Directions of Programming Research: Seeking a Needle in the Haystack?

(keynote*)

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The growing core counts of manycore hardware are racing ahead of programming paradigms and programmer productivity - not only in supercomputing, but to some extent also in mass market products. Almost all supercomputing applications had originally been written for a single processor and now more than 50% of the applications do not scale beyond eight processor cores, although the newest petascale machines employ up to 100,000 processor cores each. What about future exascale giants expected to come up with up to a million cores?

Programming research has stalled. The programming wall and the parallelism wall will force us to reshape the fundamental nature of system design, programming methods and system usage. However, the evolutionary path is not addressing the key issues of the fundamental problems. Extrapolating from today's petascale systems to future exascale machines yields for one such system an overall power consumption of about 10 GW, twice the power budget of New York City with a population of 16 millions. So we also have a power wall.

The scientific community with its current discussions looks like despairingly seeking a needle in a haystack. Extrapolations from current methods and practices are simply inadequate. The still unanswered question is, what will it really take to build affordable and successfully programmable high performance platforms. Will we be successful in addressing scalability challenges and in finding new programming models to support finding novel environments and algorithms which improve performance, resilience and power efficiency, and can exploit extreme concurrency?

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