

C-DAC's Second Technology Training Programme

on

ProMCORE –2008 : Programming on Multi Core Processors

(Performance Enhancement through Software Multi-Threading)

Venue: Centre of Modeling Simulation & Design (CMSD), University of Hyderabad

Date: February 05 –09, 2008

Day 1: February 05, 2008 (Tuesday)

Time (Hrs)	Activity
0800 ~ 0900	ProMCORE 2008 Registration
0900 ~ 0930	Inauguration of ProMCORE 2008 <ul style="list-style-type: none"> • Prof. Seyed E. Hasnain Vice-Chancellor, University of Hyderabad, • Shri S.Ramakrishnan Director General, C-DAC, INDIA • Prof. Arun Agarwal, Director, CMSD, University of Hyderabad • Dr. N.Sarat Chandra Babu, Director, C-DAC, Hyderabad • Dr.VCV.Rao, In-Charge, ProMCORE 2008, C-DAC, Pune
Day 1 Session 1: Multi-Core : Architecture & Prog. Env Tea & Refreshments Break: 1030 Hrs ~1045 Hrs	
0930 ~ 0945	An Overview of ProMCORE 2008 & Hands-on Session
0945 ~ 1030	Multi Core Architectures & System Overview (Part-I) : Introduction; An Overview of Multi Core Architectures; Multi-Core Architectures <i>versus</i> Hyper-Threading; Multi-Threading on Single /Multiple Core Platforms; Understanding Performance Issues
Day 1 Session 2: Multi-Core: POSIX-Threads/OpenMP Lunch Break: 1300 Hrs~1400 Hrs	
1100 ~ 1145	Multi Core: Multi-threaded Prog – Pthreads (Part-I) : Introduction to Multithreading; Thread Basics; Why Threads; Conventional Multithreading; The POSIX Thread APIs; Thread Basics; Creation and Termination; Synchronization Primitives; Designing Asynchronous Programs
1145 ~ 1300	Multi Cores: Multi-threaded Prog – OpenMP (Part-I) : How to write Multi-threaded programs on Multi-Core Systems? Example programs using OpenMP; Role of Compilers on UNIX/Linux environments & Windows? Application Prog Models & Threading – Prog. Languages;
Day 1 Session 3: Multi Core Processors : Hands-on Tea & Refreshments Break: 1630 Hrs~1645 Hrs	
1400 ~ 1730	Hands-on Session: Compilation and Execution on Dual Core /Quad Core Processor Systems; Example programs on PThreads & OpenMP programs; Thread Programs on Vector-Vector, Matrix-Vector computation, Tuning & Performance Issues

Day 2: February 06, 2008 (Wednesday)

Time (Hrs)	Activity
Day 2 Session 1: Multi-Core: Architecture & Prog. Env Tea & Refreshments Break: 1030 Hrs ~1045 Hrs	
0900 ~ 0945	Multi Core Architectures & System Overview (Part-II) : System Overview of Threading; Threads inside the OS/the Hardware, threading above the OS; Thread Creation; Thread Stack Size; Thread Stack allocation; Dual Core / Quad Core Processors; Memory Interconnect; Understanding Performance Issues
0945 ~ 1030	Multi Cores: Multi-threaded Prog – OpenMP (Part-II) : Shared Memory Prog. Model, OpenMP Constructs, Parallel for Loops, - Critical Sections; Reductions; Functional Parallelism;
Day 2 Session 2: Multi-Core: System Overview Lunch Break: 1300 Hrs~1400 Hrs	
1100~ 1200	Multi Core: Multi-threaded Prog – Pthreads (Part-II) : Managing Threads; Thread Synchronization; Mutex Variables; Condition Variables, Critical Section, Deadlock; Synchronization Primitives - Semaphores, Locks; Messages; Performance
1200 ~ 1300	Multi-Core: Multi-threaded Prog. – MPI 2.0: An Overview of MPI 1.0/ 2.0 on Multi Core Processors; MPI-Pthreads / MPI-OpenMP
Day 2 Session 3: Multi Core Processors: Hands-on Tea & Refreshments Break: 1630 Hrs~1645 Hrs	
1400 ~ 1430	Multi Core: Multi-threaded Prog – Pthreads (Part-III) : Multithreading Performance Issues; Common Errors in Multi-Threading on Multi Cores; Synchronization /Non Synchronization Issues; Data Races, Deadlocks, and Live Locks; Memory and Bandwidth Issues
1430 ~ 1730	Hands-on Session: Understanding Performance for Example Programs on MPI/Threads / OpenMP - Thread Programs on Matrix-Vector, Producer-Consumer Problem; Search Algorithms; Sorting Algorithms & Performance Issues of Thread APIs; Assignment Work-Outs; Compilation and Execution on Multi Core Systems; Threads/Java Threads; OpenMP programs

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Day 3: February 07, 2008 (Thursday)

Time (Hrs)	Activity
Day 3 Session 1: Multi-Core: Tuning & Performance	
Tea & Refreshments Break: 1030 Hrs ~1045 Hrs	
0900 ~ 0945	Multi Core: Tuning & Performance (Part-I) : Multi Threaded Environment – Compiler Optimization and Cache Optimization on Multiple Cores & Benchmarks Performance on Dual /Quad Core Processors
0945 ~ 1030	Multi Core Architectures & System Overview (Part-III) : Conventional Multithreading; An Overview of SMP; Superthreading & Hyperthreading ; Implementation Issues; Caching & Simultaneous Multithreading (SMT) (Hyperthreading) ; Performance Issues
Day 3 Session 2: Multi-Core: Multi-threaded Programming	
Lunch Break: 1300 Hrs~1400 Hrs	
1100~ 1200	Multi-Core: An Overview of Multi-threading - OpenMP (Part-III) : Advanced Feature of OpenMP: Performance Issues of OpenMP Programs; OpenMP –Critical Sections; Functional Parallelism; Performance Issues – Scalability – Using larger number of Threads
1200 ~ 1300	Multi-Core : Prog. Env & Algorithms Design: An overview of Algorithmic Paradigms for Threads; Programming Models; Implicit /Explicit Parallelism; Types of Parallelism; Decomposition techniques for Threads; Static and Dynamic load balancing techniques – Threads; Overheads in algorithm design – Synchronization, Communication, Load balancing
Day 3 Session 3: Multi Core Processors : Hands-on	
Tea & Refreshments Break: 1630 Hrs~1645 Hrs	
1400 ~ 1430	Multi Core - Programming Environment: Java Multithreading & Performance Issues
1430 ~ 1730	Hands-on Session: Understanding Performance for Example Programs on MPI (Fortran 90/ Fortran 77 /Threads / OpenMP - Thread Programs on Matrix-Vector, Vector-Vector Multiplication algorithms; Producer-Consumer Problem; Performance Issues of Thread APIs ; Compilation and Execution and Performance Issues; Threads/Java Threads; OpenMP programs; Performance Visualization tools; Thread Checker Tools; Thread Profiler Tools

Day 4: February 08, 2008 (Friday)

Time (Hrs)	Activity
Day 4 Session 1: Multi-Core: System Overview	
Tea & Refreshments Break: 1030 Hrs ~1045 Hrs	
0900 ~ 0945	Multi-Core -Tuning & Performance (Part-II) : An overview of Pthreads, OpenMP & Java Threads – Performance and Scalability Issues; Compiler Optimization and Cache Optimization - MPI /OpenMP/Pthreads; An overview of Loop Optimization of Programs on Multi-Cores
0945 ~ 1030	Multi-Core: Tuning & Performance Benchmarks (part-I): tuning and Performance of Micro and Macro Benchmarks on Multi-Core Systems – Use of Math Libraries & Compiler Issues; An overview tuned Mathematical libraries (BLAS-I, II & III; DGEMM, HPCC Benchmark Suite)
Day 4 Session 2: Multi-Core: Prog. Env/Tools	
Lunch Break: 1300 Hrs~1400 Hrs	
1100 ~ 1200	Multi-Core: Intel Programming Environment – I : Intel VTune Performance Analyzer & Multi-threaded performance; Intel Thread checker and the Intel Debugger, Intel Thread Profiler – POSIX-based multi-threaded & OpenMP applications; Intel MKL and Intel Integrated Prog.Performance Primitives; Speaker: Intel Technology India Pvt Ltd., Bangalore, India
1200 ~ 1300	Multi-Core: Intel Programming Environment – I I: Intel VTune Performance Analyzer & Multi-threaded performance; Intel Thread checker and the Intel Debugger, Intel Thread Profiler – POSIX-based multi-threaded & OpenMP applications; Intel MKL & Intel Integrated Prog. Performance Primitives; (Speaker: Intel Technology India Pvt Ltd., Bangalore, India)
Day 4 Session 3: Multi Core Processors: Hands-on	
Tea & Refreshments Break: 1630 Hrs~1645 Hrs	
1400 ~ 1730	Hands-on Session: Performance for Example Programs on Threads / OpenMP /MPI 2.0 Programs; Use of Performance Tools & Libraries; Thread Programs on Numerical and Non-Numerical Algorithms; Performance Visualization tools; Profilers; Performance Visualization tools; Thread Checker Tools; Thread Profiler Tools; Upshot; Performance Analysis tool – PAPI
Banquet Dinner	

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Day 5: February 09, 2008 (Saturday)

Time (Hrs)	Activity
Day 5 Session 1: Multi-Core: Prog. Env./ Performance	
Tea & Refreshments Break: 1030 Hrs ~1045 Hrs	
0900 ~ 0945	Multi Core - Programming Environment (Part-II: MPI-2.0): An Overview of MPI 2.0; Remote Memory Operations; MPI 2.0 –Threads & Performance Issues
0945 ~ 1030	Multi-Core: Tools & Performance: PAPI (Performance Application Programming Interface); hardware performance counters; performance metrics on all platforms; Events related to cache misses and floating point operations; Sustained Performance Issues of Benchmarks
Day 5 Session 2: Multi-Core: Prog. Env /Performance	
Lunch Break: 1300 Hrs~1400 Hrs	
1100~ 1145	Multi Core - Programming Environment (MPI-2.0 & Threads I/O): Performance of Micro & Macro Benchmarks on Multi-Core Systems ; I/O Threads; MPI I/O; MPI -Threads & Performance
1145 ~ 1230	Multi Core : Tuning & Performance (Part-III) : Tuning MPI Applications on Multi-Cores; Common problems with Parallel Programming Problems – Application Perspective; Cost-Performance trade-Offs; Explicit Threads versus OpenMP Based Programming on Multi-Cores
1230 ~ 1300	Multi Core: Multi-threaded Prog – Pthreads (Part-IV): Multithreading Performance Issues; Synchronization /Non Synchronization Issues; Memory Issues - Memory Contention, Memory Consistency, Memory Allocation, and Cache related Issue - False Sharing of Data; Thread Safe Functions; Example programs and Performance Issues
Day 5 Session 3: Multi Core Processors : Hands-on	
Tea & Refreshments Break: 1630 Hrs~1700 Hrs	
1400 ~ 1600	Hands-on Session: Performance for Example Programs on Threads / OpenMP /MPI 2.0 Programs; Use of Performance Tools & Libraries; Thread Programs on Numerical and Non-Numerical Algorithms; Performance Visualization tools for threads / MPI Programs; Performance of Thread I/O test suites
1600 ~ 1630	Open Discussions and Conclusions of ProMCORE 2008
Tea & Refreshments Break: 1630 Hrs~1700 Hrs	