$$S : \begin{pmatrix} s_1 & s_2 & \cdots & s_n \\ p(s_1) & p(s_2) & & p(s_n) \end{pmatrix}$$

$$S^2 : \begin{pmatrix} \overbrace{s_1 s_1}^{\sigma_1} & \overbrace{s_1 s_2}^{\sigma_2} & \cdots & \overbrace{s_2 s_1}^{\sigma_{xx}} & \cdots & \overbrace{s_n s_n}^{\sigma_{n^2}} \\ p(s_1)\cdot p(s_1) & p(s_1)\cdot p(s_2) & & p(s_2)\cdot p(s_1) & & p(s_n)\cdot p(s_n) \end{pmatrix}$$

$$H(S^2) = -\sum p(\sigma_i)\cdot \log\left(p(\sigma_i)\right)$$

$$= -\sum_i \sum_j \underbrace{p(s_i)\cdot p(s_j)}_{p(\sigma_{ij})} \cdot \underbrace{\log\left(p(s_i)\cdot p(s_j)\right)}_{\left(\log\left(p(s_i)\right) + \log p(s_j)\right)}$$

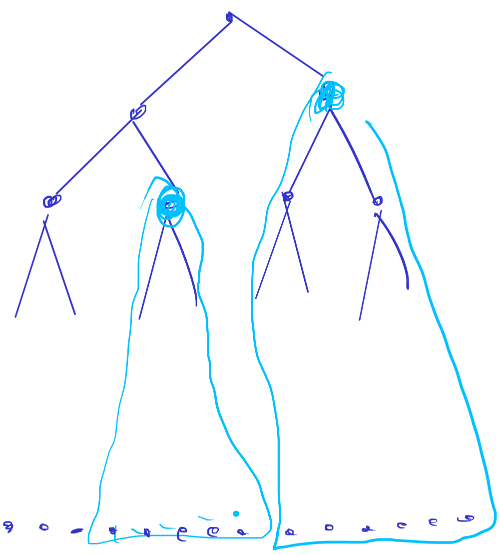
$$= -\sum_i \sum_j p(s_i)\, p(s_j) \cdot \log\left(p(s_i)\right) \quad = H(S)$$

$$-\sum_i \sum_j p(s_i)\cdot p(s_j) \cdot \log\left(p(s_j)\right) \quad H(S)$$

$$= H(S) + H(S) = 2\cdot H(S)$$

~~Inst~~

Instantaner: $\sum_i 2^{-l_i} \le 1$



2^N

$$\text{Hamming}\overset{n\ \ k}{(7,4)} \qquad n = \text{biți cuv. cod} \qquad k = \text{biți inform.}$$

$$\text{Hamming}(15, 11)$$

$$n = 7,\ 15,\ 31,\ 63$$

$$2^{3}-1 \quad 2^{4}-1 \quad 2^{5}-1 \quad 2^{6}-1$$

$$\frac{?}{31},\ \frac{?}{26}$$

$$\boxed{\begin{aligned} n &= 2^{\text{ceva}} - 1 \\ k &= 2^{\text{ceva}} - 1 - \text{ceva} \end{aligned}}$$

$$0 = H \cdot c$$

3 biți de paritate

$$H = \overbrace{\begin{bmatrix} 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 \end{bmatrix}}^{7} \qquad c = \begin{bmatrix} c_1 \\ c_2 \\ i_3 \\ c_4 \\ i_5 \\ i_6 \\ i_7 \end{bmatrix} \quad \text{Hamming}(7,4)$$

$$H = \overbrace{\begin{bmatrix} 0 & 0 & \cdots & 1 \\ 0 & 0 & \cdots & 1 \\ 0 & 1 & \cdots & 1 \\ 1 & 0 & \cdots & 1 \end{bmatrix}}^{15} \qquad \text{Hamming}(15, 11)$$

$$[i_1\ i_2\ i_3\ i_4] \cdot G = [i_1\ i_2\ i_3\ i_4\ c_1\ c_2\ c_3]$$

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$

$$H = \overbrace{\begin{bmatrix} 0 & \cdots & 1 \\ 0 & \cdots & 1 \\ 0 & \cdots & 1 \\ 0 & \cdots & 1 \\ 1 & \cdots & 1 \end{bmatrix}}^{31}$$

$$H_2 = \overbrace{\begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}}^{H} \cdot \underbrace{\begin{bmatrix} i \\ i \\ i \\ i \\ c \\ c \\ c \end{bmatrix}}_{7}$$

$$Q^T \qquad c^T$$

$$\overbrace{1\,0}^{s_1}\,\overbrace{1\,0\,1}^{s_2}$$

$$\underbrace{1\,0\,1}_{S_2}\,\underbrace{0\,1}_{S_3}$$

$$\underbrace{1\,0\,1}_{s_2}\,\underbrace{0\,0}_{s_4}\;\text{- - - - - - -}$$

$$1\,0\,1\,0\,1 \begin{cases} \nearrow\; s_2\, s_3 \\ \searrow\; s_1\, s_2 \end{cases}$$

Optimal: $\eta = 1 \iff \bar{l} = H(S) \Rightarrow l_i =$ nr. întregi

$$l_i = -\log_2 (p(s_i))$$

$$p(s_i) = 2^{-l_i}$$