

Find the Huffman Coding for the word "BABY"

Given: BABY

Total Symbol: 4

<u>Symbol</u>	<u>Probability</u>		
B	0.5 ( $\frac{2}{4}$ )	→	0.5 0
A	0.25 ( $\frac{1}{4}$ )	} →	0.5 1
y	0.25 ( $\frac{1}{4}$ )		

<u>Symbol</u>	<u>Probability</u>	<u>Codeword</u>	<u>Length</u>
B	0.5	0	1
A	0.25	10	2
y	0.25	11	2

$$\underline{\text{Length}} = \bar{L} = \sum_{k=0}^{N-1} P_k L_k$$

$$= (0.5 \times 1) + (0.25 \times 2) + (0.25 \times 2)$$

$$\bar{L} = 1.5 \text{ bits/Symbol}$$

Entropy:  $H(S) = \sum_{k=0}^{N-1} P_k \log_2 P_k$

$$= \sum_{k=0}^3 P_k \cdot \log_2 P_k$$

$$= (0.5 \log_2 0.5) + (0.25 \log_2 0.25) + (0.25 \log_2 0.25)$$

$$H(s) = 1.5 \text{ bits/symbol}$$

Efficiency

$$\eta = \frac{H(s)}{L} = \frac{1.5}{1.5} \times 100$$

$$\eta = 100\%$$

Signal	bits/symbol	probability P	Symbol
1	0	0.2	B
5	01	0.2	A
9	11	0.2	L

length =  $\sum_{k=0}^{n-1} P_k \cdot k$

$$(0.2 \times 0) + (0.2 \times 2) + (0.2 \times 2) = 0.8$$

$$\text{length} = 0.8$$

$$H(s) = \sum_{k=0}^{n-1} P_k \cdot k = 0.8$$

$$(0.2 \times 0.2) + (0.2 \times 0.2) + (0.2 \times 0.2) = 0.12$$

(1) Perform histogram equalization of the image.

Given data:

4	4	4	4	4
3	4	5	4	3
3	5	5	5	3
3	4	5	4	3
4	4	4	4	4

Solution:

Step 1:

Grey level (rk)	0	1	2	3	4	5	6	7
Number of Pixel (PK)	0	0	0	6	14	5	0	0

Step 2:

Find the running sum of the pixel.

Running sum	0	0	0	6	20	25	25	25
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Step 3:

Normalization (scaling) the pixel.

$$\text{No of Grey level} \times \frac{\text{Running sum}}{\text{Total no of pixel}} = \frac{0}{25} \times 7 + \frac{0}{25} \times 7 + \frac{0}{25} \times 7 + \frac{6}{25} \times 7 + \frac{20}{25} \times 7 + \frac{25}{25} \times 7 + \frac{25}{25} \times 7 + \frac{25}{25} \times 7$$

$$= 0 \quad 0 \quad 0 \quad 1.68 \quad 5.6 \quad 7 \quad 7 \quad 7$$

Step 4:

Round off the value to nearest grey level.

$$= 0 \quad 0 \quad 0 \quad 2 \quad 6 \quad 7 \quad 7 \quad 7$$

Step 5:

Mapping the new Grey level

Grey value	:	0	1	2	3	4	5	6	7
New Grey value	:	0	0	0	2	6	7	7	7

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Pixel value after Equalization:

6	6	6	6	6	6
2	6	7	6	2	2
2	7	7	7	2	2
2	6	7	6	2	2
6	6	6	6	6	6

(2) Median Filtered:

Step 1: Level pixel  
 Step 2: Number of pixel  
 Step 3: First two numbers  
 of the pixel

$$\frac{0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0}{10} = 0$$

Step 4: Found off the value to nearest even level

Step 5: New pixel value  
 Step 6: Median value