{Distributed Systems Group}

School of Computer Engineering - Iran University of Science and Technology
(Supervisor: Dr. M. Sharifi)

Cloud Computing & HPC

Cloud Computing Environments

Cloud computing, often referred to as simply "the cloud," is the delivery of on-demand computing resources:

- Everything from applications to data centers
- Over the Internet on a pay-for-use basis.
- Elastic resources
- Scale up or down quickly and easily to meet demand

Nominal Research Areas:

- Virtual Machine Scheduling in Support of Cloud Computing Environments
- Resource Management at Virtual Machine Monitor Level
- Network Service Provisioning at Virtual Machine Monitor Level
- Complex Event Processing in Cloud Computing Platforms (e.g. Elasticity and Parallelism)

Some papers you may be interested to view:

High Performance Computing

- Static, Dynamic and Adaptive Scheduling
- Multi-Core and Many-Core Scheduling
- High Performance Operating Systems and VMMs
- Computational and Programming Models for HPC Workloads
- Virtual HPC Clusters
- HPC in Clouds
- HPC on Many-Core Systems
- Scalable HPC Load Manager and Job Scheduling
- Performance Portability

System Software

Operating Systems Design & Performance Eval.

OSs are part of every small and large-scale deployments. The design of commodity operating systems dates back to the time that were no talk of High performance Computing. Several improvements have occurred in the design and implementation of popular open-source operating systems, and new designs are always on the way. It is of critical importance to be able to evaluate the performance of an OS, and to find the vulnerabilities in process scheduling, memory management and IO processing. To name a few, OSs should be adopted to Cloud platforms, real-time applications, and warehouse-scale datacenters for the HPC to efficiently emerge.
Nominal Research Areas:

- Kernel-Level Performance Evaluation Techniques
- Kernel-Level Techniques for Improving IO Performance and Workload-Aware Task Scheduling
- Cloud-Aware/Real-Time/ Energy-Aware Operating Systems
- Application of Machine Learning to Performance Diagnosis

System Software Security

- Proactive Detection of Distributed Denial of Service Attacks
- Digital Money Challenges and Opportunities
- Operating Systems Memory Protection Measures Analysis and Improvement
- Network Applications Vulnerability Assessment
- Defending Low-level Attacks Against Kernel and Native Services

Streams & Event Processing

Complex Event Processing

Software systems play an important role in many areas of human modern day living, enabling users to measure, infer and understand environmental events that flow as data streams from peripheries to one or more processing centers for online or real time processing. Fortunately, complex event processing (CEP) engines offer online processing support for known events and query varieties, a capability that is missing in traditional data management systems.

Data Stream Processing (DSP)

Event sources that produce event streams for Complex Event Systems may contain imprecisions [1,2] on event content attributes [3] or even lead to wrong decisions about an event occurrences. Additionally, the rules defining composite events may be probabilistic [4] (i.e., uncertain rules) so that a set of events may lead to detection of different composite events [5].

Business Process Management (BPM)

Predictive Analytics (PA) refers to a wide range of methods for understanding data and discovering knowledge out of them [1]. BMP has been the subject of extensive research, especially in the fields of data mining and machine learning. In general, PA and CEP have been proven mutually beneficial [2]. For example, PA can be used to learn new complex events and rules from data [1] or to learn predictive models based on complex events generated by a CEP engine [3]. Machine learning in particular has also been used to extract events from structured data, such as videos [4]. Some have discussed [5] how PA can be useful in a CEP system to: (a) proactively determine when and how query plans should be adapted to avoid low throughput or mis-utilization, and (b) reduce communication costs in distributed CEP settings.

Exascale Computing

Exascale Domains

Application development

Application Development focuses on providing support for scientific applications to exploit Exascale for high-confidence insights and answers to critical problems in national security, energy assurance, economic competitiveness, and healthcare.

Software Technology

The goal of Software Technology is to develop a software stack that enables application developers in productively developing high parallel applications that can portably target diverse Exascale architectures.

Hardware Technology

The goal of Hardware Technology is to accelerate innovative hardware technology options that create rich and competitive HPC ecosystems supporting at least two diverse Capable Exascale Systems, and enhance system and application performance for traditional science and engineering applications, as well as data-intensive and data-analytics applications. Nominal Research topics:

- Programming Models, Development Environment, and Runtimes
- System Software, Resource Management Threading, Scheduling, Monitoring
- Data Management, I/O and File System
- Conceptual Exascale node and system designs
- Data Analytics and Visualization
- Mathematical and Scientific Libraries and Frameworks
- Analysis of performance improvement on conceptual system design