High Performance Computing & Multicore Architecture

Colleges and Universities are being challenged to develop curricula that offer students a practical combination of business and technical skills to meet the industry demands. Today’s demands for intense computation requiring trillions of calculations to occur within a second, achievement of peak performance and productivity needed to run increasingly complex scientific, commercial applications, manipulation and management of massive amounts of data has led IBM to deliver innovative, powerful, High performance Computing solutions viz Blue Gene, Cell Broadband Engine, System p575, System Storage etc.

While manufacturing technology continues to improve by reducing the size of single gates, physical limits of semiconductor-based microelectronics have become a major design concern. Some effects of these physical limitations can cause significant heat dissipation and data synchronization problems. The demand for more capable microprocessors causes CPU designers to use various methods of increasing performance. Multiple independent CPUs (MultiCore) is one common method used to increase a system’s overall performance.

Some of the IBM Multi core processors are: POWER4 (world’s first non-embedded dual-core processor), POWER5 and POWER6 (dual-core processors), PowerPC 970MP, Xenon (triple-core, SMT-capable, PowerPC microprocessor used in the Microsoft Xbox 360 game console), Cell processor etc.

This course is designed to teach the related concepts using some of these products.
Curriculum Outline

Multicore Architecture Segment

UNIT 1: 5

UNIT 2: 5

UNIT 3: 5

UNIT 4: 3
Cell Broad band engine architecture, PPE (Power Processor Element), SPE (Synergistic processing element), Cell Software Development Kit, Programming for Multicore architecture (introduction).

HPC Segment

UNIT 1: 3
HPC case studies from science and engineering, Techniques for high performance programming (tuning), Basics of shared and distributed memory, Introduction to message passing, Introduction to OpenMP.

UNIT 2: 5
Multicore programming Model – Shared memory model, message passing model, transaction model – OpenMP and MPI Programming.

UNIT 3: 2
Performance tuning and parallelization of a simple program, application of principles learnt in Units I and II.

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