

17/11/20  
2/1/20

معدل الجاهل اقل من

Q: Design code using shanon fan to encode source using binary encode (0,1) and calculate efficiency redundancy  
a b a a a c b c e d d f g g e c h b h

c  
a = 4/20, b = 4/20, c = 4/20, d = 2/20  
e = 1/20, f = 1/20, g = 2/20, h = 2/20

P	code		
a	4/20	0 0	12 = 16 = 4
b	4/20	0 1	4 = 12 = 8
c	4/20	1 0 0	4 = 8 = 12
d	2/20	1 0 1	8 = 6 = 14
g	2/20	1 1 0	4 = 8 = 4
h	2/20	1 1 1 0	0 = 6 = 6
e	1/20	1 1 1 1 0	α 4 = 4 = 8
f	1/20	1 1 1 1 1	2 = 4 = 2
			2 = 2 = 4
			3 = 2 = 5
			8 = 4
			6 = 6
			4 = 8
			4 = 2
			2 = 4
			2 = 5
			2 2

$L_{\text{avg}} = \sum E_i P_i = \frac{2 \times 4}{20} + \frac{2 \times 4}{20} + \frac{3 \times 4}{20} + \frac{3 \times 2}{20} + \frac{3 \times 2}{20} + \frac{4 \times 2}{20}$   
 $+ \frac{5 \times 1}{20} + \frac{5 \times 1}{20} = 0.5 + 0.5 + 0.6 + 0.3 + 0.3 + 0.4$   
 $0.25 + 0.25 = 3.1 \text{ bit}$

$L_{\text{min}} = H(X) = -\frac{4}{20} \log_2 \left(\frac{4}{20}\right) - \frac{4}{20} \log_2 \left(\frac{4}{20}\right) - \frac{4}{20} \log_2 \left(\frac{4}{20}\right)$   
 $- \frac{2}{20} \log_2 \left(\frac{2}{20}\right) - \frac{2}{20} \log_2 \left(\frac{2}{20}\right) - \frac{2}{20} \log_2 \left(\frac{2}{20}\right) - \frac{1}{20} \log_2 \left(\frac{1}{20}\right) - \frac{1}{20} \log_2 \left(\frac{1}{20}\right)$   
 $= -1.393156857 - 0.9965784285 - 0.4321928095$

$$L_{min} = 2.821928095x$$

$$\gamma = \frac{L_{avg}}{L_{min}} = 0.9102 \times 100\% = 91.0299385$$

$$\text{redund} = \frac{L_{avg} - L_{min}}{L_{avg}} = 8.970061482$$

Q2 a) ~~abra~~ ~~brac~~ ~~adabra~~ ~~cabra~~

(0,0) a

(0,0) b

(0,0) r

(3,1) a

(4,3) c

(2,1) d

(7,7) a

(7,7) b

abra ~~brac~~ adabra ~~cabra~~

~~abra~~ ~~brac~~ adabra ~~cabra~~

b) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18  
 3 0 0 0 0 0 0 0 2 0 0 0 0 0 0 0 3

3 0 0 0 0 0 2 0 0 0 0 0 0 0 0 3

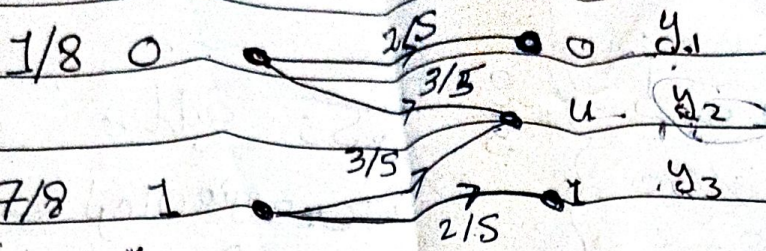
c) both of them are lossless

كلاهما خسارة؛ لا يوجد أي بيانات مفقودة

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①

$X_1 \backslash X_2$	0	1
0	2/5	3/5
1	3/5	2/5

② entropy :=  $\sum -P_i \log_2(P_i)$

$$-\frac{1}{8} \log_2\left(\frac{1}{8}\right) - \frac{7}{8} \log_2\left(\frac{7}{8}\right) = 0.543 \text{ bits}$$

③  $P(Y=U | X=1) = \frac{3}{5}$

$$P(Y=0, X=1) = 0$$

$$P(Y=U) = \frac{3 \times 1}{5 \times 8} + \frac{3 \times 7}{5 \times 8} = \frac{3}{40} + \frac{21}{40} = \frac{24}{40}$$

$$= \frac{3}{5}$$

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Q4

$\frac{1}{3}$  50% عازبان  
50% عازبان

$\frac{2}{3}$

و 50% عازبان

لينة لرهال متروحيين

50% عازبان

$$\therefore \frac{5}{100} \times \frac{2}{3} = \frac{1}{30}$$

عازبان  $\frac{19}{30}$

$$\frac{50}{100} \times \frac{1}{3} = \frac{1}{6}$$

عازبان  $\frac{1}{6}$

$$\frac{1}{30} + \frac{1}{6} = \frac{1}{5}$$

$$= 0.2$$

عازبان 0.8

~~Q4~~

$$\therefore H = -4 \log_2 \left( \frac{4}{5} \right) - \frac{1}{5} \log_2 \left( \frac{1}{5} \right)$$

$$= 0.3219280949 \text{ bit}$$