

Parallel Computing

Spring-2019

Instructor Information

Instructor

Dr. Ayaz ul Hassan Khan

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Office Location & Hours

TBA

General Information

Description

With advances in computer architecture, high performance serial and parallel computers have become readily available and affordable. As a result, high-performance and supercomputing is accessible to a large segment of the industry that was once restricted to military research and large corporations only. This course introduces practical performance optimization techniques for serial and parallel computing with an emphasis on algorithms in linear algebra. Popular parallel programming models such as shared- and distributed-memory and parallel libraries such as MPI and OpenMP will be discussed.

Expectations and Goals

- Understanding the Programming Models/Techniques for Performance Improvements
- Understanding the Performance Issues in Single-Processor and Multi-Processors Systems
- Enhancing the Cache and Memory Utilization with Code Analysis
- Designing Parallel Algorithms
- Writing Parallel Programming in Shared-Memory (using OpenMP) and Distributed-Memory Architectures (using MPI)
- Hands on Experience to setup a computing cluster using commodity hardware and evaluate parallel programs on it

Course Materials

Required Text

- Introduction to Parallel Computing, A. Grama et. al., Addison - Wesley, 2003.
- Parallel Programming in C with MPI and OpenMP, Michael J. Quinn.

Reference Text

- Using MPI - Portable Parallel Programming with the Message - Passing Interface, 2nd Edition, W. Gropp, E. Lusk, A. Skjellum, MIT Press, 1999.
- Parallel Programming in OpenMP, R. Chandra et al., Academic Press, 2001.
- Lecture Notes, Handouts, and Selected Research Papers

Pre-Requisites: Computer Programming, Operating Systems, Computer Architecture

Brief List of Topics to be covered:

Topic

Parallel Programing Platforms

Data Locality, Loop Optimizations, Data Dependency

Shared Memory Programming (OpenMP)

Message Passing Programming (MPI)

Dense Matrix Algorithms

Solving Linear Systems

Fast Fourier Transform

About Course Instructor:

Dr. Ayaz ul Hassan Khan received his BS degree from NED-Pakistan, MS degree in Computer Science from LUMS-Pakistan and PhD degree in Computer Science and Engineering with the specialization in Parallel Computing from King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia. He has seven years of experience in both industry and academics. He has hands-on experience in Database programming, Network Programming, Embedded Systems Programming, and Parallel Programming. His current areas of interest include Parallel and Distributed Computing, High Performance Computing, Computer Architecture, Operating Systems, Deep Learning and Big Data Analytics. He has published 6 journals and 11 conference papers/posters in the field of his research areas in recent years. Check out the following for details: <https://sites.google.com/site/ayazresearch/>

Related Links:

- <http://www.studentclustercompetition.us/>
- <http://www.studentclustercomp.com/>
- <https://sc-asia.org/>
- <http://www.supercomp.org/>
- <https://link.springer.com/journal/10766>
- <https://www.journals.elsevier.com/parallel-computing/>
- <https://www.open-mpi.org/>