MOSIG, PDES Option

Parallel, Distributed, Embedded Systems

October 19, 2016

LIG Teams

- CORSE: Compiler Optimizations and Runtime Systems
- DATAMOVE ("formerly" MOAIS): Data Aware Large Scale Computing
- DRAKKAR: Networking and Multimedia
- ERODS: Efficient and RObust Distributed Systems
- POLARIS ("formerly" MESCAL): Performance evaluation and Optimization of LARge Infrastructures and Systems

Plus other teams (e.g., VERIMAG for verification/embedded systems, TIMA for architecture)

Compiler Optimizations and Runtime Systems

1. Runtime systems in collaboration with with compilers
   - Memory management, data locality, dynamic load balancing
   - Using program semantics derived from DSL/compiler analysis
   - Unified performance/functional debugging
2. Compiler analysis and optimization: combining dynamic and static techniques
   - Hybrid and extensible byte-code (parallelism/low-level)
   - Hybrid compilation. Trace/static analysis
   - Instruction scheduling and I/O complexity

Typical internships:

- Exploiting the Kalray MPPA
- Producing optimized HPC kernel with meta-programming
- Energy efficiency (Mont-Blanc)
- OpenMP: tracing, debuging, locality and data-dependency aware scheduling

Data Aware Large Scale Computing

Keywords: Exascale; High Performance Computing; Parallel Algorithms; Scheduling; Multi-objective Optimization; Middleware; Batch Scheduler; High Performance Data Analytics;

1. Data Aware Batch Scheduling
2. Empirical Studies of Large Scale Platforms
3. Integration of High Performance Computing and Data Analytics

Typical internships:

- Forecasting resource availability via lachine learning, learning for backfilling
- Impact of locality in batch schedulers
- Clustering and scheduling DAGs on hybrid resources

Networking and Multimedia

Keywords: Network protocols (wireless), multimedia applications, Sensor networks, Internet of Things

Typical internships:

- Antiparallel TCP connections on Asymetric links
- Security for the Internet of Things
- Energy efficient operations (communications, routing) in wireless sensor networks
- Multi-protocol multimedia applications

ERODS

Efficient and RObust Distributed Systems

Keywords: Cloud computing, OS, Autonomous systems, ...
Typical internships:

- Huge pages in multicore systems
- Impact of syncronization algorithms in multi-core applications
- Resiliency and efficiency in multi-tier elastic applications
- SLA oriented fault tolerance in clouds
- Cloud computing on green data centers

POLARIS

Performance evaluation and Optimization of LARge Infrastructures and Systems

Keywords: Large distributed and stochastic systems; Experimental methodology; Performance evaluation; Simulation; Trace analysis and visualization; distributed and stochastic optimization; game theory

1. Measurement: Sound and Reproducible Experimental Methodology
2. Analysis: Multi-Scale Analysis and Visualization
3. Simulation: Fast and Faithful Performance Prediction of Very Large Systems
4. Asymptotic Models: Local Interactions and Transient Analysis
5. Distributed Optimization: Game Theory, On-line Distributed Optimization

Typical internships:

- Smart intrusivity control in memory tracing (measurement)
- Semi-automatic tuning of HPC computation kernels (measurement, with CORSE)
- HPC interconnect evaluation and co-design (simulation)
- Application-centric analysis of AMR applications (analysis)

International and industrial collaborations

Academia

- US (Berkeley, Illinois, Idaho, ...)
- Brazil, Columbia, Cameroon, ...
- Europe (EPFL, Juelich, BSC, ...)

Companies

- CEA, BRGM, ...
- Google, HP, Bull, Orange, Alcatel, ST Microelectronics, ...

No problem getting a very well paid job after a PhD... 

Lectures

Core

- Parallel Systems (A. Legrand, B. Raffin, 36 hours): parallel algorithms, architectures, programming, trends in HPC/cloud
- Advanced Aspects of Operating Systems (O. Gruber, R. Lachaize, 36 hours): OS structure, virtualization, ...
- Wireless and Sensor Networks (M. Heusse, 18 Hours): protocols
- Distributed Systems (V. Quéma, 18 hours): distributed algorithms, consensus, fault tolerance, fundamentals of P2P and distributed systems, ...

Option

- Scientific Methodology and Performance Evaluation (A. Legrand, J.M. Vincent, 18 hours): scientific methodology, design of experiments, statistics, visualization, ...
- Embedded Systems (P. Raymond, 18 hours): critical and embedded systems, correctness and verification
- Security and Privacy (C. Casteluccia, 18 hours)
- Machine Learning Fundamentals (Data Science, 18 hours)
- Modeling and Analysis of Concurrent Systems (HECS, 36 hours)