

# Source Code

Shanon-Fano , Huffman Code  
Source Extension

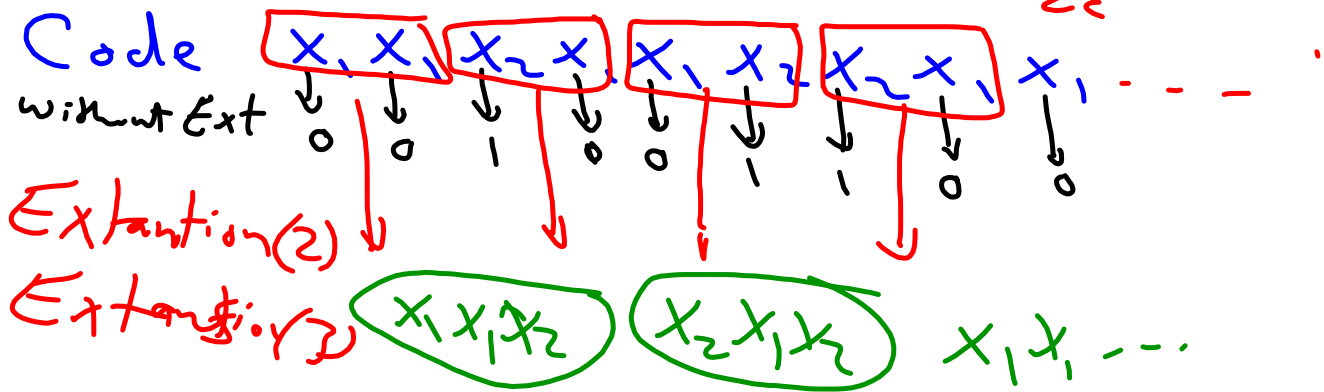
var	P(x)	Codeword	li
x <sub>1</sub>	0.9	0	1
x <sub>2</sub>	0.1	1	1

$$L_c = \sum_{i=1}^2 l_i P(x_i) = 1$$

$$H(x) = - \sum_{i=1}^2 P(x_i) \log_2 p_{x_i}$$

$$H(x) = 0.469$$

Code eff.  $\eta = \frac{H(x)}{L_c} = 46.9\%$



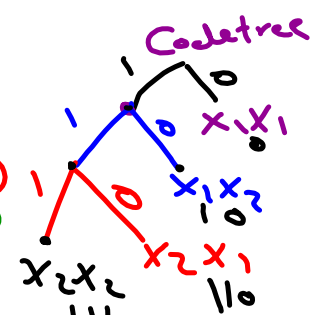
Source Ext.

msg	P(x)
$x_1x_1$	0.81
$x_1x_2$	0.09
$x_2x_1$	0.09
$x_2x_2$	0.01

$$P(x_1, x_2) = P(x_1) \cdot P(x_2)$$

① Shannon-Fano

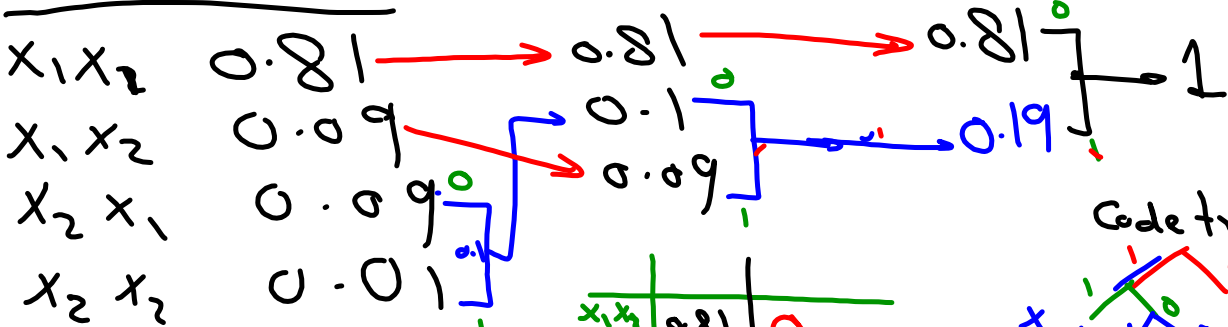
msg	P(x)	Code word
$x_1x_1$	0.81	0
$x_1x_2$	0.09	10
$x_2x_1$	0.09	110
$x_2x_2$	0.01	111



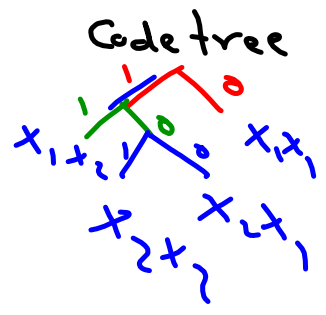
$$L_c = \sum_{i=1}^4 l_i P(x_i) = 1.29 \text{ bit/sym}$$

$$H(x) = -\sum P(x_i) \log_2 P(x_i) = 0.645 \quad \eta = 72.7\%$$

Huffman Code



$x_1x_1$	0.81	0
$x_1x_2$	0.09	10
$x_2x_1$	0.09	110
$x_2x_2$	0.01	111



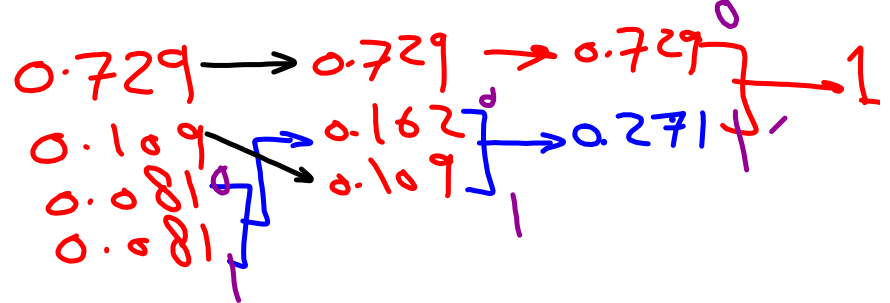
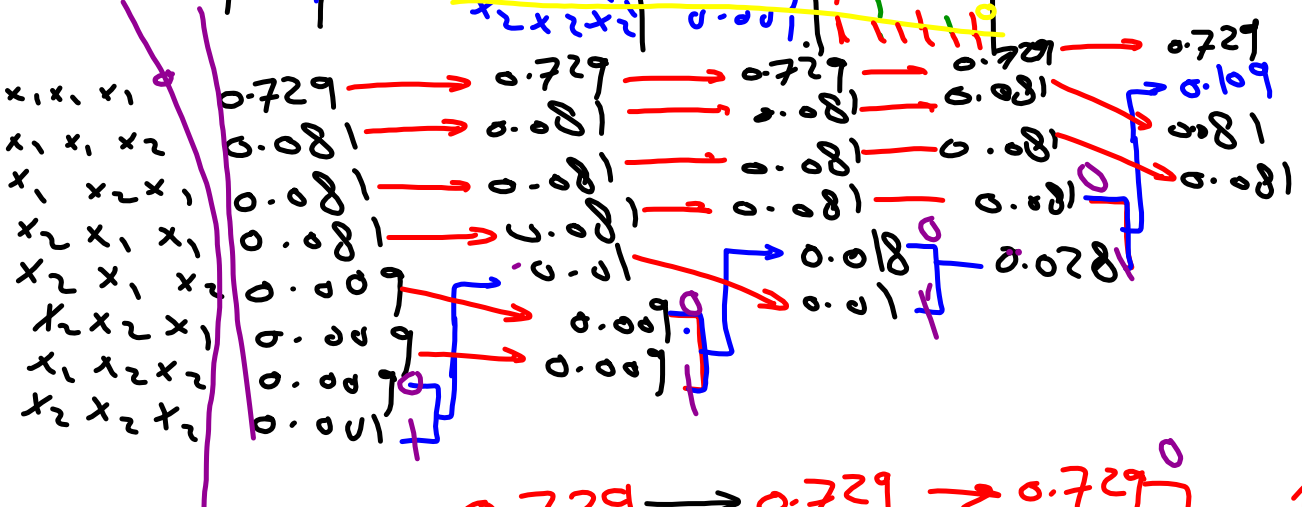
Source Ext. 3 Messages

Message	P(x <sub>i</sub> )
x <sub>1</sub> x <sub>1</sub> x <sub>1</sub>	0.729
x <sub>1</sub> x <sub>1</sub> x <sub>2</sub>	0.081
x <sub>1</sub> x <sub>2</sub> x <sub>1</sub>	0.081
x <sub>1</sub> x <sub>2</sub> x <sub>2</sub>	0.009
x <sub>2</sub> x <sub>1</sub> x <sub>1</sub>	0.081
x <sub>2</sub> x <sub>1</sub> x <sub>2</sub>	0.009
x <sub>2</sub> x <sub>2</sub> x <sub>1</sub>	0.009
x <sub>2</sub> x <sub>2</sub> x <sub>2</sub>	0.001

Shanon-Fano

Message	P(x <sub>i</sub> )	Code
x <sub>1</sub> x <sub>1</sub> x <sub>1</sub>	0.729	0
x <sub>1</sub> x <sub>1</sub> x <sub>2</sub>	0.081	100
x <sub>1</sub> x <sub>2</sub> x <sub>1</sub>	0.081	101
x <sub>2</sub> x <sub>1</sub> x <sub>1</sub>	0.081	110
x <sub>1</sub> x <sub>2</sub> x <sub>2</sub>	0.009	1110
x <sub>2</sub> x <sub>1</sub> x <sub>2</sub>	0.009	11110
x <sub>2</sub> x <sub>2</sub> x <sub>1</sub>	0.009	111110
x <sub>2</sub> x <sub>2</sub> x <sub>2</sub>	0.001	1111110

L<sub>c</sub>, H(x)  
code eff.  
 $\eta = \frac{H(x)}{L_c}$



H.c

L<sub>c</sub> =

H(x) =

$\eta = 88.5\%$