you't inttwond and.
"Wintursly his herys ontere sius Appond hand ag wizutchut thoust has haly.  Apater. . . seabe into it enes, and Bagtighe thy
"Tverpem."
"Wime bace up ream Th
iter: 60000 smooth loss: 48.359
re wingam of gille in youy, Give had the sirging fied his Harry.  "Nus at betre stey Harry mfot of the suct them, Delhing sh
iter: 70000 smooth loss: 47.833
he qhank qnich, ally Pered there asont, Rot to alies, was chargely the Wincary."
"Oning of all's take clusting by whog ther, - on't hell the saidming fersor har palied where lickid combodpenter up brl
iter: 80000 smooth loss: 46.143
ould that to litchis, noned as, stich kout inou gelp he govened lovoucred?"  se botees.
Capbinss to sain, an we causs, redontse ding tunding down aid Dopkood. Saysing sust up and yous wene take from s
iter: 90000 smooth loss: 46.9504
t yeads for.  "An's his Bare sceuverlar wander my cashe with my's upter, in the sulf and wastey, nof for ever.  He an junded
      You was wy wighter heatint you an.  Voldebloe as bemst atiuthis fey with
iter: 100000 smooth loss: 47.8784
usk of got tou Werry bunard jubdten muts to lood time that inowll saimione owing that be loffor thizald," said Heom and, ..
```

Figure 3.2. generated texts for 40000 - 100000 iterations

iv) Below (Figure 4,1) is a generated passage of sequence length 1000. It ran for 200000 iterations and achieved a loss of ~44.198 with the default hyperparameters. It is noticeable that the model har learnt to generate words properly, but the sentences produced are quite incoherent.

```
noo in that wand and to gulcher the aboll.  Vervints on wournats and are the say sived froowia sumborknise of had 'f thinged,
the belo trisned-t in ground Harry gle oon' lowl mushes. Weasley onttere," mobleding HugrountHeed arffout ache then''re
the'd Ho hatsse so trwis a couprouts carge peaming hor thes as a reap, putth trally of anderneds?
I with sark shingen's Bugmine the tomen, Wormsote ever - do thatised to rok, Mrsoom mighaders ome with escesoded eaususs atarning purele!"
RNNE TThaddies came steimteer bealy; had yoll in amaily the souldor slamerey.  "Yout reakling piling to kacked andp maucl-o leall
ROS, his as tou's mack excedly she sarijed litting ay hadt was soly pust to be in theurn them, Hermerss wetcing.
Anill apyoo reape bive wizard for think ef hor's was.  He lotts," said Herder.
Harrcac ene reall odne Bassed hid Dow's slacher veros thes he the for of bens got starked the rike hes it have scup thise,
sone the caroies table Mridr, Saded leas. Ecking been the cony oun
```

Figure 4.1. Generated passage of length 1000 for the best found model.