# Huffman Coding

- **Code**

  The Huffman coding code please look at the path of "../Huffman Coding/Huffman.py"

- **Result**

  The Huffman coding tree as shown on the Fig 1. I used the alphabet and the probability distribution from the slide to do the coding. Compared with the slide example, the sequence order will be a little different between the alphabet so program encoding result will different too.

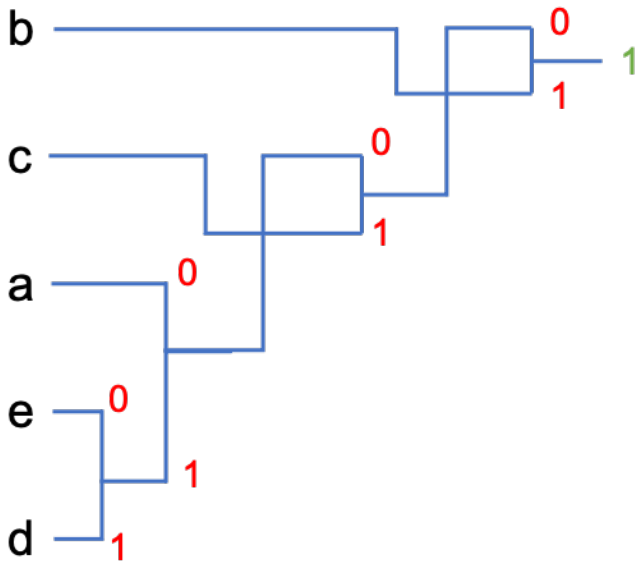


**Figure 1. Huffman Coding Tree**

In order to achieve Huffman coding, I constructs the coding tree and find the code from root to the leaf. Then let codes inverse, we will get the encoding result as shown on the Fig 2.

```
ian@IandeMBP Huffman Coding  % python3 Huffman.py
==========Data==========
a  0.200000
b  0.400000
c  0.200000
d  0.100000
e  0.100000
========================
b 1
c 01
a 000
e 0010
d 0011
```

**Figure 2. Huffman Coding Result**

# Vector Quantization

- **Code**

  The Vector Quantization code and images please look at the path of "../Vector Quantization/VQ.m"

- **Result**

  I try four different codebook size with same block size 4 * 4 to see the different of imaging quality, the image as shown on the Fig 3.

**Fig3. LBG Vector Quantization. Top left image codebook size is 16, top right codebook size is 64, bottom left is 256, bottom right is 1024.**

## Discussion

It’s not difficult to achieve a Huffman coding program. I know now that previously learned Huffman coding in data structure can be use to do the lossless compression. Also, I confirmed the problem of Huffman coding if there are many element that should be compression and have similar possibilities then the compression rate will low.

In the program of LBG vector quantization I try four different codebook size with same block size 4 * 4 to see the different of imaging quality. I found that the compressed 512 * 512 pixel image has lower image quality when the codebook size is 16 and 64, but when the codebook size is 256 and 1024, the image quality is not quite different. Also, I conducted four codebook size test experiment, showing that compression time for codebook size 1024 is much longer then other size, which confirms choose an appropriate codebook size value with target image is important.