

Assignment 4 - DD2424 - Vanilla RNN

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Gradient check

After implementing forward pass and backward pass, I've checked the gradient computation by using the `autograd.grad` method of PyTorch. I've compared the gradients with the ones analytically computed and they were very close. The relative error was less than 10^{-7} for all the parameters:

```
Relative error on V: 2.5663803526754236e-08
Relative error on c: 2.2815955347255112e-08
Relative error on W: 3.914951918204679e-08
Relative error on b: 3.6925428048562026e-08
Relative error on U: 2.9062837469950864e-08
```

These results show that the gradients are correctly computed.

Training

Loss evolution

After that, I trained the RNN for 10 epochs with `m=100`, `seq_length=25`, `eta=.001`, `gamma=.9` as hyperparameters. The smooth loss evolution is shown in the following figure:

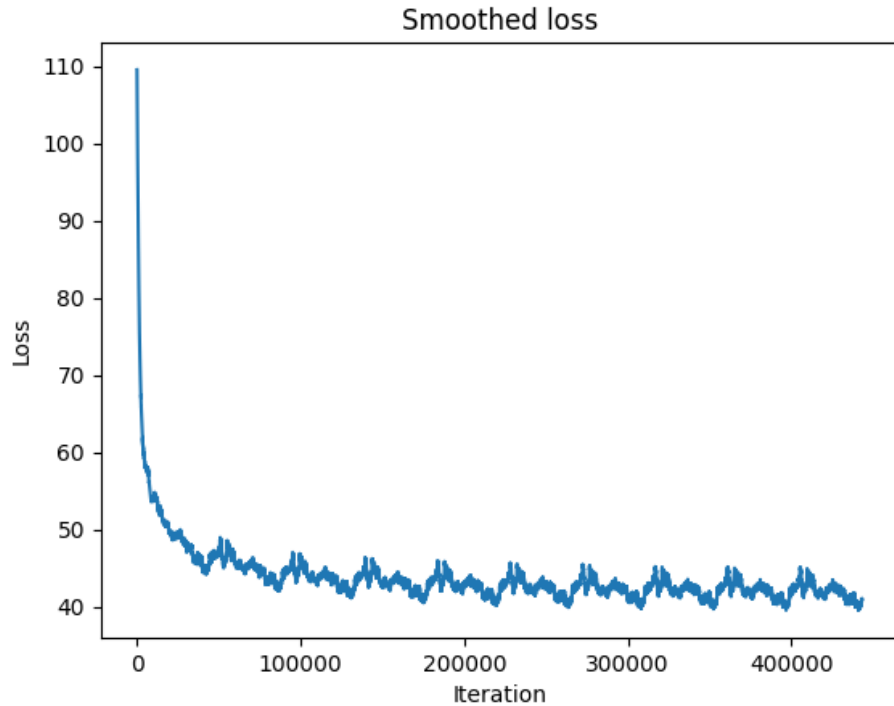


Figure 1: Smooth loss evolution for 10 epochs. The best loss observed was **39.5457**.

Synthesized text

During the training, I've also generated some text using the RNN. The text is 200 characters long and generated before the first and every 10000 iterations of the first 1000000 iterations. Here is the evolution of the generated text:

Training - Iteration 0

```
[breaklines=true]
gZQa!MZo0,S4Qi vPYyu●"z,.jgv9c:zFe6.mH
dh4bqn xMcH xT:;VhrN/q-ozq!}COIDF4I2r1Fsz :LZn4M
6I(gTdrGID4Qj!Xc!sT●j ^,_DBxLQnrCVp.dG3deyehnWQ;
FRmare(mbb6we/BEM
'P1IxXcRu;B!Jx,'.üY!ic_ NpdR●N4y'gycNX17C1'U
```

Training - Iteration 10000 - Loss 53.84928512573242

```
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?ver.
```

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Training - Iteration 20000 - Loss 49.59050369262695

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Training - Iteration 30000 - Loss 47.87261199951172

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Training - Iteration 40000 - Loss 45.59083557128906

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Training - Iteration 50000 - Loss 47.49644470214844

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Training - Iteration 60000 - Loss 45.70494842529297

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Training - Iteration 70000 - Loss 45.728790283203125

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Training - Iteration 80000 - Loss 43.62993621826172

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 vell," gasilt. re's ground. Hagelys up. said ,
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 couiches. eave

Training - Iteration 90000 - Loss 44.04008483886719

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 bark thabghtkwen, and lippith straking audiser

Training - Iteration 100000 - Loss 45.647220611572266

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Final synthesized text

Then, with the best parameters, I've generated a text of 1000 characters. Here is the result:

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Conclusion

The RNN seems to be working well. The loss is decreasing during the training and the generated text is coherent. However, the text is not perfect and some words are not correctly spelled. The model could be improved by using Adam, word embeddings, or a more complex architecture like LSTM or GRU.