- $\vec{n}_1, \vec{n}$ sec binarias de excitaciones
- $\vec{e}_{12} = \vec{n}_1 + \vec{n}_2$
- $d = w(\vec{e}_{12}) = d_H(\vec{n}_1, \vec{n}_2)$

$$\hat{X}_{12} = tr_{N\setminus L}\left(|\vec{n}_1\rangle\langle\vec{n}_2|\right)$$

si $d > L \Rightarrow \hat{X}_{12} = 0$

$\mathcal{C} = \{\vec{x}^{(1)}, \vec{x}^{(2)}, \dots\dots \vec{x}^{(2^k)}\}$ $\quad \vec{x} \in \{0,1\}^n$

$R = \frac{k}{n} \Rightarrow$ tasa del código $\quad |\mathcal{C}| = 2^{nR}$

$$\mathcal{H}_{\mathcal{C}} = \underline{\mathrm{Span}\left(|\vec{x}^{(1)}\rangle, |\vec{x}^{(2)}\rangle, \dots\dots |\vec{x}^{(2^k)}\rangle\right)}$$

$|\mathcal{H}_{\mathcal{C}}| = 2^{nR}$

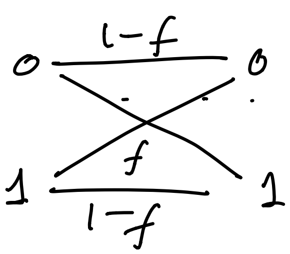
(n, k)

Códigos de distancia mínima d_{min}

$\forall\, \vec{x}^{(i)}, \vec{x}^{(j)} : \quad d_H(\vec{x}^{(i)}, \vec{x}^{(j)}) \geq d_{min}$

(n, k, d) $\quad R = k/n$

$\delta = d/n$

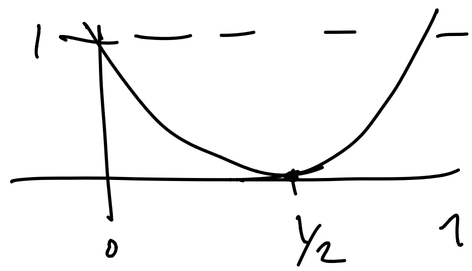


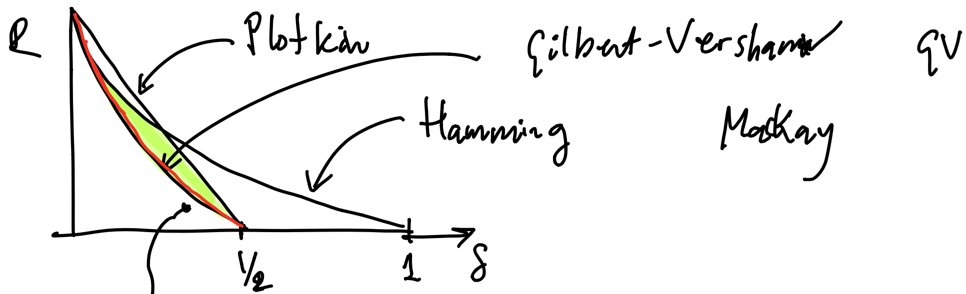
$R = 1 - H_2(f)$

n

$\langle e \rangle = nf$

$\frac{\langle e \rangle}{n} = f$





$$R(\delta) = 1 - H_2(\delta)$$

L tamaño de la subcadena $\longrightarrow$ $\ell = L/N$

Existen espacios $\mathcal{H}_c$ con $\dim |\mathcal{H}_c| \simeq 2^{N(1-H_2(\ell))}$

$N(1-H_2(\ell))$ bits

$$|\psi\rangle = \sum_{\vec{n}\in\mathcal{C}}' \psi(\vec{n})\, |\vec{n}\rangle$$

(n, k, d)

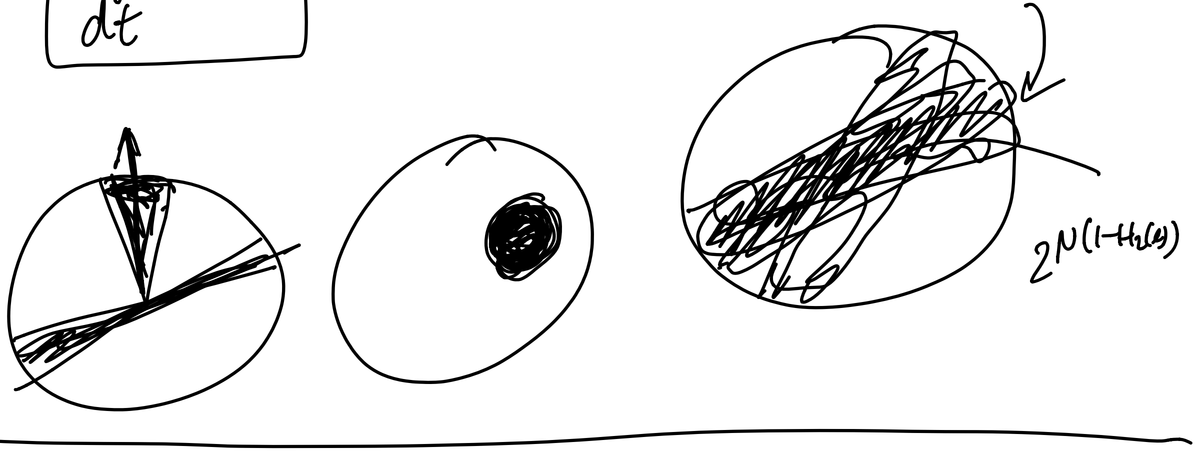
$d' \geq \ell$

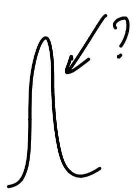
$$\rho_L(\psi) = \mathrm{tr}_{N\setminus L}\big(|\psi\rangle\langle\psi|\big) \underset{\text{exact}}{=} \sum{}' |\psi(\vec{n})|^2\, |\vec{n}\rangle\langle\vec{n}|$$

$$\boxed{\frac{d\rho_L}{dt} = 0}$$

$\ell = 0.01$

2^N ??





$\varepsilon = E/N$

$S(\varepsilon)$

$2^{NS(\varepsilon)}$

$2^{NS(\varepsilon)(1-H_2(\ell))}$

$$2^{NS(\varepsilon^*)(1-H_2(\ell))} \sim \sum_{\varepsilon} 2^{NS(\varepsilon)(1-H_2(\ell))}$$

Preguntas Interesantes:

1) si: $S(\ell) = \bigcup_{\mathcal{C}} \mathcal{H}_{\mathcal{C}}$

$\mathcal{C}$ código de $\delta > \ell$

$$r = \lim_{n\to\infty} \frac{\log_2 S(\ell)}{n} = \,?$$

2) si $\mathcal{H}_{\mathcal{C}}$ código típico de familia con $\delta > \ell$, y $\varepsilon = E/n$

(R, δ, ε)

$$R = S(\varepsilon)(1 - H_2(\ell))\ ?$$

$\vec{e} = \vec{n}_1 + \vec{n}_2$

$$\frac{1}{(e^{\beta}+1)^2} + \frac{1}{(e^{-\beta}+1)^2}$$

$$p(e_i = 1) = \frac{1}{(1 + \cosh(\beta\varepsilon_i))^2}$$

$$p(e_i = 0) = \frac{1}{(1 + \operatorname{sech}(\beta\varepsilon_i))^2}$$

$$\langle d \rangle = \sum_{\theta}' \frac{1}{1 + \cosh(\beta\varepsilon_i)} = N \oint \frac{d\theta}{2\pi} \left(\frac{1}{1 + \cosh(\beta\varepsilon(\theta))} \right)$$

$\varepsilon(\theta) = \omega(\theta) - \omega_0$

$$\langle \Delta d^2 \rangle = N \oint \frac{d\theta}{2\pi} \frac{1}{(\quad)} \frac{1}{(\quad)}$$

$$l < \langle d \rangle \pm \sqrt{\langle \Delta d^2 \rangle}$$

$$|\psi\rangle = \sum \psi_i |\vec{n}\rangle$$

$$\mathrm{tr}_{v_E}(|\psi\rangle\langle\psi|) = \omega_S + \cdots$$

$$\boxed{d < L}$$

$L = 8$

BASE:

$$x_1\, y_1\, x_3\, x_4\, x\ y\ x\ y$$
$$1\ 0\ 1\ 1\ 1\ 0\ 1\ 0\ 0.$$

$$\gamma(101110100,\ 10001010)$$

$$x_1 y_2 x_3 = \frac{1}{3!} x_{[1} y_2 x_{3]}$$

$$X = \sum f(\vec{x}, \vec{y})\, \gamma(\vec{x}, \vec{y})$$

$$\gamma(\vec{a}) = [\gamma_{a_1} \gamma_{a_2} \gamma_{a_3} \cdots \gamma_{a_p}]$$

$$\gamma_{a_i} = O_{a_i j}\, \tilde{\gamma}_j$$

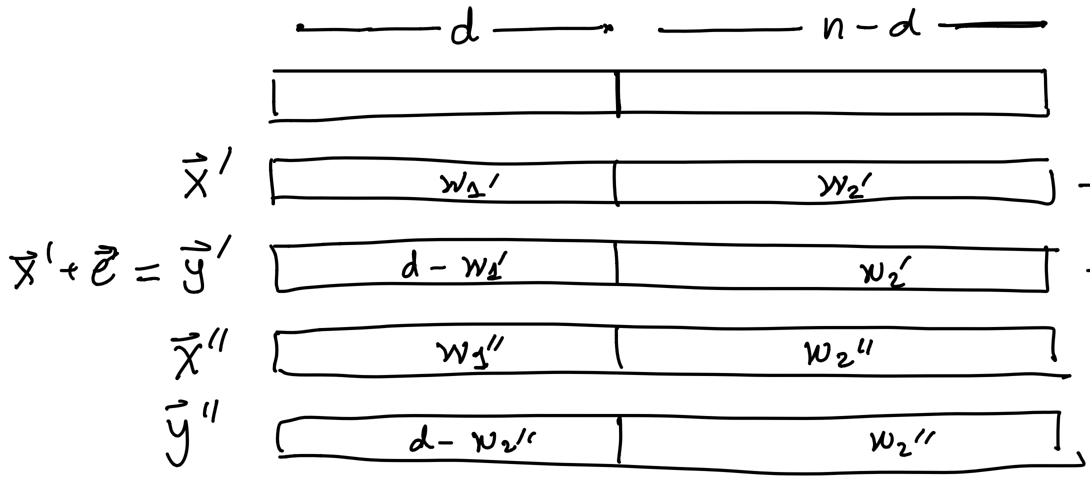
$$\begin{array}{cccc} & \tilde{1} & \tilde{2} & \tilde{3} \\ 1 & O_{11} & O_{12} & O_{13} \\ 2 & O_{21} & O_{22} & O_{23} \\ 3 & O_{31} & O_{32} & O_{33} \end{array}$$

$$\gamma(\vec{a}) = \det(O|_{\vec{a}\vec{b}})\, \gamma_{\vec{b}}$$

$$\frac{1}{2!}[\gamma_1 \gamma_2]$$

$$\frac{1}{2!}[\gamma_1, \gamma_2] = (\ \ ) \frac{1}{2}[\tilde{\gamma}_1, \tilde{\gamma}_2] + \cdots$$

$$\sum_{\vec{x}} O_{\vec{x}\vec{x}'} O_{\vec{x}\vec{x}''} = \det\left[(O \Pi O^T)|_{\vec{x}'\vec{x}''}\right]$$



$w_x' = w_1' + w_2'$

$w_y' = d - w_1' + w_2'$

$w_x'' = w_1'' + w_2''$

$w_y'' = d - w_1'' + w_2''$

$$\boxed{w_1'' = w_1^* \text{ y } w_2'' = w_2'}$$

$$\left[\begin{array}{c|c} O_x & \\ \hline & O_y \end{array}\right]$$

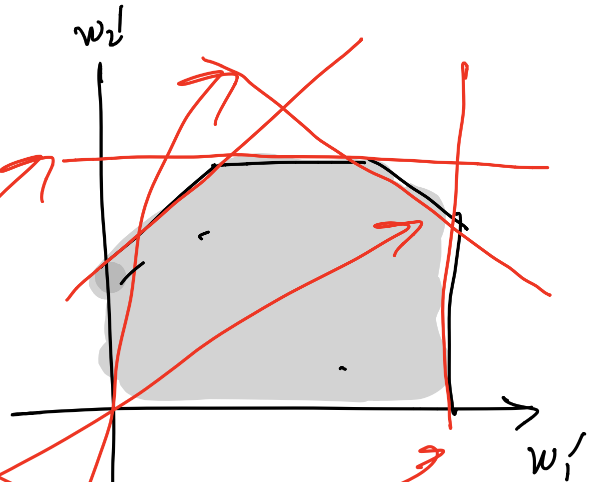
$$\boxed{\sum_{w_1', w_2'}^{*} \binom{d}{w_1'}^2 \binom{n-d}{w_2'}^2}$$

$0 \le w_1' \le d$

$0 \le w_2' \le n-d$

$0 \le w_1' + w_2' \le \ell$

$0 \le d - w_1' + w_2' \le \ell$



$\le \left|\sqrt{\frac{2}{N}}\right|$

$$\sum |O_{\vec{x}\vec{x}}| \, |O_{\vec{x}\vec{x}'}|$$

$$\begin{array}{cc} & w_x \\ w_x & \begin{bmatrix} \sqrt{2/N} & \cdots \\ \vdots & \\ \vdots & \end{bmatrix} \end{array}$$

$W_x \times W_x$

Hadamard

$$\left[\left(\sqrt{\frac{2}{N}}\right)\sqrt{W_x}\right]^{W_x}$$

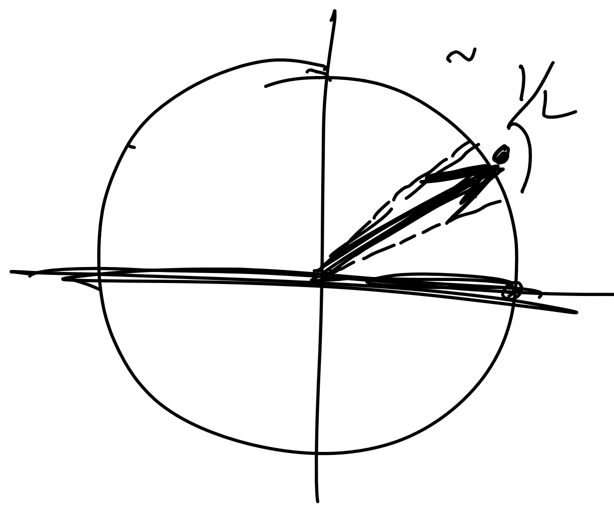
$$\|X_{l2}\|_2^2 = \frac{1}{2^L}\sum^{*}_{w_1'\, w_2'} \binom{d}{w_1'}^2 \binom{n-d}{w_2'}^2 \left[\frac{2}{N}(w_1'+w_2')\right]^{(w_1'+w_2')} \left[\frac{2}{N}(d-w_1'+w_2')\right]^{(d-w_1'+w_2')}$$

$$\leq \Theta^{n\, f_L(\delta,\ell)}$$

$$f(\delta,\ell) = \max_{R} \ldots$$

$\ldots$

$$= 2\delta\, H_2\!\left(\frac{\bar{w}_1'}{\delta}\right) + 2(1-\delta)\, H_2\!\left(\frac{\bar{w}_2'}{\delta}\right) + (\bar{w}_1'+\bar{w}_2)\log\left(2(\bar{w}_1+\bar{w}_2)\right)$$
$$+ (\delta-\bar{w}_1'+\bar{w}_2')\log\left(2(\delta-\bar{w}_1'+\bar{w}_2')\right)$$
$$-\ell\log 2$$

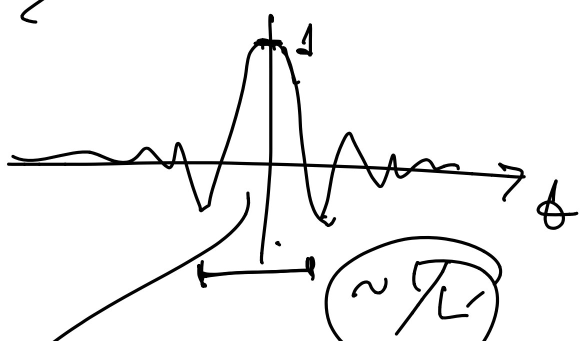


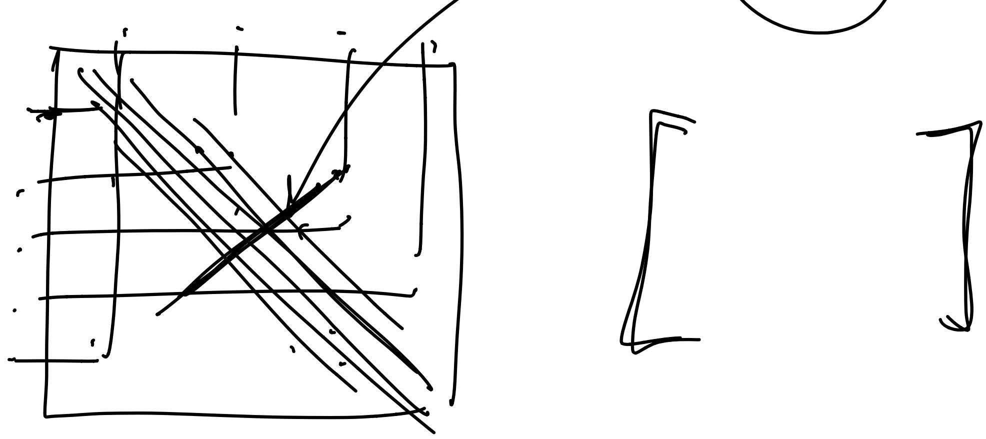
$$u^{(k)}(x) = \sqrt{\frac{2}{N}}\cos(\theta_k x)$$

$$a_{jk} = \sum_{x=-\frac{L-1}{2}}^{(L-1)/2} u^{(j)}(x)\, u^{(k)}(x)$$

$$= \frac{L}{N}\left[f_L(\theta_k-\theta_\ell) + \cancel{f_L(\theta_k+\theta_\ell)} \right]$$

$$f_L(\theta) = \frac{\operatorname{sen}(\theta L/2)}{L\operatorname{sen}(\theta/2)}$$





$\left[0 \pi\, 0^{T}\right]$