HT506_1

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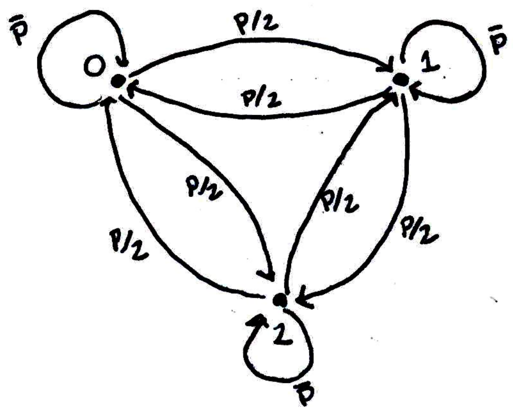
1.

$S=\{0,1,2\}$

$P(0)=P(1)=P(2)=1/3$

$\bar{p}=1-p$



a)

Informaciones Condicionadas

$I(0|0)=\log\frac{1}{P(0|0)}=\log\frac{1}{\bar{p}}$

$I(1|0)=\log\frac{2}{p}$

$I(2|0)=\log\frac{2}{p}$

$I(0|1)=\log\frac{2}{p}$

$I(1|1)=\log\frac{1}{\bar{p}}$

$I(2|1)=\log\frac{2}{p}$

$I(0|2)=\log\frac{2}{p}$

$I(1|2)=\log\frac{2}{p}$

$I(2|2)=\log\frac{1}{\bar{p}}$

Entropias Condicionadas

$H(S|0)=\bar{p}\log\frac{1}{\bar{p}}+\frac{p}{2}\log\frac{2}{p}+\frac{p}{2}\log\frac{2}{p}=\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}$

$H(S|1)=\frac{p}{2}\log\frac{2}{p}+\bar{p}\log\frac{1}{\bar{p}}+\frac{p}{2}\log\frac{2}{p}=\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}$

$H(S|2)=\frac{p}{2}\log\frac{2}{p}+\frac{p}{2}\log\frac{2}{p}+\bar{p}\log\frac{1}{\bar{p}}=\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}$

Entropia de la Fuente

$H(S)=P(0)\left[\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}\right]+P(1)\left[\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}\right]+P(2)\left[\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}\right]$

$=\frac{1}{3}\left[\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}\right]+\frac{1}{3}\left[\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}\right]+\frac{1}{3}\left[\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}\right]$

$=\bar{p}\log\frac{1}{\bar{p}}+p\log\frac{2}{p}=(1-p)\log\frac{1}{1-p}+p\log\frac{2}{p}$

Para $P=0$

$$(1-0)\log\frac{1}{1-0} + (0)\log\frac{2}{(0)}$$

No aplica dado que la division entre "0" es indefinida

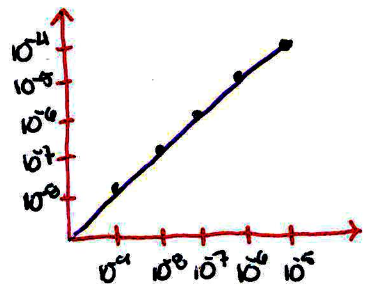
Para $P=1$

$$(1-1)\log\frac{1}{1-1} + 1\log\frac{2}{1}$$

No aplica dado que la división entre "0" es indefinida

b) $P=\varepsilon \rightarrow \varepsilon \approx 0$

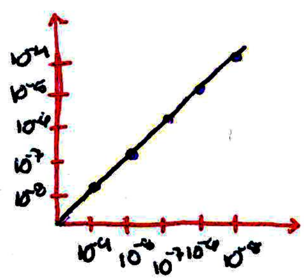
ε	$H(\varepsilon)$
10^{-9}	$3.23*10^{-8}$
10^{-8}	$2.902*10^{-7}$
10^{-7}	$2.57*10^{-6}$
10^{-6}	$2.23*10^{-5}$
10^{-5}	$1.905*10^{-4}$



c) $P=1-\delta \rightarrow \delta \approx 0$

$$(1-P) = 1-(1-\delta) = \delta$$

δ	$H(\delta)$
10^{-9}	$3.09*10^{-8}$
10^{-8}	$2.758*10^{-7}$
10^{-7}	$2.425*10^{-6}$
10^{-6}	$2.093*10^{-5}$
10^{-5}	$1.761*10^{-4}$



d) $P=\frac{1}{4}$

$$H(S|0) = H(S|1) = H(S|2) = \bar{p}\log\frac{1}{\bar{p}} + P\log\frac{2}{P}$$

$$= (1-P)\log\frac{1}{1-P} + P\log\frac{2}{P}$$

$$= \left(1-\frac{1}{4}\right)\log\frac{1}{1-\frac{1}{4}} + \frac{1}{4}\log\frac{2}{\frac{1}{4}}$$

$$= \frac{3}{4}\log\frac{4}{3} + \frac{1}{4}\log 8 = 1.061$$

2.

$P(0|0) = \bar{p}$ $\qquad$ $P(0|1) = q$

$P(1|0) = p$ $\qquad$ $P(1|1) = \bar{q}$

a)

$$H(S|0) = \bar{p} \log \frac{1}{\bar{p}} + p \log \frac{1}{p} = (1-p) \log \frac{1}{1-p} + p \log \frac{1}{p}$$

$$H(S|1) = q \log \frac{1}{q} + \bar{q} \log \frac{1}{\bar{q}} = q \log \frac{1}{q} + (1-q) \log \frac{1}{1-q}$$

$$H(S) = P(0)\, H(S|0) + P(1)\, H(S|1)$$

b)

$p = 0.1$ $\qquad$ $q = 0.2$

$$P(0) = \frac{q}{p+q} = \frac{0.2}{0.1+0.2} = \frac{0.2}{0.3}$$

$$P(1) = \frac{p}{p+q} = \frac{0.1}{0.1+0.2} = \frac{0.1}{0.3}$$

$$H(S) = P(0)\, H(S|0) + P(1)\, H(S|1)$$

$$= \frac{q}{p+q}\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right] + \frac{p}{p+q}\left[q\log\frac{1}{q} + (1-q)\log\frac{1}{1-q}\right]$$

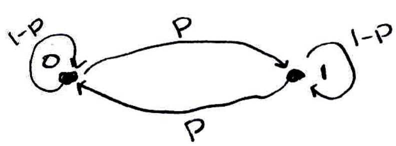
$$= \frac{0.2}{0.3}\left[0.9\log\frac{1}{0.9} + 0.1\log\frac{1}{0.1}\right] + \frac{0.1}{0.3}\left[0.2\log\frac{1}{0.2} + 0.8\log\frac{1}{0.8}\right]$$

$$= 0.5533$$

+

c)

$p = q$



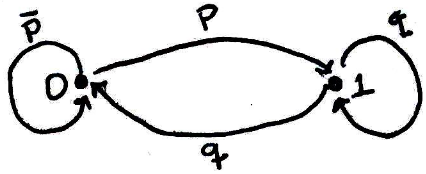
$$H(S) = \frac{p}{p+p}\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right] + \frac{p}{p+p}\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right]$$

$$= \frac{1}{2}\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right] + \frac{1}{2}\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right]$$

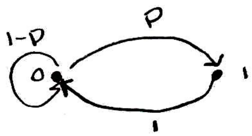
$$= (1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}$$

+

3o



$P(0) = \frac{q}{p+q}$ $\qquad P(1) = \frac{p}{p+q}$ $\qquad q = 1 \rightarrow p \neq q$



$I(0|0) = \log \frac{1}{1-p}$ $\qquad I(0|1) = \log(1) = 0$

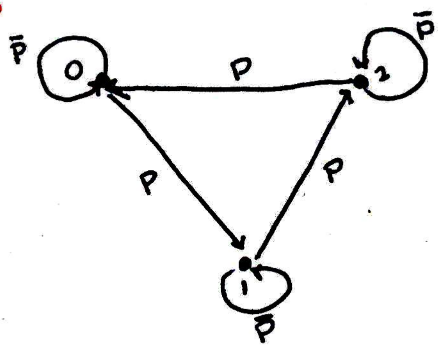
$I(1|0) = \log \frac{1}{p}$

$H(s|0) = (1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}$

$H(s|1) = 0$

$$H(s) = P(0)\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right] = \frac{1}{p+1}\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right]$$

4o



$S = \{0,1,2\}$

$P(0) = P(1) = P(2) = \frac{1}{3}$

a) $\bar{p} = 1-p$

$I(0|0) = \log\frac{1}{1-p}$ $\qquad I(1|1) = \log\frac{1}{1-p}$ $\qquad I(0|2) = \log\frac{1}{p}$

$I(1|0) = \log\frac{1}{p}$ $\qquad I(2|1) = \log\frac{1}{p}$ $\qquad I(2|2) = \log\frac{1}{1-p}$

$H(s|0) = (1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}$

$H(s|1) = (1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}$

$H(s|2) = p\log\frac{1}{p} + (1-p)\log\frac{1}{1-p}$

H(s) no aplica para p=0 y p=1 porque la división entre "0" no es definida

$$H(s) = P(0)\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right] + P(1)\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right] + P(2)\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right]$$

$$= \left[P(0)+P(1)+P(2)\right]\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right] = \left[\tfrac{1}{3}+\tfrac{1}{3}+\tfrac{1}{3}\right]\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right]$$

$$= (1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}$$

b)

$H(S^2) = ?$

$s_0 = 0,\ s_1 = 1,\ s_2 = 2$

σ_i	correspondencia	$P(\sigma_i)$	$I(\sigma_i)$
σ_0	s_0/s_0	$P(0\|0) = 1-p$	$\log \frac{1}{1-p}$
σ_1	s_0/s_1	$P(1\|0) = p$	$\log \frac{1}{p}$
σ_2	s_0/s_2	0	0
σ_3	s_1/s_0	0	0
σ_4	s_1/s_1	$1-p$	$\log \frac{1}{1-p}$
σ_5	s_1/s_2	p	$\log \frac{1}{p}$
σ_6	s_2/s_0	p	$\log \frac{1}{p}$
σ_7	s_2/s_1	0	0
σ_8	s_2/s_2	$1-p$	$\log \frac{1}{1-p}$

$$H(S^2) = (1-p)\log\frac{1}{1-p} + p\log\frac{1}{p} + (1-p)\log\frac{1}{1-p} + p\log\frac{1}{p} + p\log\frac{1}{p} + (1-p)\log\frac{1}{1-p}$$

$$= 3\left[(1-p)\log\frac{1}{1-p} + p\log\frac{1}{p}\right]$$

$$= 3H(S)$$

HTS07_2

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1.

a)

Codigo A - Es univocamente decodificable pq todas las palabras son de la misma longitud.

Codigo B - Es univocamente decodificable pq es un codigo coma

Codigo C - Es univocamente decodificable pq es un codigo coma

Codigo D - No es univocamente decodificable pq no es sintetizable

Codigo E - Es univocamente decodificable pq es sintetizable

Codigo F - No es univocamente decodificable pq no es sintetizable

b)

Codigo A - Es instantaneo

Codigo B - Es instantaneo

Codigo C - Es instantaneo

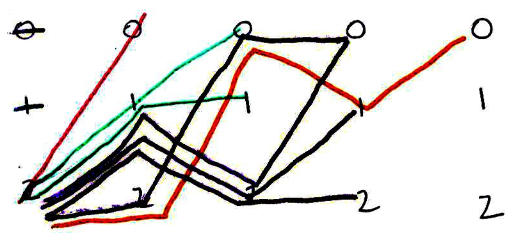
Codigo D - No es instantaneo

Codigo E - Es instantaneo

Codigo F - No es instantaneo

2.

S_i	l_i	Código A
S_1	1	0
S_2	1	1
S_3	2	20
S_4	3	210
S_5	3	211
S_6	4	2120
S_7	4	2121
S_8	4	2122
S_9	4	2200
S_{10}	5	22010

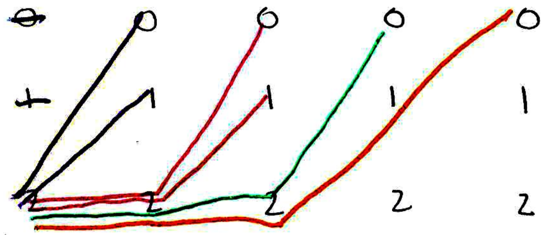


$$\sum_{i=1}^{10} 3^{-l_i} \leq 1$$

$$2(3)^{-1} + (3)^{-2} + 2(3)^{-3} + 4(3)^{-4} + (3)^{-5} \leq 1$$

$$0.9053 \leq 1 \checkmark$$

s_i	l_i	Código B
s_1	1	0
s_2	1	1
s_3	2	20
s_4	2	21
s_5	3	220
s_6	3	221
s_7	4	2220
s_8	5	22210

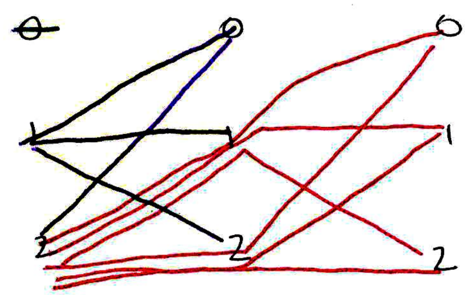


$$\sum_{i=1}^{8} (3)^{-l_i} \leq 1$$

$$2(3)^{-1} + 2(3)^{-2} + 2(3)^{-3} + (3)^{-4} + (3)^{-5} \leq 1$$

$$0.9794 \leq 1 \ \checkmark$$

s_i	l_i	Código C
s_1	1	0
s_2	2	10
s_3	2	11
s_4	2	12
s_5	2	20
s_6	3	210
s_7	3	211
s_8	3	212
s_9	3	220
s_{10}	3	221
s_{11}	3	222



$$\sum_{i=1}^{11} (3)^{-l_i} \leq 1$$

$$(3)^{-1} + 4(3)^{-2} + 6(3)^{-3} \leq 1$$

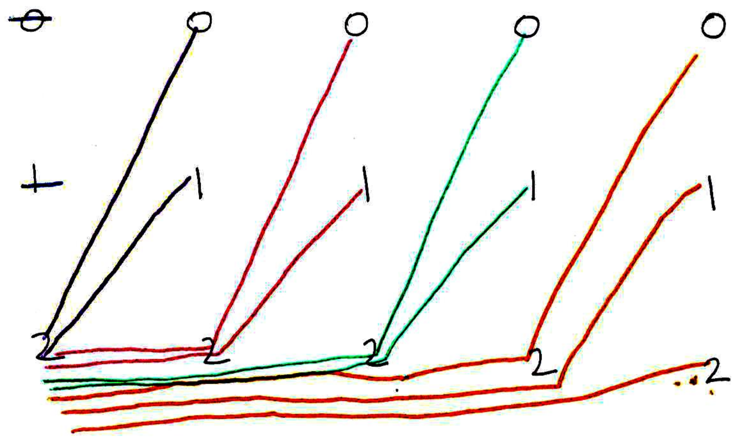
$$1 \leq 1 \ \checkmark$$

S_i	l_i	Código D
S_1	1	0
S_2	1	1
S_3	2	20
S_4	2	21
S_5	3	220
S_6	3	221
S_7	4	2220
S_8	4	2221
S_9	5	22220
S_{10}	5	22221
S_{11}	5	22222

$$\sum_{i=1}^{11} (3)^{-l_i} \le 1$$

$$2(3)^{-1} + 2(3)^{-2} + 2(3)^{-3} + 2(3)^{-4} + 3(3)^{-5} \le 1$$

$$1 \le 1 \checkmark$$



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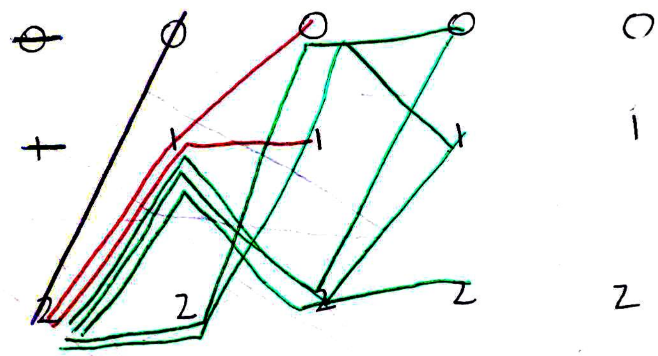
HTS08

1.

s_i	l_i	Código A
s_1	1	0
s_2	1	1
s_3	2	20
s_4	3	210
s_5	3	211
s_6	4	2120
s_7	4	2121
s_8	4	2122
s_9	4	2200
s_{10}	5	22010



$n_1 \le r$

$2 \le 3$ ✓

$n_2 \le (3-2)3$

$1 \le 3$ ✓

$n_3 \le (3-1)3$

$2 \le 6$ ✓

$n_4 \le (6-2)3$

$4 \le 12$ ✓

$n_5 \le (12-4)3$

$1 \le 24$ ✓

s_i	l_i	Código B
s_1	1	0
s_2	1	1
s_3	2	20
s_4	2	21
s_5	3	220
s_6	3	221
s_7	4	2210
s_8	5	22210

$n_1 \le 3$

$2 \le 3$ ✓

$n_2 \le (3-2)3$

$2 \le 3$ ✓

$n_3 \le (3-2)3$

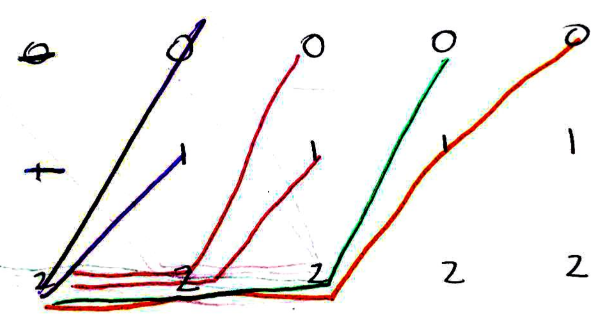
$2 \le 3$ ✓

$n_4 \le (3-2)3$

$1 \le 3$ ✓

$n_5 \le (3-1)3$

$1 \le 6$ ✓



s_i	l_i	Código C
s_1	1	0
s_2	2	10
s_3	2	11
s_4	2	12
s_5	2	20
s_6	3	210
s_7	3	211
s_8	3	212
s_9	3	220
s_{10}	3	221
s_{11}	3	222

$n_1 \leq 3$

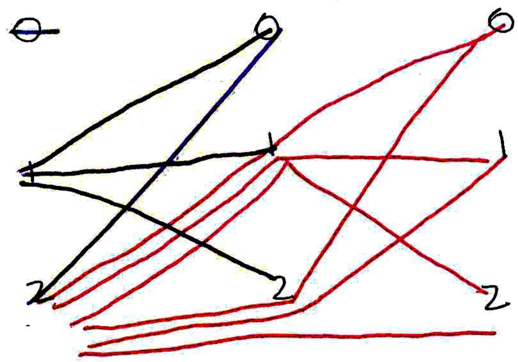
$1 \leq 3$ ✓

$n_2 \leq (3-1)3$

$4 \leq 6$ ✓

$n_3 \leq (6-4)3$

$6 \leq 6$ ✓



s_i	l_i	Código D
s_1	1	0
s_2	1	1
s_3	2	20
s_4	2	21
s_5	3	220
s_6	3	221
s_7	4	2220
s_8	4	2221
s_9	5	22220
s_{10}	5	22221
s_{11}	5	22222

$n_1 \leq 3$

$2 \leq 3$ ✓

$n_2 \leq (3-2)3$

$2 \leq 3$ ✓

$n_3 \leq (3-2)3$

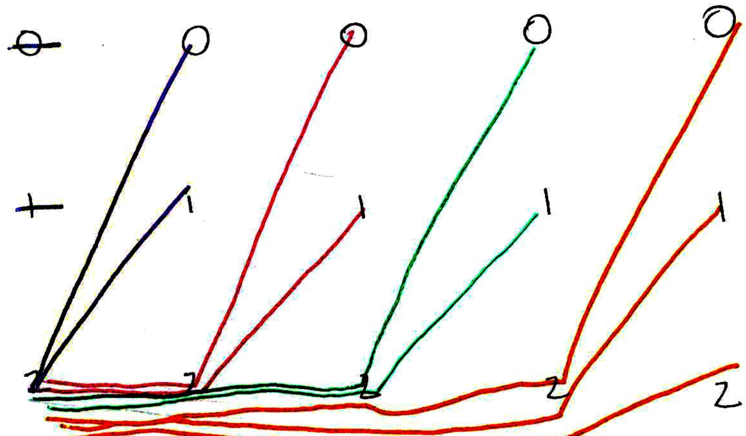
$2 \leq 3$ ✓

$n_4 \leq (3-2)3$

$2 \leq 3$ ✓

$n_5 \leq (3-2)3$

$3 \leq 3$ ✓



2o

a)

s_i	l_i	Código
s_1	1	
s_2	2	
s_3	2	
s_4	2	
s_5	2	
s_6	2	
s_7	3	
s_8	3	
s_9	3	
s_{10}	3	

$$\sum_{i=1}^{10} (3)^{-l_i} \leq 1$$

$$(3)^{-1} + 5(3)^{-2} + 4(3)^{-3} \leq 1$$

$$1.037 \leq 1 \text{ X}$$

No es posible dado que las longitudes de las palabras de código no cumplen con la desigualdad de Kraft

b)

s_i	l_i	Código
s_1	1	0
s_2	2	10
s_3	2	11
s_4	2	12
s_5	2	20
s_6	3	210
s_7	3	211
s_8	3	212
s_9	3	220
s_{10}	4	2210

$$\sum_{i=1}^{10} (3)^{-l_i} \leq 1$$

$$(3)^{-1} + 4(3)^{-2} + 4(3)^{-3} + (3)^{-4} \leq 1$$

$$0.9383 \leq 1 \checkmark$$

$n_1 \leq 3$

$1 \leq 3 \checkmark$

$n_2 \leq (3-1)3$

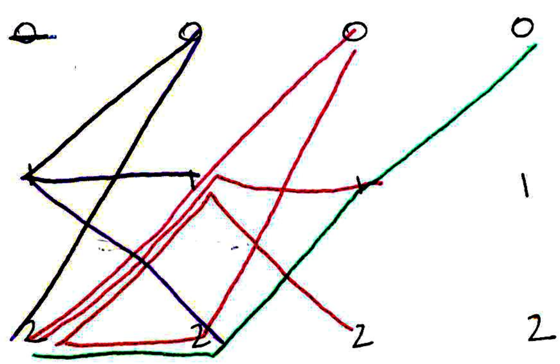
$4 \leq 6 \checkmark$

$n_3 \leq (6-4)3$

$4 \leq 6 \checkmark$

$n_4 \leq (6-4)3$

$1 \leq 6$



30

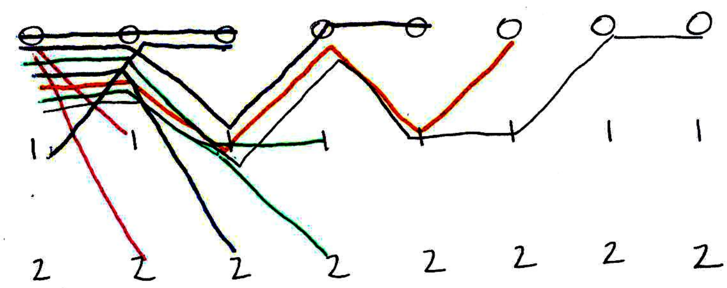
a)

s_i	l_i	código
s_1	3	000
s_2	5	00100
s_3	2	01
s_4	4	0011
s_5	3	002
s_6	6	001010
s_7	4	0012
s_8	8	00101100
s_9	2	02
s_{10}	3	100

$$\sum_{i=1}^{10} (3)^{-l_i} \leq 1$$

$$3(3)^{-3} + (3)^{-5} + 2(3)^{-2} + 2(3)^{-4} + (3)^{-6} + (3)^{-8} \leq 1$$

$$0.3637 \leq 1 \checkmark$$



b)

$$\sum_{i=1}^{q} r^{-l_i} \leq 1$$

Definamos n_1 como el número de palabras de longitud "1"; n_2 las de longitud "2", etc. si la mas larga de las l_i es igual a l, tendremos

$$\sum_{i=1}^{l} n_i = q$$

al introducir en la primera expresión

$$\sum_{i=1}^{l} n_i r^{-i} \leq 1 \quad // * r^l$$

$$\sum_{i=1}^{l} n_i r^{-i} r^l \leq r^l$$

$$\sum_{i=1}^{l} n_i r^{l-i} \leq r^l$$

$$n_1 r^{l-1} + n_2 r^{l-2} + \dots + n_l r^0 \leq r^l$$

$$n_l \leq r^l - n_1 r^{l-1} - n_2 r^{l-2} - \dots - n_{l-1} r \quad // * (r)^{-1}$$

$$n_{l-1} \leq r^{l-1} - n_1 r^{l-2} - n_2 r^{l-3} - \dots - n_{l-2} r$$

$$n_3 \leq r^3 - n_1 r^2 - n_2 r$$

$$n_2 \leq r^2 - n_1 r$$

$$n_1 \leq r$$

Puesto que se pueden elegir n_1 símbolos de código arbitrariamente, quedan entonces $r-n_1$ prefijos de longitud 1 permitidos. Pueden formarse hasta $(r-n_1)r = r^2 - n_1 r$ palabras de longitud 2. Esta ecuación asegura que el número de palabras de longitud 2 no deben exceder de esta cantidad, quedan entonces

$$(r^2-n_1 r)-n_2$$

por lo que las palabras de longitud 3 deben cumplir

$$n_3 \leq [(r^2-n_1 r)-n_2]\,r$$

y así sucesivamente, en cada etapa queda un número suficiente de prefijos

Ejemplo

S_i	l_i	Código
S_1	3	020
S_2	5	10020
S_3	2	00
S_4	4	1000
S_5	3	021
S_6	6	100210
S_7	4	1001
S_8	8	10021100
S_9	2	01
S_{10}	3	022

$n_1 \leq 3$

$0 \leq 3$

$n_2 \leq (3-0)3$

$2 \leq 9$

$n_3 \leq (9-2)3$

$3 \leq 21$

$n_4 \leq (21-3)3$

$2 \leq 54$

$n_5 \leq (54-2)3$

$1 \leq 156$

$n_6 \leq (156-1)3$

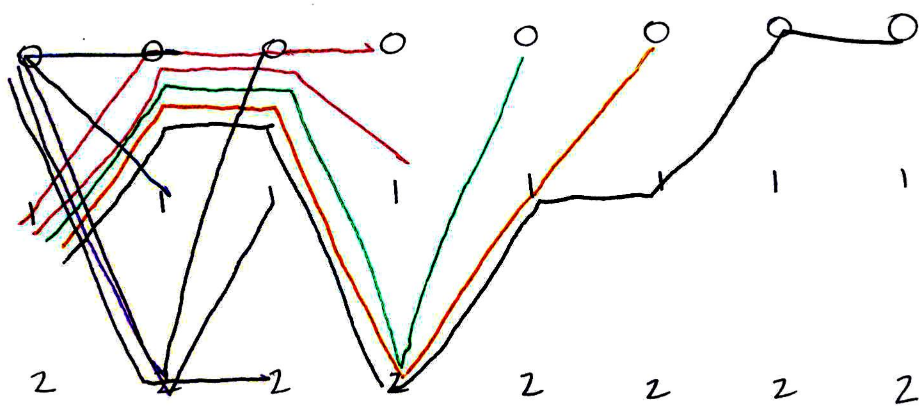
$1 \leq 465$

$n_7 \leq (465-1)3$

$0 \leq 1392$

$n_8 \leq (1392-0)3$

$1 \leq 4176$



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HTS09_2

1.
a)

Demostrar si $l_i = \log_r\left(\frac{1}{P_i}\right)$ y l_i es un entero entonces $L = H_r(S)$

L longitud promedio

$$H(S) = \sum_{i=1}^{q} P_i \log \frac{1}{P_i}$$

$$\sum_{i=1}^{q} X_i \log \frac{1}{X_i} \leq \sum_{i=1}^{q} X_i \log \frac{1}{Y_i}$$

$$\sum_{i=1}^{q} P_i \log \frac{1}{P_i} \leq \sum_{i=1}^{q} P_i \log \frac{1}{Q_i}$$

$$H(S) \leq \sum_{i=1}^{q} P_i \log \frac{1}{Q_i}$$

si $Q_i = \dfrac{r^{-l_i}}{\sum_{i=1}^{q} r^{-l_i}}$ entonces

$$Q_1 + Q_2 + \dots + Q_q = \frac{r^{-l_1}}{\Sigma(\ )} + \frac{r^{-l_2}}{\Sigma(\ )} + \dots + \frac{r^{-l_q}}{\Sigma(\ )} = \frac{\Sigma(\ )}{\Sigma(\ )} = 1$$

$$\sum_{i=1}^{q} P_i \log \frac{1}{Q_i} = -\sum_{i=1}^{q} P_i \log Q_i$$

$$= -\sum_{i=1}^{q} P_i \log (r^{-l_i}) + \sum_{i=1}^{q} P_i \log \left(\sum_{j=1}^{q} r^{-l_j}\right)$$

$$= -\sum_{i=1}^{q} P_i \log (r^{-l_i}) + \left[\log\left(\sum_{j=1}^{q} r^{-l_j}\right)\right] \sum_{i=1}^{q} P_i$$

si $r = 2$ entonces

$$\sum_{i=1}^{q} P_i \log \frac{1}{Q_i} = L + \log\left(\sum_{j=1}^{q} r^{-l_j}\right) \leq L$$

$$H(S) \leq L + \log\left(\sum_{j=1}^{q} r^{-l_j}\right) \leq L$$

si $l_i = \log \frac{1}{P_i}$ y l_i es un entero

$$H(S) = \sum_{i=1}^{q} P_i \log \frac{1}{P_i} \qquad L = \sum_{i=1}^{q} P_i l_i$$

$$= \sum_{i=1}^{q} P_i l_i$$

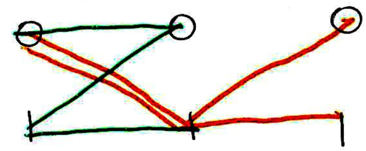
$$H(S) = L$$

+

b)

$S = \{S_1, S_2, \dots, S_5\}$ $L = H(S)$

S_i	$P(S_i)$	l_i	Código
S_1	1/4	2	00
S_2	1/8	3	010
S_3	1/8	3	011
S_4	1/4	2	10
S_5	1/4	2	11



2.

Está demostrado en el problema 1

3.

$H_2(S) = L \rightarrow H_2(S) = 1.8$

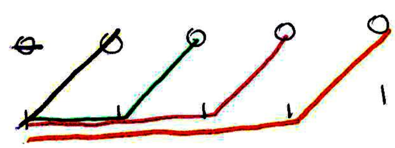
a)

S_i	$P(S_i)$	Código	l_i
S_1	0.5	0	1
S_2	0.25	10	2
S_3	0.125	110	3
S_4	0.1	1110	4
S_5	0.025	11110	5

$$\sum_{i=1}^{5} (2)^{-l_i} \leq 1$$

$$(2)^{-1} + (2)^{-2} + (2)^{-3} + (2)^{-4} + (2)^{-5} \leq 1$$

$$0.9684 \leq 1 \checkmark$$



b)

$$\log \frac{1}{P_i} \leq l_i < \log \frac{1}{P_i} + 1$$

$P_1 = 0.5$

$1 \leq l_1 < 2 \rightarrow l_1 = 1$

$P_2 = 0.25$

$2 \leq l_2 < 3 \rightarrow l_2 = 2$

$P_3 = 0.125$

$3 \leq l_3 < 4 \rightarrow l_3 = 3$

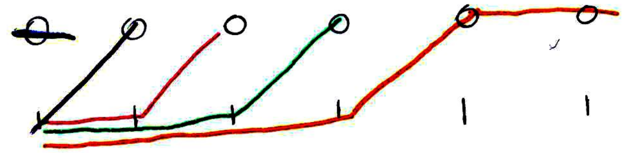
$P_4 = 0.1$

$3.322 \leq l_4 < 4.322 \rightarrow l_4 = 4$

$P_5 = 0.025$

$5.322 \leq l_5 < 6.322 \rightarrow l_5 = 6$

s_i	l_i	$P(s_i)$	Código
S_1	1	0.5	0
S_2	2	0.25	10
S_3	3	0.125	110
S_4	4	0.1	1110
S_5	6	0.025	111100



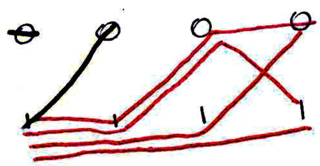
4o

s_i	$P(s_i)$	l_i	Código
S_1	0.4	1	0
S_2	0.3	2	10
S_3	0.1	4	1100
S_4	0.1	4	1101
S_5	0.06	4	1110
S_6	0.04	4	1111

$$\sum_{i=1}^{4} (2)^{-l_i} \leq 1$$

$$(2)^{-1} + (2)^{-2} + 4(2)^{-4} \leq 1$$

$$1 \leq 1 \checkmark$$



$$H(S) = \sum_{i=1}^{6} P_i \log \frac{1}{P_i} = 0.4 \log \frac{1}{0.4} + 0.3 \log \frac{1}{0.3} + 0.1 \log \frac{1}{0.1} + 0.1 \log \frac{1}{0.1} + 0.06 \log \frac{1}{0.06} + 0.04 \log \frac{1}{0.04}$$

$H(S) = 2.144$ binits/mensaje

$$L = \sum_{i=1}^{6} P_i l_i = (0.4)(1) + (0.3)(2) + 4(0.1 + 0.1 + 0.06 + 0.04) = 2.2 \text{ binits/mensaje}$$

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HTS10_2

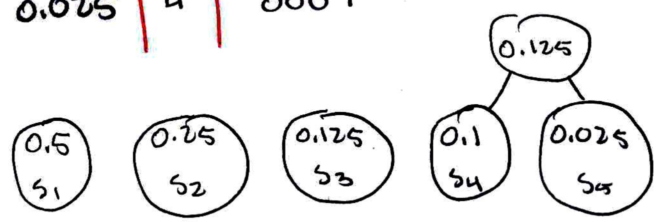
10

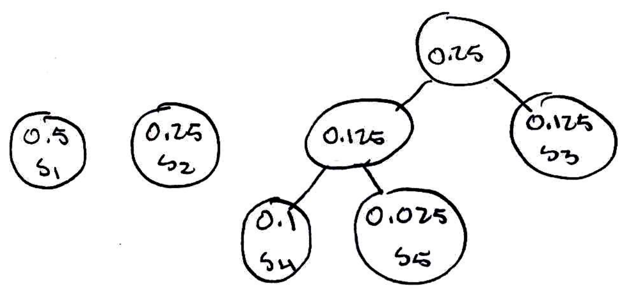
S_i	$P(S_i)$	l_i	Código
S_1	0.5	1	1
S_2	0.25	2	01
S_3	0.125	3	001
S_4	0.1	4	0000
S_5	0.025	4	0001

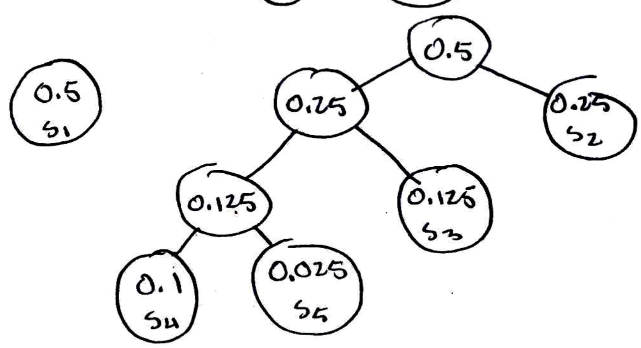
$$L = \sum_{i=1}^{5} P_i l_i =$$

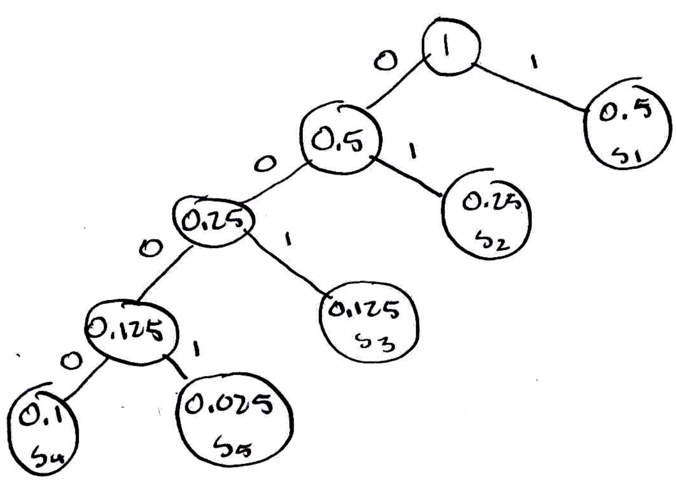
$$L = (0.5)(1) + (0.25)(2) + (0.125)(3) + (0.1 + 0.025)(4)$$

$$L = 1.875 \text{ binits/mensaje}$$









20

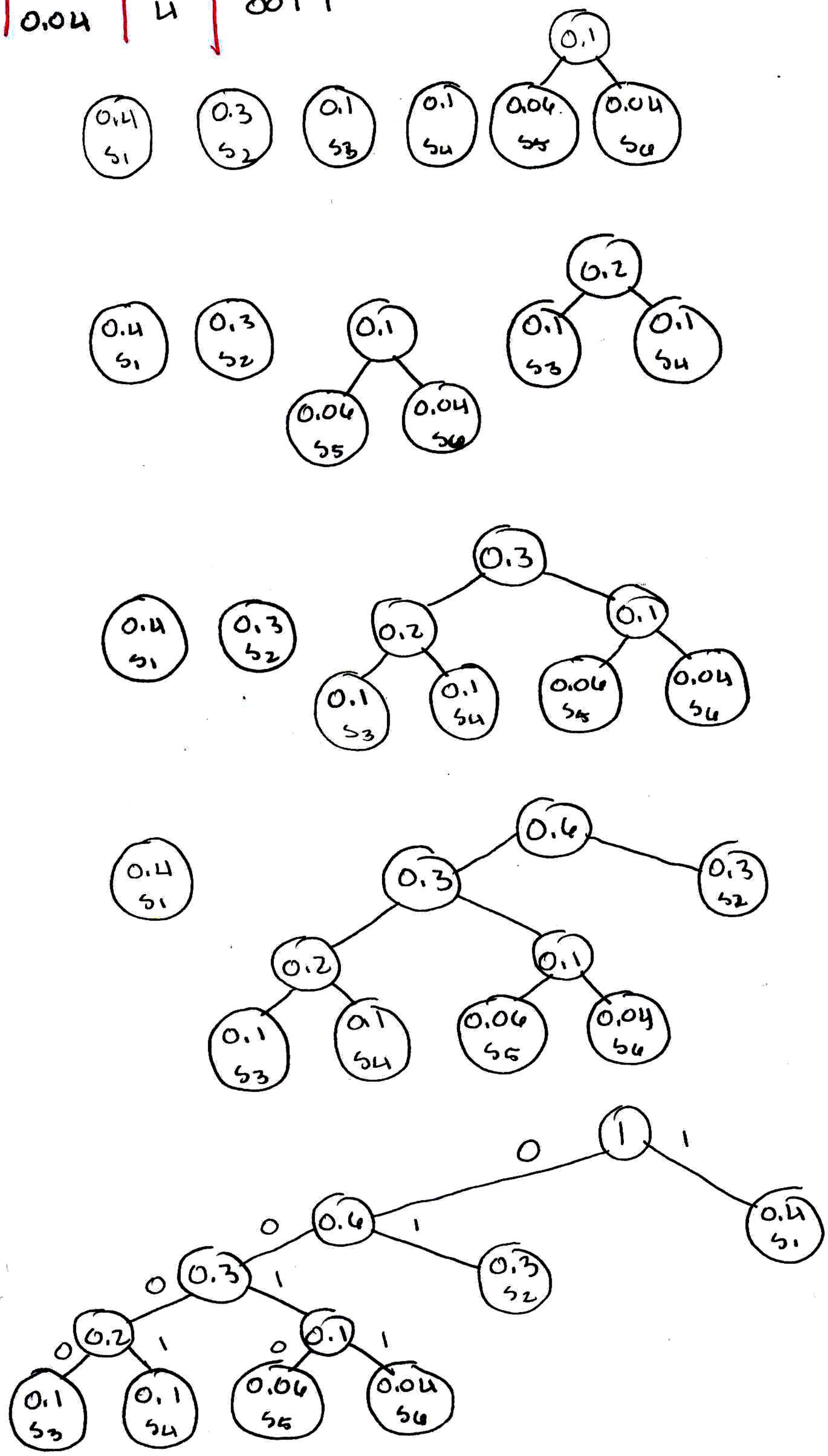
a)

s_i	$P(s_i)$	l_i	Código
s_1	0.4	1	1
s_2	0.3	2	01
s_3	0.1	4	0000
s_4	0.1	4	0001
s_5	0.06	4	0010
s_6	0.04	4	0011

$$L = \sum_{i=1}^{6} P_i l_i$$

$$L = (0.4)(1) + (0.3)(2) + (0.1 + 0.1 + 0.06 + 0.04)(4)$$

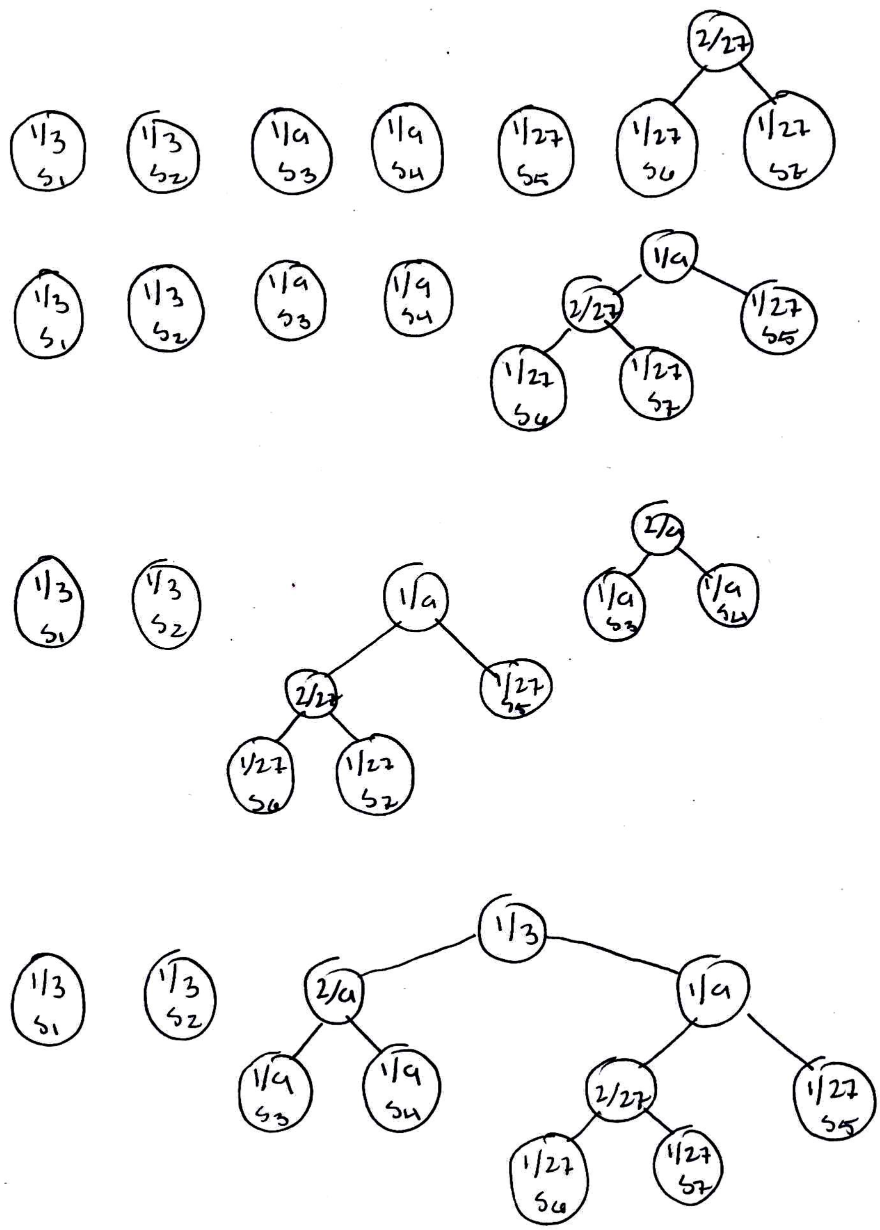
$$L = 2.2 \text{ binits/mensaje}$$

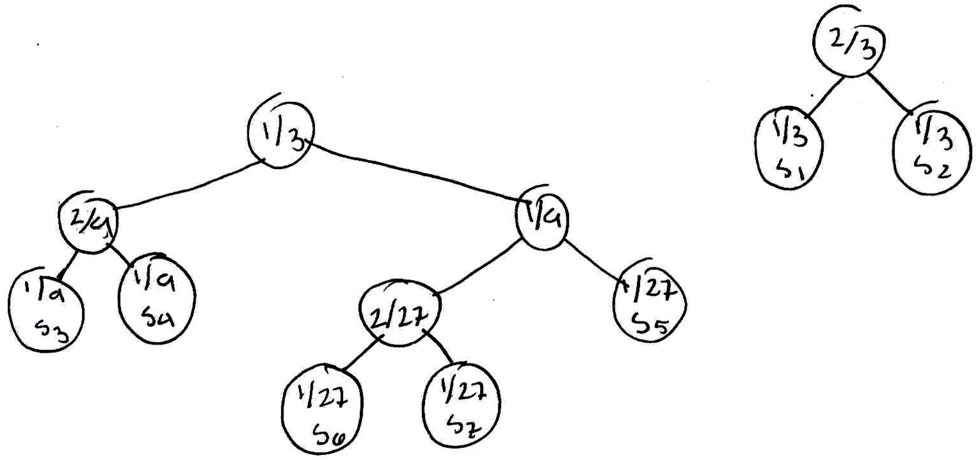


3o

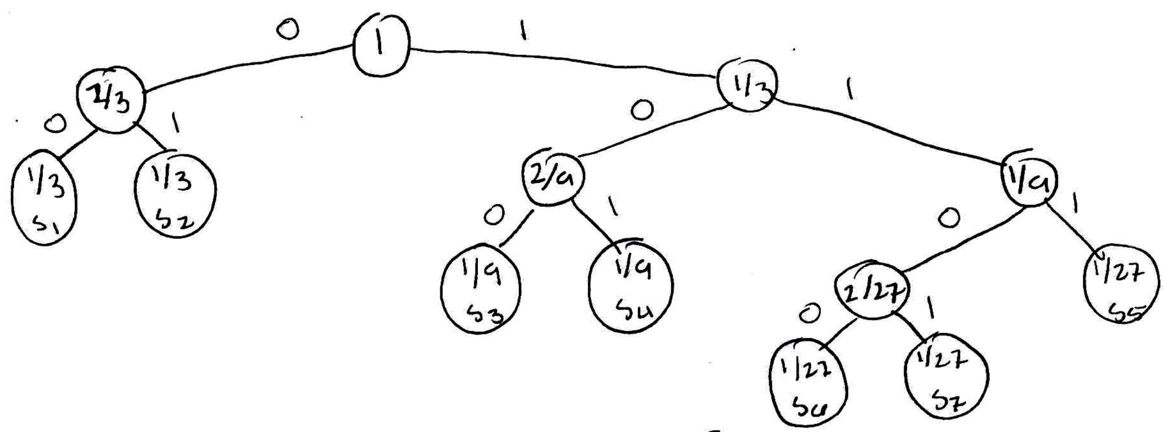
s_i	$P(s_i)$		Código A	Código B
s_1	1/3		00	1
s_2	1/3		01	2
s_3	1/9		100	01
s_4	1/9		101	02
s_5	1/27		111	000
s_6	1/27		1100	001
s_7	1/27		1101	002

a)



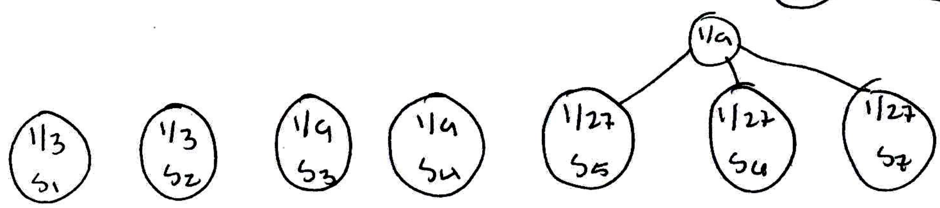


2/3
1/3 s1
1/3 s2
1/3
2/9
1/9
1/9 s3
1/9 s4
2/27
1/27 s5
1/27 s6
1/27 s7

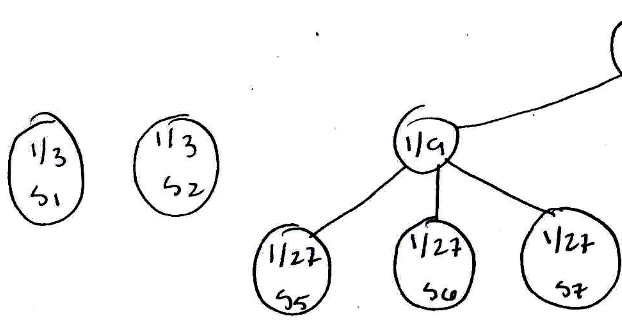


1
0
1
2/3
1/3
1/3 s1
1/3 s2
2/9
1/9
1/9 s3
1/9 s4
2/27
1/27 s5
1/27 s6
1/27 s7

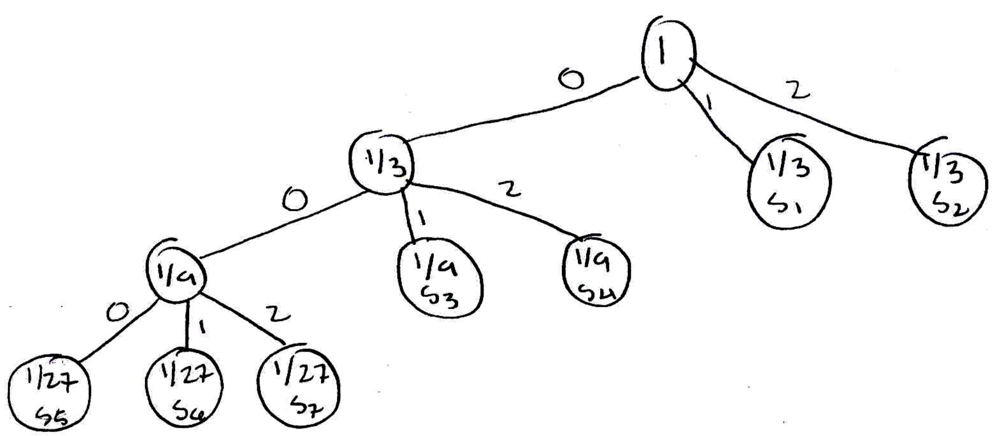
b)



1/3 s1
1/3 s2
1/9 s3
1/9 s4
1/9
1/27 s5
1/27 s6
1/27 s7



1/3 s1
1/3 s2
1/3
1/9
1/9 s3
1/9 s4
1/27 s5
1/27 s6
1/27 s7



1
0
1
2
1/3
1/3 s1
1/3 s2
1/9
1/9 s3
1/9 s4
1/27 s5
1/27 s6
1/27 s7