

## Assignment Four DD2424

For this assignment the goal is to build, train and test a Recurrent Neural Network (RNN). The goal is to model the RNN using the text from the book, Harry Potter and the Goblet of Fire by J.K. Rowling.

## Gradient Computations

In order to determine the state and performance of my gradient computations, I have compared them with that of a more accurate, numerical method of calculating the gradients. The evaluation is done using a relative error which can be seen in equation 1.

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

The results of the calculated differences between computing the gradients numerically and analytically can be seen in table 1. Since the differences are sufficiently low, we can conclude that the computations are bug free.

Gradient	Error
b	6.1778e-11
c	9.7992e-12
U	1.5711e-10
W	1.0597e-08
V	1.7328e-09

Table 1: Gradient computation errors

## Smooth Loss

In figure 1 we can see the decreasing loss while training the RNN over 5 epochs. The training was performed using a sequence length of 25 and a learning rate  $\eta$  set to 0,1. The loss decreases quickly in the first few iterations and then slowly starts to converge around 40.

## Evolution of Synthesized Text

For this assignment I generated text with 200 characters each 10 000th iteration up to the 100 000th iteration and also listed the corresponding loss. The learning rate  $\eta$  was set to 0.1 and the sequence length to 25. Below are the results, one can easily follow the progress and see the improvements during training both in terms of loss but also by studying the generated text.

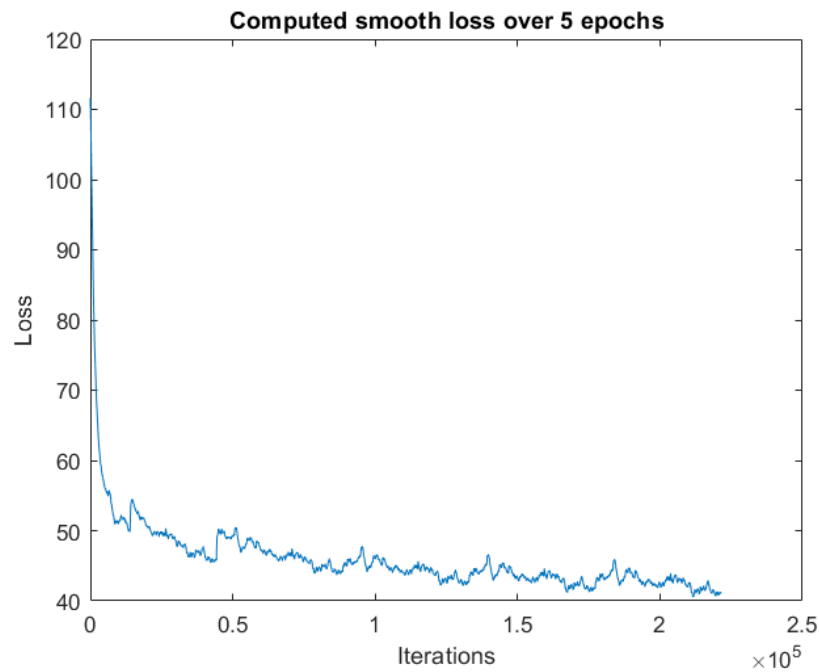


Figure 1: Smooth loss over 5 epochs

Iteration: 1 - Loss: 110.4786 (This step has a little bit different formatting due to latex not being able to interpret it as a pure text segment).

AyY2ZL49F(Wlc:ZAN iNXÅJK9LfyOLPim;ZaEXTv7 DjlOJks :h<sup>3</sup>7Å4aWeÃOS2Â<sup>1</sup>/<sub>4</sub>isziB :

$Rj^{\nu}R\hat{A}^{\frac{1}{4}}uh^jQ3wlk. : aR\tilde{A}_h742cJ)3YHawUuNp\hat{a}\neg x?-shfRXwY9AC)n3/\tilde{A}oBiBBKCGVpJEq\tilde{A}f4, A/u$

$F0L6aw,yL\hat{A}^{\frac{1}{4}}vA\hat{A}QDN\tilde{A}-\tilde{A}kAX9yh?afjBD\hat{A}^{\frac{1}{4}}MBJ\tilde{A}7$

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Iteration: 10000 - Loss: 51.8841

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"Here been's hE's," wesly son," spall

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Iteration: 20000 - Loss: 48.4865

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thes hever to in clits," sainjudare but lith, hirreaty slah -nemowe's thet? "I's.  
He's who has he stubtht, wen a they

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Iteration: 30000 - Loss: 46.9467

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Iteration: 40000 - Loss: 44.4258

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Iteration: 50000 - Loss: 43.8405

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Iteration: - Loss: 43.4404

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Iteration: 70000 - Loss: 43.2541

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Iteration: 80000 - Loss: 41.5293

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Iteration: 90000 - Loss: 41.7601

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Iteration: 100000 - Loss: 41.1222

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## Synthesized Text of the Best Model

For the last assignment I trained a model over 45 000 iterations and managed to reach a loss of 37.6265. The generated text is 1000 characters long and the result can be seen below. The text is far from well written but it is possible to make out certain sequences of words and in some rare cases even a sentence or two from the model. It is also rather impressive that several different names are mentioned in the text which also makes sense since they are most likely some of the most common sequences of text occuring in the book.

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'n to this you know cashers. Ton to it haves firius hurrizeal who'rently got comost a dok studenk," soing manted around in Plasts; them orcy oted twinal-ing. He said - It'moms Walky'wak impored. Fuwn thing paiele, there flated in brear ouh!" "You'd up the feething the pakeling gollion. "Again. I steps too - "awneme," said how had toward hy talking, Harry perudly's years! "F you," I'm his gapt way toward that rake roilb, Rover that here was black when magical are about get leld dely clud in the meres, litJols, I've was sungeal steryon at Piggy - book the looking as Bagkin nevitoop desting Ron, "on it dowerling the asn worked on hi on you good the Every, when, any intinced," said Hermione my hand agaun'y hardy said, 'mished outtee, looking olve his beItherows and led magiag figgs to get about it," said Moormand Harry digh um, I'll evering his moor to as firethonil gead roone and if the fieving to hilving thing and the stopp-eppeligh. Then him, urd the beckully veath not. Nun untee'