Exploring Emerging Technologies in the HPC Co-Design Space

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Concerns about energy-efficiency and reliability have forced our community to reexamine the full spectrum of architectures, software, and algorithms that constitute our ecosystem. While architectures and programming models remained relatively stable for almost two decades, new architectural features, such as heterogeneous processing, nonvolatile memory, and optical interconnection networks, will demand that applications be redesigned so that they expose massive amounts of hierarchical parallelism, carefully orchestrate data movement, and balance concerns over accuracy, reliability, and time to solution. In what we have termed "co-design," teams of architects, software designers, and applications scientists, are working collectively to realize an integrated solution to these challenges. Not surprisingly, this design space can be massive, uncertain, and disjointed. To assist in this design space exploration, our team is using modeling, simulation, and measurement on prototype systems in order to assess the possible trajectories of these future systems. In this talk, I will sample these emerging technologies and discuss how we can prepare for these prospective systems.