HPCS 2010 PANEL SESSION

Energy-aware, Power-aware, and Green Computing for Large Distributed Systems and Applications

PANEL MEMBERS:

Frédéric Giroire, CNSR and INRIA Sophia Antipolis, France
Frédéric Guinand, Le Havre University, France
Laurent Lefèvre, INRIA, Rhône-Alpes, Université de Lyon, France
Jordi Torres, Technical University of Catalonia (UPC), Barcelona, Spain

MODERATORS: Derrick Kondo and Sangho Yi
INRIA, Grenoble Rhône-Alpes, France

ABSTRACT:
Green Computing is one of the hottest subjects these days for people in industry, academia and even for businesses. The major benefits of using Green Computing (including energy-aware, and power-aware) is not perfectly clear in terms of monetary cost, performance, and the amount of pollutants such as carbon footprint.

This panel will assess the state of the art in Green Computing, and the main issues and challenges facing the community. The panel will also address the differences and similarities with other concepts and systems, and discuss the suitability of current green computing technologies. The panel will tackle current shortfalls, and suggest recommendations for future research directions.

PANEL OUTLINE:

• Introduction (Moderators)
• Presentations, discussions and debates of questions (panelists) such as
  • How good are models of environmental impact of energy usage?
- What are good metrics for energy and its efficient usage?
- What level in the hardware/software stack can the most energy savings be achieved?
- What method is the best way to reduce power costs (for given level of usage)?
- What are the most practical ways that heat can be re-used for monetary and ecological gain?
- How accurate are cost models and assumptions for power usage and how do these costs compare with others?
- How should standards (such as those proposed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers) be expressed?
- What is relationship between performance and power?
- What are the dimensions and scopes of Green Computing?
- What are the Challenges and Opportunities?
- What are Timelines and Future Trends and Directions?

- Summary and conclusions
- Question and Answers from audience

PANLEISTS SHORT BIOS:

Frédéric Giroire

*Frédéric Giroire* is a researcher in the joint project MASCOTTE working on the analysis of a peer-to-peer storage system. He also works on energy efficiency and methods for providing security to end hosts in typical enterprise environments. Dr. Giroire obtained his PhD in Computer Science, Telecommunications and Electronics from the University Paris 6 in 2006.

Frédéric Guinand

*Frédéric Guinand* is a professor at the Le Havre University. His current interests are Dynamic Graphs, Mobile Ad Hoc Networks (MANET), Optimization Algorithms, and Complex Systems.

Laurent Lefèvre

*Laurent Lefèvre* is a permanent researcher at INRIA Rhône-Alpes, Université de Lyon, France. His research interests are Grid and distributed computing and networking, Green and Energy Efficient Computing and Networking, Autonomic Networking, High Performance Networks protocols, Active networks, Active services, Protocols and network services, Active Grid, Disruption Tolerant Networks, Cluster computing, Distributed shared memory systems, Data consistency, Security, Fault tolerance.
Jordi Torres is has a Masters degree in Computer Science from the Technical University of Catalonia (UPC, 1988) and also holds a Ph. D. from the same institution (Best UPC Computer Science Thesis Award, 1993). Currently he is a full professor in the Computer Architecture Department at UPC. He has more than twenty years of experience in research and development of advanced distributed and parallel systems in the High Performance Computing Group at UPC. He has been a visiting researcher at the “Center for Supercomputing Research & Development” at Urbana-Champaign (Illinois, USA, 1992).

His current principal interest as a researcher is making IT resources more efficient, and focuses on the resource management needs of modern distributed and parallel cloud computing environments. Currently he is actively working to combine the research from different research areas such as autonomic computing, parallel and distributed systems, performance modelling, virtualization, machine learning, amongst others, to reasonably stem the difficulties to obtain more sustainable IT by itself (Green Computing).
DEMO ABSTRACT
This demonstration will show how legacy codes can be incrementally ported to GPU based systems. The approach is based on HMPP (Heterogeneous Multicore Parallel Programming), a directive based environment for C and Fortran. HMPP generates CUDA and OpenCL allowing programmers to target NVIDIA and ATI GPU using a single portable source code.

In this demonstration a set of scientific applications served as porting examples for both latest NVIDIA and ATI based systems. In particular, we will show how code can be tuned for each system as well as how CPU cores can be exploited in parallel to GPU cores.

REQUIREMENTS AND TARGET AUDIENCE
This demonstration targets HPC users.

DEMO DURATION
The demo will be presented in a 30-minute session.

A/V AND EQUIPMENT
NVIDIA and ATI GPU based systems.
PRESENTER BIOGRAPHY

Tim Legrand is engineer at CAPS enterprise. Founded in 2002 by members of an IRISA research team, CAPS enterprise develops and commercializes innovative software for high performance application tuning in the domains of HPC and embedded systems. CAPS enterprise offers a whole range of development tools and services enabling its customers’ applications to optimize the performance of multicore processors used by the last generation hardware.

CAPS enterprise mission is in keeping with the innovative and fast moving multicore market and helps industries with high level HPC issues such as oil and gas, defense, finance and life sciences to allow their software developers to take the most of multicore processors while preserving their legacy source. Built on over five years of advanced research and development, CAPS provides high quality and cost effective programming tools that leverage the computing power of evolving manycore hybrid platforms. Tim has been involved with general computing on graphics processor units (GPGPU) from it early time. He is in charge of GPGPU training.
DEMO II

Distributed Software for Benchmark Computing

J. Mahier, B. Hemery, C. Rosenberger
GREYC Lab
ENSICAEN – University of Caen - CNRS
France

DEMO ABSTRACT

Benchmarks are more and more used for the objective comparison of algorithms in different fields. The size of these benchmarks is constantly increasing. For researchers, it is becoming an important problem to test their own algorithms on these benchmarks. We provide a demo on a distributed software for benchmark computation that is under development at the GREYC Lab (France). It is actually used in biometrics to test our algorithms on large benchmarks (face, fingerprints, ...). The computation is done on many clients (run on personal computers in the lab) distributed by a server that centralizes the results. It can be used for any kind of application but we will try to provide a specific version for researchers in biometrics.

REQUIREMENTS AND TARGET AUDIENCE

Researchers interested in benchmarking of high performance computing systems.

DEMO DURATION

The demo will be presented in a 30-minute session.

A/V AND EQUIPMENT

Computer laptop and projector.

PRESENTER BIOGRAPHY

Julien Mahier is a R&D engineer at the GREYC Lab (France). He is particularly interested in biometrics and the evaluation of biometric systems.
DEMO III

The GReIC Data Access and Integration Service

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DEMO ABSTRACT
A Hypercube-Based NoC Routing Algorithm for Efficient All-to-All Communications in Embedded Image and Signal Processing Applications

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ABSTRACT
Embedded multi-core architectures will require a higher bandwidth and scalable Networks on Chip (NoC) to sustain an increasingly demanding communication load in both image and signal processing areas. Corner turns (or matrix transpose) are frequently used in such applications and require special attention due to their all-to-all communications patterns. To address such issues, we propose a variation of a hypercube NoC topology and evaluate it using a circuit switching based routing algorithm. We also propose a new exhaustive partially profitable backtracking algorithm, and we show that it outperforms existing protocols by 40% and by 15% on average for image and signal processing applications on the same topology.

Experimental Results of a Coarse-Grained Parallel Algorithm for Spanning Tree and Connected Components

Edson Norberto Cáceres, Henrique Mongelli, Christiane Nishibe, Siang Wun Song
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ABSTRACT
Dehne et al. present a BSP/CGM algorithm for computing a spanning tree and the connected components of a graph, that requires $O(\log p)$ communication rounds, where $p$ is the number of processors. It requires the solution of the Euler tour problem which in turn is based on the solution of the list ranking problem. In this paper we present experimental results of a parallel algorithm that does not depend on the solution of the Euler tour or the list ranking problem. The proposed algorithm has the practical advantage of avoiding the list ranking computation and is based on the integer sorting algorithm which can be implemented efficiently on the BSP/CGM model. We implemented the proposed algorithm on a Beowulf cluster and on a grid running the InteGrade middleware. We obtained encouraging albeit modest speedup on a small Beowulf cluster and expect good speedups on the grid for larger size graphs and clusters.
An Intercept Driven Approach for Monitoring of Grid Applications

Syed Alam, Norlaily Yaacob, Anthony Godwin
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ABSTRACT
Time interval triggered external daemon based monitoring approach restricts to externally collecting certain parameter of interest such as CPU/memory consumption for a grid job. In this paper, we propose an intercept driven monitoring approach that allows for self monitoring capability to be embedded within a grid job. The approach apart from gathering and publishing conventional grid job monitoring statistics, also allows for monitoring the internal state of the objects within an object oriented grid job context. It further allows for monitoring of thrown exceptions within a Java based grid job and allows offers fault tolerance by maintaining a data structure at meta level that can be used for starting the job from the point of crash.

Modular Implementation of Dense Matrix Operations in a High-level BSP Language

Sovanna Tan, Frédéric Gava
Laboratory of Algorithms, Complexity and Logic (LACL), University of Paris-East, France

ABSTRACT
BSML is a high-level language for programming parallel algorithms. Built upon the OCaml language, it provides a safe setting for the implementation of BSP algorithms and for avoiding concurrency related problems (deadlocks, indeterminism, etc.). Dense matrices appear in many scientific computations but many libraries are limited to matrices of numeric elements. This paper is our first experiment to design a generic library of BSP implementation in ML of dense matrix operations for scientific computation.

Calculating the Impact Factor of Neural Networks on Optimization Algorithm for Sensor Selection

Abdolhossein Alipoor, Touraj Banirostam, Mehdi N. Fesharaki
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ABSTRACT
Intelligent sensor selection for monitoring operations is one of the serious subjects to reduce information processing time and increase information fusion accuracy. This paper attempts to design an intelligent sensor selection service by using optimization algorithm and neural networks. This service specifies the best group of sensors having the highest recognition rate in each situation. The important part of optimization algorithms is heir fitness function. Since in this problem, unlike the problems explained in [1, 2] we can not extract a mathematical fitness function, we use a neural network as an estimator to evaluate the fitness value of each chromosome in genetic algorithm. In this paper, three types of neural network including Multilayer Perceptron (MLP), Radial Basis function (RBF) and ELMAN network are used. Then these three networks are performed within a genetic algorithm and compare their influence on the result of genetic algorithm. We define 500 various scenarios for 6 different sensors in several conditions. Then object recognition rate of each sensor is calculated and used for
neural networks training process. After running three different scenarios separately in 10 times, we found that using MLP neural network in genetic algorithm has maximum object recognition rate, 97.6% and minimum time consuming, 22 seconds.

Fault-aware Scheduling in Grid Environment Based on Linear Programming

Mehdi Sarikhani, Bahman Javadi, Askari Parichehre
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ABSTRACT
Grid system provides the sharing, selection and aggregation on distributed autonomous resources while it is an error prone environment. So, grid component like scheduler must provide the user’s Quality of Service (QoS) requirements by selecting the appropriate resources for user’s jobs. In this paper, we have proposed a fault-aware economy scheduling model based on binary integer programming (FES-BIP) to allocate resources to application jobs such that the users’ requirements are met while we know the distribution of resource failure in the grid environment. FES-BIP algorithm guarantees optimal resource selection.

Preliminary Results for Atmospheric Remote Sensing Data Processing through Grid Computing

Lorenzo Mossucca, Olivier Terzo, Maurizio Molinaro, Giovanni Perona, Manuela Cucca, Riccardo Notarpietro
Istituto Superiore Mario Boella, Torino; Politecnico di Torino, Torino, Italy

ABSTRACT
In September 2009, the Indian Remote Sensing OCEANSAT-2 satellite was launched from Sriharikota (India). Moreover, OCEANSAT-2 carries on-board a third payload, called ROSA (Radio Occultation Sounder of the Atmospheric) and developed by the Italian Space Agency, which give very accurate information about the vertical structure of the atmosphere, through the exploitation of the GPS Radio Occultation technique. This is a remote sensing technique aiming to characterize the Earth atmosphere. The GPS signal observed when it emerges from the Earth limb, is refracted by the Earth atmosphere; through inversion techniques, it is possible to retrieve atmospheric refractivity profiles, which in turn may be used to obtain temperature, pressure and humidity profiles. Considering that there is a great deal of data to process, this paper presents an architecture solution based on Grid Computing. We want to focus the attention on how we managed the parallelization of the processing chain of Radio Occultation data in order to evaluate the gain in performances and time obtained using the distributed architecture and for a collaborative engineering approach.
An Enhanced Virtual Object Management Scheme for Personalized Ubiquitous Computing Services at Peer-to-Peer

Cheong Ghil Kim, Dong Wook Kim, Choong Pyo Hong, and Shin Dug Kim
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ABSTRACT
This paper presents an enhanced virtual object management scheme for a personalized ubiquitous computing service, Virtual Personal World (VPW), at peer-to-peer. In the proposed scheme, more detailed descriptions for virtual objects are added in addition to the existing definitions on communications and data of them, and then two phases of virtual object discovery scheme are applied. Therefore, the management scheme can be individualized more effectively according to users’ preferences and behaviors and provide a fast way of finding virtual objects. For performance verification, we have implemented a prototype of the proposed scheme as a part of VPW and compare the speed of finding virtual objects in the proposed scheme with those in other DHT P2P networks. Simulation results shows that the proposed scheme can achieve performance improvements compared with other P2P networks.

Efficient Secure Multicast Route using Genetic Algorithms for Wireless Sensor and Actor Networks

Zeng Yong, Pei Qinqi, Ma Jianfeng, Dong Lihua
Xidian University, Xi’an, China

ABSTRACT
Multicast routing is very important for wireless sensor and actor networks (WSANs), where the decisions or control information from actors will be delivered to sensors over each link of the WSANs only once. In the multicast route each copy should be securely send to the authenticated destinations. The relay nodes should compute and identify forwarding paths to meet packet’s security requirement. This problem can be described as degree-constrained minimum spanning tree problem, which is an NP-complete problem. This paper uses genetic algorithm to compute such multicast route. In detail, the Prüfer encoding method is adopted to encode the solutions of the problem. Two genetic operators are specifically designed. We proved the operators can avoid producing infeasible solutions and missing feasible solutions.

Efficient Security Transmission Protocol with Identity-based Encryption in Wireless Mesh Networks

Yahui Li, Xining Cui, Linping Hu, Yulong Shen
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ABSTRACT
The wireless mesh network is a new networking technology, but the security information transmission of mesh points (MPs) is still a discussion for the requirements of convenience, flexibility and self-organization the current model of wireless mesh networks. So an efficient security solution of wireless mesh network is proposed, which
consists of a three-party (Mesh Point, Mesh Key Distributor and Authentication Server) security transmission protocol for the data transmission between MPs in the wireless mesh network and an ID-based broadcast encryption scheme for the secure session keys of a MP. Finally, we show that the session key has the several security properties which archive unforgeability, confidentiality and non-repudiation, and the new protocol has the much better performance than the other current solutions.

**Framework of Web Content Filtering for IPv6**

Yingxu Lai, Qian Ma, Zhen Yang, Jing Liu  
*Beijing University of Technology, Beijing, China*

**ABSTRACT**

IPv6 embraces various good features from the security perspective, but the improvements also bring us some new challenges for web content filtering. This paper presents a new framework of web content filtering in IPv6, which is helpful to purifying network environment. In this framework, using EM (Expectation maximization) algorithm, the active drift and self-learning mechanisms are proposed. Based on the new mechanisms, we can shield unknown illegal URLs effectively, and the illegal web content can be totally prevented from sneaking into the Intranet. Finally, our experimental results show that the performance of the system is very promising.

**Power Estimation of 1-d Cellular Automata Circuits**

Georgios Ch. Sirakoulis, Ioannis Karafyllidis  
*Democritus University of Thrace, Xanthi, Greece*

**ABSTRACT**

During the last decades Cellular Automata (CAs) have been extensively used as powerful computational tool able to represent phenomena of arbitrary complexity and at the same time can be simulated exactly by digital computers, because of their intrinsic discreteness. Furthermore, due to their simple, regular, modular and cascadable structure with local interconnections CAs algorithms are ideally suited for hardware implementation. On the other hand, power dissipation is recognized as a critical parameter in modern VLSI design field. In this paper a power estimation model based on CAs is proposed. With the help of this model the power consumption of 1-d CAs rules logic circuits is investigated in details. More specifically, CMOS power consumption estimation measurements for the entireness of 1-d CAs rules as well as entropy variation measurements were conducted based on the proposed model. The presented simulation results prove the robustness of the aforementioned model and discuss the Wolfram 1-d CAs classes categorization based on the produced power estimation results and depending on the corresponding initial conditions.