Dystopia

For several of the past ten years, I have helped to organize and manage a summer program for undergraduates that is sponsored by the laboratory where I work. Everyone who's acted as a mentor in a program like the one at my job will tell you it takes a lot of effort ("Skate-boarding in the halls is strictly forbidden!"), but those efforts are rewarded the joy of working with bright and eager young scientists ("This student writes more code in a week than I do in a month!").

One side-effect of my involvement is that I get part of the picture of how undergraduate education in the sciences and engineering is evolving. In some areas things are changing more rapidly than I'd guessed while in other ways change is not nearly fast enough. Both trends are mostly healthy but, in this imperfect world there is, as usual, some cause for worry. On the too fast side - there are now majors in topics like gaming and web design. These topics are, in my humble opinion, well worth learning something about and may provide a way to earn a living, but in and of themselves surely do not constitute an education. On the other side, I was slightly dismayed to discover that some mathematics majors at first-rate universities can graduate without having taken any courses in computing.

The foundational document, "Preliminary discussion of the logical design of an electronic computing instrument" by Arthur W. Burks, Herman H. Goldstine, and John von Neumann is treasure trove of information for those interested in the history of digital computers. It contains many of the basic ideas that have driven the development of programming and computing, including the notion of the stored program machine. Although the concept had certainly been invented earlier several times (by Turing in 1936, Zuse in 1936, Eckert and Mauchly in 1943, etc), the Burks-Goldstein-von Neumann report had the greatest influence. An interesting feature of the report is its discussion of possible uses of computing devices. The usual things related to modeling of physical situations are, of course, mentioned but there is also material on non-numeric, combinatorial applications.

It is these combinatorial applications that are now heavily used by some mathematicians working in fields that were traditionally called "pure", such as algebraic topology, study of groups, and graph theory. I want to be clear that these application are not based on symbolic computing, which is also widely used, but rather on use data structures and combinatorial algorithms to test out conjectures and construct examples as an aid to proposing and proving theorems. To do this effectively and productively, the researcher has to have a fairly deep understanding of data structures and the practical meaning of computational complexity. The investigations cannot by carried out merely by running an existing script on Mathematica, Matlab, R, etc. Things often have to be built from the ground up. Doing so requires a solid background in computing.

The author Gary Shteyngart, in his beautiful recent novel "Super Sad True Love Story" imagines a dystopian near future in which the world is much more digitally connected than the one we live in. One can get a profile of another person simply by pointing something like an advanced iPod in the direction of that person's iPod. Individual credit ratings are now common knowledge, posted every time one comes near to a "credit pole". Almost nobody reads printed matter, but everyone streams stories and texts to friends. People "verbal" one another rather than talking and the one of the most socially elevated jobs is fashion store clerk. However, there is one false note in Shteyngart's amazing construction. No mention of made of how the technology is created and none of the characters in the novel exhibit any knowledge of how it works. In short, the main characters are sensitive and intelligent college graduates, but they are not educated.

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