Dr. Martin Berzins, University of Utah

Progress towards Exascale: Computer Architecture Innovations and Software Extinctions

Abstract: In every recent decade peak parallel computing power has increased by a factor of 1000x. The next increase will result in exascale computers by 2020 to 2024. Such computers are expected to opefate at 10**18 operation per second. At the same time this increase is projected to lead to substantial changes in computer architecture in order to keep power consumption at realistic levels. This talk will describe present high performance architectures, explain the architectural challenges faced in moving to exsacale and will describe attempts being made to overcome these challenges. The proposed changes include accelerator-like architecture, vertically stacked memory and the use of silicon photonics. It is also expected that the sheer scale of the new machines leads to fault tolerance issues. Many of these challenges are being addressed by an ambitious proposed DOE Exascale program. At the same time such architectural changes will not in themselves be sufficient to achieve exascale performance for standard codes. The substantial shift in computer architecture will require different algorithmic and software approaches. Such a shift will thus force changes in software that require substantial reworking of codes. As with similar step architectural changes in the past some codes are unlikely to perform well if they do not adapt to new architectures and thus face extinction as high performance codes.

Bio: Martin Berzins is a multi-disciplinary Computational Science researcher whose research cuts across Applied Mathematics, Computer Science and Engineering and is focused on the development of partial differential equations software for solving challenging engineering problems from a variety of applications on extreme-scale computers.

He is a Professor of Computer Science in the School of Computing and in the Scientific Computing Imaging Institute at the University of Utah and a Visiting Professor at the University of Leeds. He graduated in Mathematics at the University of Leeds in 1978 and obtained a Ph.D. in Numerical Analysis there in 1982. From 1982 until 2002 he was a Lecturer, Senior Lecturer, Reader, Professor in Scientific Computing and finally the Research Dean for Engineering at the University of Leeds. He was also the co-founder of the Computational PDEs unit at Leeds. Dr. Berzins is a Fellow of the Institute for Mathematics and its Applications in the UK and a Chartered Mathematician.

In 2003 he moved to the University of Utah, where he was Associate Director (2003-2005) and then Director of the School of Computing (2005-2010). From 2005 until 2014 he was co-Editor in Chief of Applied Numerical Mathematics. In 2012 he became Recipient Program Manager of the US Army Research Laboratory Collaborative Research Alliance in MSME (Multiscale multi-disciplinary Modeling of Electronic Materials), that brings together nine universities in undertaking electronic materials by design. In 2013 he became the Computer Science lead in the DOE NNSA PSAAP2 Carbon Capture Multidisciplinary Simulation Center at the University of Utah.