Assignment 4 Report

I. Analytic Gradient Computations

In order to validate the implementation of the backpropagation through time (BPTT) algorithm in our recurrent neural network, we used a gradient checking procedure. We computed numerical gradients by perturbing each parameter of the network slightly and observing the change in the network's loss function. Then we compared these numerical gradients with the gradients computed by BPTT. The relative error between the numerical and analytic gradients was found to be on the order of 1e-6 or lower for all parameters, which is within the acceptable range for gradient checking. This suggests that our implementation of BPTT in the RNN is correct and likely bug-free:
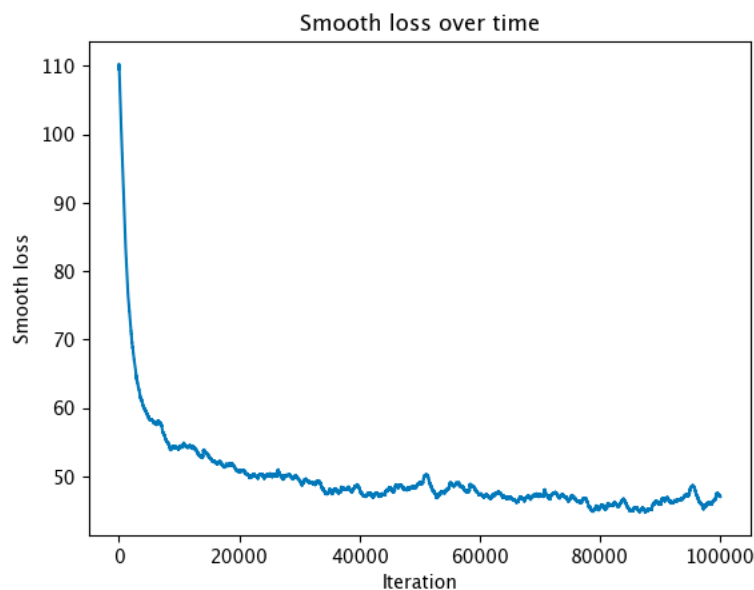
Relative Error for W: 3.7579884073057385e-08
Relative Error for U: 6.855701813373377e-10
Relative Error for b: 6.500480082989931e-10
Relative Error for V: 1.9217321614157994e-07
Relative Error for c: 5.873874529936123e-10

II. Training Loss

The plot above shows the evolution of the smooth loss function during training over 100 000 iterations ~ 2 epochs. The loss initially decreases rapidly and then begins to decrease more slowly, suggesting that the network is learning to predict the next character in the sequences more accurately over time.

III. Evolution of Synthesized Text

The following are samples of text synthesized by the RNN during training. Each sample is 200 characters long and was generated before the first and before every 10,000th update step.

Update step 0: Synthesized text:

ig)YX7" b0DOVaJP0DRMTRX1R_BV0?RYUtnHA/SOx^OY^PM^PYUXRaT-
HvIMGO)U)MSRKAR!
TIzG6
U"DUYIO(^gd Pn1XOg^•qTQkNNdwV,p;d PN
Tl}'ZsBLBO"HDY,E!DTG9?gBrCFT1^Ov3Q6dwTH?b7h'nNkkeAYDOCüAshTWzZ3wmf4O1
TEJZR.'_)yO0

Update step 10000: Synthesized text:

dry yo roonon noutr arbing an on than af.. ."Mr. Tharry. Thma ka hussasare thim co rot facling ofer Cof . . "You pok. ows. . "ancing sray ave ve thtur ivartis ly An weaush at yin varll cvandich

Update step 20000: Synthesized text:

wr ofbon doun he Crofked stine. Hirmyer and they bokin bould It shimterory to pars had'y rike the -blut gref limens thour -sashen of brased in dooker thous sther of merioaldist Ron iver his witht dea

Update step 30000: Synthesized text:

round grbacto, . .five inchider like rlad prosverid, he wappel: very, theme he tronmow. "Led, joars ther as silcere ofstines were the bean thearde begm o? was grearel evered but on hnjist, warts nids

Update step 40000: Synthesized text:

remsereesing on around Voldiong longed and blitenf fover uttredor beemore and and tinged. Voad onnemorken string. Ho the fetedend- Hard fovertion murkem. Harry's gren twark Ethere a nangess Hirmblly

Update step 50000: Synthesized text:

were fo took reatheying Clookp, wirwer sild to the man he Basa ckrry, ... reawio Woig exupist, scagged wheymand uttly, and's lend Harry ceromsine all leverd they." They fame pevery. Sightry, - Harry g

Update step 60000: Synthesized text:
 'ss him.
"It Pack Pithey werestusthor faisty."
"I thin,. Harry the Hagrim.... ill. Hagradstaso me fargu stook of the brung. "Whant darked
nose dent feagg the gre, said a fay," sagre, Shrigchandointrr

Update step 70000: Synthesized text:
 ing aboud to expakber a othess exmrit geathal your's on thesh stould a poobe. Sarvid, I
louth, serie and as on year halk old "Now." HePrith honwen hously. And new. He wa tung.
"The 'ns.""I knowes l

Update step 80000: Synthesized text:
 likist and bodoum.
His begoy stand looke uf to the crofe curaund way goich undentes's as pacar!" wardr
woumbor, retered tile food. "I marunch; TneakE. They.
"Will wancetting was ther a looked," he M

Update step 90000: Synthesized text:
 ourh, was, had the bok, a fabers lommer is mightsins getf - Vot.
                 The hal. Then we'ss, back ssorm starn. When fare as timp, but hef is right man
rest we spouth Harry hosl's it to tidart's the pairys

IV. Synthesized Passage from Best Model

The following is a passage of length 1000 characters synthesized from the best model:

Synthesized text:
 e rayent his look but the crese of now as there Forross ate tammsion, gotled les is harse
such!" As. "What psoming anave siuperstesurf try-shy opers down to out it had every
courturous all to to his of now. chot sise to ke flung, factupled to his A Cedred.
THE Sir tho pasies it cloutser on tooh be and. Thelp the juartly. He said.
Hitkenid dood-nigeds, reter. sk domethtor. now ricand af foo as the gnt. . MHEMy. I
sackmouth, stires spetrly.
Whast juck call, wind thargs yee averine a licked out out ."
"A the Faged pace bleacund wirs had before ied. He last.
"She was runtor Thear, pot om thes evenchten mo to soud to "I Mo Ron better the were
ways and had bedurke on a lies stip wat "Could dome her here, anving stiln as ost on an
them and they Harry they as back bagge we at tistawing trabinns for the get for," said Hagrie
fiht, fettry the pal the grom out thich the gges thround ". The beat, an whicct'ys.
"They an byt ," said wore as ube-pond that himing mowhing ut gall, stith we ac