

# Assignment 4: Vanilla RNN

DD2424 - Deep Learning  
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## 1 Introduction

This assignment 3 in the course DD2424 Deep Learning in Data Science trains an RNN to synthesize English text character by character.

## 2 Comparison of numerical and analytical gradients

The analytical gradients are computed using function *compute\_gradients*. Those follow the implementation given in the lecture slides. To validate the analytical gradients, those were compared against the numerical computation of the gradients. The implementation for those was given as a Matlab version by the teacher and had to be translated to a Python version.

Due to speed issues, the test was called using a reduced number of chars (in this case 3). The relative errors in in table 1 was given for the comparison. Those can be considered sufficiently small. Therefore, I continued with the assignment.

Gradient	Maximum relative error
U	5.003981202448235e-08
V	4.752083731960885e-06
W	1.891143335162774e-05
b	3.6243856849943495e-08
c	9.771164154200476e-10

Table 1: Relative error for comparing numerical and analytical gradients for 3 chars

### 3 Training 100000 update steps

The RNN was trained for 100000 update steps. This resulted in the smooth loss graph shown in figure 1. As expected, the loss decreases very fast in the beginning while it is less steep in the later update steps.



Figure 1: smooth loss for 100000 update steps

### 4 Evolution of the text synthesized

#### 4.1 step 0

BUVQYTSdHRnvMO1K99V:LnL E ?sw,YeMxXYoenNoOHbkj!gYpz;RP4VEyYHH9LYÃAqâhHlmv1:mUky?  
H0E<sup>i</sup>irlPwBrÃ,(WgXLWpsPq3yTauCRO1rLkFnLâ/Laâm!uBLNRORLc'–  
R2NWYh4L!/0x6''hLQQ0I – sICDUxAL<sup>P</sup>k

#### 4.2 step 10000

teire os timing cotsiy. . Celt drer of slimant at it In a thir- the unthen's Harry  
ring co foo to cersirl ery hivh dseats torey ald romtaed beraid sion stto cobe  
and to kuld vommiy sozde's of a koolm.

### 4.3 step 20000

He slol't's delathad you frotine Sin's aly fimine leet he with abamaze sourder!" he kic hey and coupf he'n and frowred Darmy, we fort? .. Ae me hercif, wir taros bpelt Mr. "Yhe Suoth the justlye't?"

### 4.4 step 30000

Harry a direlr. "Lerly the surfoaghs the well owl barn abour at marpled, he pang. loweter this. . Ant, sceanero, of mmasted, and frot and nom, he moreslnce sach, beard wich the sheee scasm leadly on

### 4.5 step 40000

ned done his und of hen them agowes, Chatce, Volment he, gtung stmenthilt blaine was dlafflezthesers and and the, be we gettere nold stin refter. , "Whering notlad and abould hir Tore - notwert sorte

### 4.6 step 50000

d cry. He lorcy. Frame, show tores sigh of he was sardly, saigh me as he ling al he cam they connted to Mig sSer wak mest, and justwy timonn it. "Beriir, and falling knourss suld.ydizany vearle over

### 4.7 step 60000

umpe'vingy of vord from. "Moughing in the eyed Fruse every say was teven kilay, Ge tancee as oud was tantinf and erings of abven likes this sting asks exhah de that we'lededs Prahlevoid,?" shid whem

### 4.8 step 70000

y. "Oterasen wlre bece dark comoon, weenting his his courning his of are Ron, his Mooduin?" geicund nothery, on?" Sees botcounthands bulzed thou?H. I wosts her. It Hagricey betith!" bobbrefured

### 4.9 step 80000

. . ...." Deosion to sud thoy has be, net in Cack keardaning and have! be doun, and he pase take Croach dind, rays queelored it s moter nick was his must whovers. Vininded retpele a mentiin anyte at

### 4.10 step 90000

pavevlipp.... " He igguruss that forethe gle book mant, and as and itter's, the jupped it's sting os the ..

#### 4.11 step 100000

was statch Harry, ter and Harry. " "Well, gobly, a fack up to beery clatiff, puppedu!" "The grith mon topruir the dust to budost the, what wanking stulle brentidndoramed, flecticked the byent Hirroure

#### 4.12 Best parameters

ts Dightwered, who was louden Dombroase is whow and Banding a duch of Rineding gacind living Ron as id ffall to stoor toway of nat onthins to were out Hermione foustly, whom keppett to eeplemoning alpmand in quigst firthen was it the spalloon. . . .ising foor out brick be itinf the jobt. "Thimk forwarne quicking ously a dights ancor was rotsed the ous from," cking ago .. Ssaring them wave a very strow -flealaard theup theubly the Dusming one the very bavintming to thut the jinging he fuc fichin on the maghes. I mar as's wham, hes threghen's Erow thryarged oak delating neslione they?" Thi" CETTERR" "Bat the Goys thow,, as has thook It roun his as thear yeal. The sillt anchen, wat lik'd not ded in was threan the clouse su as thas muliun's runors? Harry encly . judthanted tooffe ous; seen on, he and very then it who come shom that Geamater likone faces, in it, Rone albed was grysny if shrover, andele senor the Wearlioke at themstione overthowbe fay at it aveald cullaly you "They hus