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Distracting Digits

FROM THE SIAM PRESIDENT

By Nick Trefethen

Sometime around last Halloween, the world population reached 7 billion. So we all wanted to make a fuss about the 7 billionth baby. Who was she? In the Philippines, newborn Danica May Camacho was offered as a candidate. India put forward a baby girl called Nargis. Of course, everybody knows these choices are arbitrary. The world's population is a ten-digit number, and we certainly don't know it to ten digits of accuracy. Maybe two digits? Three? Yet there's something irresistible about high precision, even if it's artificial.

This is as good a time as any to congratulate SIAM on reaching its own fuzzy milestone. Sometime around now, the 100th SIAM student chapter is opening for business. It's been a remarkable progress since the first student chapter was set up in 1975. Congratulations! The only thing is, we're just a little unsure which chapter to congratulate. Is it Northwestern? Dartmouth? Reading? Peking? Although the number 100 has barely 3 digits, our accuracy still falls a little short since it all depends on exactly how you count a couple of borderline cases—new chapters just going through approval or old ones currently inactive. In any event, reaching 100 student chapters is a cause for real satisfaction and reflects a healthy engagement of applied mathematics students with research.

As a dyed-in-the-wool digits man, I happily recollect other stories of the encounter between high-precision aspirations and low-precision data. Back when I was in graduate school, Steven Weinberg published his marvelous book *The First Three Minutes* about the physics of the early universe. I remember describing the book to a non-scientist friend who said, "Wow, I didn't realize they knew the age of the universe that accurately!"

Sometimes we can take advantage of the magic of multidigits in our work. For example, suppose you calculate the integral of $\exp(-x)\cos^5(6x)\sin^6(5x)$ from −1 to 1 in Maple. The result is a symbolic expression with 94 terms, a typical term being (195/86656)exp(−1)sin(26). How in the world do you know if this extraordinarily complicated answer is correct? Well, of course, you evaluate it numerically! When you calculate 10 digits or so and they match a result from numerical quadrature, that is highly reassuring. It isn't a proof, but checking those digits is the basic first step that any careful scientist would take. If only every multidigit number we run across had some genuine content like this one.

An example of empty digits comes up in the controversial area of impact factors for journals, which are based on citation counts of articles. Thomson Reuters publishes its impact factors to 4 digits of accuracy. Thus, for example, the 2010 impact factor of *SIAM Review* was 6.580, and that of *SIAM Journal on Imaging Sciences* was 4.279. Some people feel that such numbers are so unreliable that we should regard them as meaningless. (For a fascinating discussion, see "Nefarious Numbers" by Arnold and Fowler in the March 2011 *Notices of the American Mathematical Society*.) I don't go quite that far, but one thing I am sure of is that the last two digits of a four-digit impact factor are content-free. For those digits to have meaning, the impact factor would have to be based on a sample of millions of papers and citations, whereas, in fact, the sample sizes are only in the hundreds. I get so cranky about the persistence of these silly extra digits that I have asked: If a number like this must be reported in a SIAM committee paper, couldn't it perhaps be rounded to 6.6 or 4.3? Alas, I have learned that the power of the SIAM president does not extend so far.

Which brings me to something startling I learned last month about myself. One of the products of the citation-counts industry is the list of *Highly Cited Researchers* (HCRs) compiled by Thomson Reuters. There are 6103 of these in all subjects worldwide, 343 of them in mathematics. I am happy to be one of those 343, a distinction I regard as having only a certain amount of meaning. Many Fields Medalists, for example, are not HCRs.

Here is what I learned. An article by Panaretos and Malesios in this February's *Notices*, "Influential Mathematicians: Birth, Education, and Affiliation," is full of tables detailing the career trajectories of the HCRs in mathematics. I looked at Table 7, which correlates where the HCRs were born against where they now live. Among those born in Europe, there are 54 who now live in the USA. And among those born in the USA, how many are there who, like me, live in Europe? To find the answer to this question, I looked in Table 7 at the intersection of the column labelled "EU" and the row labelled "USA."

The number is 1. That's me, Billy Pilgrim. I'm a rounding error.