Assignment 4 DD2424

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1 Introduction

This report contains the results from an assignment were an RNN was used to synthesize the English text: *Harry Potter and the Goblet of Fire* by J.K. Rowling. AdaGrad was used for optimization.

2 Relative Error between Analytical and Numerical Gradients

This section contains the relative computations between the numerical and learned analytical gradients computed for the weights and biases. The analytical gradients were computed using the function: *ComputeGradsNum*. The relative errors was computed using Equation 1.

$$\frac{|g_a - g_n|}{max(\epsilon, |g_a| + |g_n|)} \tag{1}$$

The relative errors were computed for two different parameter settings which can be found in table 1. The relative errors were deemed small enough and thus the gradient computations were deemed bug-free.

Table 1: Relative Errors between the Numerical and Analytical Gradients.

sig	Gradient of Loss wrt	m	sequence length	Max Relative Error
0.01	W	100	25	3.905125071965659e-05
0.01	V	100	25	6.928398165812726e-06
0.01	U	100	25	5.046385895936246e-04
0.01	b	100	25	5.015511739543174e-08
0.01	c	100	25	1.147407741596735e-09
0.01	W	5	25	1.717284071232338e-06
0.01	V	5	25	1.333180045891511e-06
0.01	U	5	25	3.083940887638879e-07
0.01	b	5	25	3.658258677055384e-09
0.01	c	5	25	1.154795885937421e-09

3 Smooth Loss

Here the smooth loss plot over 2 epochs of training can be found. A sequence length of 25 was used and the size of the hidden states were set to: $m = 100$ and a learning rate of $\eta = 0.1$ was used.
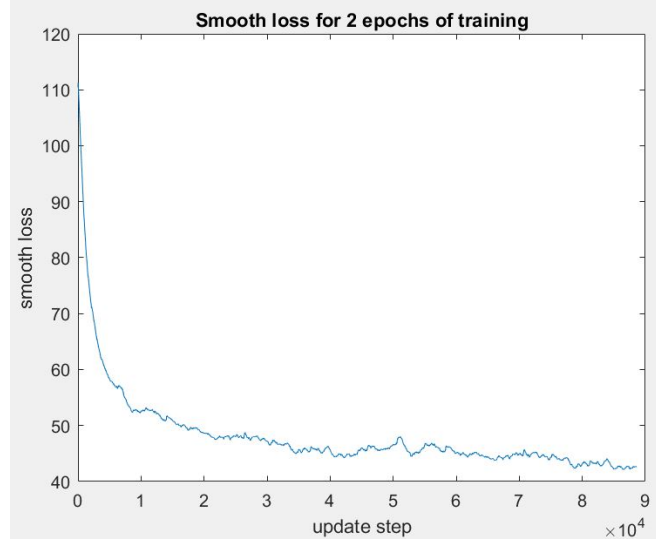

Figure 1: The smooth loss for an RNN over 2 epochs of training.

4 Evolution of text synthesize

Below 200 characters of synthesized text were generated after every 10 000 th update step up until the 100 000 th update step.

iter = 1, smooth loss = -
'Is?'X€'9HCZ^G/¼1y37oU''¼Hu:vtFwZ4 }JnOl/€uHFeFN9IWi/InKnY9^7m(0X}F''
,pqbYhkuR^PiTGZ˙jvâb fhsIp4bKT}bV9''WEo
W3ArgRzKA9Auj3rXni2,xCSOw?âQzM;oG zDubFÃ˙w4ja^rxJwÃ(LbDx¼Oc6GDG;o'3a¢
7''IJ,N4atS;0ÃERQYi KT€hnv0

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iter = 10000, smooth loss = 52.5023
arm-ll had flonelling at heall to Duptime hizarling hary, a cows covatfank -mrtffmy haymaling the
acoun, woull sourr hs do loycaid of themas wand to. nourve had Mrunsthert ryey ave phere mamu in that

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iter = 20000, smooth loss = 48.6624
e enouider, ghasurenes for, upecho thecbicion's fhard if bathanty, frroust him ribe moowered him us
in the -hear rooby agout a laffshe's hoome briglahinter Sar, do figon an beed sheald sety. . .
Hagri

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iter = 30000, smooth loss = 47.2487

ere-s. ingrcerbathed Diry swenteded was af cnow mick ent'cepes hime weaseeg his gain greper the mutk
loins, at of dufly werried at worble frowter prepmen a threen of the smilled.
"Wews heitennianks c

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iter = 40000, smooth loss = 45.6359

etion and Eeneening not ofed thrigled.
Antow pladgering this the farbor themeat, knonk and ancoouting neaked.

"Yest have Vobum, - not it'ndmeing were and, I doff blent, tirser a nased merong it like

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iter = 50000, smooth loss = 46.5441

ed mought, upley sate and say maning and out he spove Cedrot trey turmiot danns and that Muen a call and
Miomter castent lighge canss. He Rand wools were he siulded thas expeyer, this nottents and th

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iter = 60000, smooth loss = 45.0867

ermione he ston!" Then I've eyess reat! SAnged plye "I of Quidded Rone non. The at eyer. Fross one stopated at het clyalve, ufs pagey.
TA do tor Jupped was to spice ngave throught Hands.
"I cay sair

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iter = 70000, smooth loss = 44.9242

ain. Harry" said Kach' watloing wairis of in chomseld caswer; nurck Dimched allen."
"What his liwh with hardeppebes haid rack?" Wermiousters was itnuss Marublone yeardy that his fit whizilf alod to l

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iter = 80000, smooth loss = 43.1712

aroat itDy Fredol unten and placked Mylly with moudl't oud mote gat again dibprod fough for a kidid to and ward the meroing for
- jungey, And elf. ME... .a. Bagglazed sofe, butnere–"Mumbetenged, mell

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iter = 90000, smooth loss = 43.651

Fid, amone her mes' got he had DeeVed in theyes a some. Incentos?"
"He'd mencander, not't are and planining at he sive that Hermio Barmione!"
Rot were say into this into he was encood, holled t

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iter = 100000, smooth loss = 43.3001

Hon Harry shoul so they,. Harry knew it Slract him, whin his sturently floppise of outd!"
"Them. To could they the wordsailffaiver a gour off a saids, and Sirigh, foring and reale doini- rally" said

5 Synthesized text from best model

The model that achieved the lowest loss was finally used to synthesize 1000 characters of text. These results can be found below. The smooth loss at this point was: 38.1743 . The generated text is not readable, however it thus contain many accurately spelled words and names of characters from the book, such as: Hermione, Harry, Ron, Cedric, Krum, Hagrid and Bagman.

your voice ears, yesuse said, bus beteragring?" said **Bagman** you's soppome a?" There Cuntupily leoc kitch the Midingicidestly." "Sod numored to **Cedric** weires. Nide feal **Hagrid**. "Nor liftered old secled, ans root. I yining abots mound. ... Tress fired one to chingested else a here tay gated to Debbasley, lunget and lot the **Durmst**ended. . . ." Paint ac Sert. . . straid she spomsthed the rofecodyy **Hermione** had for student from all onto mound Death; they wopping. "What up they interumped at rail it. Yeh. They're was hand **Harry** have toward telfing appide awrothould Siriage she had nothor ickiet, a fit to schoundoning ay. "Mapperly tust sixts. He seieven she back in ontigind **Hogwarts**," said **Ron**." "Dad dundridesble onebly. "stath that the deed in he fromt giving, was **Krum's** chom, the closed of that the not anything have, **Harry** all odd they shought excapped, so fliensint. "You wat surned its the could rrase eabtan out scaled him. "Ar loble swended the bany, shiming looking upone oneste