Course Code	ECE/CSExxx
Course Name	Intelligent Applications Implementation on Heterogeneous Platforms
Credits	4
Course Offered to	UG, PG
Course Description	Intelligent computing systems have started to play key roles in many spheres of human endeavor. Their contributions in facilitation and enhancement of human life are following high growth trajectories in various domains. Commercial examples of such intelligent systems are data analytics systems deployed by various corporations (e.g. Facebook, Google), computational finance systems (e.g. automated trading), augmented reality (AR) applications and games, various subsystems of autonomous driving vehicles, biomedical signal processing systems etc. Development of intelligent computing systems requires complex challenges to be solved such that deployment of intelligent computing systems remains justified and lucrative. Specifically, efficiency of such systems is a key criterion for majority of the stakeholders. A high- performance, but low-efficiency, intelligent computing system typically does not ignite sufficient excitement in many commercial application areas. Heterogeneous computing platforms are offering unprecedented efficiency enhancements for many applications, notably intelligent applications. This course will include discussion of relevant key algorithms from the implementation perspective, and equip students with following important skills: - * Understand key challenges and technologies associated with the development of efficient intelligent computing systems. * Implement intelligent computing applications in computational finance (e.g. automated trading), real-time computer vision (e.g. augmented reality application) and biomedical engineering (e.g. automated medical diagnosis) using OpenCL (Open Computing Language) programming framework. * Optimize and evaluate OpenCL applications for achieving high efficiency on heterogeneous computing platform consisting of CPU, general- purpose GPU (GPGPU) and FPGA devices. Skills learned in this course will enable students to better deal with and exploit opportunities created by the proliferation

Pre-requisites

Pre-requisite (Mandatory)	Pre-requisite (Desirable)	Pre-requisite (Other)
* Software programming using C & C++ * Computer organization	techniques e.g. regression, support vector machine (SVM), neural networks.	

Post Conditions

CO1	CO2	CO3	CO4
Understand characteristics and requirements of intelligent computing applications.	Able to perform comparative evaluation of various relevant computing approaches for intelligent computing applications.	intelligent computing applications (e.g. automated trading, augmented reality) using OpenCL programming framework on a heterogeneous computing platform consisting of advanced CPU and GPGPU.	intelligent computing applications (e.g. automated trading, augmented reality) using OpenCL programming framework on a heterogeneous computing platform consisting of advanced CPU and FPGA.

Weekly Lecture Plan

Week Number	Lecture Topic	COs Met	Assignment/Tutorial
1, 2	Motivation and course overview; Computational characteristics and system requirements of intelligent computing applications	CO1	3 homeworks will be assigned in the first half of course.
2, 3	Various computing approaches and their trade-offs: - - Advanced CPUs, general-purpose GPUs, FPGAs and DSPs	CO2	
4, 5	OpenCL programming framework	CO2, CO3, C04	
5, 6, 7, 8	Computational finance application programming using OpenCL on CPU, GPGPU and FPGA: - - Discussion of computational finance concepts and key algorithms from the implementation perspective. Focus on automated trading (including high-frequency trading). - Implementation using OpenCL and relevant optimization techniques.	CO1, CO2, CO3, C04	
8, 9, 10, 11	Computer vision application programming using OpenCL on CPU, GPGPU and FPGA: - - Discussion of real-time computer vision concepts and key algorithms from the implementation perspective. Focus on augmented reality (AR) applications, vision subsystem of autonomous driving vehicles. - Implementation using OpenCL and relevant optimization techniques.	CO1, CO2, CO3, C04	
11, 12, 13	Biomedical engineering application programming using OpenCL on CPU, GPGPU and FPGA: - - Discussion of medical diagnosis concepts and key algorithms from the implementation perspective. Focus on automated breast histopathology, blood cell classiication. - Implementation using OpenCL and relevant optimization techniques.	CO1, CO2, CO3, C04	

Assessment Plan

Type of Evaluation	% Contribution in Grade
Assignment/ quizzes	20
Project I	20
End sem	40

Project II	20
Resource Material	
Type	**Title**
Books	“Heterogeneous Computing with OpenCL 2.0”, David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang
Books	“Computer Vision: Models, Learning, and Inference”, Dr Simon J. D. Prince
Books	“A First Course in Quantitative Finance”, Thomas Mazzoni
Books	“Biomedical Engineering: Bridging Medicine and Technology”, W. Mark Saltzman
User Guides and Reference Manuals	OpenCL standard specification and reference guide.
Software	Relevant software for OpenCL from FPGA and graphics cards vendors.
Hardware	FPGA and graphics cards that support OpenCL for heterogeneous computing.
Reference	“OpenCL in Action: How to Accelerate Graphics and Computations”, Matthew Scarpino
Reference	“Advanced Quantitative Finance with C++”, Alonso Peña
Reference	“Programming Computer Vision with Python: Tools and algorithms for analyzing images”, Jan Erik Solem