

# DSP hw2 Report

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## Baseline

```
===== HTK Results Analysis =====  
Date: Wed Nov 21 18:36:15 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]  
=====
```

## Accuracy Improvement

### ■ Initial Model

There are 15 states for each number.

In each state, means are all 0 while variances are all 1.

The transition probabilities are set to:

$$a_{1j} = \begin{cases} 1, & j = 2 \\ 0, & \text{else} \end{cases}$$
$$a_{ij} = \begin{cases} 0.5, & j = i, i + 1 \\ 0, & \text{else} \end{cases} \quad i = 2, 3, \dots, 13, 14$$
$$a_{15j} = 0 \quad \forall j$$

### ■ Training Steps

1. HERest for 100 times
2. HHed to add sp model
3. HERest for 100 times
4. HHed
5. HERest for 10 times
6. Repeat step 4,5 for 10 times (11 times in total)

### ■ Gaussian Mixture

In step 4, number of Gaussian for each state in 9 numbers is increased by 3 while that in silence model is increased by 2. Finally, there are 34 Gaussians in each state in numbers and 24 Gaussians in each state in silence model.

## ■ Result

With such configuration, the accuracy enhanced to 98.56%.

```
===== HTK Results Analysis =====
Date: Thu Nov 22 22:16:12 2018
Ref : labels/answer.mlf
Rec : result/result.mlf
----- Overall Results -----
SENT: %Correct=95.42 [H=458, S=22, N=480]
WORD: %Corr=98.68, Acc=98.56 [H=1715, D=19, S=4, I=2, N=1738]
=====
```

## Discussion

Here we further discuss the impact of the increment and the total number of Gaussians on accuracy.

### ■ Increment of Gaussians

In this part, the total number of Gaussians is fixed. However, in step 4, number of Gaussians for each state is increased by 11. The resulting accuracy is 98.27%, which is a little bit lower than the previous result.

```
===== HTK Results Analysis =====
Date: Fri Nov 23 14:57:38 2018
Ref : labels/answer.mlf
Rec : result/result.mlf
----- Overall Results -----
SENT: %Correct=94.38 [H=453, S=27, N=480]
WORD: %Corr=98.50, Acc=98.27 [H=1712, D=21, S=5, I=4, N=1738]
=====
```

### ■ Number of Gaussians

In this part, the increment of Gaussians is modified to 5 while the total number of Gaussians for each state is 56. The resulting accuracy is 98.33%, which is still worse than the previous result.

```
===== HTK Results Analysis =====
Date: Fri Nov 23 14:22:28 2018
Ref : labels/answer.mlf
Rec : result/result.mlf
----- Overall Results -----
SENT: %Correct=93.96 [H=451, S=29, N=480]
WORD: %Corr=98.62, Acc=98.33 [H=1714, D=21, S=3, I=5, N=1738]
=====
```

From the result above we can easily observe the fact that the total number of Gaussians indeed affect the performance of models. Adequate number of Gaussians and increasing Gaussians little by little yield better performance.