

① $A_x = \{B, b, m, a, A\}$ $x_9 = \underbrace{mmAaAaAaAa}_{Y=x_9 \text{ super de 2}} \underbrace{bBbBbB}_{m}$

a) $p(B) = 2/16$
 $p(b) = 3/16$
 $p(m) = 5/16$
 $p(a) = 3/16$
 $p(A) = 3/16$

$H(x) = 2.258$

b) $p(mm) = 1/8$
 $p(Aa) = 2/8$
 $p(mA) = 1/8$
 $p(am) = 1/8$
 $p(bB) = 2/8$
 $p(bm) = 2/8$

$H(Y) = 2.5$

$H(x) = \frac{H(Y)}{2} = 1.25$

c) $p(m|m) = 1/4$

$\bullet p(A|m) = 1/2 = 2/4$

$\bullet p(a|A) = 1/3 = 3/9 = 1$

$\bullet p(A|a) = 1/3$

$\bullet p(m|a) = 1/2 = 2/4$

$\bullet p(b|m) = 1/4$

$H(B) = 0$

$H(b) = H(\frac{1}{3}, \frac{2}{3}) = 0.918$

$H(m) = H(\frac{1}{4}, \frac{1}{4}, \frac{2}{4}) = 1.5$

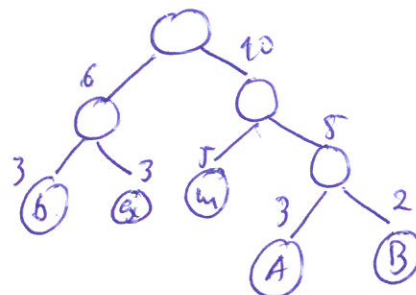
$H(a) = H(\frac{1}{3}, \frac{2}{3}) = 0.918$

$H(A) = 0$

$H(x) = \frac{2}{16} \times 0 + \frac{3}{16} \times 0.918 + \frac{5}{16} \times 1.5 + \frac{3}{16} \times 0.918 + \frac{3}{16} \times 0 = 0.813$

d) $\bar{L} < H(x) + 1 = 2.258 + 1 = 3.258$

x_i	Simbolo	prob
2	m	5/16
2	b	3/16
2	a	3/16
3	A	3/16
3	B	2/16



$\bar{L} = 2 \times \frac{5}{16} + 2 \times \frac{3}{16} + 2 \times \frac{3}{16} + 3 \times \frac{3}{16} + 3 \times \frac{2}{16} = 2.313$

f) 001|010|0101|00100|00100|10010
 $\begin{matrix} b & m & m & b & B & a \end{matrix}$

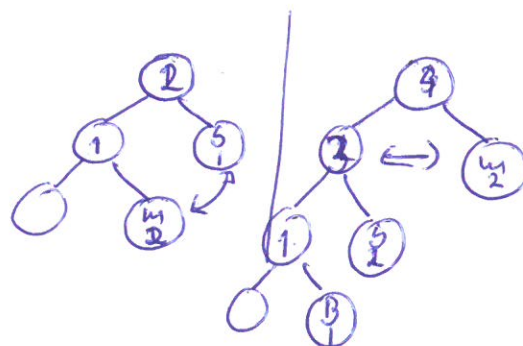
Códigos binários

k	Sim.	cod
1	B	000
2	b	001
3	m	01
4	a	10
5	A	11

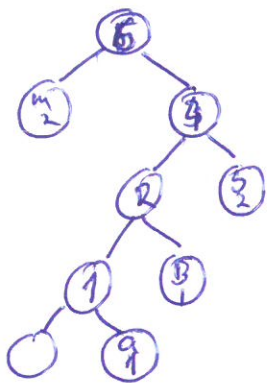
$2^k + n = 5 \Rightarrow k = 2$
 $n = 1$

$k \leq 2n \Rightarrow k \leq 2 \Rightarrow k-1$ com $2n-1 = 3$ bits

$k > 2n \Rightarrow k > 2 \Rightarrow k-n-1$ com $2n-2 = 2$ bits
 $k-2$ com $2n-2 = 2$ bits



b, m, m, b, B, a



6	mm
7	mA
8	Aa
9	aA
10	Aam
11	mAa
12	am
13	mb
14	bB
15	Bb
16	bBb
17	bmb

$m|n|A|a|A|m|A|a|m|5|8|5|m$
 $3|3|5|4|8|7|4|3|2|1|14|2|3$

$$\tau_{q_{10}} = 2^{-1} + 2^{-2} = 0.5 + 0.25 = 0.75$$

simb	p	F
B	2/16	2/16 = 0.125
b	3/16	5/16 = 0.3125
w	5/16	10/16 = 0.625
a	3/16	13/16 = 0.8125
A	3/16	1

$$\begin{aligned} l^0 &= 0 \\ \mu^0 &= 1 \\ \tau_{ag} &= 0.75 \end{aligned}$$

$$1) t = \frac{\tan^{-1} 0}{40^\circ - 0^\circ} = \frac{0.75 - 0}{1 - 0} = 0.75$$

$\Rightarrow \underline{a}$

$$\begin{aligned} \ell^1 &= \ell^0 + a_{\text{mp}}^0 \times 0.625 = 0.625 \\ \mu^1 &= \ell^0 + a_{\text{p}}^0 \times 0.8125 = 0.8125 \end{aligned}$$

$$2) t = \frac{0.75 - 0.625}{0.8125 - 0.625} = 0.6667$$

$\Rightarrow a$

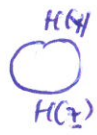
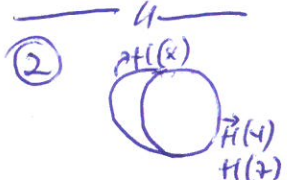
$$Q^2 = 0.625 + 0.1875 \times 0.625 = 0.7422$$

$$\mu^2 = 0.625 + 0.1875 \times 0.8125 = 0.7773$$

$$3) t = \frac{0.75 - 0.7422}{0.7773 - 0.7422} = 0.2222$$


→ b

Словарь: a, a, b



a) $I(x; z) = H(x, z)$ b) $I(x; z) = H(z) + H(z|x)$
 $[H(z|x) = 0]$

c) $H(x) \leq \log_2 101$ and $H(x) \leq 6.658$

③ Redundância $\in [0, 1]$

 obij. desejável

$$r_{\text{indep}} \Rightarrow R = 0$$

$$I(x, y) \geq 0 \Rightarrow R \geq 0$$



op 1: $R = 1 \Rightarrow u = 0$
 op 2: $R = 1 \Rightarrow u = 0$
op 3: $R = 0$
 tot deg. $R = 1$ ✓
 op 4: $R = \infty$
 op 5: $R = H(x) + H(y)$

~~(7)~~ $n = 18871$, $e = 2479$, $\phi(n) = 18592$

a) $C = 136 \Rightarrow m = ?$

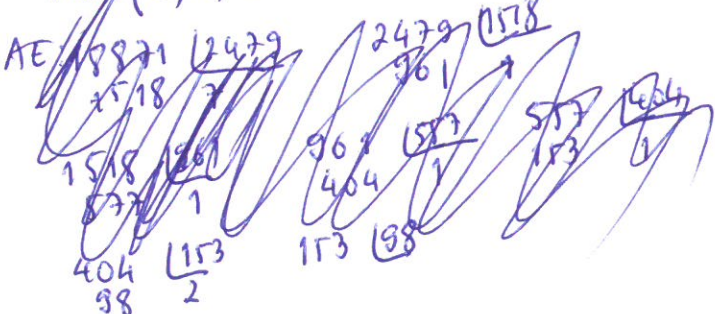
$$m = c^d \bmod n \Leftrightarrow m = 136^d \bmod 18871$$

$$x \cdot d \equiv 1 \pmod{\phi(n)} \Leftrightarrow x \cdot d \equiv 1 \pmod{18592} \Leftrightarrow$$

$$ed = 1 + kn \Rightarrow ed + kn = 1 \Rightarrow$$

$$\Rightarrow 2479d + 18592u = 1$$

$$\text{mdf}'(x, u) =$$



7a (cont.)

A.E. $\gcd(18592, 2479) = 1? \checkmark$

$$2479d + 18592K = 1$$

$$\begin{array}{r} 18592 \\ 1239 \overline{) 18592} \\ \underline{1239} \\ 7 \end{array}$$

$$\begin{array}{r} 2479 \\ 1239 \overline{) 2479} \\ \underline{1239} \\ 1239 \\ \underline{1239} \\ 0 \end{array}$$

$$\begin{array}{r} 1239 \\ 0 \overline{) 1239} \\ \underline{1239} \\ 0 \end{array}$$

$$d_0 = 0$$

$$d_1 = 1$$

$$d_2 = -q_1 d_1 + d_0 = -7 \times 1 + 0 = -7$$

$$d_3 = -q_2 d_2 + d_1 = -2 \times (-7) + 1 = 15 \Rightarrow d = 15$$

$$m = 136^{15} \bmod 18871 = 17025 \quad \text{sol: } 17025$$

$$= 136^8 \times 136^4 \times 136^2 \times 136 \bmod 18871$$

$$136^2 \equiv 18496$$

$$136^4 \equiv 18496^2 \equiv 342,102,016 \equiv 8528$$

$$136^8 \equiv 8528^2 \equiv 16821$$

$$6) \phi(n) = (p-1)(q-1)$$

$$p \cdot q = n$$

$$(p-1)(q-1) = 18592$$

$$p \cdot q = 18871$$

$$\left(\frac{18871-1}{9} - 1 \right) (q-1) = 18592$$

$$p = \frac{18871}{9}$$

$$18871 - \frac{18871}{9} - q + 1 = 18592$$

$$\begin{cases} 18871q - 18871 - q^2 + q = 18592q \\ q^2 - 280q + 18871 = 0 \end{cases}$$

$$q = \frac{280 \pm \sqrt{280^2 - 4 \times 18871}}{2} \quad q = \frac{280 \pm \sqrt{2916}}{2} \quad q = \frac{280 \pm 54}{2}$$

$$\text{sol: } p = 167, q = 113, d = 15$$

$$q = 167 \vee 113$$

$$p = 113 \vee 167$$