CSE 6422 (Approved): Advanced Computer Architecture

Course Description

Fundamental design issues in parallel architectures, design of scalable shared memory and distributed memory systems, interconnection networks (on-chip and off-chip), multi-core architectures, accelerators, embedded systems, and exascale systems.

Prior Course Number: CSE 875
Transcript Abbreviation: Advanced Comp Arch
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Graduate
Student Ranks: Masters, Doctoral
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: (CSE 6421 or CSE 775) and (CSE 6441 or CSE 721)
Exclusions: Not open to students with credit for CSE 875
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.0901
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
MS CSE	MS Computer Science and Engineering
PhD CSE	PhD Computer Science and Engineering

Course Goals

Master the principles of advanced computer architecture
Master the implications of different ways of using hardware parallelism (processors, interconnection networks and accelerators)
Master the architectural design issues in shared memory, distributed-memory, distributed shared memory, and petascale/exascale systems
Master the design principles of interconnection networks
Be familiar with the architectural designs of past and present (state-of-the-art)computer systems

Be familiar with analyzing and solving architectural design problems
Be exposed to the future trends in parallel computer architectures

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Design issues of Parallel Architectures	3.0							
Interconnection Network Design Principles (Classification of interconnection networks, basic switching techniques, virtual channels)	3.0							
Design Principles (Cont'd): Deadlock, Livelock, and Starvation; Routing Algorithms for direct, indirect, and switch-based networks; System support, hardware implementations, and software implementations for collective communication	6.0							
Latest Multi-core Architectures	3.0							
On-Chip Interconnect Architectures	3.0							
Design of Shared-Memory Multiprocessors (Cache Coherence, Memory Consistency, Snooping Protocols, Protocol Design Tradeoffs, Synchronization, and Implications on Software)	4.0							
Snoop-based Multiprocessor (Symmetric Multiprocessor) Design (Single-level cache with an atomic bus, multi-level cache hierarchies and split-transaction bus.)	5.0							
Acclerator Architectures	3.0							
Issues in Designing Scalable Systems (DSM Systems with Directory-based Cache Coherence, Software DSM Systems, and Scalable Non Cache Coherent Systems Supporting PGAS Models)	3.0							
Architectural Issues in Designing Power-Aware and Embedded Computing Systems	3.0							
Overview of Current Multi-Petaflop Systems and Architecture for Emerging Exascale Systems	6.0							

Grades

Aspect	Percent
Homeworks	15%
Final Exam	40%
Project	35%
Class Participation and Discussion	10%

Representative Textbooks and Other Course Materials

Title	Author
Parallel Computer Architecture: A Hardware/Software Approach	David Culler, Jaswinder Pal Singh and Anoop Gupta
Interconnection Networks: An Engineering Approach	Jose Duato, Sudhakar Yalamanchili and Lionel Ni

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
	c	An ability to design a system, component, or process to meet desired needs.
	d	An ability to function on multi-disciplinary teams.
	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: Dhabaleswar Panda