

“Computers Are Becoming Less General-Purpose: Deep Learning, Hardware Specialization, and the Fragmentation of Computing”

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Abstract:

It is a triumph of technology and of economics that our computer chips are so universal. Countless applications are possible because of the staggering variety of calculations that modern chips can compute. But, this was not always the case. Computers used to be specialized, doing only narrow sets of calculations. Their rise as a ‘general purpose technology (GPT)’ only happened because of ground-breaking technical advancements by computer scientists like von Neumann and Turing, and virtuous economics common to general purpose technologies, where product improvement and market growth fuel each other in a mutually reinforcing cycle. This paper argues that technological and economic forces are now pushing computing in the opposite direction, making computer processors less general-purpose and more specialized. This process has already begun, driven by the slow-down in Moore’s Law and the algorithmic success of Deep Learning. This threatens to fragment computing into ‘fast lane’ applications that get more powerful customized chips and ‘slow lane’ applications that get stuck using general-purpose chips whose progress fades. The rise of general purpose computer chips has been remarkable. So, too, could be its fall. This paper outlines the forces already starting to fragment this general purpose technology.

Bio:

Neil Thompson is a Research Scientist at MIT’s Computer Science and Artificial Intelligence Lab and a Visiting Professor at the Lab for Innovation Science at Harvard. He is also an Associate Member of the Broad Institute, and was previously an Assistant Professor of Innovation and Strategy at the MIT Sloan School of Management, where he co-directed the Experimental Innovation Lab (X-Lab). He has advised businesses and government on the future of Moore’s Law and have been on National Academies panels on transformational technologies and scientific reliability. He did his PhD in Business and Public Policy at Berkeley, where he also did Masters degrees in Computer Science and Statistics. He has a masters in Economics from the London School of Economics, and undergraduate degrees in Physics and International Development. Prior to academia, he worked at organizations such as Lawrence Livermore National Laboratories, Bain and Company, The United Nations, the World Bank, and the Canadian Parliament.