Arithmetic coding

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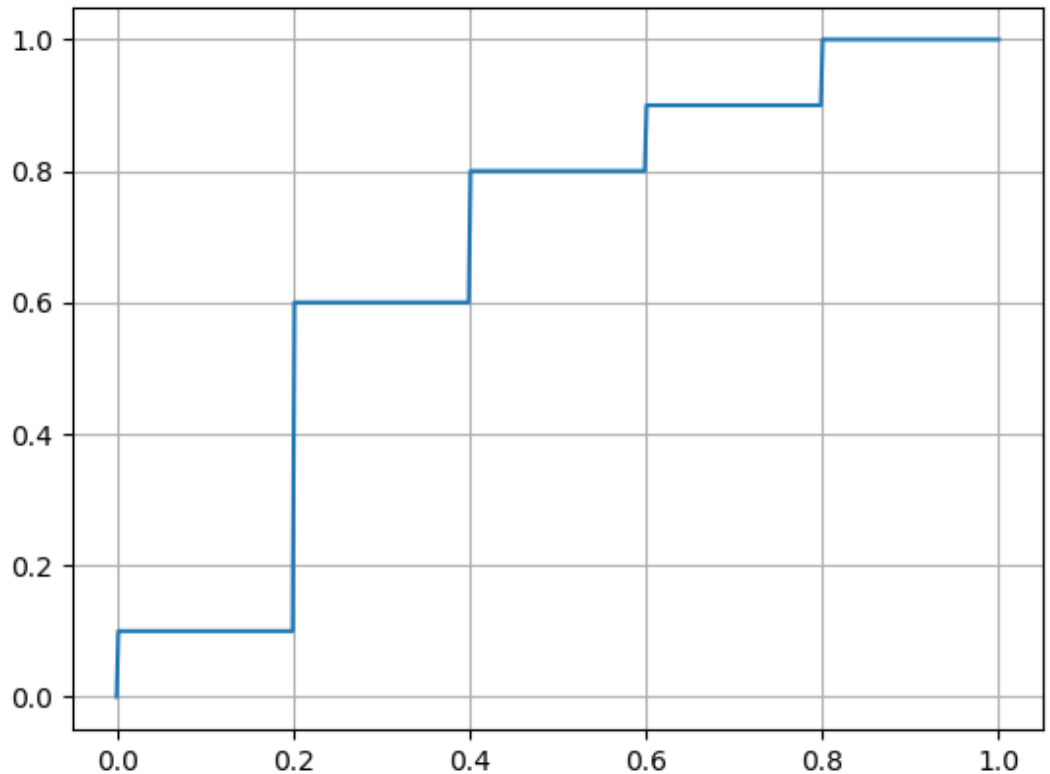
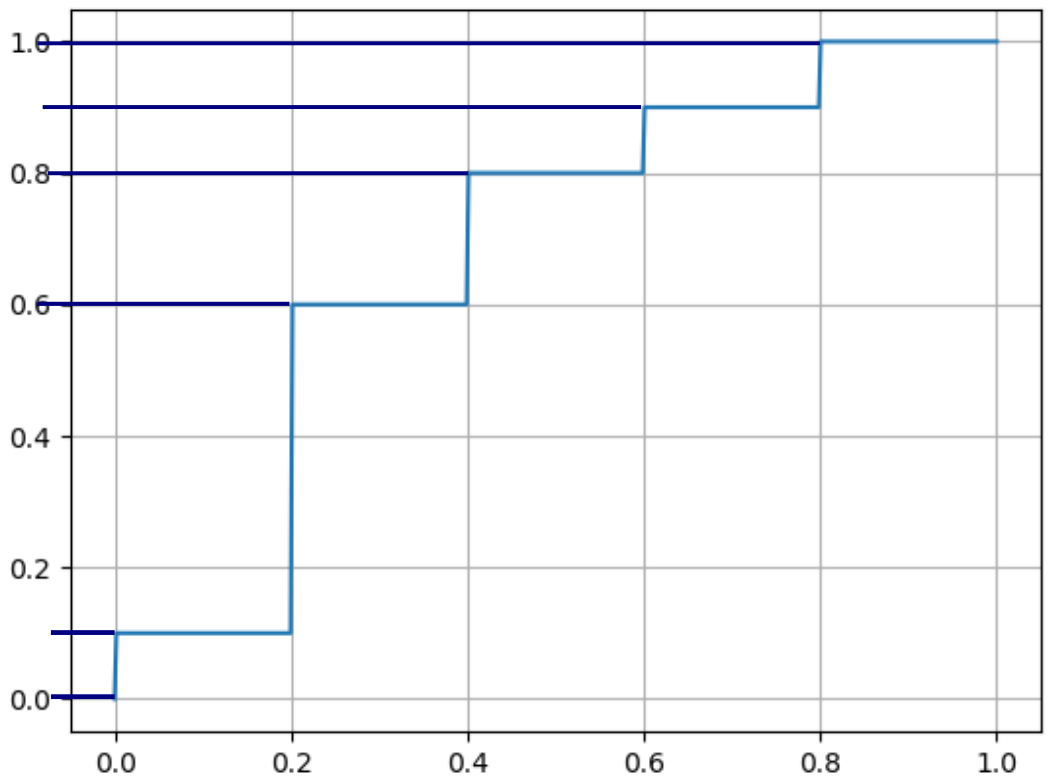
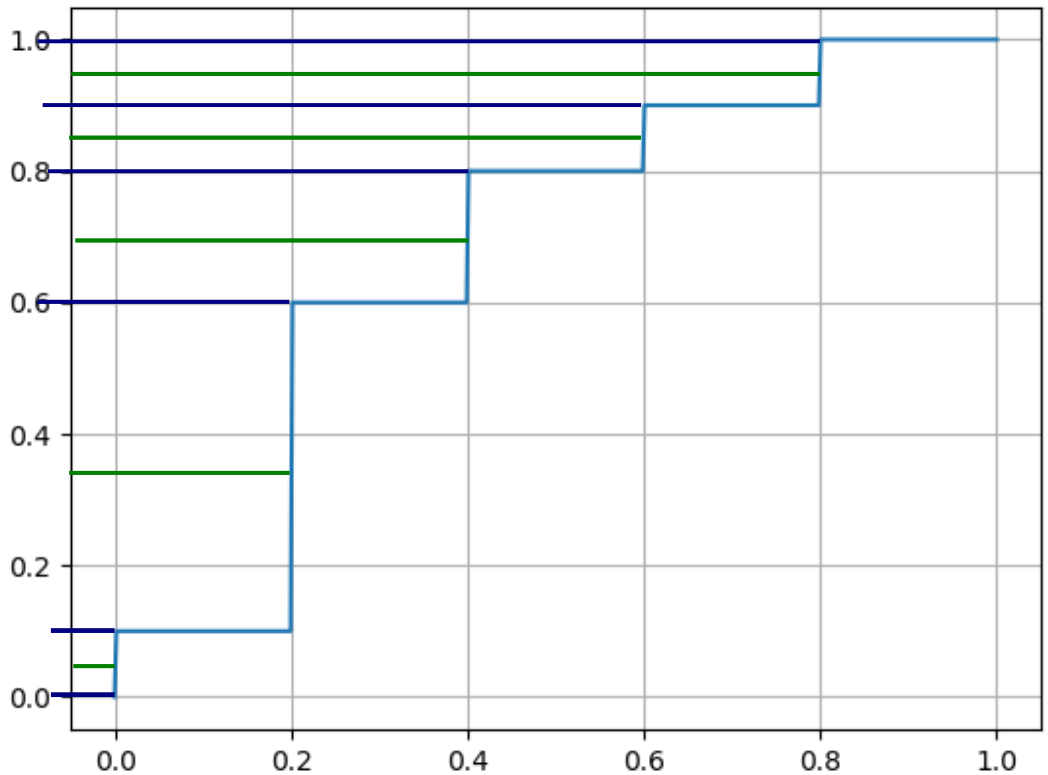
Idea behind Shannon-Fano-Elias code



Idea behind Shannon-Fano-Elias code



Idea behind Shannon-Fano-Elias code



Example

$$\underline{p} = [0.1, 0.5, 0.2, 0.1, 0.1]$$

$$\bar{F} = [0.05, 0.35, 0.7, 0.85, 0.95]$$

$$\underline{l} = [5, 2, 4, 5, 5]$$

$$\mathcal{C} = \{00001, 01, 1011, 11011, 11110\}$$

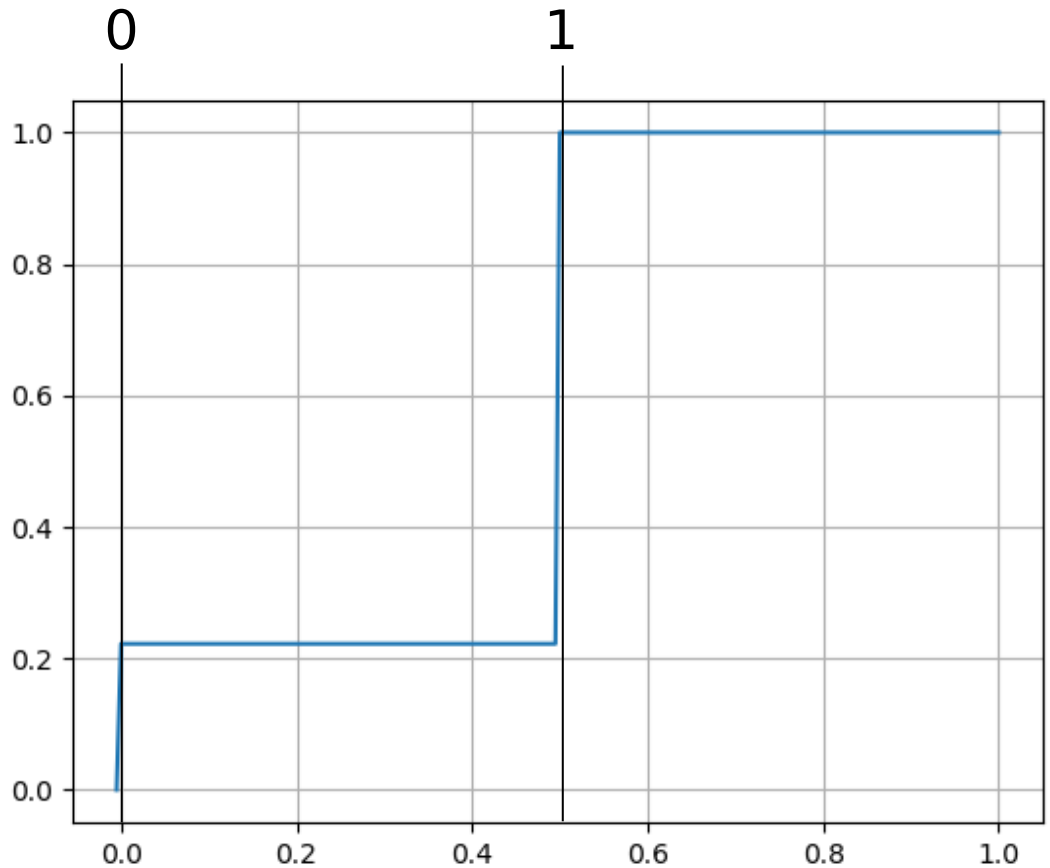
Extension to longer sequences

WLOG assume $\mathcal{X} = \{0, 1, 2, \ldots, m-1\}$

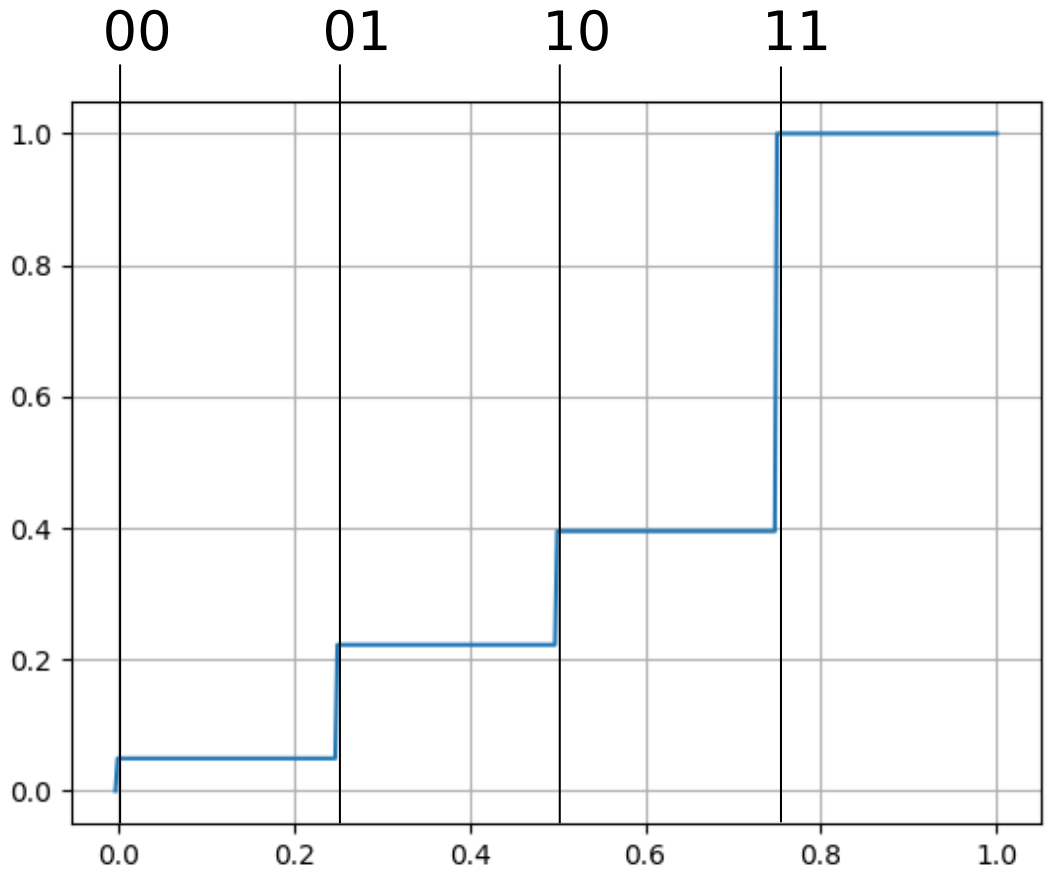
Write $x^n = (x_1, \ldots, x^n) \in \mathcal{X}^n$, in $m - ary$

$$b(x^n) = \sum_{i=1}^{n} x_i m^{-i}$$

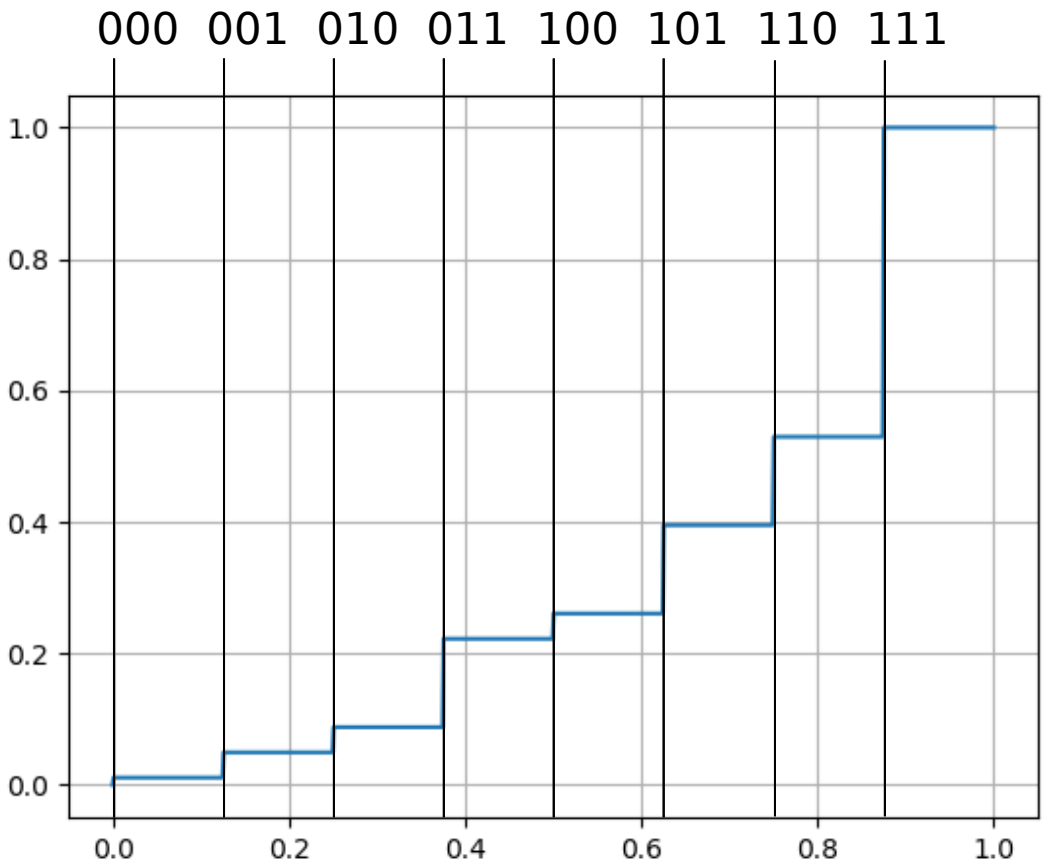
Increasing sequence lengths



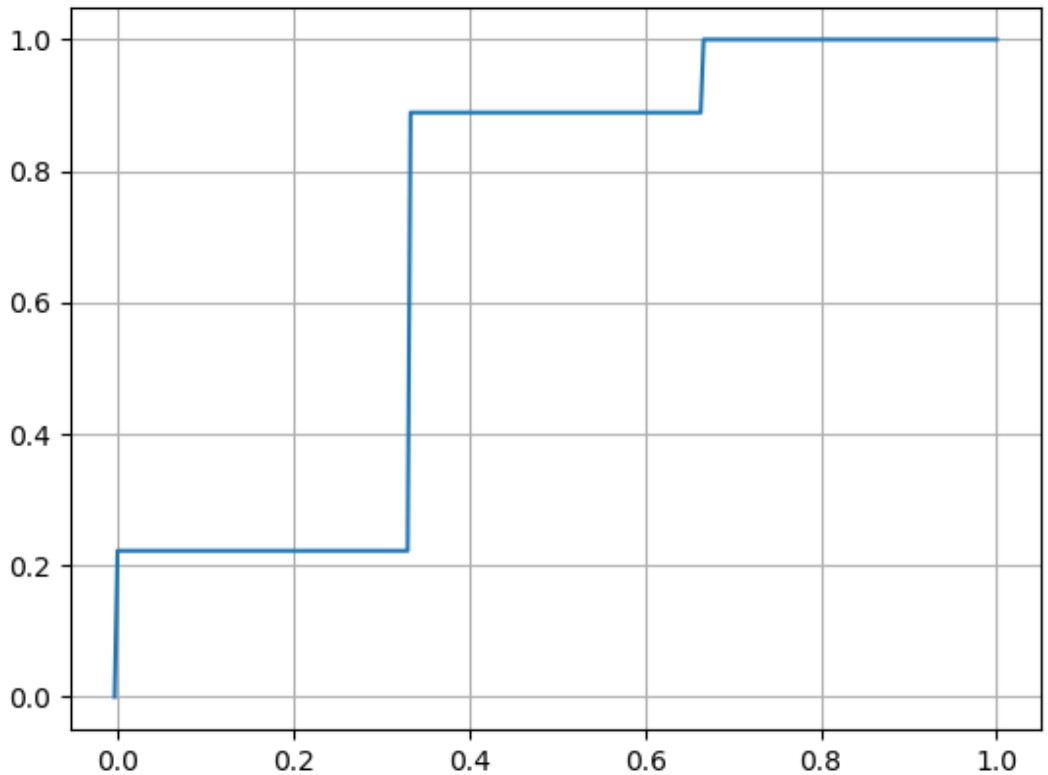
Increasing sequence lengths



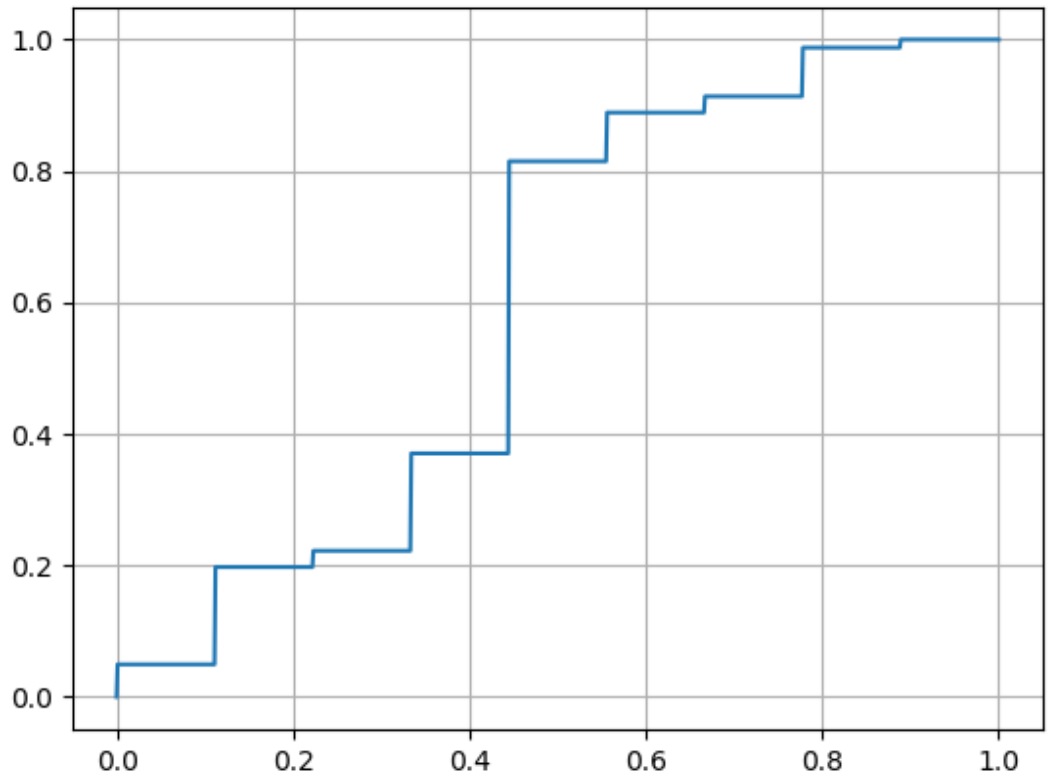
Increasing sequence lengths



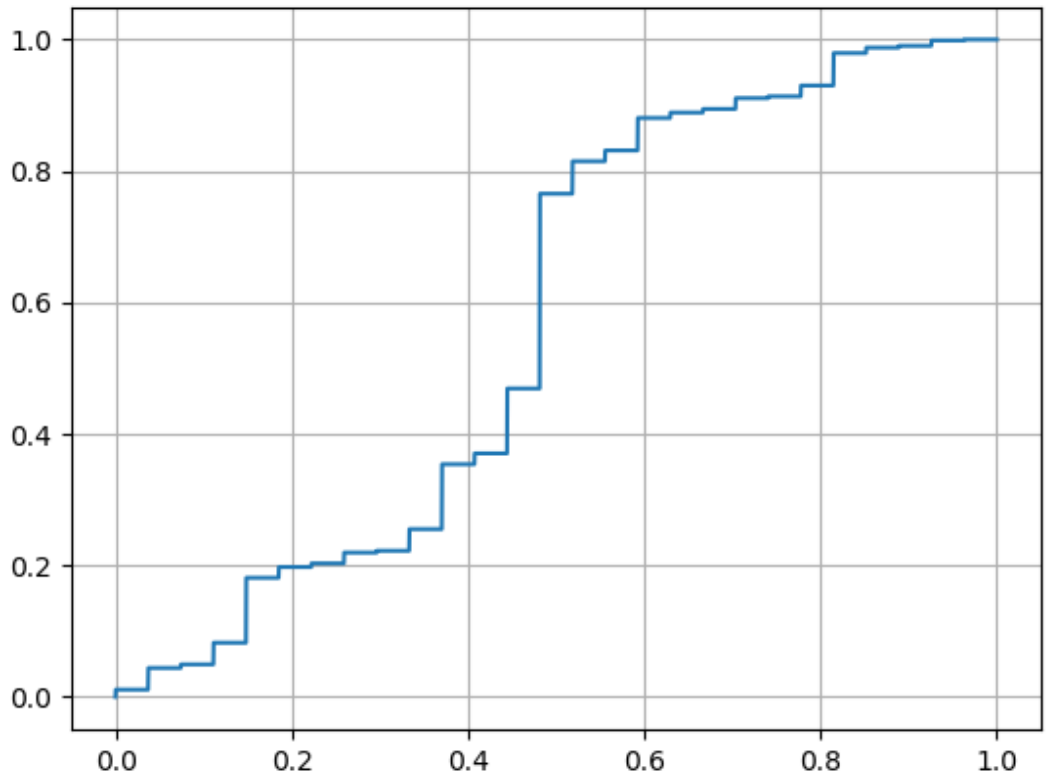
Increasing sequence lengths



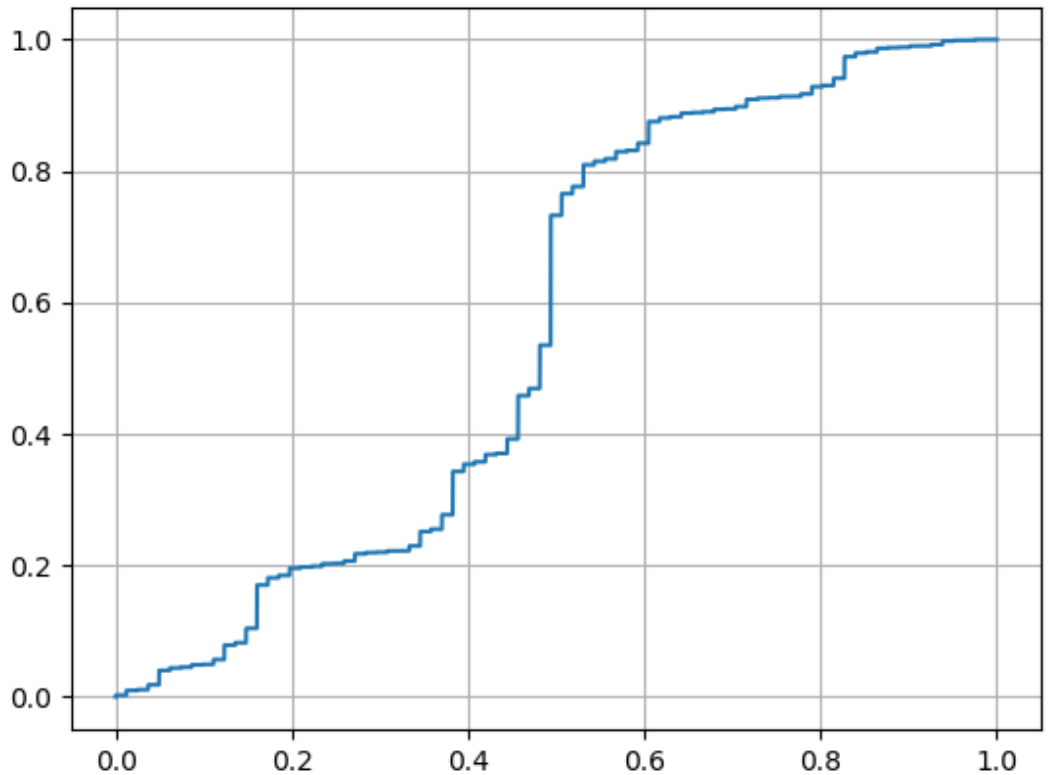
Increasing sequence lengths



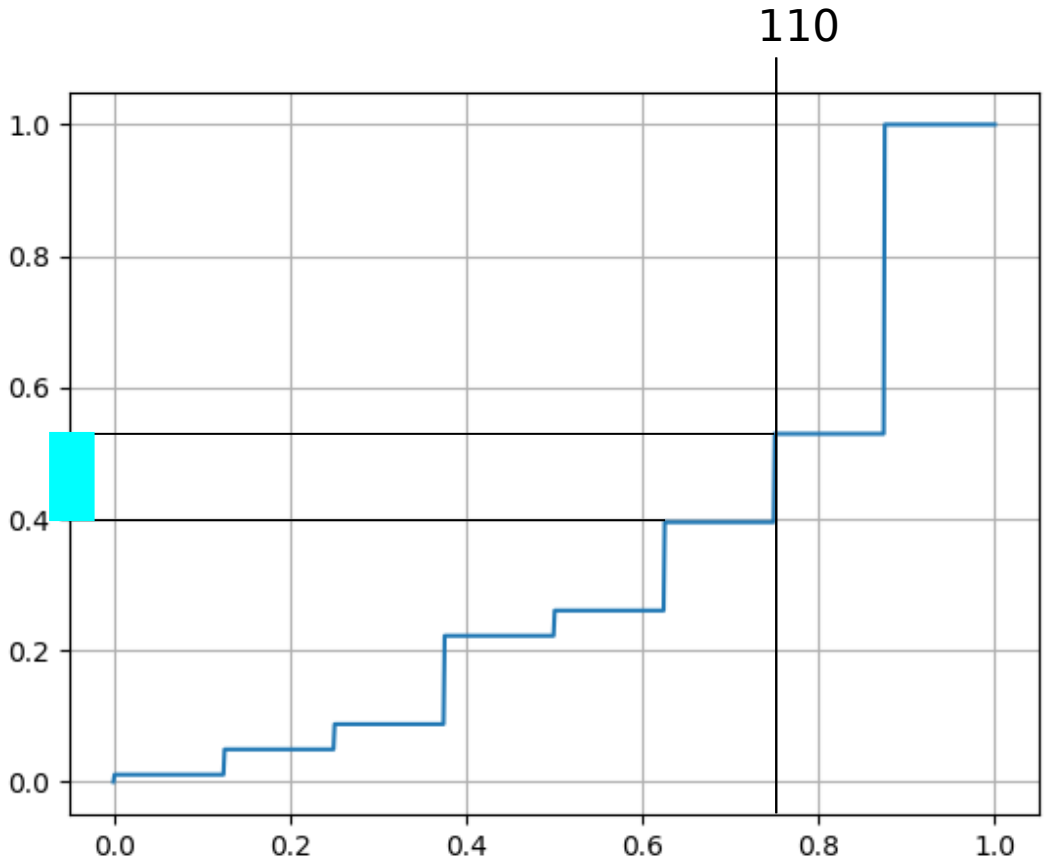
Increasing sequence lengths



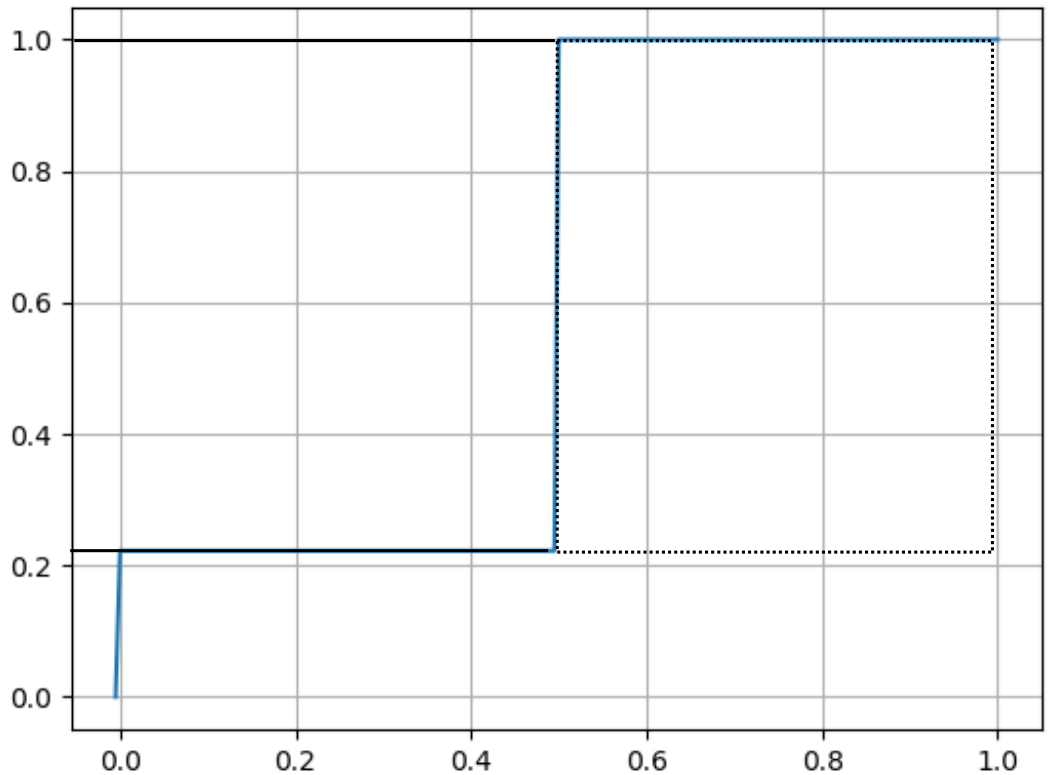
Increasing sequence lengths



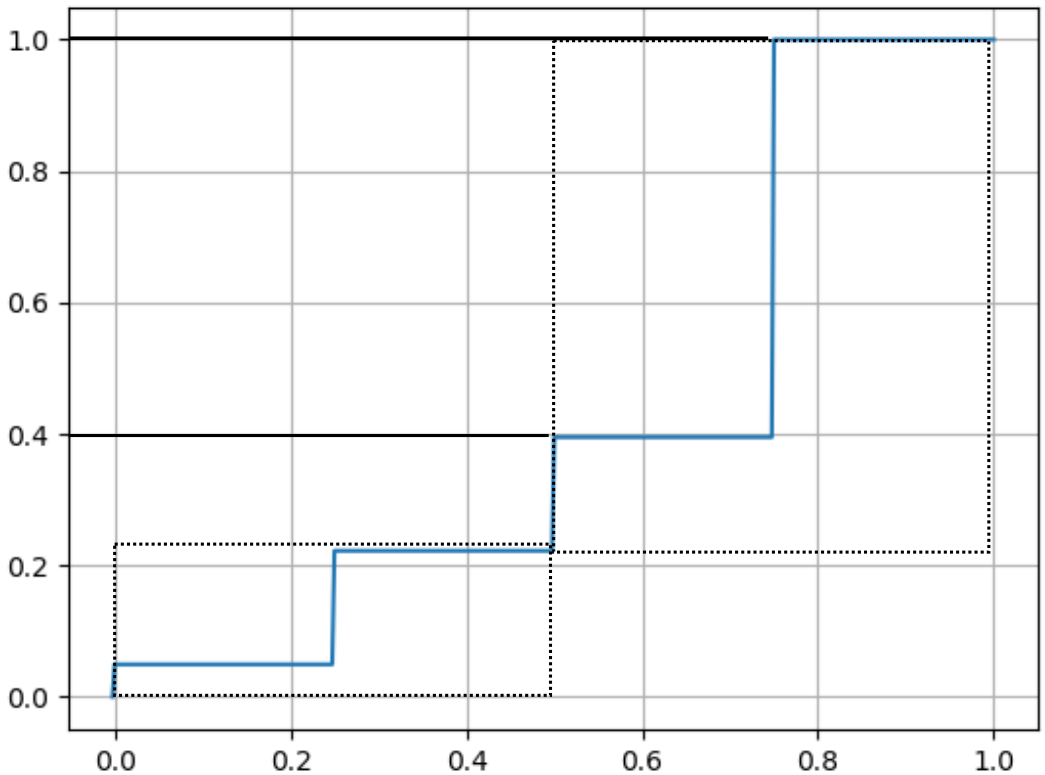
Online computation of interval



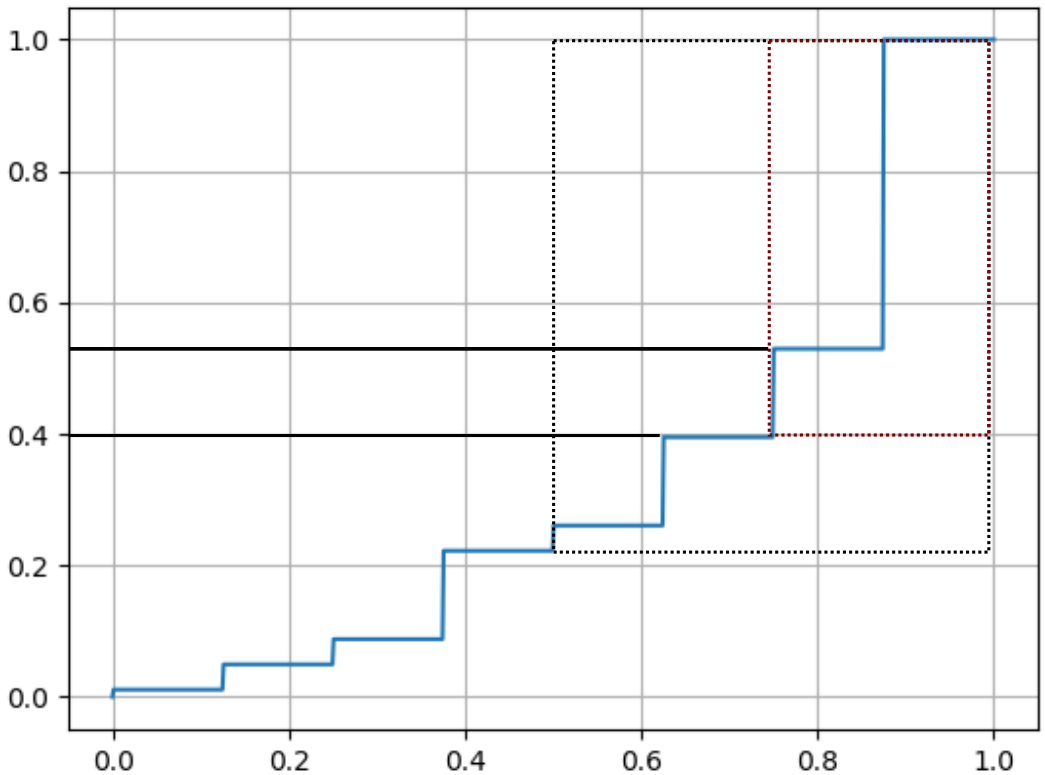
Online computation of interval



Online computation of interval



Online computation of interval



Basic mathematical idea

Verify the following recursion:

$$F(x^n) = F(x^{n-1}) + p(x^{n-1})F(x_n)$$

$$p(x^n) = p(x^{n-1})p(x_n)$$