

Homework 5

Due: 2021-11-17 (Wed.) 8pm

Fun with RNNs

In this project, you will work on extending `min-char-rnn.py`. This was written by Andrej Karpathy¹. You will experiment with the Shakespeare dataset (`shakespeare_train.txt`).

Part 1: (20 points)

The RNN language model uses a softmax activation function for its output distribution at each time step. It's possible to modify the distribution by multiplying the logits by a constant α :

$$y = \text{softmax}(\alpha z)$$

Here, $1/\alpha$ can be thought of as a “temperature”, i.e. lower values of α correspond to a “hotter” distribution. (This terminology comes from an algorithm called simulated annealing.)

Write a function to sample text from the model using different temperatures. Try different temperatures, and, in your report, include examples of texts generated using different temperatures. Briefly discuss what difference the temperature makes.

Include the listing (i.e., source code) of the function you wrote/modified to accomplish the task in the report.

You should either train the RNN yourself, or use the weights from Part 3 -- up to you.

Part 2: (50 points)

Write a function that uses an RNN to complete a string. That is, the RNN should generate text that is a plausible continuation of a given starter string. In order to do that, you will need to compute the hidden activity h at the end of the starter string, and then to start generating new text.

Include 5 interesting examples of outputs that your network generated using a starter string. (This part need not be easily reproducible).

Include the listing (i.e., source code) of the function you wrote in the report.

You should either train the RNN yourself, or use the weights from Part 3 -- up to you.

Part 3: (30 points)

The weights for a trained RNN are included as `char-rnn-snapshot.npz`. Some samples from the RNN (at temperature $1/\alpha=1$) are included as `samples.txt`, and code to read in the weights is included as `read_in_npz.py` (if this doesn't work, try the pickle file and get a using `import cPickle as pickle; a = pickle.load(open("char-rnn-snapshot.pkl"))`).

In the samples that the RNN generated, it seems that a newline or a space usually follow the colon (i.e., ":") character. In the weight data provided, identify the specific weights that are responsible for this behavior by the RNN. In your report, specify the coordinates and values of the weights you identified, and explain how those weights make

¹ <https://gist.github.com/karpathy/d4dee566867f8291f086>

the RNN generate newlines and spaces after colons.

Part 4: (10 points bonus)

Identify another interesting behaviour of the RNN, identify the weights that are responsible for it.

Specify the coordinates and the values of the weights, and explain how those weights lead to the behaviour that you identified. To earn bonus points, the behaviour has to be more interesting than the behaviour in Part 3 (i.e., character A following character B)

Submission

- You need to submit the following files:
 - 1) hw5_code.py
 - 2) experiment report.pdf
- Please convert your experiment report to PDF format
- Suggestion: if you are using randomness anywhere, use `numpy.random.seed()`.