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Euro-Par 2014: Parallel Processing Workshops

Euro-Par 2014 International Workshops Porto, Portugal, August 25-26, 2014 Revised Selected Papers, Part II



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Preface

Euro-Par is an annual series of international conferences dedicated to the promotion and advancement of all aspects of parallel and distributed computing. Euro-Par 2014, held in Porto, Portugal, was the 20th edition of the series. The conference covers a wide spectrum of topics from algorithms and theory to software technology and hardware-related issues, with application areas ranging from scientific to mobile and cloud computing. Euro-Par conferences host a set of technical workshops, with the goal of providing a space for communities within the field to meet and discuss more focused research topics. The coordination of the workshops was in the hands of Workshop Chairs Luc Bougé, also with the Euro-Par Steering Committee, and Luís Lopes, with the local organization. In the coordination process, we were kindly assisted by Dieter an Mey, one of the workshop chairs for the Euro-Par 2013 event at Aachen, to whom we wish to express our warm thanks for his availability, expertise, and advice. In early January 2014, a call for workshop proposals was issued, and the proposals were reviewed by the co-chairs, with 18 workshops being selected for the 2-day program:

- APCI&E First Workshop on Applications of Parallel Computation in Industry and Engineering
- BigDataCloud Third Workshop on Big Data Management in Clouds
- DIHC Second Workshop on Dependability and Interoperability in Heterogeneous Clouds
- FedICI Second Workshop on Federative and Interoperable Cloud Infrastructures
- HeteroPar 12th International Workshop on Algorithms, Models and Tools for Parallel Computing on Heterogeneous Platforms
- HiBB 5th Workshop on High-Performance Bioinformatics and Biomedicine
- LSDVE Second Workshop on Large-Scale Distributed Virtual Environments on Clouds and P2P
- MuCoCoS 7th International Workshop on Multi-/Many-Core Computing Systems
- OMHI Third Workshop on On-chip Memory Hierarchies and Interconnects: Organization, Management and Implementation
- PADABS Second Workshop on Parallel and Distributed Agent-Based Simulations
- PROPER 7th Workshop on Productivity and Performance Tools for HPC Application Development
- Resilience 7th Workshop on Resiliency in High-Performance Computing with Clouds, Grids, and Clusters
- REPPAR First International Workshop on Reproducibility in Parallel Computing
- ROME Second Workshop on Runtime and Operating Systems for the Many-Core Era

SPPEXA – Workshop on Software for Exascale Computing - Project Workshop TASUS – First Workshop on Techniques and Applications for Sustainable Ultrascale Computing Systems

UCHPC - 7th Workshop on UnConventional High-Performance Computing

VHPC – 9th Workshop on Virtualization in High-Performance Cloud Computing

Furthermore, collocated with this intensive workshop program, two tutorials were also included:

Heterogeneous Memory Models – Benedict R. Gaster (Qualcomm, Inc.) High-Performance Parallel Graph Analytics – Keshav Pingali (UT Austin) and Manoj Kumar (IBM)

Paper submission deadlines, notification dates, and camera-ready submission deadlines were synchronized between all workshops. The new workshop coordination procedures, established with the 2012 edition, turned out to be very helpful for putting together a high-quality workshop program. After the conference, the workshop organizers delivered a workshop management report on the key performance indicators to the Workshop Advisory Board and the Steering Committee. These reports will help to improve the procedures for, and the quality of, the workshop program of future Euro-Par conferences. Special thanks are due to the authors of all the submitted papers, the members of the Program Committees, the reviewers, and the workshop organizers. We had 173 paper submissions, with 100 papers being accepted for publication in the proceedings. Given the high number of papers, the workshops proceedings were divided into two volumes with the following distribution:

LNCS 8805 – APCI&E, BigDataCloud, HeteroPar, HiBB, LSDVE, PADABS, REPPAR, Resilience

LNCS 8806 – DIHC, FedICI, MuCoCoS, OMHI, PROPER, ROME, TASUS, UCHPC, VHPC, SPPEXA

We are grateful to the Euro-Par general chairs and the members of the Euro-Par Steering Committee for their support and advice regarding the coordination of workshops. We would like to thank Springer for its continuous support in publishing the workshop proceedings.

It was a great pleasure and honor to organize and host the Euro-Par 2014 workshops in Porto. We hope all the participants enjoyed the workshop program and benefited from the ample opportunities for fruitful exchange of ideas.

October 2014

Luís Lopes

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Workshop Introduction and Organization

First Workshop on Applications of Parallel Computation in Industry and Engineering (APCI&E 2014)

Workshop Description

The APCI&E minisymposium/workshop series started in 2008 at the Workshop on State of the Art in Scientific and Parallel Computing (PARA) and continued at the International Conference on Parallel Processing and Applied Mathematics (PPAM). Since PARA was held on even years and PPAM on odd years, the APCI&E minisymposium alternated between these two conference series on parallel computing. The minisymposium was held at PARA 2008 in Trondheim (Norway), PPAM 2009 in Wroclaw (Poland), PPAM 2011 in Torun (Poland), PARA 2012 in Helsinki (Finland), and PPAM 2013 in Warsaw (Poland). This year the minisymposium was renamed as workshop and was held at the International European Conference on Parallel Processing (Euro-Par).

The Workshop APCI&E provided a forum for researchers and practitioners using parallel computations for the solution of complex industrial and engineering applied problems. Topics discussed included application of parallel numerical methods to engineering and industrial problems, scientific computation, parallel algorithms for the solution of systems of PDEs, parallel algorithms for optimization, solution of data and computation-intensive real-world problems, and others.

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Third Workshop on Big Data Management in Clouds (BigDataCloud 2014)

Workshop Description

The Workshop on Big Data Management in Clouds was created to provide a platform for the dissemination of recent research efforts that explicitly aim at addressing the challenges related to executing big data applications on the cloud. Initially designed for powerful and expensive supercomputers, such applications have seen an increasing adoption on clouds, exploiting their elasticity and economical model. While Map/Reduce covers a large fraction of the development space, there are still many applications that are better served by other models and systems. In such a context, we need to embrace new programming models, scheduling schemes, hybrid infrastructures and scale out of single data centers to geographically distributed deployments in order to cope with these new challenges effectively.

In this context, the BigDataCloud workshop aims to provide a venue for researchers to present and discuss results on all aspects of data management in clouds, as well as new development and deployment efforts in running dataintensive computing workloads. In particular, we are interested in how the use of cloud-based technologies can meet the data-intensive scientific challenges of HPC applications that are not well served by the current supercomputers or grids, and are being ported to cloud platforms. The goal of the workshop is to support the assessment of the current state, introduce future directions, and present architectures and services for future clouds supporting data-intensive computing.

BigDataCloud 2014 followed the previous editions and the successful series of BDMC / CGWS workshops held in conjunction with EuroPar since 2009. Its goal is to aggregate the data management and clouds/grids/p2p communities built around these workshops in order to complement the data-handling issues with a comprehensive system / infrastructure perspective. This year's edition was held on August 25 and gathered around 40 enthusiastic researchers from academia and industry. We received a total of ten papers, out of which four were selected for presentation. The big data theme was strongly reflected in the keynote given this year by Dr. Toni Cortes from Barcelona Supercomputing Center. The talk introduced the idea of self-contained objects and showed how third party enrichment of such objects can offer an environment where the data providers keep full control over data while service designers get the maximum flexibility.

We wish to thank all the authors, the keynote speaker, the Program Committee members and the workshop chairs of EuroPar 2014 for their contribution to the success of this edition of BigDataCloud.

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Second Workshop on Dependability and Interoperability in Heterogeneous Clouds (DIHC 2014)

Workshop Description

The DIHC workshop series started in 2013 with the aim of bringing together researchers from academia and industry and PhD students interested in the design, implementation, and evaluation of services and mechanisms for dependable cloud computing in a multi-cloud environment. The cloud computing market is in rapid expansion due to the opportunities to dynamically allocate a large amount of resources when needed and to pay only for their effective usage. However, many challenges, in terms of interoperability, performance guarantee, and dependability, still need to be addressed to make cloud computing the right solution for companies, research organizations, and universities.

This year's edition consisted of three sessions and focused on heterogeneous cloud platforms and aspects to make cloud computing a trustworthy environment

addressing security, privacy, and high availability in clouds. The accepted papers address issues to manage complex applications and facilitate the seamless and transparent use of cloud platform services, including computing and storages services, provisioned by multiple cloud platforms. The workshop also covered HPC applications with the need of a new generation of data storage, management services and heterogeneity-agnostic programming models for a better utilization of heterogeneous cloud resources for scientific and data-intensive applications while dealing with performance and elasticity issues. Privacy and security aspects in cloud computing from theory to practical implementations were presented and discussed.

In addition to the presentation of peer-reviewed papers, the 2014 edition of the DIHC workshop includes a presentation on "Identities and Rights in e-Infrastructures" by the invited keynote speaker Jens Jensen. The keynote presented lessons from the state-of-the-art technology used to identify management in clouds and took a look into standards and the future solutions for federated identity management.

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Second Workshop on Federative and Interoperable Cloud Infrastructures (FedICI 2014)

Workshop Description

Infrastructure as a service (IaaS) cloud systems allow the dynamic creation, destruction, and management of virtual machines (VM) on virtualized clusters. IaaS clouds provide a high level of abstraction to the end user that allows the creation of on-demand services through a pay-as-you-go infrastructure combined with elasticity. As a result, many academic infrastructure service providers have started transitions to add cloud resources to their previously existing campus and shared grid deployments. To complete such solutions, they should also support the unification of multiple cloud and/or cloud and grid solutions in a seamless, preferably interoperable way. Hybrid, community, or multi-clouds may utilize more than one cloud system, which are also called cloud federations. The management of such federations raises several challenges and open issues that require significant research work in this area.

The Second Workshop on Federative and Interoperable Cloud Infrastructures (FedICI 2014) aimed at bringing together scientists in the fields of highperformance computing and cloud computing to provide a dedicated forum for sharing the latest results, exchanging ideas and experiences, presenting new research, development, and management of interoperable, federated IaaS cloud systems. The goal of the workshop was to help the community define the current state, determine further goals, and present architectures and service frameworks to achieve highly interoperable federated cloud infrastructures. Priority was given to submissions that focus on presenting solutions to interoperability and efficient management challenges faced by current and future infrastructure clouds.

The call for papers for the FedICI workshop was launched early in 2014, and by the submission deadline we had received six submissions, which were of good quality and generally relevant to the theme of the workshop. The papers were swiftly and expertly reviewed by the Program Committee, each of them receiving at least three qualified reviews. The program chair thanks the whole Program Committee and the additional reviewers for the time and expertise they put into the reviewing work, and for getting it all done within the rather strict time limit. Final decision on acceptance was made by the program chair and co-chairs based on the recommendations from the Program Committee. Being half-day event, there was room for only four of the contributions, resulting in an acceptance ratio of 66%. All the accepted contributions were presented at the workshop vielding an interesting discussion on the role that federated management may play in the broad research field of cloud computing. Presentations were organized in two sessions: in the former, two papers discussed performance analysis issues of interoperating clouds, while in the later session, two papers were presented on the topic of elastic management of generic IaaS and MapReduce-based systems in interoperable and federated clouds. These proceedings include the final versions of the presented FedICI papers, taking the feedback from the reviewers and workshop audience into account.

The program chairs sincerely thank the Euro-Par organizers for providing the opportunity to arrange the FedICI workshop in conjunction with the 2014 conference. The program chairs also warmly thank MTA SZTAKI for its financial support making it possible to organize the workshop. Finally, the program chairs thank all attendees at the workshop, who contributed to a successful scientific day. Based on the mostly positive feedback, the program chairs and organizers plan to continue the FedICI workshop in conjunction with Euro-Par 2015.

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12th International Workshop on Algorithms, Models and Tools for Parallel Computing on Heterogeneous Platforms (HeteroPar 2014)

Workshop Description

Heterogeneity is emerging as one of the most profound and challenging characteristics of today's parallel environments. From the macro level, where networks of distributed computers, composed by diverse node architectures, are interconnected with potentially heterogeneous networks, to the micro level, where deeper memory hierarchies and various accelerator architectures are increasingly common, the impact of heterogeneity on all computing tasks is increasing rapidly. Traditional parallel algorithms, programming environments, and tools, designed for legacy homogeneous multiprocessors, will at best achieve a small fraction of the efficiency and the potential performance that we should expect from parallel computing in tomorrow's highly diversified and mixed environments. New ideas, innovative algorithms, and specialized programming environments and tools are needed to efficiently use these new and multifarious parallel architectures. The workshop is intended to be a forum for researchers working on algorithms, programming languages, tools, and theoretical models aimed at efficiently solving problems on heterogeneous platforms.

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5th International Workshop on High-Performance Bioinformatics and Biomedicine (HiBB 2014)

Workshop Description

The HiBB workshop series started in 2010 and its first edition was held at Ischia (Italy) in conjunction with the Euro-Par conference. Since then, the workshop has been held, always in conjunction with Euro-Par, at Bordeaux (France), Rhodes (Greece), Aachen (Germany), and Porto (Portugal), respectively, in 2011, 2012, 2013, and 2014.

Since 2010, the HiBB workshop series has included 25 regular papers, two invited talks, two panels, and one tutorial on several aspects of parallel and distributed computing applied to bioinformatics, health informatics, biomedicine, and systems biology.

The main motivation for the HiBB workshop is the increasing production of experimental and clinical data in biology and medicine, and the needs to provide efficient storage, preprocessing, and analysis of these data to support biomedical research.

In fact, the availability and large diffusion of high-throughput experimental platforms, such as next-generation sequencing, microarray, and mass spectrometry, as well as the improved resolution and coverage of clinical diagnostic tools, such as magnetic resonance imaging, are becoming the major sources of data in biomedical research, and the storage, preprocessing, and analysis of these data are becoming the main bottleneck of the biomedical analysis pipeline.

Parallel computing and high-performance infrastructures are increasingly used in all phases of life sciences research, e.g., for storing and preprocessing large experimental data, for the simulation of biological systems, for data exploration and visualization, for data integration, and for knowledge discovery.

The current bioinformatics scenario is characterized by the application of well-established techniques, such as parallel computing on multicore architectures and grid computing, as well as by the application of emerging computational models such as graphics processing and cloud computing. Large-scale infrastructures such as grids or clouds are mainly used to store in an efficient manner and to share in an easy way the huge amount of experimental data produced in life sciences, while parallel computing allows the efficient analysis of huge data. In particular, novel parallel architectures such as GPUs and emerging programming models such as MapReduce may overcome the limits posed by conventional computers to the analysis of large amounts of data.

The fifth edition of the HiBB workshop aimed to bring together scientists in the fields of high-performance computing, bioinformatics, and life sciences, to discuss the parallel implementation of bioinformatics algorithms, the deployment of biomedical applications on high-performance infrastructures, and the organization of large-scale databases in biology and medicine.

These proceedings include the final revised versions of the HiBB papers taking the feedback from the reviewers and workshop audience into account. The program chair sincerely thanks the Program Committee members and the additional reviewers, for the time and expertise they put into the reviewing work, the Euro-Par organization, for providing the opportunity to arrange the HiBB workshop in conjunction with the Euro-Par 2014 conference, and all the workshop attendees who contributed to a lively day.

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Second Workshop on Large-Scale Distributed Virtual Environments on Cloud and P2P (LSDVE 2014)

Workshop Description

The LSDVE workshop series started in August 2013, in Aachen, where the first edition of the workshop was held in conjunction with Europar 2013. LSDVE 2014, the second edition of the workshop, was held in Porto, in August 2014, again in conjunction with Europar.

The focus of this edition of the workshop was on cooperative distributed virtual environments. The recent advances in networking have determined an increasing use of information technology to support distributed cooperative applications. Several novel applications have emerged in this area, like computer-supported collaborative work (CSCW), large-scale distributed virtual worlds, collaborative recommender and learning systems. These applications involve several challenges, such as the definition of user interfaces, of coordination protocols, and of proper middle-ware and architectures supporting distributed cooperation.

Collaborative applications may benefit greatly also from the support of cloud and P2P architectures. As a matter of fact, with the emergence of readily available cloud platforms, collaborative applications developers have the opportunity of deploying their applications in the cloud, or by exploiting hybrid P2P/cloud architectures with dynamically adapting cloud support. This brings possibilities to smaller developers that were reserved for the big companies until recently. The integration of mobile/cloud platforms for collaborative applications is another challenge for the widespread use of these applications.

The LSDVE 2014 workshop aim was to provide a venue for researchers to present and discuss important aspects of P2P/cloud collaborative applications and of the platforms supporting them. The workshop's goal is to investigate open challenges for such applications, related to both the application design and to the definition of proper architectures. Some important challenges are, for instance, collaborative protocol design, latency reduction/hiding techniques for guaranteeing real-time constraints, large-scale processing of user information, privacy and security issues, state consistency/persistence. The workshop presented assessment of current state of the research in this area and introduced further directions.

LSDVE 2014 was opened by the invited talk "Decentralization: P2P and Personal Clouds" by Prof. Pedro Garcia Lopez, Universitat Rovira i Virgili. The program of the workshop included two sessions, "Cooperative Distributed Environments" and "Architectural Supports." The papers presented in the first session regard novel cooperative distributed applications, like social networks and massively multi player games, while those of the second session present architectural supports, both cloud and P2P based, for these applications.

We remark that the number of submissions to LSDVE 2014 has almost doubled over the previous edition. Finally, the extended version of selected papers accepted and presented at the workshop will be published in a special issue of the Springer journal *Peer-to-Peer Networking and Applications* (PPNA).

We wish to thank all who helped to make this second edition of the workshop a success: Prof. Pedro Garcia Lopez who accepted our invitation to present a keynote, authors submitting papers, colleagues who refereed the submitted papers and attended the sessions, and finally the Euro-Par 2014 organizers whose invaluable support greatly helped in the organization of this second edition of the workshop.

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7th International Workshop on Multi-/Many-Core Computing Systems (MuCoCos 2014)

Workshop Description

The pervasiveness of homogeneous and heterogeneous multi-core and many-core processors, in a large spectrum of systems from embedded and general-purpose to high-end computing systems, poses major challenges to the software industry. In general, there is no guarantee that software developed for a particular architecture will run on another architecture. Furthermore, ensuring that the software preserves some aspects of performance behavior (such as temporal or energy efficiency) across these different architectures is an open research issue.

Therefore, a traditional focus of the MuCoCos workshop is on language level, system software and architectural solutions for performance portability across different architectures and for automated performance tuning.

The topics of the MuCoCoS workshop include but are not limited to:

- Programming models, languages, libraries and compilation techniques
- Run-time systems and hardware support
- Automatic performance tuning and optimization techniques
- Patterns, algorithms and data structures for multi-/many-core systems
- Performance measurement, modeling, analysis and tuning
- Case studies highlighting performance portability and tuning.

Besides the presentation of selected technical papers, MuCoCos 2014 featured a keynote talk on "Execution Models for Energy-Efficient Computing Systems" by Philippas Tsigas, Chalmers University, Sweden.

Previous workshops in the series were: MuCoCoS 2008 (Barcelona, Spain), MuCoCoS 2009 (Fukuoka, Japan), MuCoCoS 2010 (Krakow, Poland), MuCoCoS 2011 (Seoul, Korea), MuCoCoS 2012 (Salt Lake City, USA), and MuCoCoS 2013 (Edinburgh, UK).

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Third International Workshop on On-chip Memory Hierarchies and Interconnects (OMHI 2014)

Workshop Description

The gap between processor and memory performances has been growing for more than four decades since the first commercial microprocessor was built by Intel in 1971. To avoid the memory access times caused by this gap, manufacturers implemented cache memories on-chip. Moreover, as the memory latency became larger, more cache levels were added to the on-chip memory hierarchy, and, as a consequence, on-chip networks were also integrated to interconnect the different cache structures among the different levels.

Nowadays, commercial microprocessors include up to tens of processors sharing a memory hierarchy with about three or four cache levels. In the lowest levels of the on-chip memory hierarchy, the cache structures can store hundreds of megabytes, requiring alternative memory technologies (such as eDRAM or STT-RAM) as well as new microarchitectural techniques to limit energy consumption and power dissipation. In addition, advanced on-chip networks are needed to cope with the latency and bandwidth demands of these complex memory hierarchies.

Finally, new manufacturing techniques, such as 3D integration is considered to enlarge even more the capacity and complexity of these memory hierarchies and interconnection networks.

In this context, the synergy between the research on memory organization and management, interconnection networks, as well as novel implementation technologies becomes a key strategy to foster further developments. With this aim, the International Workshop on On-chip Memory Hierarchy and Interconnects (OMHI) started in 2012 and continued with its third edition that was held in Porto, Portugal. This workshop is organized in conjunction with the Euro-Par annual series of international conferences dedicated to the promotion and advancement of all aspects of parallel computing.

The goal of the OMHI workshop is to be a forum for engineers and scientists to address the aforementioned challenges, and to present new ideas for future on-chip memory hierarchies and interconnects focusing on organization, management and implementation. The specific topics covered by the OMHI workshop have been kept up to date according to technology advances and industrial and academia interests.

The chairs of OMHI were proud to present Prof. Manuel E. Acacio as keynote speaker, who gave an interesting talk focusing on the key topics of the workshop entitled "Increased Hardware Support for Efficient Communication and Synchronization in Future Manycores," which jointly with the paper sessions finally resulted in a nice and very exciting one-day program.

The chairs would like to thank the members of the Program Committee for their reviews, the Euro-Par organizers, Manuel E. Acacio and the high number of attendees. Based on the positive feedback from all of them, we plan to continue the OMHI workshop in conjunction with Euro-Par.

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Second Workshop on Parallel and Distributed Agent-Based Simulations (PADABS 2014)

Workshop Description

The Parallel and Distributed Agent-Based Simulations workshop series started in 2013.

Agent-based simulation models are an increasingly popular tool for research and management in many fields such as ecology, economics, sociology, etc..

In some fields, such as social sciences, these models are seen as a key instrument to the generative approach, essential for understanding complex social phenomena. But also in policy-making, biology, military simulations, control of mobile robots and economics, the relevance and effectiveness of agent-based simulation models has been recently recognized.

The computer science community has responded to the need for platforms that can help the development and testing of new models in each specific field by providing tools, libraries, and frameworks that speed up and make massive simulations.

The key objective of the workshop is to bring together researchers who are interested in getting more performances from their simulations, by using:

- Synchronized, many-core simulations (e.g., GPUs)
- Strongly coupled, parallel simulations (e.g., MPI)
- Loosely coupled, distributed simulations (distributed heterogeneous setting).

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7th Workshop on Productivity and Performance – Tools for HPC Application Development (PROPER 2014)

Workshop Description

The PROPER workshop series started at Euro-Par 2008 in Gran Canarias, Spain. Since than it has been held at every Euro-Par conference. It is organized by the Virtual Institute – High Productivity Supercomputing (VI-HPS), an initiative to promote the development and integration of HPC programming tools.

Writing codes that run correctly and efficiently on HPC computing systems is extraordinarily challenging. At the same time, applications themselves are becoming more complex as well, which can be seen in emerging scale-bridging applications, the integration of fault-tolerance and uncertainty quantification, or advances in algorithms. Combined, these trends place higher and higher demands on the application development process and thus require adequate tool support for debugging and performance analysis. The PROPER workshop serves as a forum to present novel work on scalable methods and tools for high-performance computing. It covers parallel program development and analysis, debugging, correctness checking, and performance measurement and evaluation. Further topics include the integration of tools with compilers and the overall development environment, as well as success stories reporting on application performance, scalability, reliability, power and energy optimization, or productivity improvements that have been achieved using tools.

This year's keynote on "Rethinking Productivity and Performance for the Exascale Era" was given by Prof. Allen D. Malony, Department of Computer and Information Science, University of Oregon. The talk discussed directions for parallel performance research and tools that target the scalability, optimization, and programmability challenges of next-generation HPC platforms with high productivity as an essential outcome. Further, Prof. Malony stated that it is

becoming more apparent that in order to address the complexity concerns unfolding in the exascale space, we must think of productivity and performance in a more connected way and the technology to support them as being more open, integrated, and intelligent.

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First International Workshop on Reproducibility in Parallel Computing (REPPAR)

Workshop Description

The workshop is concerned with experimental practices in parallel computing research. We are interested in research works that address the statistically rigorous analysis of experimental data and visualization techniques of these data. We also encourage researchers to state best practices to conduct experiments and papers that report experiences obtained when trying to reproduce or repeat experiments of others. The workshop also welcomes papers on new tools for experimental computational sciences, e.g., tools to archive large experimental data sets and the source code that generated them. This includes (1) workflow systems for defining the experimental structure of experiments and their automated execution as well as (2) experimental testbeds, which may serve as underlying framework for experimental workflows, e.g., deploying personalized operating system images on clusters.

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Second Workshop on Runtime and Operating Systems for the Many-core Era (ROME 2014)

Workshop Description

Since the beginning of the multicore era, parallel processing has become prevalent across the board. However, in order to continue a performance increase according to Moore's Law, a next step needs to be taken: away from common multi-cores toward innovative many-core architectures. Such systems, equipped with a significant higher amount of cores per chip than multi-cores, pose challenges in both hardware and software design. On the hardware side, complex on-chip networks, scratchpads, and memory interfaces as well as cache hierarchies, cache-coherence strategies and the building of coherency domains have to be taken into account.

However, the ROME workshop focuses on the software side because without complying system software, runtime and operating system support, all these new hardware facilities cannot be exploited. Hence, the new challenges in hardware/software co-design are to step beyond traditional approaches and to wage new programming models and OS designs in order to exploit the theoretically available performance as effectively and power-aware as possible.

This focus of the ROME workshop stands in the tradition of a successful series of events originally hosted by the Many-core Applications Research Community (MARC). Such MARC symposia took place at the Hasso Plattner Institute in Potsdam in 2011, at the ONERA Research Center in Toulouse in 2012 and at the RWTH Aachen University in 2012. This successful series was then continued by the 1st ROME workshop (*R*untime and *O*perating Systems for the *M*any-core *E*ra) at the Euro-Par 2013 conference in Aachen as a thematically related follow-up event for a broader audience.

This year, this tradition was again pursued by holding the Second ROME workshop in conjunction with the Euro-Par 2014 conference in Porto. The organizers were very happy that Prof. Norbert Eicker from Jülich Supercomputing Centre (JSC) volunteered to give an invited keynote for this workshop with the title "Running DEEP – Operating Heterogeneous Clusters in the Many-core Era."

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7th Workshop on Resiliency in High-Performance Computing in Clusters, Clouds, and Grids (Resilience 2014)

Workshop Description

Clusters, clouds, and grids are three different computational paradigms with the intent or potential to support high performance computing (HPC). Currently, they consist of hardware, management, and usage models particular to different computational regimes, e.g., high-performance cluster systems designed to support tightly coupled scientific simulation codes typically utilize high-speed interconnects and commercial cloud systems designed to support software as a service (SAS) do not. However, in order to support HPC, all must at least utilize large numbers of resources and hence effective HPC in any of these paradigms must address the issue of resiliency at large scale.

Recent trends in HPC systems have clearly indicated that future increases in performance, in excess of those resulting from improvements in single-processor performance, will be achieved through corresponding increases in system scale, i.e., using a significantly larger component count. As the raw computational performance of these HPC systems increases from today's tera- and peta-scale to next-generation multi-peta-scale capability and beyond, their number of computational, networking, and storage components will grow from the ten-to-onehundred thousand compute nodes of today's systems to several hundreds of thousands of compute nodes and more in the foreseeable future. This substantial growth in system scale, and the resulting component count, poses a challenge for HPC system and application software with respect to fault tolerance and resilience.

Furthermore, recent experience in extreme-scale HPC systems with nonrecoverable soft errors, i.e., bit flips in memory, cache, registers, and logic added another major source of concern. The probability of such errors not only grows with system size, but also with increasing architectural vulnerability caused by employing accelerators, such as FPGAs and GPUs, and by shrinking nanometer technology. Reactive fault-tolerance technologies, such as checkpoint/restart, are unable to handle high failure rates due to associated overheads, while proactive resiliency technologies, such as migration, simply fail as random soft errors cannot be predicted. Moreover, soft errors may even remain undetected resulting in silent data corruption.

The goal of this workshop is to bring together experts in the area of fault tolerance and resilience for HPC to present the latest achievements and to discuss the challenges ahead. The program of the Resilience 2014 workshop included one keynote and six high-quality papers. The keynote was given by Ives Robert from ENS Lyon with the title "Algorithms for Coping with Silent Errors."

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Workshop on Software for Exascale Computing (SPPEXA 2014)

Workshop Description

SPPEXA is a priority program of the German Research Foundation (DFG). It targets the challenges of programming for exascale performance, which have been recognized in recent years and are being addressed by national and international research initiatives around the world. Exascale computing promisses performance in the range of 10^{18} floating-point operations per second. Today's fastest supercomputers are just a factor of 30 away from this mark. Software technology faces extreme challenges, mainly because of the massive on-chip parallelism necessary to reach exascale performance, and because of the expected complexity of the architectures that will be able to deliver it.

The DFG runs close to 100 priority programs at any one time, each lasting up to six years. SPPEXA started in January 2013 and will run through to the end of 2018. It consists of two three-year funding periods. In the first period, 13 projects were chosen from 67 proposals. Each project is being run by a multi-site consortium with between three and five funded research positions. The overall funding amounts to roughly 3.7 million Euro per year. Each project addresses at least two and concentrates on at most three of the following six challenges:

- Computational algorithms
- System software
- Application software
- Data management and exploration
- Programming
- Software tools

The program is more than the sum of the individual projects. There are interproject collaborations and program-wide activities like an annual *SPPEXA Day* and an annual *Coding Week* devoted each year to a specific theme.

This workshop started with a keynote by Rosa Badia from the Barcelona Supercomputing Center and then continued with the initial results of the following six of the 13 projects:

- EXA-DUNE: Flexible PDE Solvers, Numerical Methods and Applications
- DASH: Data Structures and Algorithms with Support for Hierarchical Locality
- ExaStencils: Advanced Stencil-Code Engineering
- EXAHD: An Exa-Scalable Two-Level Sparse Grid Approach for Higher-Dimensional Problems in Plasma Physics and Beyond
- ESSEX: Equipping Sparse Solvers for Exascale
- Catwalk: A Quick Development Path for Performance Models

For more information on the program and the individual projects, please consult the website: http://www.sppexa.de.

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First Workshop on Techniques and Applications for Sustainable Ultrascale Computing Systems (TASUS 2014)

Workshop Description

The TASUS workshop series started in 2014 to join researchers on ultrascale computing systems (UCS), envisioned as a large-scale complex system joining parallel and distributed computing systems, perhaps located at multiple sites, that cooperate to provide solutions to the users. As a growth of two or three orders of magnitude of today's computing systems is expected, including systems with unprecedented amounts of heterogeneous hardware, lines of source code, numbers of users, and volumes of data, sustainability is critical to ensure the feasibility of these systems. Due to these needs, currently there is an emerging cross-domain interaction between high-performance computing in clouds or the adoption of distributed programming paradigms, such as Map Reduce, in scientific applications, the cooperation between HPC and distributed system communities still poses many challenges toward building the ultrascale systems of the future. Especially in unifying the services to deploy sustainable applications portable to HPC systems, multi-clouds, data centers, and big data.

The TASUS workshop focuses specially on the software side, aiming at bringing together researchers from academia and industry interested in the design, implementation, and evaluation of services and system software mechanisms to improve sustainability in ultrascale computing systems with a holistic approach, including topics like scalability, energy barrier, data management, programmability, and reliability.

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7th Workshop on UnConventional High-Performance Computing (UCHPC 2014)

Workshop Description

Recent issues with the power consumption of conventional HPC hardware resulted in new interest in both accelerator hardware and low-power mass-market hardware. The most prominent examples are GPUs, yet FPGAs, DSPs, and other embedded designs may also provide higher power efficiency for HPC applications. The so-called dark silicon forecast, i.e., that not all transistors can be active at the same time, may lead to even more specialized hardware in future mass-market products. Exploiting this hardware for HPC can be a worthwhile challenge.

As the word "UnConventional" in the title suggests, the workshop focuses on usage of hardware or platforms for HPC that are not (yet) conventionally used today, and may not be designed for HPC in the first place. Reasons for its use can be raw computing power, good performance per watt, or low cost. To address this unconventional hardware, often, new programming approaches and paradigms are required to make best use of it. A second focus of the workshop is on innovative, (yet) unconventional new programming models.

To this end, UCHPC tries to capture solutions for HPC that are unconventional today, but could become conventional and significant tomorrow, and thus provide a glimpse into the future of HPC.

This year was the seventh time the UCHPC workshop took place, and it was the fifth time in a row that it was co-located with Euro-Par (each year since 2010). Before that, it was held in conjunction with the International Conference on Computational Science and Its Applications 2008 and with the ACM International Conference on Computing Frontiers 2009. However, UCHPC is a perfect addition to the scientific fields of Euro-Par, and this is confirmed by the continuous interest we see among Euro-Par attendees for this workshop.

While the general focus of the workshop is fixed, the topic is actually a moving target. For example, GPUs were quite unconventional for HPC a few years ago, but today a notable portion of the machines in the Top500 list are making use of them. Currently, the exploitation of mobile processors for HPC – including on-chip GPU and DSPs – are a hot topic, and we had a fitting invited talk on the EU Mont-Blanc project given by Axel Auweter, LRZ, Germany.

These proceedings include the final versions of the papers presented at UCHPC and accepted for publication. They take the feedback from the reviewers and workshop audience into account.

The workshop organizers want to thank the authors of the papers for joining us in Porto, the Program Committee for doing the hard work of reviewing all submissions, the conference organizers for proving such a nice venue, and last but not least the large number of attendees this year.

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9th Workshop on Virtualization in High-Performance Cloud Computing (VHPC 2014)

Workshop Description

Virtualization technologies constitute a key enabling factor for flexible resource management in modern data centers, and particularly in cloud environments. Cloud providers need to dynamically manage complex infrastructures in a seamless fashion for varying workloads and hosted applications, independently of the customers deploying software or users submitting highly dynamic and heterogeneous workloads. Thanks to virtualization, we have the ability to manage vast computing and networking resources dynamically and close to the marginal cost of providing the services, which is unprecedented in the history of scientific and commercial computing. Various virtualization technologies contribute to the overall picture in different ways: machine virtualization, with its capability to enable consolidation of multiple underutilized servers with heterogeneous software and operating systems (OSes) and its capability to live-migrate a fully operating virtual machine (VM) with a very short downtime, enables novel and dynamic ways to manage physical servers; OS-level virtualization, with its capability to isolate multiple user-space environments and to allow for their co-existence within the same OS kernel, promises to provide many of the advantages of machine virtualization with high levels of responsiveness and performance and I/O virtualization allowing physical NICs/HBAs to take traffic from multiple VMs.

The workshop series on Virtualization in High-Performance Cloud Computing (VHPC) – originally the Workshop on Xen in High-Performance Cluster and Grid Computing Environments – started in 2006. It aims to bring together researchers and industrial practitioners facing the challenges posed by virtualization. VHPC provides a platform that fosters discussion, collaboration, mutual exchange of knowledge and experience, enabling research to ultimately provide novel solutions for virtualized computing systems of tomorrow.

VHPC 2014 was again successfully co-located with Euro-Par. We would like to thank the organizers of this year's conference and the invited speakers: Helge Meinhard, CERN, and Ron Brightwell, Sandia National Laboratories, for their very well received talks.

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