

DSP Homework 2

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Testing Environment :

CSIE workstation

- Linux linux8 4.18.6-arch1-1-ARCH
- gcc 8.2.1

Part 1 – Run Baseline

Screenshot of my result :

```
b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy
===== HTK Results Analysis =====
Date: Mon Nov 19 23:07:12 2018
Ref : labels/answer.mlf
Rec : result/result.mlf
----- Overall Results -----
SENT: %Correct=38.54 [H=185, S=295, N=480]
WORD: %Corr=96.61, Acc=74.34 [H=1679, D=13, S=46, I=387, N=1738]
=====
```

Baseline accuracy is 74.34%

Part 2 – Improve Accuracy

To improve accuracy, I modify three files :

- In lib/proto, I set <NumStates> to **15**
- In lib/mix2_10.hed, I increase the number of Gaussian mixture (total 2+8 = **10**) for liN to jiou model.
- In 03_training.sh, I set the iterations of Step 1, Step 3 and Step 5 to **20**.

Screenshot of my result :

```
b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy
===== HTK Results Analysis =====
Date: Tue Nov 20 16:19:25 2018
Ref : labels/answer.mlf
Rec : result/result.mlf
----- Overall Results -----
SENT: %Correct=91.88 [H=441, S=39, N=480]
WORD: %Corr=97.58, Acc=97.41 [H=1696, D=34, S=8, I=3, N=1738]
=====
```

Improved accuracy is **97.41%**

Part 3

首先，我增加了 Number of state (當 state 的數量增加時，能將訊息分攤，使 model 更精確的描述該 phoneme 的特性)，當 state 個數從原先的 5 增加至 10、15 時，accuracy 分別提高至 93.67%、95.91%。

<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 14:56:25 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=80.83 [H=388, S=92, N=480] WORD: %Corr=96.61, Acc=93.67 [H=1679, D=26, S=33, I=51, N=1738] </pre>	<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 15:04:18 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=87.50 [H=420, S=60, N=480] WORD: %Corr=96.26, Acc=95.91 [H=1673, D=41, S=24, I=6, N=1738] </pre>
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接續上述(# state = 15)，我增加 Gaussian mixtures 的個數 (增加所使用的 Gaussian 數目，能使 model 更精確的描述機率分布)，當 Gaussian mixtures 個數從原先的 2 提升至 5、10 時，accuracy 分別提高至 96.32%、96.55%。

<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 15:16:58 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=88.54 [H=425, S=55, N=480] WORD: %Corr=96.78, Acc=96.32 [H=1682, D=38, S=18, I=8, N=1738] </pre>	<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 15:21:25 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=89.38 [H=429, S=51, N=480] WORD: %Corr=97.01, Acc=96.55 [H=1686, D=37, S=15, I=8, N=1738] </pre>
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但當我繼續將 Gaussian mixtures 個數提高時，正確率不增反降 (11=>96.43% ; 12=>96.43% ; 13=>96.43% ; 14=>96.38% ; 15=>96.26%)，推測原因為 Gaussian 數量過多時，會 over fit training data.

<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 15:51:09 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=89.17 [H=428, S=52, N=480] WORD: %Corr=96.89, Acc=96.43 [H=1684, D=37, S=17, I=8, N=1738] </pre>	<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 15:43:23 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=89.17 [H=428, S=52, N=480] WORD: %Corr=96.84, Acc=96.43 [H=1683, D=38, S=17, I=7, N=1738] </pre>
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<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 15:39:13 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=89.17 [H=428, S=52, N=480] WORD: %Corr=96.89, Acc=96.43 [H=1684, D=38, S=16, I=8, N=1738] </pre>	<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 15:36:07 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=88.75 [H=426, S=54, N=480] WORD: %Corr=96.89, Acc=96.38 [H=1684, D=38, S=16, I=9, N=1738] </pre>
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```

b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy
===== HTK Results Analysis =====
Date: Tue Nov 20 15:31:35 2018
Ref : labels/answer.mlf
Rec : result/result.mlf
----- Overall Results -----
SENT: %Correct=88.75 [H=426, S=54, N=480]
WORD: %Corr=96.78, Acc=96.26 [H=1682, D=38, S=18, I=9, N=1738]

```

最後(# state = 15，#GMM = 10)，我調整 iteration 的數量(增加 iteration 數量能提升收斂程度)，當 iteration 數從原本的 3 增加至 5、10、15、20 時，accuracy 分別提高至 96.49、96.84、97.07、97.41。而當 iteration 數增加至 25 時，accuracy 則會下降至 97.35。

我最後採用 # state = 15、#GMM = 10、#iteration = 20，accuracy = 97.41%

<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 16:01:27 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=89.38 [H=429, S=51, N=480] WORD: %Corr=96.95, Acc=96.49 [H=1685, D=37, S=16, I=8, N=1738] </pre>	<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 16:06:13 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=90.42 [H=434, S=46, N=480] WORD: %Corr=97.30, Acc=96.84 [H=1691, D=34, S=13, I=8, N=1738] </pre>
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<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 16:11:37 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=90.62 [H=435, S=45, N=480] WORD: %Corr=97.41, Acc=97.07 [H=1693, D=33, S=12, I=6, N=1738] </pre>	<pre> b04902099@linux8 [~/DSP/dsp_hw2] cat result/accuracy ===== HTK Results Analysis ===== Date: Tue Nov 20 16:19:25 2018 Ref : labels/answer.mlf Rec : result/result.mlf ----- Overall Results ----- SENT: %Correct=91.88 [H=441, S=39, N=480] WORD: %Corr=97.58, Acc=97.41 [H=1696, D=34, S=8, I=3, N=1738] </pre>
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