EXTENDED ABSTRACT

The foundations of computer science (Aho and Ullman 1994) are generally considered to have begun with the pioneering work of mathematicians such as Turing, Kleene, and Post beginning in the 1930s. The field is constructed primarily from discrete mathematics, including formal logic. Defining computer science in this way makes it difficult to view computing as a science in the strong sense of a science being a set of related disciplines involving observation of nature. However, computer science is a science in the way in which Simon (1996) characterizes the field.

There are problems arising from this view of computer science. The first problem is one of history. As Ifrah (2001) documents, if calculation can be seen to be the bedrock on which computing is founded, then we must look further back. Talley sticks, abaci, and devices such as the Antikythera mechanism qualify as computing and so the foundations should be broadened to accommodate their operation. The second problem can be phrased with comparison with mathematics. Early mathematics in the form of geometry used instruments such as a straight edge, compass, and plumb line. However, we would not suggest that mathematics is tied to this hardware, and so at least from a pedagogical perspective, mathematics is taught as “being out in the world.” For instance, one can see conic sections, lines, and fractals in nature. Oddly, computing is not similarly positioned—as being observed. The general framework when teaching computer science is to begin with a computer and to proceed to do computing. To return to the second problem, it is then that computing is traditionally considered to be equivalent to using a specific device, a computer. One engages in computing on computers.

One solution to the two problems of capturing the foundations of computing is to treat modeling and simulation (M&S) as being at the heart of computing (Fishwick 2014), rather than M&S being a discipline on the periphery. If the Antikythera mechanism involves computing, then computing is captured by a mechanical model of the complex gear train that made the celestial mechanics computation—known at the time—possible. But this is analog computing, suggesting that for a broader computer science, analog computing must be embraced at the foundational level of computer science. Such an embrace naturally solves the issue of whether computer science is a science, since models serve as human interactive interfaces to nature.

REFERENCES


BRIEF BIOGRAPHY

Paul Fishwick is Distinguished Chair of Arts and Technology and Professor of Computer Science at the University of Texas at Dallas. He began employment working at Newport News Shipbuilding and at NASA Langley Research Center. Fishwick obtained the PhD in Computer and Information Science at the University of Pennsylvania, followed
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