## Tips for Writing Lecture Notes or Papers with Latex

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## $\sqrt{}$ Use punctuation in sentences with equations.

Equations, like words, are part of the sentence and therefore we need to use punctuation. For instance, Shannon showed [1] that the capacity of a memoryless channel is given by

$$C = \max_{P_{\mathbf{x}}} I(X;Y),\tag{1}$$

where the random variables X and Y denote the input and the output of the channel, respectively. Note, that in (1) there is comma which is part of the punctuation in sentence.

#### $\sqrt{}$ Use the right mathematical notation.

For instance, the pmf of a random variable X with an alphabet  $\mathcal{X}$  may be written as  $P_X$  (or P(x) for all  $x \in \mathcal{X}$ ), but not as P(X).

## $\sqrt{}$ Citation and references: use them correctly.

Latex is a powerful tool for writing math correctly. For instance, it allows you to give names to equations, theorem and figures using the \label command and then refer to them by the given name. When you refer to an equation add (). For instance, the capacity of a memoryless channel is given in (1).

## $\sqrt{}$ Learn how to write math from good writers.

For instance, use the textbook by Cover and Thomas [2] as an excellent example of a good writing.

## $\sqrt{}$ Use correctly capital letters.

When you start a sentence, or there is a name involved use capital letters. For instance, in Equation (1), in Figure 1, in Theorem 1. However, we write, in "the equation above" and not "in the Equation above".

#### $\sqrt{}$ Emphasis new definitions.

Use italic style for new definitions. For instance: The *capacity* of a channel is the supremum of all achievable rates.

 $\sqrt{$  Use  $\setminus \log$ ,  $\setminus Pr \setminus \max$  and  $\setminus \min$ . For instance, do not write

but

$$H(X) = \sum_{x} P(x) log P(x)$$

$$H(X) = \sum_{x} P(x) \log P(x).$$

 $\sqrt{}$  Keep one equality in a line. If you need more than one equality, break it using equarray or align. Do not have

$$I(X;Y) = H(X) - H(Y|X) = H(X) + H(Y) - H(Y,X),$$
(2)

instead use the following pattern, which is taken from [2]:

$$I(X;Y) \stackrel{(a)}{=} H(X) - H(Y|X)$$
$$\stackrel{(b)}{=} H(X) + H(Y) - H(Y,X), \tag{3}$$

where

- (a) follows from definition of mutual information,
- (b) follows from the chain rule of entropy.
- $\sqrt{}$  If possible, provide names for lemmas and theorems.

For instance:

Lemma 1 (Nonegativity of mutual information): For any two random variables, X,Y,

$$I(X;Y) \ge 0,\tag{4}$$

with equality if and only if X and Y are independent.

This is done using brackets after the lemma, namely,  $\begin{lemma} [Nonegativity of mutual information]. <math>\sqrt{$  Introducing the theorem.

# Do not state the theorem abruptly, but first introduce it. Prepare the reader to understand the theorem, understand its main idea and its importance. Here is an example:

Example:

We now show that the entropy of a discrete random variable with finite alphabet  $\mathcal{X}$  is bounded by logarithm of the alphabet size, i.e.,  $\log |\mathcal{X}|$ . Furthermore, the unique distribution that achieve this bound is the uniform distribution over  $\mathcal{X}$ .

Theorem 1: For any discrete random variable X with a finite alphabet  $\mathcal{X}$ ,

 $H(X) \le \log |\mathcal{X}|$ 

with equality if and only if X has a uniform distribution over  $\mathcal{X}$ .

## $\sqrt{}$ Introducing the proof.

When you have a complicated or just long proof, write a paragraph before the actual proof, where you explain the main ideas or the main steps of the proof. Do not start the proof abruptly, but first explain the reader what to expect before he/she starts reading the proof itself.

## $\sqrt{}$ Placing figures and table in the right place in the paper.

Its important to place the figure immediately after you mention it or even a little before. You may use the option [h!] to force it, namely, if its a figure use  $\begin{figure}{figure}{[h!]}{.}$  Similarly for tables.

## $\sqrt{}$ Keep reasonable size of paragraphs.

The division into paragraphs is very important. A new paragraph should have a new idea or a new subject and vis versa, namely new idea or subject should be in a new paragraph. Its important extremely important to avoid paragraphs of one sentence or of more than half a page.

#### REFERENCES

[1] C. E. Shannon. A mathematical theory of communication. Bell Syst. Tech. J., 27:379-423 and 623-656, 1948.

[2] T. M. Cover and J. A. Thomas. Elements of Information Theory. Wiley, New-York, 2nd edition, 2006.