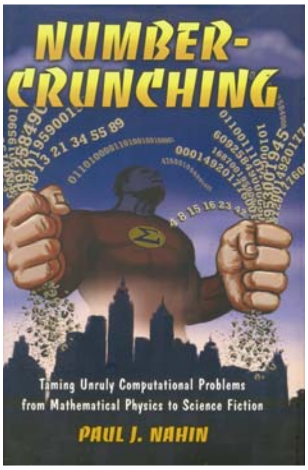

Number Crunching: Taming Unruly Computational Problems from Mathematical Physics to Science Fiction. Paul J. Nahin. Princeton University Press, 2011. xxvi + 376 pp. Price: $29.95/£20.95.

Having read Nahin's *When Least is Best*, I was looking forward to reading his latest book on how seemingly intractable computational problems have been subdued. His racy and anecdotal style keeps the reader engaged. But the book fell far short of my expectations.

Nahin adopts an engaging style in describing computational problems and their possible solutions. He also does not shy away from presenting equations and ploughing through the solutions. Thus the book is for those who are mathematically at least semi-literate. He first serves up the hors d'oeuvre in the form of Fermat's last theorem, and the calculation of irrational numbers and continued fractions, peppering the discussion with anecdotes. He describes well the three approaches to the hot plate problem. Given the temperature at the edges of the plate, how does one find the steady-state temperature at the plate centre? The analytical, numerically iterative and the Monte Carol method cover the methods adopted by applied mathematicians. Other problems he describes are the Fermi–Pasta–Ulam computer experiment and the Leap Frog problem.

Problems are posed in each chapter, some easy, some tough, but many interesting. Nahin provides solutions to them at the end of the book. This gives the reader a feel for the field as well as a sense of participation.

The book reserves one chapter each to three problems: the hanging mass, the celestial three-body problem (sun–earth–moon) and electrical circuit. While these problems are important, I think the large amount of space devoted to them is the book's failing. Over 80 pages out of some 370 are devoted to the three-body problem. I found this tiresome, even though I have an interest in many-body theory. So although Nahin does a competent job, his approach is not inclusive – he leaves out several that most authors would not. A typical problem, say, each from solid state, quantum chemistry or bioinformatics should have found some place in a book on number crunching.

My own understanding is that mounting a credible attack on 'hard' computational problems, if I may adopt a battlefield terminology, requires a two-pronged approach: suitable hardware and suitable algorithms. As for the hardware part, Nahin describes the first electronic computers, the ENIAC and the MANIAC (Mathematical Analyser, Numerical Integrator and Computer). But curiously, he does not detail the enormous advances that followed. The development of supercomputers and parallel processing are given a bye. Nahin is also silent on the efforts by scientists to configure hardware for specific problems such as Pearson's Ising model processor or the QCDPAX for lattice QCD.

Regarding the algorithmic part, Nahin does describe the major strategies one adopts in the context of the hot plate problem. Selecting out the topics is the author's prerogative. My own wish list would have included the fast Fourier transform with its antecedents in the work of Gauss, a matrix diagonalization method, say Lanczos' (a form of which was reportedly used by the ancient Egyptians) or Davidson's celebrated approach which is employed by quantum chemists, and perhaps quantum algorithms and/or neural networks. On p. xxiv, Nahin mentions Metropolis promising that he will appear in a more central role in chapter 3. I eagerly turned to chapter 3, only to find that Metropolis' role in the development of the electronic computer is mentioned, but not the famous algorithm that goes by his name.

One chapter is devoted to computers in science fiction. The science fiction literature is replete with computers, mostly malevolent and robots. One is familiar with HAL of *2001 A Space Odyssey* fame and the cognoscenti have read Philip K. Dick's *Do Androids Dream of Electric Sheep?*, which was made into the cult classic 'Blade Runner'. One would have expected Nahin to guide us to the best reads and provide insights in this area which have escaped our attention. Alas, he does no such thing. Instead he has reeled-off verbatim some of his own science-fiction writings. Each of them runs into several pages. This was by far the most disappointing chapter of the book.

What also detracts from the readability of the book is repeated harking back to his earlier books. One does not need to read his book on *Duelling Idiots* to find out the pitfalls associated with the mid square method of generating random numbers. It is there for one to read in any book which describes random number generation. What is also irksome is a large number of references which are more in the nature of extensions of the chapter and less of a reference. There are repeated references to Feynman. It has become standard fare to refer to him and of course to quote Einstein (which Nahin does) – a sort of science writer's version of propitiating the gods.

As a practising numerical physicist I did learn from this book and enjoyed reading parts of it. But for one who has an amateur interest or a beginning student, the book would provide a narrow and lopsided view of the field. With some effort Nahin could have come up with a much better book.

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