

## Practice - LAB - part 1

1. Consider the two random variables  $X$  and  $Y$  that takes values  $\{x_1, \dots, x_N\}$  and  $\{y_1, \dots, y_M\}$  (you can decide  $N$ ,  $M$  and the values of  $x_n$ 's and  $y_m$ 's).
  2. Define a joint probability mass  $p(x, y)$ .
  3. Compute all the conditional and the marginal densities of the two random variables  $X$  and  $Y$ .
  4. Compute all the possible entropies and the mutual information.
  5. Check some inequalities in the slides (for instance  $H(X, Y) \leq H(X) + H(Y)$ ).
  6. Plot something similar to a diagram-bar as in the slides, in order to show the relationships among all the possible entropies and the mutual information.
  7. Change the joint probability mass  $p(x, y)$  and repeat the procedure above; what happens if  $Y = X$ ? what happens if  $X$  and  $Y$  are independent?
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8. Consider the marginal densities  $p(x)$  and  $p(y)$  and  $X$  and  $Y$ . Create a random number generator for  $X$  and  $Y$ .