Contents

Preface v

Erik D'Hollander, Jack Dongarra, Ian Foster, Lucio Grandinetti and Gerhard Joubert

Reviewers vii

Chapter 1. Supercomputing and the Exascale Challenge

The K Computer and Beyond
Yuichiro Ajima, Toshio Yoshida, Toshiyuki Shimizu, Shinji Sumimoto, Eiji Yamanaka, Masaki Aoki, Naoki Shinjo and Kenichi Miura 3

Exascale Computing & Beyond: Meeting the Challenges
Karthikeyan Vaidyanathan, Sasikanth Avancha and Sunil Sherlekar 24

Chapter 2. The Energy Challenge

Achieving the 20MW Target: Mobilizing the HPC Community to Accelerate Energy Efficient Computing
Natalie J. Bates and Michael K. Patterson 37

Palette: A Cache Leakage Energy Saving Technique for Green Computing
Sparsh Mittal and Zhao Zhang 46

Chapter 3. Scalable Computing

Scalable Dense Linear Algebra on Heterogeneous Hardware
George Bosilca, Aurelien Bouteiller, Anthony Danalis, Thomas Herault, Jakub Kurzak, Piotr Luszczek, Stanimire Tomov and Jack J. Dongarra 65

Achieving Scalability in the Presence of Asynchrony for Exascale Computing
Thomas Sterling, Matthew Anderson and Maciej Brodowicz 104

Chapter 4. Architectural Concepts

The Role of Non-Strict Fine-Grain Synchronization
Juergen Ributzka, Joseph B. Manzano and Guang R. Gao 121

On the Role of Co-Design in High Performance Computing
Richard F. Barrett, Shekhar Borkar, Sudip S. Dosanjh, Simon D. Hammond, Michael A. Heroux, X. Sharon Hu, Justin Luitjens, Steven G. Parker, John Shalf and Li Tang 141
Chapter 5. Programming Heterogeneous Architectures

Uniform High-Level Programming of Many-Core and Multi-GPU Systems
Philipp Kegel, Michel Steuwer and Sergei Gorlatch

Performance and Programming Environment of a Combined GPU/FPGA Desktop
Bruno da Silva, An Braeken, Erik H. D'Hollander, Abdellah Touhafi, Jan G. Cornelis and Jan Lemeire

High Performance Sequence Mining Using Pairwise Statistical Significance
Yuhong Zhang and Feng Chen

Subject Index

Author Index