Digital Speech Processing HW1

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1. Environment

Operation System: Ubuntu 18.04 .1 LTS
Language: C
Compiler: gcc 7.3.0

2. How to execute my code

Open your terminal and command the follows:

cd hw1_r07944005/
make
./train [iteration] [model_init.txt] [seq_model_01.txt] [model_01.txt]
./train [iteration] [model_init.txt] [seq_model_02.txt] [model_02.txt]
./train [iteration] [model_init.txt] [seq_model_03.txt] [model_03.txt]
./train [iteration] [model_init.txt] [seq_model_04.txt] [model_04.txt]
./train [iteration] [model_init.txt] [seq_model_05.txt] [model_05.txt]
./test [modellist.txt] [testing_data1.txt] [result1.txt]
./test [modellist.txt] [testing_data2.txt] [result2.txt]

(Replace your files in the bracket, and do not need to key in the bracket itself.)

3. Discussion

In this homework, I implemented the Baum-Welch algorithm to train the HMM models. By using the forward and backward algorithm, I can calculate the variable α and β, respectively. As soon as I have α and β, I can apply Baum-Welch algorithm to get γ and ε, and iteratively re-estimate the model parameters in an EM algorithm fashion until the given iteration.

Once I have the trained models of each class, the Viterbi algorithm could be used to inference the testing data. By recursively calculating the variable δ, I obtained the highest probability single path of state sequences. Finally, comparing each likelihood of the observation at each model, their belonging classes can be decided.

In order to know how the iteration could influence the accuracy, I recorded the models for every 25 iterations from 1 to 10000 iterations (Fig. 1). And the evaluation result tested on testing_data1.txt shows that the accuracy increases dramatically at the first 1000 iterations and reaches the peak accuracy 0.870852 at about the 1050-th iteration.

Then, the accuracy slowly decreases. The phenomenon could arise from the model overfitting on the training data but failing to represent the testing data. Hence, I choose the 1050-th iteration model as my final submission.

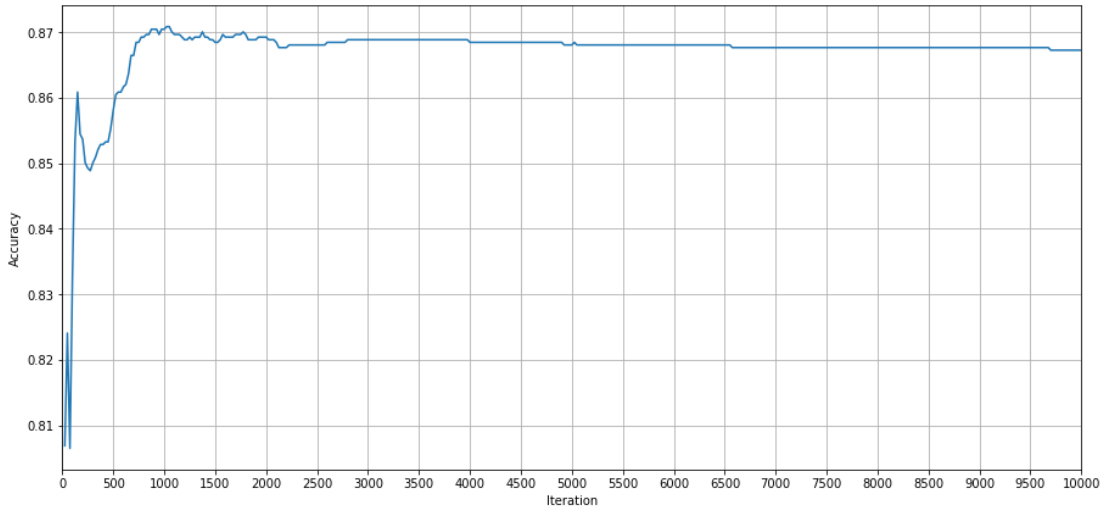

Fig. 1 The accuracy curve. The peak accuracy 0.870852 is at the 1050-th iteration.