Course: DD2424 - Assignment 4

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# **Q1: Gradient Computations**

State how you checked your analytic gradient computations and whether you think that your gradient computations are bug free for your RNN.

# **A1:**

I calculated the gradients numerically as it was suggested in the assignment and compared these values with the ones I derived analytically. To check if the computations are bug free, I used the relative error formula given on the [Standford](https://cs231n.github.io/neural-networks-3/) page:

Text

Description automatically generated with low confidence

Where f\_a' represents the analytical gradients and f\_n' represents the numerical gradients. Max relative error was for grad\_W (4.5395022299828325e-06).

|  |  |
| --- | --- |
| Parameter | Value |
| K | 80 |
| m | 5 |
| eta | 0.1 |
| seq\_length | 25 |
| sig | 0.01 |

**Table-1:** Parameters used for Gradient Computations

|  |  |  |  |
| --- | --- | --- | --- |
|  | grad\_W | grad\_U | grad\_V |
| MEAN | 5.721857655398036e-07 | 2.0073072354229825e-09 | 7.648515785404735e-08 |
| MAX | **4.5395022299828325e-06** | 1.1291280754341362e-07 | 5.403300733099425e-07 |
| MIN | 5.40208728428326e-09 | 0.0 | 8.06930618392259e-11 |

**Table-2:** Relative errors between numerical and analytic Gradients of Weights

|  |  |  |
| --- | --- | --- |
|  | grad\_b | grad\_c |
| MEAN | 4.217786027707498e-09 | 1.3895726298730234e-09 |
| MAX | 8.756013561045187e-09 | 1.8782966366826153e-09 |
| MIN | 1.5056811658156454e-09 | 1.6559669038602898e-10 |

**Table-3:** Relative errors between numerical and analytic Gradients of biases

# **Q2: graph of the smooth loss function**

Include a graph of the smooth loss function for a longish training run (at least 2 epochs).

# **A2:**

|  |  |
| --- | --- |
| Parameter | Value |
| K | 80 |
| m | 100 |
| eta | 0.1 |
| seq\_length | 25 |
| sig | 0.01 |
| n\_epochs | 7 |

**Table-4:** Parameters used for Training RNN - AdaGrad

Chart

Description automatically generated

**Picture-1:** RNN – Ada Grad Smooth Loss by update step

# **Q3: Evolution of the synthesized text**

Show the evolution of the text synthesized by your RNN during training by including a sample of synthesized text (200 characters long) before the first and before every 10,000th update steps when

you train for 100,000 update steps.

# **A3:**

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 0 ……….…… smooth\_loss: 90.18372351968591

q}

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Z9W0 ijK,DWgGd

YTFNA'axfVn1mTWMZe\_Fü^npQNPox2,FZFQ\_mnS,;jL0q-UaWH-6qE\_"HUb

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 10.000 …… smooth\_loss: 90.18372351968591

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"Ard - Of the to Wericler avotcad youd ut rot the ma

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 20.000 …… smooth\_loss: 45.275206236112766

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\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 30.000 …… smooth\_loss: 44.02861031888586

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\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 40.000 …… smooth\_loss: 42.798313717351114

he fered pling, oans as spece bettes wave tanw bobbes dobledotchalted Curshrout anked thooking thing hes raben; Vordor often pome Treft gors, was wandedstacheved ret stingles bry at and Harrim, masen

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 50.000 …… smooth\_loss: 43.637645450952874

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"Shain whanglded pack and fign, they of they wave deen, thouk and fistingly and was have wyovery has upzing mene might. Hhenly a

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 60.000 …… smooth\_loss: 42.41268752881072

und Hayrying anry's sinked been," said every dold to fookstsplentsh of hiu by avor slange, cooned it hir forir moggold harm theme did that it. Lroughtings, shant."

"Ge've it havustially by deed, Hand

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 70.000 …… smooth\_loss: 42.05942290065522

are Vore wak wave sloned brouve flets brow, formrer. . . . Baght Svew."

Herm pomed!"

Bumbeto op?" said Flets he kefting now" Dor. Rand were offe the farve.

Thes obIouse. Harry wazarmy "Head sace not

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 80.000 …… smooth\_loss: 40.45303970326621

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"Dumblize lake a swaafy. "Bo the lath, was

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 90.000 …… smooth\_loss: 41.05749847589323

ll was of wizer dinwins wastabed for fared pilleven. It poriex, but a cak Fill clower the curley, them kand oWher me grother wazcrss? Snoped a didpe into thit, prepam frome ormingimen'd ip the he lo

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 100.000 …… smooth\_loss: 42.20117163248899

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\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 200.000 …… smooth\_loss: 39.46531265367112

had been for it! Thucch, beep out not his, graitabous to . . . Wivey back poice mowned sint -'W han blinger. . . want, and te'll, tehing ffor-baulding, here ses!" said Hoglle, but do the Deast, ow to

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 250.000 …… smooth\_loss: 40.17442111034912

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\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* update\_step: 310.000 …… smooth\_loss: 37.63871074327056

as ned Crought. I right.

Harry sack. "Enwy, and bel" pulled a soment. Gown quartres, clulmled what the curdory, Harry one whink all of keed, But younten of whime to black, that Harry taskhing paitr

# **Q4: A passage of 1000-characters**

A passage of length 1000 characters synthesized from your best model (the one that achieved the lowest loss).

# **A4:**

The lowest loss was at the update\_step 300391 with the value of 37.14203943906468

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Best Model >> Synthesized text (1000 characters):

iveres weir to gourge.

"They bay nevions then but She, thent it was Gry you dy harh antigs, only about aventroons everyparn, givengered with the know old?"

"Not ip it complete hooble. "So, get of were in at iggered walle strang ocketthere them and Harry. They was would-foom into the back, his fittting at Gorried wive bleothed erse bight intucks, sirausn't is to mefeps was the had mose."

COOB, I eppeasly haur becounder, anting the and you'll luldous.

"Not ezormennlels than a stay and acounxtring your preas of himleed and that chose was at myed on the shacorme it wold, and Harry. The going Morted on him when in her red arrive.

"On," said Harry. "Well, shear danly all loyew him Viktor thought tell wers."

"Mr. Crous, hove tecored to the bange.

"I eye hend. he hade Aps' about her cave?" Maxtmen to by then in the walls, you been suieventince of, Sefused keep. He chose," said Fres."

"Hermagot ovo," he say judged from when feem on the trouk, That houseatled tIries that thing your, will in