



UNIVERSITI TEKNOLOGI MARA

CSC780: PARALLEL PROCESSING

Course Name (English)	PARALLEL PROCESSING APPROVED
Course Code	CSC780
MQF Credit	3
Course Description	The course introduces the students to range of topics involved in parallel operations to improve computational performance. It explores various aspects of parallel computing including parallel architectures, parallel algorithms and parallel applications.
Transferable Skills	Demonstrate analytical skills using technology.
Teaching Methodologies	Lectures, Blended Learning, Demonstrations, Simulation Activity, Presentation
CLO	CLO1 Demonstrate an understanding of parallelism fundamentals and algorithm design. CLO2 Design and develop a parallel program for solving a simplified computational problem. CLO3 Evaluate the performance of a parallel program.
Pre-Requisite Courses	No course recommendations
Topics	
1. Parallel Computing Fundamentals 1.1) Motivating Parallelism 1.2) Scope of Parallel Computing 1.3) Setting up Parallel Computing Environment	
2. Parallel Platforms 2.1) Implicit Parallelism: Trends in Microprocessor Architectures 2.2) Limitations of Memory System Performance 2.3) Dichotomy of Parallel Computing Platforms 2.4) Physical Organization of Parallel Platforms 2.5) Communication Costs in Parallel Machines	
3. Parallel Algorithm Design 3.1) Preliminaries 3.2) Decomposition Techniques 3.3) Tasks and Interactions 3.4) Mapping Techniques 3.5) Interaction Overheads 3.6) Parallel Algorithm Models	
4. Shared Address Space Programming Paradigm 4.1) Multithreading Concepts 4.2) Thread Lifecycle 4.3) Mutual Exclusion 4.4) Synchronization 4.5) Liveness problems 4.6) Multithreading Implementation in a programming language (e.g. Java or C#)	
5. Message Passing Programming Paradigm 5.1) Message passing concepts 5.2) MPI: Message Passing Interface 5.3) Basic Operations: Send and Receive 5.4) Point-to-point communication 5.5) Collective communication 5.6) Message passing implementation in a programming language (e.g. Java or C#)	

6. Analytical Modeling 6.1) Source of Overhead 6.2) Performance Metrics 6.3) Granularity on Performance 6.4) Scalability of Parallel Systems
7. Parallel Algorithms 7.1) Sorting Algorithms 7.2) Graph Algorithms 7.3) Search Algorithms
8. Test 8.1) n/a
9. Project 9.1) n/a

Assessment Breakdown	%
Continuous Assessment	70.00%
Final Assessment	30.00%

Details of Continuous Assessment	Assessment Type	Assessment Description	% of Total Mark	CLO
	Assignment	6 Assignments with 5% each.	30%	CLO1 , CLO2 , CLO3
	Group Project	Students are expected to produce and evaluate a parallel program with a report.	30%	CLO2 , CLO3
	Lab Exercise	4 programming exercises where 2.5% each.	10%	CLO1 , CLO2

Reading List	Recommended Text	<ul style="list-style-type: none"> Peter S. Pacheco 2011, <i>An Introduction to Parallel Programming</i>, 1st Ed., Morgan Kaufmann Pub [ISBN: 0123742609]
	Reference Book Resources	<ul style="list-style-type: none"> Ananth Grama 2003, <i>Introduction to Parallel Computing</i>, 2nd Ed., Pearson Education [ISBN: 9780201648652] Jordan, H.F., Alaghband, G. & Jordan, H.E., 2002, <i>Fundamentals of Parallel Computing</i>, Prentice Hall Diaz, Javier 2012, <i>A survey of parallel programming models and tools in the multi and many-core era</i>, IEEE Transactions on Parallel and Distributed Systems [ISBN: 1045-9219] William, Groop 2011, <i>Using MPI - Portable Parallel Programming with the Message-Passing Interface</i>, 3rd Ed., MIT Press [ISBN: 978-0-262-571] Jin, Haoqiang, Jespersen, Dennis, et al. 2011, <i>High performance computing using MPI and OpenMP on multi-core parallel systems</i> [ISBN: 0167-8191] Norm, Matloff 2012, <i>Programming on Parallel Machine GPU, Multicore and Cluster</i>, University of California

Article/Paper List	Reference Article/Paper Resources	<ul style="list-style-type: none"> Pingali, Keshav 2014, <i>Parallel Programming in the Age of Ubiquitous Parallelism</i> Tomar, Anuradha, Bodhankar, Jahnvi, et al. 2013, <i>Parallel implementation of machine translation using MPJ Express, 2013 National Conference on Parallel Computing Technologies (PARCOMPTECH)</i> Kecker, Stephen W, Dally, William J, et al. 2011, <i>GPUs and the future of parallel computing, IEEE Micro</i> [ISSN: 0272-1732]
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Other References	<ul style="list-style-type: none"> Website Blaise Barney <i>Introduction to Parallel Computing</i> https://computing.llnl.gov/tutorials/parallel_comp/ Website MSDN <i>Parallel Programming in the .NET Framework</i> https://msdn.microsoft.com/en-us/library/dd460693%28v=vs.110%29.aspx Website MPJExpress <i>MPJExpress Project</i> http://mpj-express.org/
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