EEL6935 Course Project
Final Report

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EEL6935 T21

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Sentiment Analysis

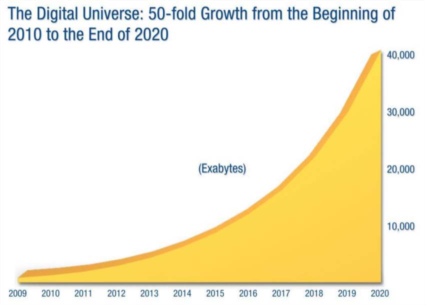
Goal: assign sentiment labels to a sentence.

$f : \mathcal{D} \rightarrow \mathcal{L}$

- $\mathcal{D} = \{d_0, d_1, \dots, d_{n-1}\}$ is the set of sentence
- $\mathcal{L} = \{l_0, l_1, \dots, l_{k-1}\}$ is the set of labels.

Movie review is ideal for sentiment analysis

- Most dataset of movie review are already associated with scores
- The scores in dataset are reliable



[1] Gantz, J., & Reinsel, D. (2012). The digital universe in 2020: Big data, bigger digital shadows, and biggest growth in the far east. IDC iView: IDC Analyze the future, 2007(2012), 1-16.

Text Encoding

- Define the collection of text documents to be

$$\mathcal{D} = \{d_1, d_2, \ldots, d_D\}$$

- Define vocabulary to be

$$\mathcal{V} = \{v_0, v_1, \ldots, v_{m-1}\}$$

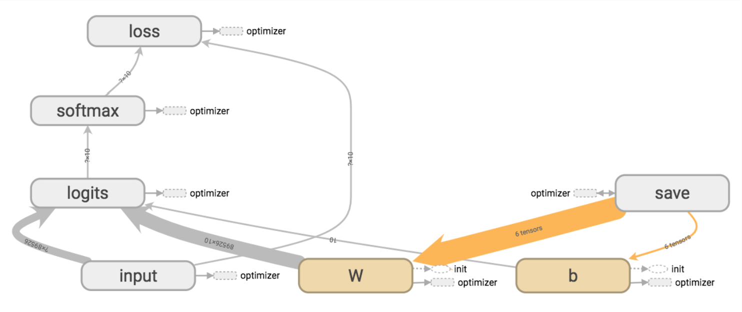
- The notation of frequency of a word $v \in \mathcal{V}$ occurred in document $d \in \mathcal{D}$ is $f_d(v)$, hence a document can be represented as a vector

$$\bar{d} = \{f_d(v_1), f_d(v_2), \ldots\}$$

- Define total number of documents $d \in \mathcal{D}$ containing the word w is represented as

$$f_{\mathcal{D}}(v)$$

Backend: Logistic Regression



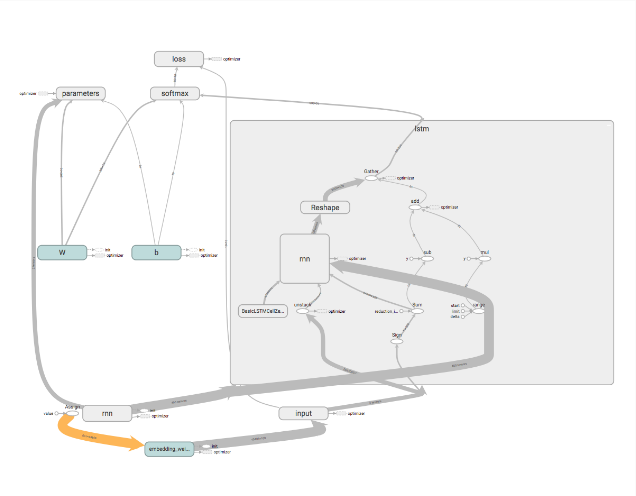
- Multiply input vectors by W, add b
- Convert output into probabilities with Softmax
- pick $i = argmax(\hat{y}_i)$
- Train the model using Adam Optimizer
- Common baseline model and simple to implement

Backend: LSTM Model

Given a word sequence $S = \{v_0, v_1, \ldots, v_{l-1}\}$ with length l, the states of LSTM are updated as:

$$\begin{bmatrix} i_t \\ f_t \\ o_t \\ c_t \end{bmatrix} = \begin{bmatrix} \sigma \\ \sigma \\ \sigma \\ \tanh \end{bmatrix} S[h_{t-1}, x_t]$$

- $c_t = f_t \circ c_{t-1} + i_t \circ \hat{c}_t$
- $h_t = o_t \circ \tanh c_t$



Backend: LSTM Model

To build our LSTM model:

- Define a dictionary

$$D = [w_1, w_2 ... w_N]$$

  to contain the set of all words representable by our LSTM network
- The i-th input to our LSTM is a vector

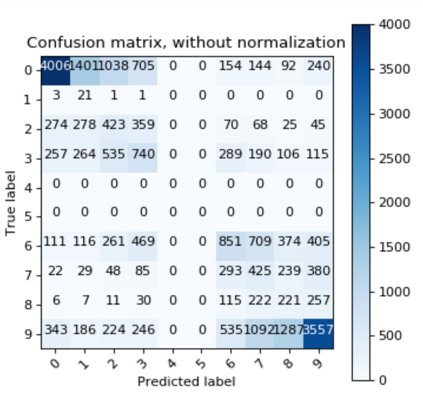
$$v_i = [\pi_{i1}, \pi_{i2} ... \pi_{iL}]$$

  corresponding to a movie review r_i of length L, where π_{ij} is the dictionary index of the j-th word of r
- $D = [\text{cat}, \text{dog}, \text{meow}]$

$$r = [\text{dog}, \text{dog}, \text{cat}, \text{meow}] \Rightarrow v = [1, 1, 0, 2]$$

Simulation Platform Specs

- Training based on Stanford Large Movie Review Dataset
  - 50,000 highly polar movie reviews
  - 25,000 for training, 25,000 for testing
- Code in Python with Tensorflow/Scikit-Learn
- simulations will be conducted on computers with
  - 3.1GHz Intel Core i7 CPU with 8MB cache
  - nVidia GTX 1050 GPU with 4GB Memory
  - 16GB RAM
  - Ubuntu 14.04 LTS



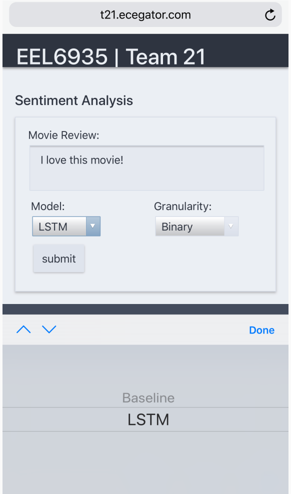
Result

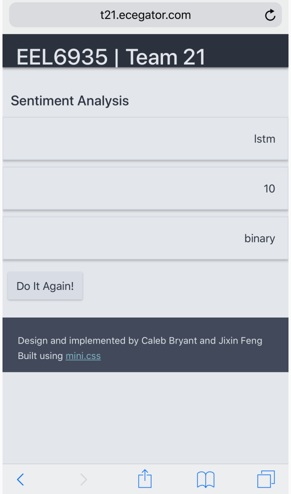
Table 1: System Performance

Method	Epochs	Binomial Training	Binomial Testing	Multinomial Training	Multinomial Testing
scikit-learn LR	N/A	0.9981	**0.8697**	N/A	N/A
tensorflow LR	20	0.8670	0.8583	0.9982	0.3734
larger LSTM	8	N/A	N/A	0.6693	0.3657
smaller LSTM	2	N/A	0.8507	0.5622	**0.4098**

Front End: Flask Web App

- Web App via Flask
- Allow model selection
- Accept text input and sentiment analysis output
- Hosted on low spec VM
    - Ubuntu 16.04 LTS
    - Single Core CPU
    - 2GB RAM
    - No standalone GPU





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Thank You!

Questions?