Some uses of asymptotic notations considered harmful

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The title of this note is a humorous *cliché*. Its content is made of remarks on the uses of asymptotic notations. But I hope that my attempt since years to analyse and separate the bad uses from the good uses will be taken seriously, even by those that have already read Meyer (2002). At the moment, this note is mainly on $O(.)$, and, a little less, on $\Omega(.)$.

Let's start by what I consider good uses: in science and informatics (I dislike the name "computer science", and informatics is broader), we must stay humble; computers do not always take the same number of cycles to execute an instruction; with cache mechanisms, even two identical instructions can take a distinct time. Hence analysing an algorithm giving its execution time without asymptotic notation would be kind of a deception. Similarly, for cellular automata, there are acceleration theorems by increasing the number of states and the size of the neighborhoud. For memory use, it can depend of the size of pages, of words, etc.

But, in theoretical informatics and in discrete mathematics, many results are published with asymptotic notations for combinatorial structures and their properties, and not for algorithms. For a function that estimates a property of a family of combinatorial structures, the asymptotic notations hide an important part of reality. It seems sometimes justified to have asymptotic notations in introduction or in conclusion of an article. But it is harmful to not give the true combinatorial constants on top of asymptotic notations in the statement of lemmas, propositions, theorems, and corollaries. Why harmful ?

- It makes the researcher lazy and clumsy with calculus.
- It encourages proof ideas instead of true proofs. I like proof ideas, but only in summary before the true proof, when we don't talk about very simple results.
- It is a kind of snobbism to look "true" researcher, and follow the direction of flow. It can hide a superiority feeling: "I do not give the constants to the mere mortals, they would not understand them." (I'm looking at you, stupid anonymous referee... XD).

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- It prevents knowing the best result obtained by the authors of the article. And hence it prevents also publishing improvements.
- It encourages a "general knowledge" science for the persons with a good memory, to the detriment of a "skill" science for the persons who trouble themselves at improving down to the details.

Hence, writing $O(n)$ when it is enough to think 2 seconds to see that it is $2 \times n - 3$, that is useless. Giving directly the exact value avoids this snobbism. And even if after that it is used for the execution time of an algorithm, it is totally valid to write $O(2 \times n - 3)$, to explicit at least the constants that are of combinatorial nature. It permits finer comparisons.

A friend answered me on a first version of this note: "Hello Laurent, I agree on some of the points, in particular on 'the O prevents publishing improvements'. This is especially annoying when the O appears (you will be horrified!) at the exponent and not only as a multiplicative constant.". Indeed, I have already seen a few times $n^{O(1)}$ to say polynomial. I find this ridiculous. I don't know if it is to gain half an inch of text or to show off, but this kind of "cleverness" doesn't make me want to applaud... XD

References

E. A. Meyer. "Considered harmful" essays considered harmful. `https://meyerweb.com/eric/comment/chech.html`, 2002.

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