

Exercise 1

$$a - \frac{8 \times 4 + 8 + 8}{4} = 12 \text{ bpp} \quad \text{bit per pixel}$$

$$b - 360 \times 640 \times 30 \times 12 = \underline{29.944 \text{ Mbits}}$$

$$c - \frac{60 \times 60 \times 29944}{2 \rightarrow 12} = \underline{37.326 \text{ Bytes}}$$

$$d - \text{avg bits per pixel} = \frac{4 \times 8 + 4 + 4}{4} = \underline{10 \text{ bits}}$$

reduction from 12 bits to 10 bits (2 bits)

$$\Rightarrow ? \rightarrow 100 \Rightarrow \frac{2 \times 100}{12} = \underline{16.6 \%}$$

Exercise 2

4:2:2

(50, 50, 60)	(70)	(80, 30, 30)	(120)
(20, 80, 60)	(80)	(95, 82, 40)	(100)

(20, 80, 60)	(80)	(95, 82, 40)	(100)
:	:	:	:
:	:	:	:

$L:2:0$ for the first block: $\frac{50+100+80+18}{4} = 72$
 $\frac{60+30+60+50}{4} = 50$

50	70		
20	80		

$L:1:1$

50, 90, 60	70	80	120
20, 80, 60	80	95	100
-	-	-	-
-	-	-	-

Exercise 3:

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a-  $\log_2(7) = 2,3 \Rightarrow \underline{3 \text{ bits symbols}}$

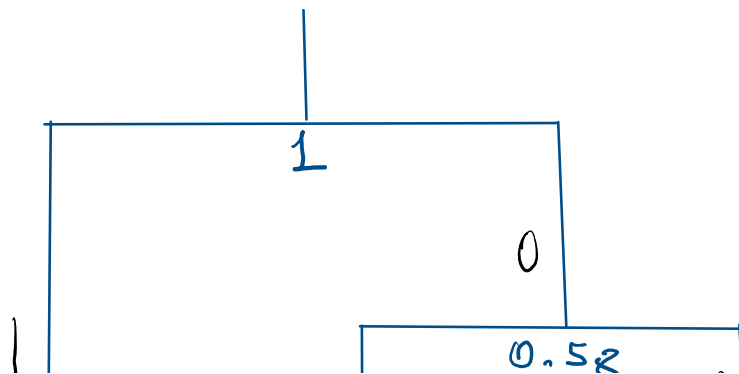
$$3 \text{ bits} \times 100 \text{ symbols} = \underline{300 \text{ bits}}$$

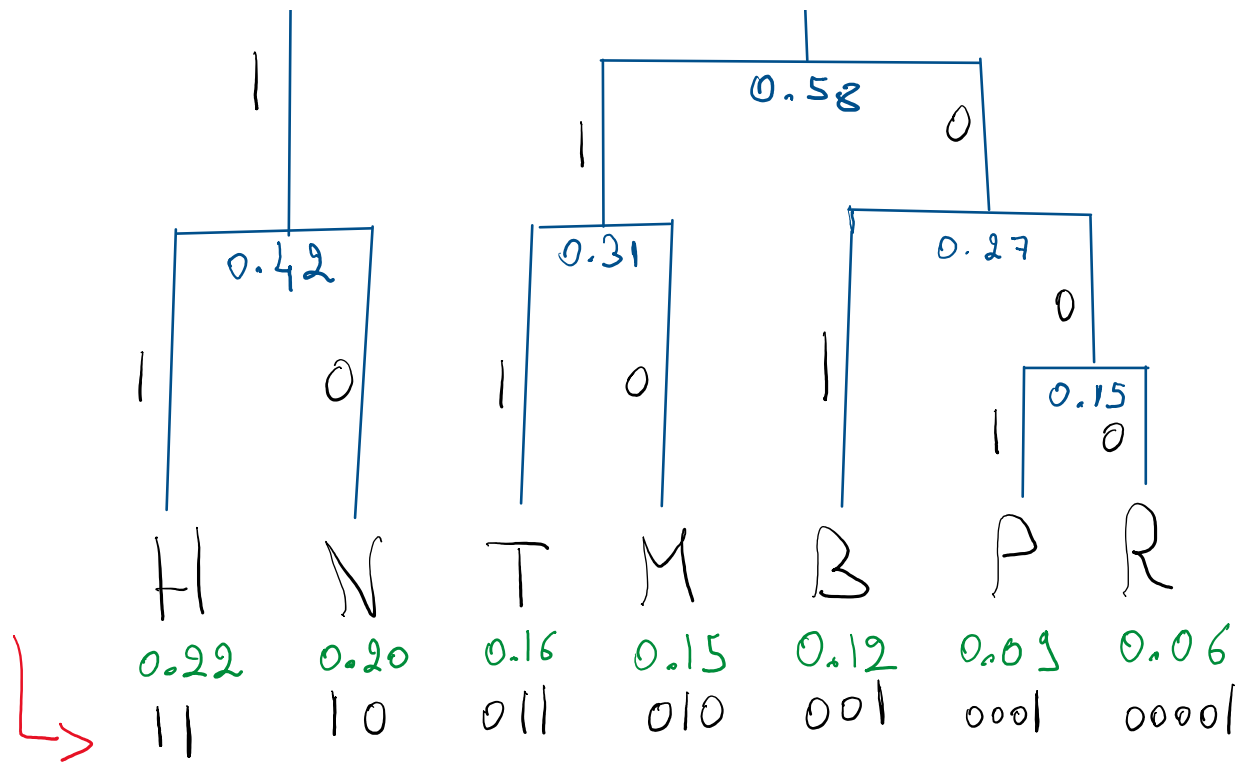
b- entropy =  $-\sum p_i \log_2(p_i)$

$$= 0.12 \times \log_2(0.12) + 0.15 \log_2(0.15) + \dots$$

$$= \underline{2.7}$$

c-





d-

$$\begin{aligned}
 & \text{probability of the symbol} \quad \text{the new bit representation for this symbol} \\
 & 0.22 \times 2 + 0.20 \times 2 + 0.16 \times 3 \\
 & + 0.15 \times 3 + 0.12 \times 3 + 0.09 \times 4 + 0.06 \times 4 \\
 & = \underline{\underline{2.73}}
 \end{aligned}$$

e- Compression ratio =  $\frac{\text{size of the original}}{\text{size of the compression}} = \frac{300}{273} = \underline{\underline{1.09}}$

$$G = 0.12 + 0.15 = 0.27$$

$$= \underline{\underline{27\%}}$$

(Annotations:   
 - Probability for Germany's car (points to 0.12)   
 - B BHW (points to 0.12)   
 - M Mercedes (points to 0.15))

$$J = 0.22 + 0.20 + 0.16$$

$$= 0.58 = \underline{\underline{58\%}}$$

$$F = 0.06 + 0.09 = 0.15$$

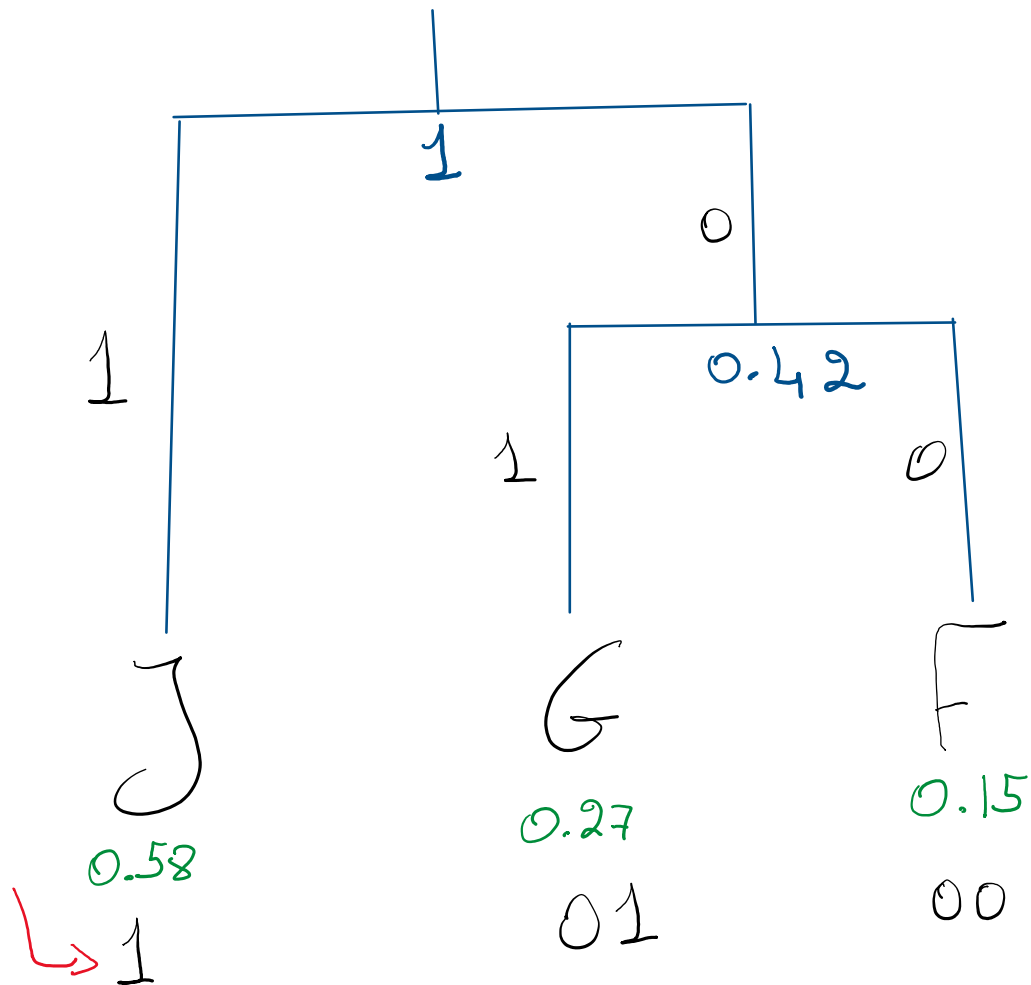
$$= \underline{\underline{15\%}}$$

$$\text{entropy} = \sum p_i \log_2(p_i)$$

$$= 0.27 \log_2(0.27) + 0.58 \log_2(0.58)$$

$$+ 0.15 \log_2(0.15)$$

$$= \underline{\underline{1.38}}$$



$$\begin{aligned} \text{avg bits per symbol} &= 0.58 \times 1 + 0.27 \times 2 + 0.15 \times 2 \\ &= \underline{\underline{1.42}} \end{aligned}$$

$$\text{efficiency} = \frac{1.38}{1.42} = 97\%$$

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h- we can combine each  
2 or 3 symbols together.