The Algorithmic Lens: How the Computational Perspective is Transforming the Sciences

Computational research transforms the sciences (physical, mathematical, life or social) not just by empowering them analytically, but mainly by providing a novel and powerful perspective which often leads to unforeseen insights. Examples abound: quantum computation provides the right forum for questioning and testing some of the most basic tenets of quantum physics, while statistical mechanics has found in the efficiency of randomized algorithms a powerful metaphor for phase transitions. In mathematics, the P vs. NP problem has joined the list of the most profound and consequential problems, and in economics considerations of computational complexity revise predictions of economic behavior and affect the design of economic mechanisms such as auctions. Finally, in biology some of the most fundamental problems, such as understanding the brain and evolution, can be productively recast in computational terms. My talk is structured around eight vignettes exemplifying this pattern.

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