



Harel, David: Computers Ltd.: What They Really Can't Do.

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All of us know that computers are just *amazing*. They have become such important, omnipresent, and inevitable components of our lives that most people - regardless of professional area, subject specialisation, or even age - would find it most difficult to do without them. Since the fifties, science fiction authors have depicted computers as potentially omnipotent rulers of the galaxies; leading trade journals and magazines have popularized the view that, given the right kind of software, they will do whatever you want them to. These days, even humble librarians like you and me are aware that they can do practically everything.

Nevertheless, here comes David Harel, a professor of computer science and Dean of Faculty at the renowned Weizman Institute of Science in Israel, questioning this view outright. In his new volume, the author of the best-selling book *Algorithmics* focuses on what he calls “the bad news” and one of the fundamental yet under-reported facets of computers - the inherent limitations of their seemingly unlimited power.

This compact and well-written book comprises seven chapters.

- The first (*What is it all about?*) introduces us into the basics of computing and software.
- The second (*Sometimes we can't do it*) dives deeply into the “bad news”, discussing problems that “cannot be solved by *any* computer, past, present or future, running *any* program that can be devised, even if given unlimited

amounts of time and even if endowed with unlimited storage space [...]” One example of this category is the *tiling problem* (working out whether it is possible to cover an infinite plane with a given set of patterned tiles). Harel shows that problems of this kind are *noncomputable*, or undecidable, and even display various degrees of difficulty.

- Chapter 3 (*Sometimes we can't afford to do it*) deals with problems that are *intractable*, i.e. that cannot be solved in a reasonable amount of time, not even with faster computers or parallel processing techniques. Examples are games such as *Roadblock*, puzzles like *Towers of Hanoi*, or winning strategies for arbitrary chess problems.
- In Chapter 4 (*Sometimes we just don't know*) the author illustrates another category, the so-called “NP-complete” class of problems, such as monkey puzzles or the famous *travelling salesman problem* (aiming at determining the shortest route for a travelling salesman to visit several cities). Problems like these are not currently solved, but it is not clear if there will ever be a solution or not.
- In Chapter 5 (*Trying to ease the pain*), Professor Harel discusses possible solutions to the basic problem - parallelism (or “concurrency”), randomization, quantum computing, and molecular computing - which might, but only *might*, make things a little better in the future.
- Chapter 6 (*Turning bad into good*) is devoted to cryptography as a possible solution for some of the aforementioned problems.
- The last chapter (*Can we ourselves do any better?*) deals with some of the difficulties of “intelligent computing” or *Artificial Intelligence (AI)*, discussing concepts such as heuristics, knowledge and natural language.

Harel's book is certainly a thoughtful provocation to all of us naïve believers in the almighty power of computers and software. Unlike so many computer books, this is a text that probably will not be outdated after just a short period of time. It can be read (and enjoyed) on various levels; it is popular science writing as it should be. Certainly a must for all relevant library collections.

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