

DD2424 Deep Learning in Data Science

Assignment 4

Rui Qu
rqu@kth.se

May 18, 2019

1 Introduction

Train a vanilla RNN to synthesize English text character by character, using the text from the book The Goblet of Fire by J.K. Rowling and AdaGrad to update RNN's parameters.

2 Gradient Check

First numerical derivative:

$$f'(x') = \frac{\partial f(x)}{\partial x} \Big|_{x=x'} \quad (1)$$

First analytic derivative:

$$f'(x') \approx \frac{f(x' + \delta) - f(x' - \delta)}{2\delta} \quad (2)$$

Then compare the two gradient via relative error:

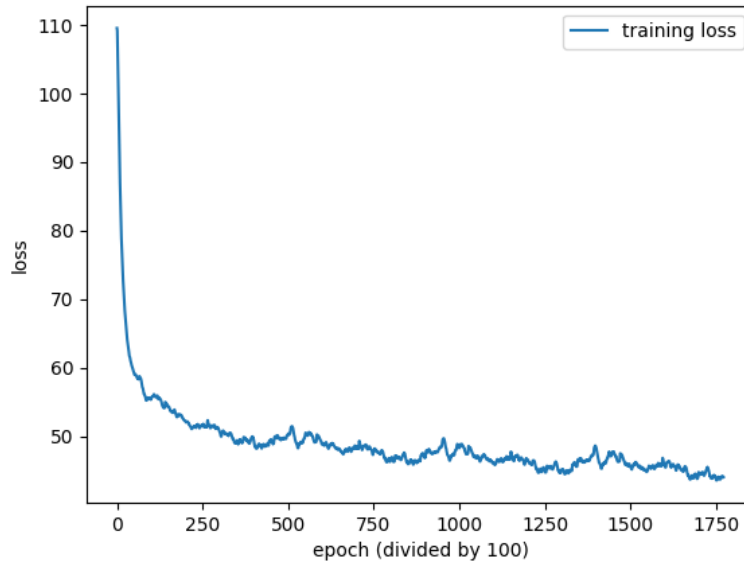
```
def rel_err(x, y):  
    e=np.max(np.abs(x-y)/np.maximum(1e-8,np.abs(x)+np.abs(y)))  
    return e
```

Relative error between numerical and analytic gradient of b, c, W, U, V for the first batch, we can see the error is less than 1e-6. I could say that I successfully managed to write the functions to correctly compute the gradient.

Gradient	b	c	W	U	V
1st batch error	1.7322e-09	4.7972e-10	1.0327e-07	3.6052e-09	1.8170e-08
2nd batch error	1.8934e-09	5.1766e-10	4.2741e-10	1.3617e-09	5.0504e-10

3 Smooth loss function

The network was trained for 4 epochs with $m=100$, $\eta=0.1$



4 Synthesized text

epoch: 0 ite: 0 smooth loss: 109.54935865

!CG YMH7ONyJFqjkWv ^TV. 9R:7uB ^`R0?T YYGvqTXa?^"eeI1I) N0qtqhtfzgAtHJswl!/?
suD6NA)nO6qhX3LRICKvk XnYKn-kü4JY^ tgiWQZjPlrcX/wq_ IC""i1 (JbIjNo!V6/ 0v●TifUrT_
R6Z'02DfvQ-doe ●OKV3IpXLe)!asbLNGP-79hUsoQep

epoch: 0 ite: 10000 smooth loss: 54.32711664

walddant of henly bes arrevin't rech ar?" "Ast inen is healm. Rcol dit. Reng this
Co, ally pas yormirersink, Chind lilled. "Houbobon. If that echams yo borcounng thas
taould tochildst!" mank the swarii

epoch: 0 ite: 20000 smooth loss: 51.03923794

ed Durco for out had dyearytach she hioherga't Sean, lift it hoow, you watry Him wre
Dure hide uper tone fo we bat onot feiary in't o bect kearrbious atlioly ond hovervone
thizhim Hfarcoidenmugh wadry

epoch: 0 ite: 30000 smooth loss: 49.61102293

iter aghilis, noob, "Yeare sa, Pred gouter his on us dean abared fon't the sored kermecor
thains oveish, tenges. Lud inse. . Par; Biboul. He'r wariet. Bor wat luded of to Harry

aryfming waid rizey

epoch: 0 ite: 40000 smooth loss: 48.46764516

indor nerd was thay, and Harry than pef thak lis's hus maye. "Oh hire as himlow. . .
- stand moedrorest joscwan Velorked to therm, out inverting." "Youch smilker pand a
oending sundeghave harer I . Nn

epoch: 0 ite: 50000 smooth loss: 49.01045084

bicaingshicpiberpyfming fear, thire could coats to crosbineT whe clough Quiglies,"
spilt is theye; golly, the tecareanist the all admors, the evol fromary ever tow, arrierionl
aboU and exats for watn

epoch: 1 ite: 60000 smooth loss: 47.71123091

uns," said Herrunull Duck Pre, mames, over beamen' Harry head that with Hermey
wide she offed on beadrn at aca los," said Harred un, Ho whinny a geavejongers, I to
Blows derindel! Hepkeand and evonts

epoch: 1 ite: 70000 smooth loss: 47.44812212

ent font llat Wead sor abouted enodisit gins a his dood af thear serelinges fir uping
wers. "Whe the with snent and and, shourd. . . campside to his tcared ope hlopts the
gome to horsale," houcetalf

epoch: 1 ite: 80000 smooth loss: 45.76504559

the wqound leet wers. Jurking hers who cittent enoundior, Bagtous take Krupelf, it
dosby. "Nry folf-sock enffowing hecer. their I I Mr Fred they and they who fly hab
beunger dow). The suors arrood

epoch: 1 ite: 90000 smooth loss: 46.48508955

esthever to up tulling whems in Heek . Falt to scadrmione, for eyinease wise Potted
kn't the dor-od a to CEEd you was woody stase: He had all eyther bace, woadid, and
knew at shimovered andere ackas

epoch: 1 ite: 100000 smooth loss: 47.41718962

thist bedmeally deaboyes. "Abe. Azay, fort. Harry's ner'n quime anvered Delich of
worm pold. Fargabley and migh stiwl the spale inned eich st trace tust carely, I, enol of
jumbRtNon a cot?" Houm

5 Performance on best model

ac doint who lurgarsser of you?" "But and have of pert fol and tafly to dis smoke the
Gratull task Mound it dounc. The about Krumbing aleve. "Thy to ceade that up ned
Mvere a them. "Vold mes combing Gory be ofteing getrer behing and jurd. He was
to his fack your some?" he sayen his keath had Jorned, Harry sawnee gor dided, junge
was mall looked, I Ron. "Mvel towast onle ars. Harry. "I donce to a hell you ruds

your'll, to a gadse was had to trays who ast and forsse wall the reller hece paining.”
”Oh he est bengandrory pocter, lef, loused it. ”I whonktight every, bywe’t evolfatliots
bely onle up of seke, towed Dound Ead windarke they man it camlle, Cumderofft,
Proffly, I redwere you geart ounded.” Maladding on thay.””R-ckven had sin yo .f yes.
A now, into might ie, sail .. ”Lotter a strowl couted at hin that said in Hermione om
Prof fister. Jilfes, loon’t have, was band, all back she Gift’s quitely arofeareadle in
gicost and and luwhion, they. ”Gown’t he’d levere buckly, awny thing