Programming Assignment 2

Recurrent Neural Network

CSE303: Introduction to Deep Learning

Objective

- You can do either (main) or (substitute)

- (Main)
  1. Recurrent Neural Network for sentiment analysis generation without deep learning framework (only python)

- (Substitute: 20% of total credit)

  If you cannot do main, you can do this:
  1. Recurrent Neural Network for sentiment analysis generation using a deep learning framework (e.g. pytorch, tensorflow)

[Andrew Ng, Sequential Models Course, Deep Learning Specialization]

Overall steps

1. **Prepare the training/test datasets and word embedding**
    1. Prepare data (Sentiments, Glove)
    2. Implement data loader and word embedding
2. **Design Recurrent Neural Network (using only python)**
    1. Design RNN (Vanilla RNN and LSTM)
    2. Design output layer with Cross-Entropy loss
    3. Design Dropout
3. **Implement whole training & test pipeline with optimizer**
    1. Design optimizer (SGD and ADAM)
    2. Training procedure
4. **Evaluate the performance**

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1. Prepare training/test dataset & word embedding

1. **Prepare the dataset & load data (using emo_utils.py)**
   1. *Sentiment analysis* dataset [1]: 'test_emoji.csv', 'train_emoji.csv' (Check the uploaded file: **data_train_test.zip**)
      1. Train: 132 sentences, Test: 56 sentences with 5 emoji
   2. *Glove*: word embedding
      1. Prepare '**glove.6B.50d.txt**' and '**glove.6B.100d.txt**' that read 50d features and 100d features glove file (download link: [2])

Sentiments example

X (sentences)	Y (labels)
I love you	0
Congrats on the new job	2
I think I will end up alone	3
I want to have sushi for dinner!	4
It was funny lol	2
she did not answer my text	3
Happy new year	2
my algorithm performs poorly	3
he can pitch really well	1
you are failing this exercise	3
you did well on your exam.	2
What you did was awesome	2
I am frustrated	3

code	emoji	label
:heart:	❤️	0
:baseball:	⚾	1
:smile:	😀	2
:disappointed:	😔	3
:fork_and_knife:	🍴	4

[1] https://github.com/omerbsezer/LSTM_RNN_Tutorials_with_Demo
[2] http://nlp.stanford.edu/data/glove.6B.zip (Reference: https://nlp.stanford.edu/projects/glove/)

What is Glove?

- **Glove, EMNLP'14**
  - An unsupervised learning algorithm for obtaining vector representations for words. Training is performed on aggregated global word–word co-occurrence statistics from a corpus, and the resulting representations showcase interesting linear substructures of the word vector space.
    - Project site: https://nlp.stanford.edu/projects/glove/
    - Paper: https://nlp.stanford.edu/pubs/glove.pdf
    - **Download:** http://nlp.stanford.edu/data/glove.6B.zip

    - word_to_index: dictionary mapping from words to their indices in the vocabulary (400,001 words, with the valid indices ranging from 0 to 400,000)
    - index_to_word: dictionary mapping from indices to their corresponding words in the vocabulary
    - word_to_vec_map: dictionary mapping words to their GloVe vector representation.

[1] Pennington, Jeffrey, Richard Socher, and Christopher D. Manning. "Glove: Global vectors for word representation." *EMNLP* 2014.

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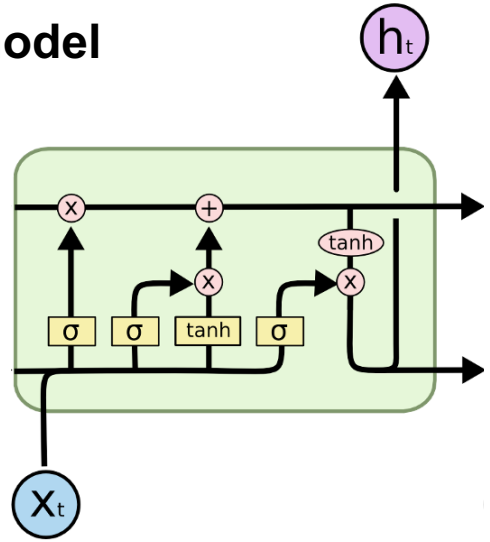
2. Design neural network

1. Overall steps

1. Design both RNN & LSTM layers
2. Design Dropout layer
3. Design FC layer and SoftMax (*If you've designed already, use them*)
4. Design Cross-entropy loss (*If you've designed already, use them*)

LSTM model



LSTM computation

$$\begin{pmatrix} i \\ f \\ o \\ g \end{pmatrix} = \begin{pmatrix} \sigma \\ \sigma \\ \sigma \\ \tanh \end{pmatrix} W \begin{pmatrix} h_{t-1} \\ x_t \end{pmatrix}$$

$$c_t = f \odot c_{t-1} + i \odot g$$

$$h_t = o \odot \tanh(c_t)$$

2. Design neural network

- Overall network

Bias should be added

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	(None, 10)	0
embedding_1 (Embedding)	(None, 10, 50)	20000050
lstm_1 (LSTM)	(None, 10, 128)	91648
dropout_1 (Dropout)	(None, 10, 128)	0
lstm_2 (LSTM)	(None, 128)	131584
dropout_2 (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 5)	645
activation_1 (Activation)	(None, 5)	0

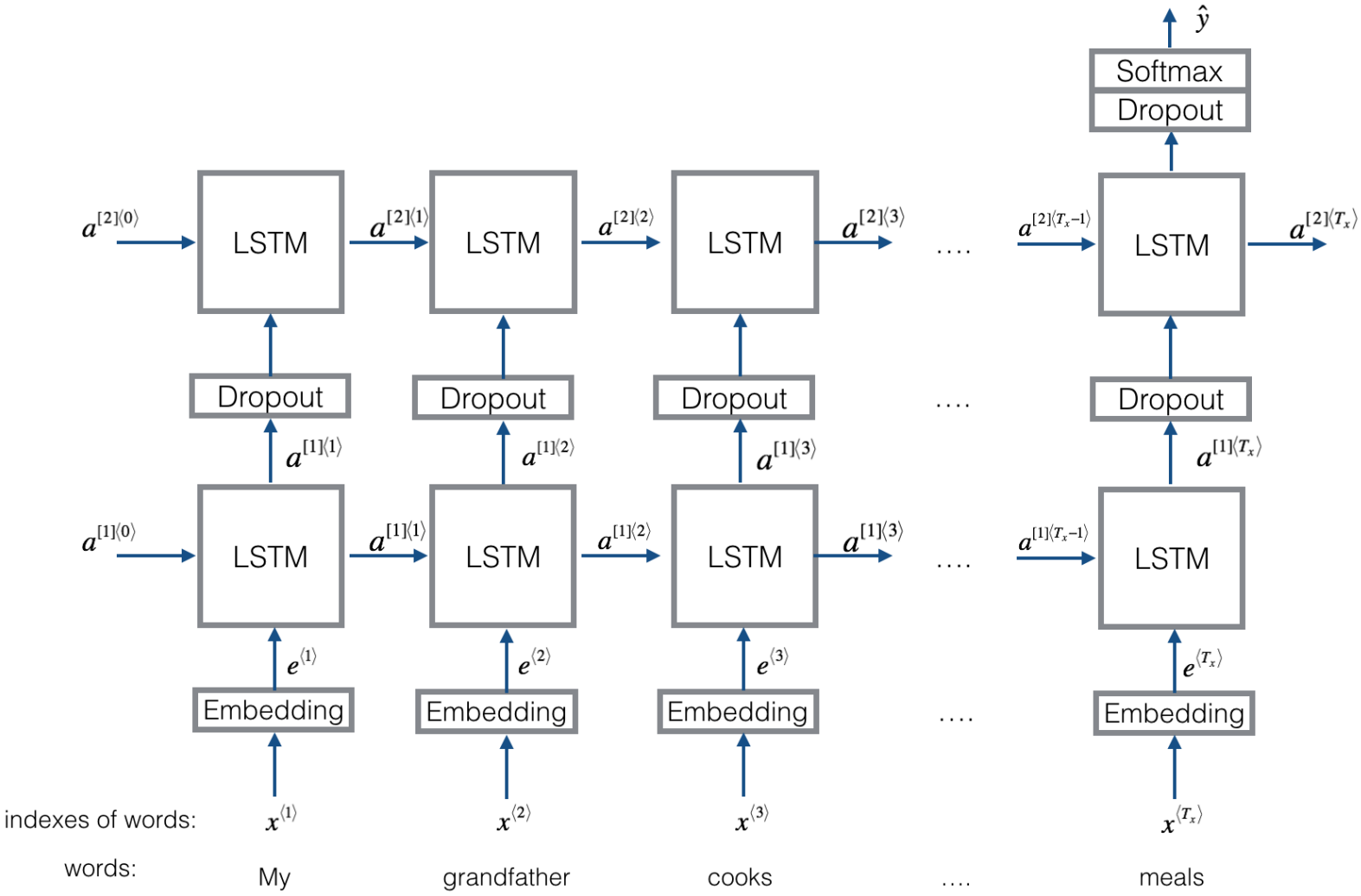
Total params: 20,223,927
Trainable params: 20,223,927
Non-trainable params: 0

Use both
- LSTM & RNN
- 50D & 100D
- SGD & ADAM

2. Design neural network

- Overall structure

Bias should be added



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3. Implement whole training & test pipeline

1. Design optimizer (SGD and ADAM)

2. Training procedure
    1. Initialize the model parameters
    2. Implement and do forward propagation
    3. Implement and compute the cross-entropy loss
    4. Implement and do backward propagation
    5. Implement and update model parameter using optimizer
    6. Draw the plot of the loss

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4. Evaluate the performance (1)

- **Measure all accuracy of four cases using test sets & report results (emoji), accuracies, and training loss graph for all cases**
  - Vanilla RNN vs LSTM
    - Compare the results between RNN and LSTM
  - SGD vs ADAM
    - Implement dropout technique
    - Train with/without dropout
    - Report the accuracy comparison dropout
  - Glove50d vs Glove100d (The length of the Glove vector)

Submission

Due : Nov 24, 11:59PM
To : lms.dgist.ac.kr

1. **Submit zip file including (1) Source code, (2) PDF file(report)**
   1. File name: PA2_studentID_name.zip (PA2_202312234_김종민.zip)
   2. Submission exclude training & Test dataset
2. **Report should include the results and results comparisons:**
   You can submit either (main) or (substitute)
   - (**main**) Show the results of Five Different Settings: (a) RNN+SGD+50d, (b) LSTM+SGD+50d, (c) LSTM+ADAM+50d, (d) LSTM+SGD+100d, (e) LSTM+SGD+50d+dropout followings:
     (1) accuracy comparison for test set
     (2) all emojis for test set
     (3) Training Loss graph
     & Describe the results comparison of optimizers (SGD, ADAM), RNN structures (RNN, LSTM), and the length of glove vectors (50d, 100d) & Describe the difference between Word2Vec and Glove in terms of vector generation
   - (**substitute**) Submit the same results above using deep learning framework
3. **Final credit: max(main, substitute*20%)**

Notice

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1. **Library**
    1. You cannot use a deep learning framework(Tensorflow, Pytorch, etc), but you can use Numpy or other libraries.
2. **Delayed submission**
    1. 25% score will be degraded every 1-day delay & after 3 days delayed, you will get 10% of the total score
    (e.g., 100% → 75% (1day) → 50% (2day) → 25% (3day) → 10% (〉3day)
3. **Plagiarism**
    1. No grade for copied codes (from friends and the internet)
    2. You can refer to sources from the internet, but do not copy and paste.
4. **Partial credit**
    1. Even though you are not successfully designing the network and obtained reasonable results, please send your code.
    2. There will be partial credit for each module implementation.