MULTIMEDIA INFORMATICS

MMI 713– Applied Parallel Programming on GPU

SYLLABUS

Course Name & Credit: MMI 713– Applied Parallel Programming on GPU
Year, Semester: 2018-2019 Spring
Location & Time: Classroom 4 - Tuesday 9:40 - 12:30
Instructor: Prof.Dr. Alptekin Temizel, atemizel@metu.edu.tr

COURSE OUTLINE

Week	Date	
1	12.02.19	Introduction to GPUs and GPU Programming
		History of GPU and General Purpose Programming on GPU (GPGPU) GPU based applications GPU programming frameworks Advantages and disadvantages of GPGPU
2	19.02.19	Introduction to GPU Architecture and CUDA Basics
		PC and GPU architecture Introduction to CUDA CUDA API and SDK CUDA Threads Code Walkthrough
3	26.02.19	Hands-on Lab
		CUDA environment installation Implementation of sample programs Lab assignment
4	05.03.19	Effective Use of Memory and Optimization
		Global Memory, coalescing Shared Memory, bank conflicts Latency Hiding Page-locked transfers Asynchronous access
5	12.03.19	Effective Use of Memory and Optimization – Lab
		Zero Copy Constant Memory, Read-only memory Textures
6	19.03.19	Control Flow, parallel reduction, optimization
		Block partitioning, warps, Branch divergence overhead Parallel Reduction Floating point and double operations Atomic Operations
7	26.03.19	Project Proposals
		Presentation of project proposals by the students

8	02.04.19	CUDA Debugging, Profiler/Parallel Nsight
		Local and remote debugging PTX and SASS debugging Performance analysis and profiling Parallel Nsight statistics and examples
9	09.04.19	Analytical Modeling of Parallel Systems and Performance Analysis
		Analytical modelling Overheads in parallel programs Performance Metrics Cost of a parallel system Amdahl's law Scaling characteristics of parallel systems
10	16.04.19	Thrust Library
		Thrust Basics Templates and functors Thrust algorithm Optimization in Thrust
11	23.04.19	NO LECTURE DUE TO PUBLIC HOLIDAY
12	30.04.19	OpenCL and Case Studies
		Case Study I – Background Subtraction Implementation of background subtraction algorithm on GPU Memory optimization (coalesced access, asynchronous copying) Case Study II – Cross Correlation Implementation of cross correlation on GPU Memory optimization (shared memory, avoiding bank conflicts)
13	07.05.19	Multi GPU programming and Advanced Concepts
		Using Multiple GPUs Dynamic Parallelism HyperQ WARP Operations and Shuffling
14	14.05.19	Deployment
		Deployment Tools, GPU containerization PyCUDA, Numba TensorRT Tensor Cores GPU Rest Engine

TEXTBOOK

David B. Kirk and Wen-mei W. Hwu "Programming Massively Parallel Processors: A Hands-on Approach – 2nd Edition", Morgan Kaufman, ISBN-13: 978-0-12-415992-1.

REFERENCE MATERIAL

- Wen-mei W. Hwu (Editor), "GPU Computing Gems", Morgan Kaufman, ISBN-10: 0123849888, ISBN-13: 978-0123849885.
- H. Bidgoli, "CUDA by Example: An Introduction to General-Purpose GPU Programming", Addison Wesley, ISBN-10: 0131387685, ISBN-13: 978-0131387683.
- Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", ISBN-13: 978-0124159334
- Rob Farber, "CUDA Application Design and Development", ISBN-13: 978-0123884268.
- NVIDIA Developer Zone, http://developer.nvidia.com/page/home.html
- OpenCL Developer Zone, http://www.khronos.org/opencl/

COURSE CONDUCT

The course will be taught in class and also will involve application. The students are expected to present a project proposal that involves parallel programming and implement on GPU using CUDA or OpenCL. The term project will help the students to apply the knowledge obtained in the class and gain practical experience by implementing it.

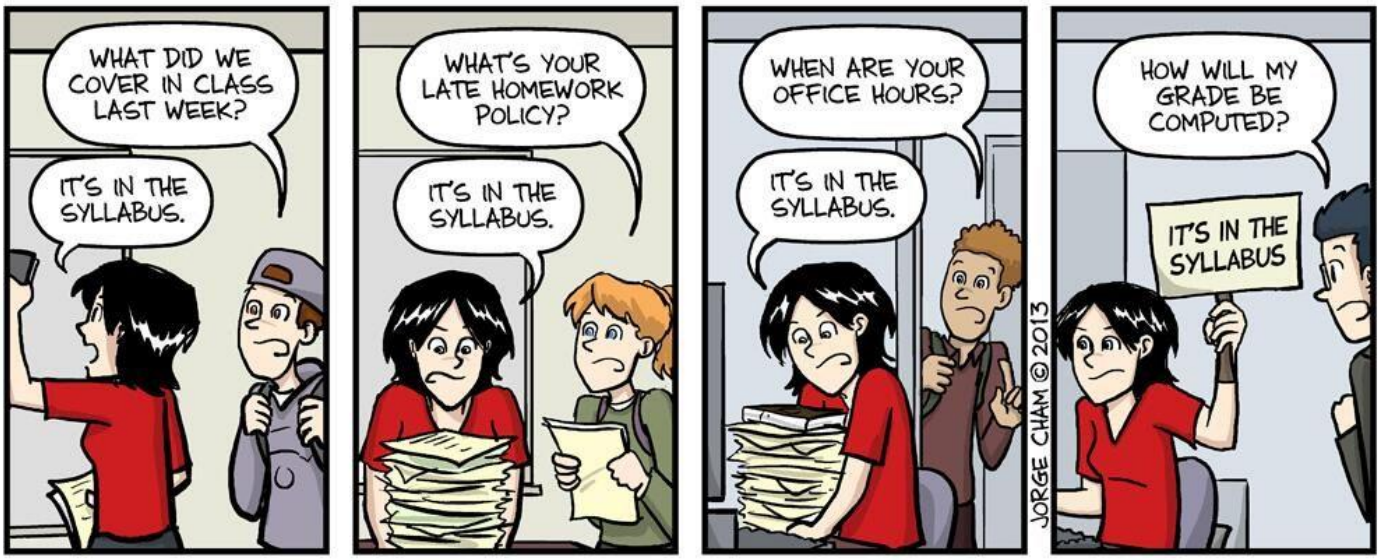
GRADING

5% Lab Assignment
30% Assignments (3 Assignments – 10% each)
50% Project (Project has 3 phases)
15% Quiz (3 quizzes – 5% each)
5% Attendance – Participation/Quiz
Total: 105%

You will be told about the **quiz time and the content** one week before the quiz at the lecture hours!
No late submissions will be allowed for the assignments and the project phases.
You will submit your work (assignments and project phases) to **ODTUClass**. Note that the system closes at 23:55 at the due date so do not leave it to the last minute.

OFFICE HOURS

There are no set office hours, please do not hesitate to contact me on my e-mail **atemizel@metu.edu.tr** to get an appointment if you need help with anything related with the course. Alternatively you can use ODTUClass to ask any question or to share anything related with the course.
The course assistant is Cihan Öngün – **congun@metu.edu.tr** , please contact Cihan regarding any questions on labs or assignments.



IT'S IN THE SYLLABUS

This message brought to you by every instructor that ever lived.

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