SORS: Datacenter Computers: modern challenges in CPU design

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Abstract: Computers used as datacenter servers have usage patterns that differ substantially from those of desktop or laptop computers. We discuss four key differences in usage and their first-order implications for designing computers that are particularly well-suited as servers: data movement, thousands of transactions per second, program isolation, and measurement underpinnings.
Maintaining high-bandwidth data movement requires coordinated design decisions throughout the memory system, instruction-issue system, and even instruction set. Serving thousands of transactions per second requires continuous attention to all sources of delay – causes of long-latency transactions. Unrelated programs running on shared hardware produce delay through undesired interference; isolating programs from one another needs further hardware help. And finally, when running datacenter servers as a business it is vital to be able to observe and hence decrease inefficiencies across dozens of layers of software and thousands of interacting servers. There are myriad open research problems related to these issues.

Bio: Dick Sites is a Senior Staff Engineer at Google, where he has worked for 11 years. He previously worked at Adobe Systems, Digital Equipment Corporation, Hewlett-Packard, Burroughs, and IBM. His accomplishments include co-architecting the DEC Alpha computers and building various computer performance monitoring and tracing tools at the above companies. He also taught Computer Science for four years at UC/San Diego in the 1970s. His work at Google has included CPU disk and network performance anomalies, and web-page language detection. He currently works in the Google Translate group. Dr. Sites holds a PhD degree in Computer Science from Stanford and a BS degree in Mathematics from MIT. He also attended the Master's program in Computer Science at UNC Chapel Hill 1969-70. He holds 38 patents and is a member of the U.S. National Academy of Engineering.

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