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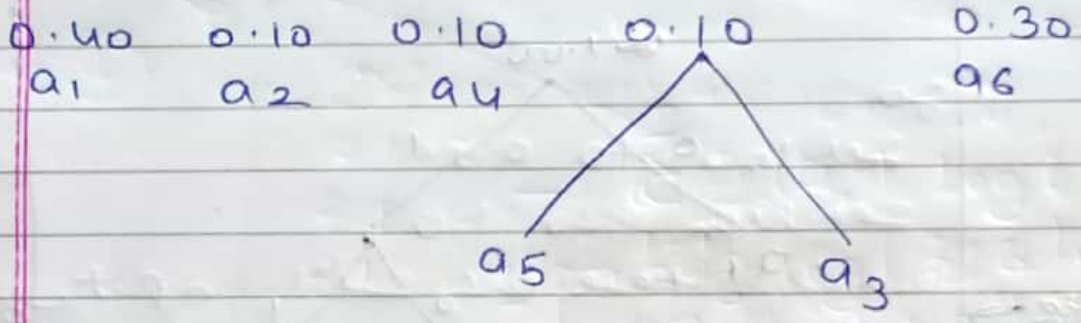
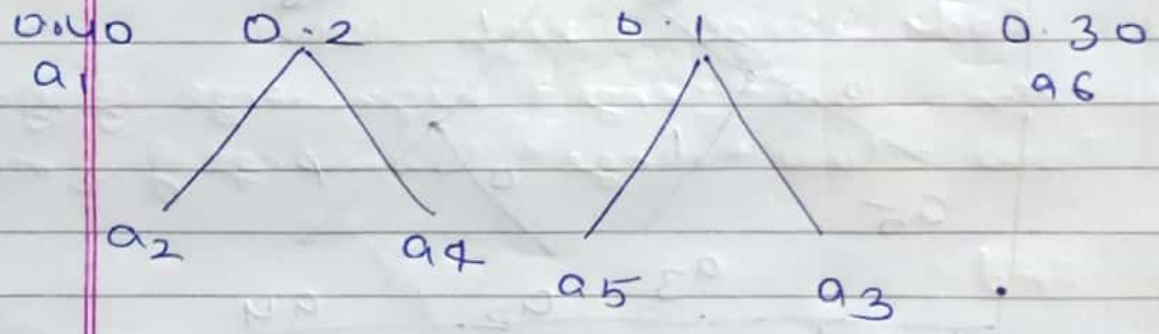
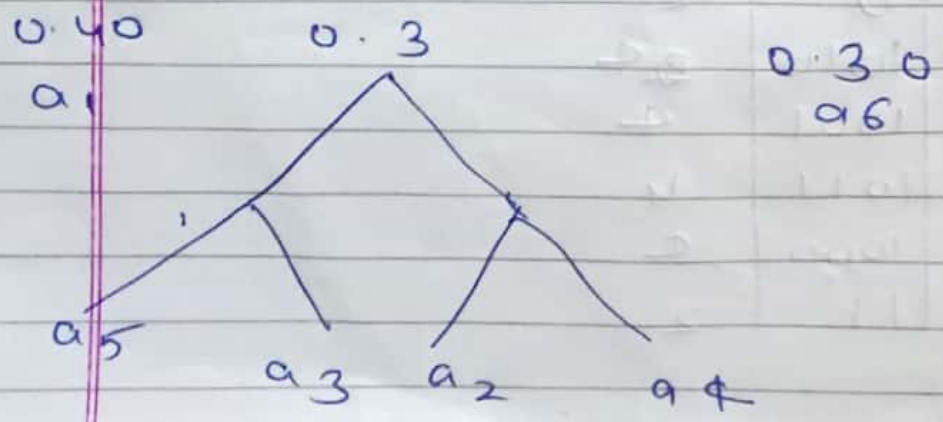
Subject: Image Processing

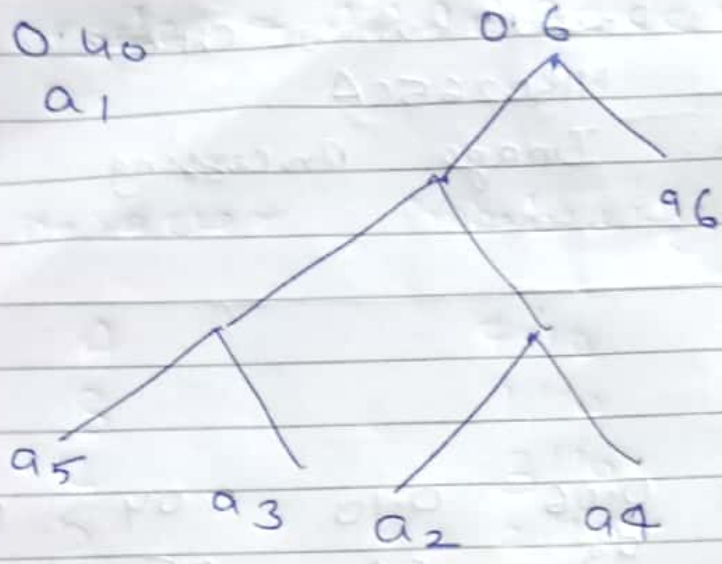
A (1)

0.40	0.10	0.06	0.10	0.04	0.30
a_1	a_2	a_3	a_4	a_5	a_6

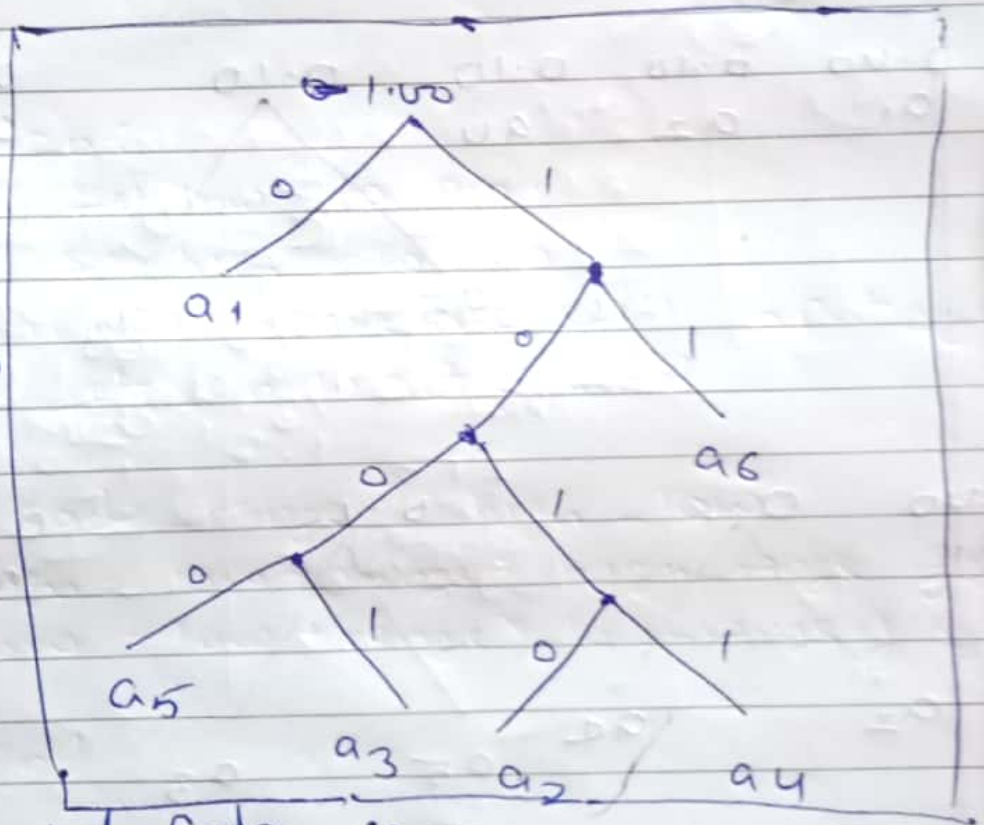








Final Tree →



Symbol		Code	Length
a_1	→	0	1
a_2	→	1010	4
a_3	→	1001	4
a_4	→	1011	4
a_5	→	1000	4
a_6	→	11	2

$$\text{Average} = \sum_{k=0}^{L-1} p_r(r_k)$$

$0.40 \times 1 + 0.10 \times 4 + 0.06 \times 4 +$
$0.10 \times 4 + 0.04 \times 4 + 0.30 \times 2$

$= 0.4 + 0.4 + 0.24 + 0.4 + 0.16 + 0.6$

$= 2.2$

2.2 ~~bits~~ Average bits will be required.

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(5)

string ~~Code~~ = AAAABCCCDD

character	Probability	Range
A	4/10	0.00 - 0.40
B	1/10	0.40 - 0.50
C	3/10	0.50 - 0.80
D	2/10	0.80 - 1.00

Algo:

Set low to 0.0
Set high to 1.0
while there are still input symbols
do get an input Symbol

code_range = high - low.
high = low + range * high_range of symbol
low = low + range * low_range of Symbol

End.

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Arithmatic code for AAAABCCCDD

New character	low value	High value
	0.0	1.0
A	0.00	0.40
A	0.00	0.16
A	0.00	0.064
A	0.00	0.0256
B	0.01024	0.0128
C	0.01152	0.012288
C	0.011904	0.0121344
C	0.0120192	0.01208832
D	0.012074496	0.01208832
D	0.012085552	~~0.01208832~~ 0.012075784

So the generated unique tag is

0.012085552 ✓

Q (3)

(b) Both statement (1) and (2) are true

Q 2

(i) true
(ii) true
(iii) true
(iv) false

Q (4)

21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243

The entropy of 8-bit image (given)

Gray level	Count	Probability
21	12	3/8
95	4	1/8
169	4	1/8
243	12	3/8

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$$E = -\sum_{i=1}^{I} P(a_i) \log_2 P(a_i)$$

$$= -\left[3/8 \log(3/8) + (1/8)\log(1/8) + (1/8)\log(1/8) + (3/8)\log(3/8)\right]$$

$$= 1.81 \text{ bits/pixel}$$