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**Kingdom of Saudi Arabia**

**Ministry of Education**

**College of Computer & Information Sciences**

**Majmaah University**

**CS350 Parallel and Distributed Computing**

**Credits and contact hours:** *3 Credits* (3 Lecture, 1 Tutorial)

**Instructors:** ***Dr. Jayadev Gyani, Dr. Hadeel***

**Textbook:** “Introduction to Parallel Computing”, (Second Edition) Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar. Addison-Wesley, 2003. ISBN 0-201-64865-2.

**Specific course information:**

1. **Catalogue Description:** The Course presents parallel and distributed processing concepts including concurrency and its management, models of parallel computation, and synchronous and asynchronous parallelism. Topics include simple parallel algorithm formulation, parallelization techniques, interconnection networks, arrays, trees, hyper cubes, message routing mechanisms, shared address space and message-passing multiprocessor systems, communication cost and latency-hiding techniques, scalability of parallel systems, and parallel programming concepts and application case studies.
2. **Prerequisite:** CS312 (Computer Organization)

**Specific goals for the course:**

**a. Specific outcomes of instruction: (CLO)**

1. The student will appreciate and understand the importance of parallel computation in solving practical problems in science & engineering.
2. The student will be able to select the proper parallel processing strategy that is expected to work best for solving a particular problem in given parallel processing platform.
3. The student will be able to develop a parallelization strategy for numerical and other algorithms for science and engineering problems such as solving a system of linear equations, sorting the records of large database, computing numerically a difficult integral, performing a montecarlo simulation etc...
4. The student will be able to develop, test and debug intermediate level message passing parallel programs using C/MPI in a pc cluster and write a data parallel program for a graphics processing unit.
5. The student will able be able to compare the performance of alternative parallel processing strategies for a given problem in a PC cluster and a GPU.
6. The student will be able to evaluate how performance is affected as the problem size increases.
7. **ABET Criterion 3 Student Outcomes addressed by the course:**

**SO (1): Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identity solutions.**

Students keenly understand the importance of parallel computation in solving practical problems in science and engineering (parallel thinking) and apply knowledge of various mathematical techniques, to solve parallel addition using PRAM, Use Amdahl’s law.

**SO (2): Design, implement and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program’s discipline**

Students need to design and implement numerical and image processing algorithms to improve the system performance and achieve efficiency using advanced programming concepts like java and submit as project work.

**SO (6): Apply computer science theory and software development fundamentals to produce computing–based solutions.**

Students develop a parallelization strategy for numerical and other algorithms for science and engineering problems, such as, sorting the records of a large database, performing a Monte Carlo simulation etc. (parallel algorithms). Students are able to apply the principles of principles of Cache Coherence, including numerical integration, bucket sort case studies and others to enhance the performance of parallel systems.

**Topics covered:**

* Fundamentals of Parallel Processing
* Introduction to Multiprocessor & Multicomputer
* Interconnection networks
* Graphics Processing Units and other parallel devices
* Message Passing methods and tools and MPI: the Message Passing Interface
* Partitioning, divide-and-conquer strategies
* Data Parallel & synchronous computing
* Load balancing, distributed termination detection
* Parallel Numerical and Image Processing Algorithms
* Languages and language extensions, including Pthreads, OpenCL and C
* Distributed Computing