Rate of random low-density parity-check codes

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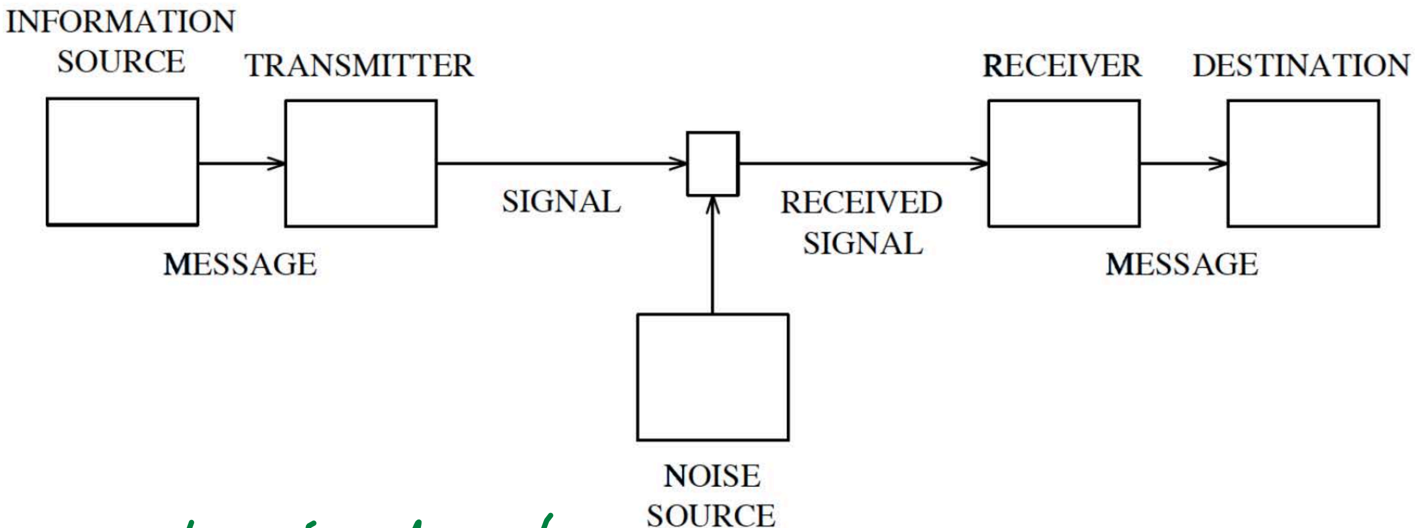
Joint work with Amin Coja-Oghlan

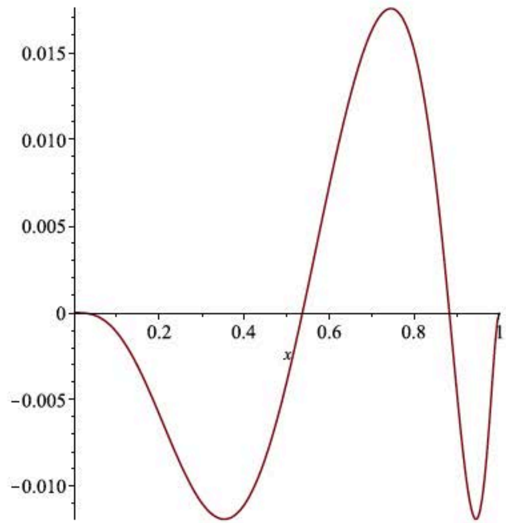
Information theory.

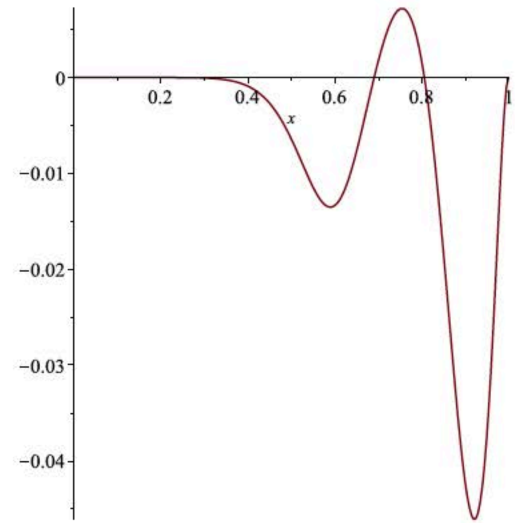
$\{0,1\}^m \xrightarrow{\text{Enc}} x \in \{0,1\}^n$ $\qquad$ $y \in \{0,1\}^n \xrightarrow{\text{Dec}} \{0,1\}^m$



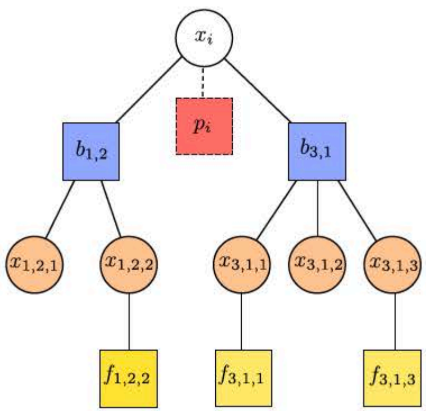
Shannon's channel coding theorem

$\Rightarrow$ random codes achieve the theoretical best performance.


0.015
0.010
0.005
0
−0.005
−0.010
0.2
0.4
0.6
0.8
1
x


0
−0.01
−0.02
−0.03
−0.04
0.2
0.4
0.6
0.8
1
x

$$\mathscr{B}(\pi) = \mathbb{E}\left[\log_q \sum_{\sigma_1 \in \mathbb{F}_q} \prod_{i=1}^{\boldsymbol{d}} \sum_{\sigma_2,\ldots,\sigma_{\hat{\boldsymbol{k}}_i} \in \mathbb{F}_q} \mathbf{1}\left\{\sum_{j=1}^{\hat{\boldsymbol{k}}_i} \sigma_j \boldsymbol{\chi}_{i,j} = 0\right\} \prod_{j=2}^{\hat{\boldsymbol{k}}_i} \boldsymbol{\mu}_{i,j}(\sigma_j)\right]$$
$$- \frac{d}{k}\mathbb{E}\left[(\boldsymbol{k}-1)\log_q \sum_{\sigma_1,\ldots,\sigma_{\boldsymbol{k}} \in \mathbb{F}_q} \mathbf{1}\left\{\sum_{i=1}^{\boldsymbol{k}} \sigma_i \boldsymbol{\chi}_{1,i} = 0\right\} \prod_{i=1}^{\boldsymbol{k}} \boldsymbol{\mu}_i(\sigma_i)\right].$$


x_i
p_i
$b_{1,2}$
$b_{3,1}$
$x_{1,2,1}$
$x_{1,2,2}$
$x_{3,1,1}$
$x_{3,1,2}$
$x_{3,1,3}$
$f_{1,2,2}$
$f_{3,1,1}$
$f_{3,1,3}$