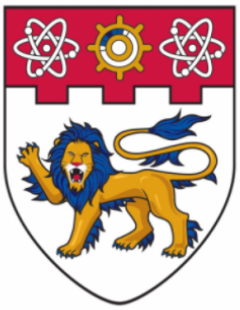

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

Assignment ON
EE4478 Digital video processing
Tutorial 2-12

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EEE

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Contents

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1 Assignment 2 Halffman Code

1.1 Question 1

To generate halfman code first is to sort combile the 2 items with lowest possibilites and resort. Until the table only have 2 items left.

Table 1: 1st round of sort

Symbol	Probalility
C	0.05
A	0.1
F	0.12
D	0.18
B	0.2
E	0.35

Table 2: combile & 2nd round of sort

Symbol	Probalility
F	0.12
AC	0.15
D	0.18
B	0.2
E	0.35

Table 3: combile & 3rd round of sort

Symbol	Probalility
D	0.18
B	0.2
ACF	0.27
E	0.35

Then I can use the table above to generate halfman tree, I will use the 0 for the low probalities. And 1 for the high probalities.

After generate the halfman tree, I can generate the halfman code by go through the path

Table 4: combile & 4th round of sort

Symbol	Probalility
ACF	0.27
E	0.35
BD	0.38

Table 5: combile & 5th round of sort

Symbol	Probalility
BD	0.38
ACFE	0.62

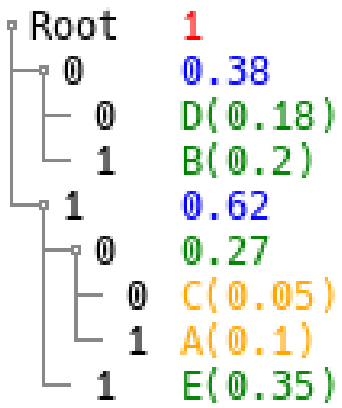


Figure 1: Tutorial 2.1

Table 6: Halfman code table

Symbol	Code
C	1010
A	1011
F	100
D	00
B	01
E	11

1.2 Question 2

To generate halfman code first is to sort combile the 2 items with lowest possibilites and resort. Until the table only have 2 items left.

Table 7: 1st round of sort

Symbol	Probalility
A	0.04
B	0.1
C	0.11
D	0.15
G	0.18
E	0.2
F	0.22

Table 8: combile & 2nd round of sort

Symbol	Probalility
C	0.11
AB	0.14
D	0.15
G	0.18
E	0.2
F	0.22

Table 9: combile & 3rd round of sort

Symbol	Probalility
D	0.15
G	0.18
E	0.2
F	0.22
ABC	0.25

Then I can use the table above to generate halfman tree, I will use the 0 for the low probalities. And 1 for the high probalities.

After generate the halfman tree, I can generate the halfman code by go through the path

Table 10: combile & 4th round of sort

Symbol	Probalility
E	0.2
F	0.22
ABC	0.25
DG	0.33

Table 11: combile & 5th round of sort

Symbol	Probalility
ABC	0.25
DG	0.33
EF	0.42

Table 12: combile & 6th round of sort

Symbol	Probalility
EF	0.42
ABCDG	0.58

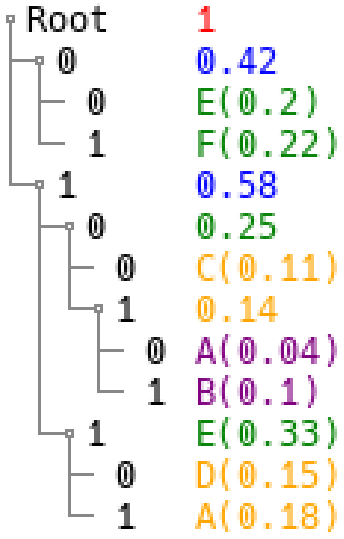


Figure 2: Tutorial 2.2

Table 13: Halfman code table

Symbol	Code
A	1010
B	1011
C	100
D	110
G	111
E	00
F	01

2 Assignment 3 Arithmetic Coding

My matric card is shown below in Figure 3 So my matric number is U1521516C my last 8 character is 1521561C.

Figure 3: Matriculation Card

Symbol	Frequet Number
1	3
2	1
5	2
6	1
C	1

SO each range will be $\frac{1}{8} = 0.125$, So we can gererate arthmetic table

Symbol	Probability	Interval Low	Interval High	Interval
1	$\frac{3}{8}$	0	0.375	0.375
2	$\frac{1}{8}$	0.375	0.5	0.125
5	$\frac{1}{4}$	0.5	0.75	0.25
6	$\frac{1}{8}$	0.75	0.875	0.125
C	$\frac{1}{8}$	0.875	1	0.125

New Char	Low Value	High Value
1	0	0.375
5	$0+(0.375-0)\times 0.5=0.1875$	$0+(0.375-0)\times 0.75=0.2813$
2	$0.1875+(0.2813-0.1875)\times 0.375=0.2227$	$0.1875+(0.2813-0.1875)\times 0.5=0.2344$
1	$0.2227+(0.2344-0.2227)\times 0=0.2227$	$0.2227+(0.2344-0.2227)\times 0.375=0.2271$
5	$0.2227+(0.2271-0.2227)\times 0.5=0.2249$	$0.2227+(0.2271-0.2227)\times 0.75=0.2260$
1	$0.2249+(0.2260-0.2249)\times 0=0.2249$	$0.2249+(0.2260-0.2249)\times 0.375=0.2253$
6	$0.2249+(0.2253-0.2249)\times 0.75=0.2252$	$0.2249+(0.2253-0.2249)\times 0.875=0.22525$
C	$0.2252+(0.22525-0.2252)\times 0.875=0.22524375$	$0.2252+(0.22525-0.2252)\times 1=0.22525$

Decoded Number	Output Symbol	Low	High	Interval
0.22524375	1	0	0.375	0.375
0.60065	5	0.5	0.75	0.25
0.4022	2	0.375	0.5	0.125
0.2177	1	0	0.375	0.375
0.5806	5	0.5	0.75	0.25
0.3223	1	0	0.375	0.375
0.8594	6	0.75	0.875	0.125
0.8750	C	0.875	1	0.125

3 Assignment 4 Discrete Cosine Transform (DCT)

$$A = \begin{Bmatrix} \frac{1}{2}cos(0) & \frac{1}{2}cos(0) & \frac{1}{2}cos(0) & \frac{1}{2}cos(0) \\ \sqrt{\frac{1}{2}}cos(\frac{\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{3\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{5\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{7\pi}{8}) \\ \sqrt{\frac{1}{2}}cos(\frac{2\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{6\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{10\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{14\pi}{8}) \\ \sqrt{\frac{1}{2}}cos(\frac{3\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{9\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{15\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{21\pi}{8}) \end{Bmatrix}$$

$$X = \begin{Bmatrix} 5 & 5 & 10 & 10 \\ 5 & 10 & 10 & 10 \\ 1 & 10 & 10 & 10 \\ 1 & 1 & 5 & 10 \end{Bmatrix}$$

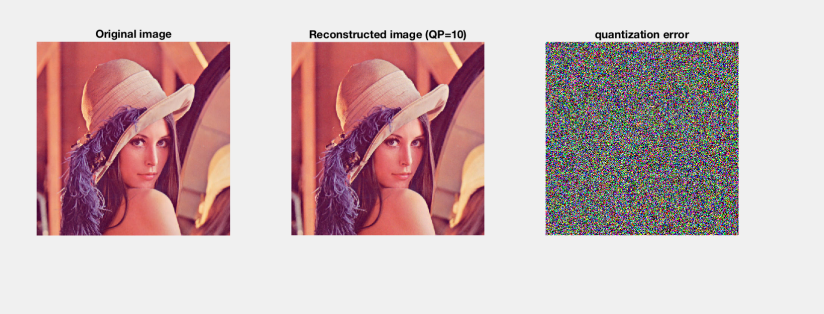
$$A^T = \begin{Bmatrix} \frac{1}{2}cos(0) & \sqrt{\frac{1}{2}}cos(\frac{\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{2\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{3\pi}{8}) \\ \frac{1}{2}cos(0) & \sqrt{\frac{1}{2}}cos(\frac{3\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{6\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{9\pi}{8}) \\ \frac{1}{2}cos(0) & \sqrt{\frac{1}{2}}cos(\frac{5\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{10\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{15\pi}{8}) \\ \frac{1}{2}cos(0) & \sqrt{\frac{1}{2}}cos(\frac{7\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{14\pi}{8}) & \sqrt{\frac{1}{2}}cos(\frac{21\pi}{8}) \end{Bmatrix}$$

$$Y' = A \times X = \begin{Bmatrix} 6 & 13 & 17.5 & 20 \\ 3.6955 & 2.6131 & 3.2664 & 0 \\ 0 & -7 & -2.5 & 0 \\ -1.5307 & 1.0823 & 1.325 & 0 \end{Bmatrix}$$

$$Y = Y' \times X = \begin{Bmatrix} 28.25 & -10.36 & -2.25 & -0.8486 \\ 4.7875 & 2.22374 & -1.092 & 1.4268 \\ -4.75 & -1.2177 & 4.75 & 2.9398 \\ 0.45 & -1.073 & -1.983 & -0.237 \end{Bmatrix}$$

4 Assignment 5 Discrete Cosine Transform (DCT)

The output shown in below and I find that the higher the quant level the quality of the imgae will drop and more color appear in error.



5 Assignment 6 Zig-Zag Scan

5.1 Question a

My name is xiongchenyu so the matric will be

$$in = \begin{matrix} x & i & o & n \\ g & c & h & e \\ n & y & u & x \\ i & o & n & g \end{matrix}$$

The input matric in matlab will be [120 105 111 110;103 99 104 101;110 121 117 120;105 111 110 103]

out =

120 105 103 110 99 111 110 104 121 105 111 117 101 120 110 103

5.2 Question b

in = [4 -1 0 0; 1 0 0 0 ;-1 0 1 0; 0 0 0 0]

out = 4 -1 1 -1 0 0 0 0 0 0 0 1 0 0 0 0

5.3 Question c

I just change the input to 8 * 8 I think the origin code will support artitury shape to do the zigzag.

in =[

7 -1 0 -2 -1 1 0 -1; 1 0 0 0 0 0 0 0; 0 0 0 0 0 0 0 0; 1 0 0 0 0 0 0 0; -1 0 0 0 1 0 0 1; 0 0 0 0 0 0 0 0; 0 0 0 0 0 0 0 0; 0 0 0 0 -1 0 0 0]

out =

Columns 1 through 22

7 -1 1 0 0 0 -2 0 0 1 -1 0 0 0 -1 1 0 0 0 0 0 0

Columns 23 through 44

0 0 0 0 0 0 -1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0

Columns 45 through 64

0 0 0 0 0 0 0 0 0 0 0 1 0 0 -1 0 0 0 0 0 0 0

6 Assignment 7 Run-Level Coding (RLC)

6.1 Question a

x =

Columns 1 through 21

0 0 0 0 0 7 28 0 0 0 0 0 5 9 0 0 0 0 0 0 0

Columns 22 through 40

0 0 30 5 0 30 18 0 35 32 0 0 0 0 14 0 0 0 0

6.2 Question b

```
y =
    Columns 1 through 21
    0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
    Columns 22 through 40
    0 0 0 0 0 0 1 0 0 0 0 5 1 0 0 2 0 6 0
```

7 Assignment 8 JPEG / MPEG Intra frame encoding

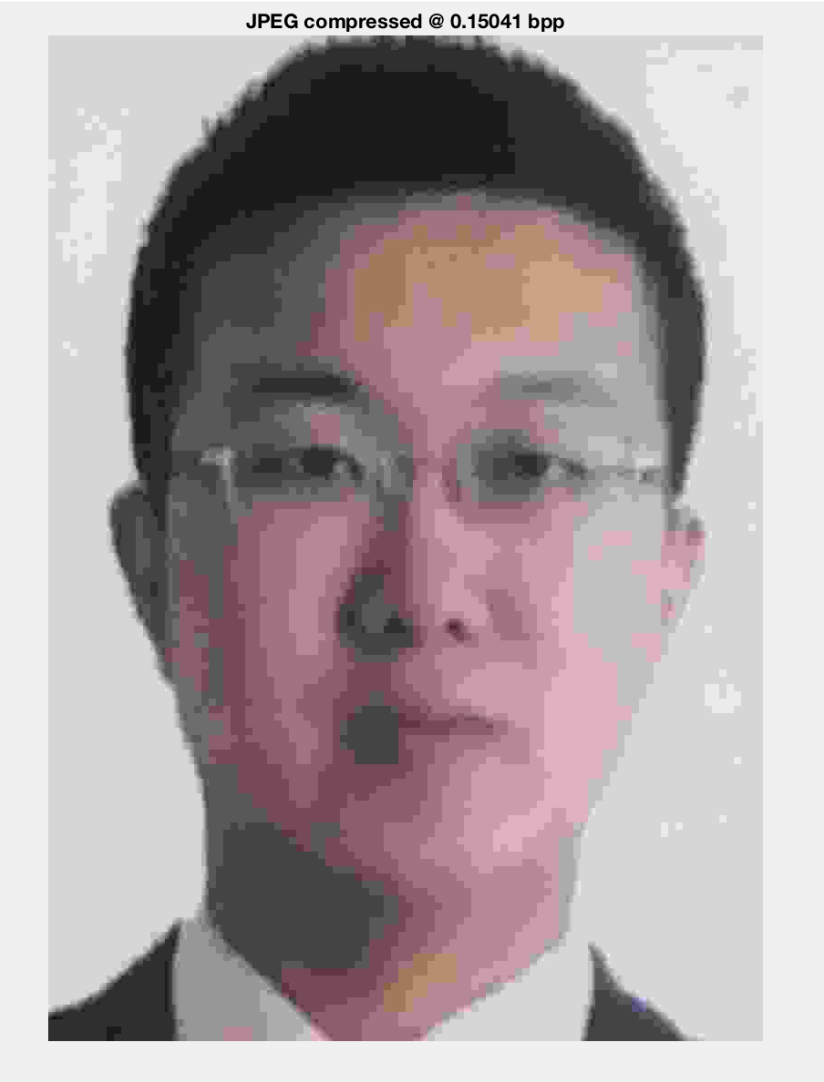


Figure 4: Orgion

Type	Value
Oscale	9
PSNR	31.61dB
SNR(Cb)	34.99dB
PSNR(Cr)	34.24dB

type	value
oscale	0.83
psnr	45.41db
snr(cb)	50.49db
psnr(cr)	50.25db

Type	Value
Oscale	0.332
PSNR	49.43dB
SNR(Cb)	54.69dB
PSNR(Cr)	54.64dB

8 Assignment 9 Motion estimation

8.1 Apply quantization error on MC prediction error

8.2 Question a

8.3 Question b

8.4 Question c

9 Assignment 10

1. Uncomment % A=transpose(A); line 26
2. Uncomment % B=transpose(B); line 63
3. The image size normaliztion is incorrect.

change to 8 as
line 23

1. change inFile1='table$_{40.raw}$'; to 'table$_{39.raw}$' line 23
2. change F = int16(41:43); to F = int16(40:43); line 50
3. change legend('MC','No MC', 0) to legend('MC','No MC', 'best') line 114
4. change legend('MC','No MC', 0) to legend('MC','No MC', 'best') line 118

10 Assignment 11 Stereo Imaging

Original : D = round(Y2{nf}/2); %adjust depth factor '2'
Modify To : D = round(Y2{nf}/5);