Computer Architecture (CS 2420) Fall 2013

Time and Place: 11 AM - 12:15 PM Tuesday and Thursday in ITTC 328

Web-site: **http://www.cs.uni.edu/~fienup/cs2420f13/**

Class Email List: Send messages to Google group for the course at CS-2420-01-fall@uni.edu

Instructor: Mark Fienup (fienup@cs.uni.edu)
Office: ITTC 313
Phone: 273-5918 (Home 266-5379)
Office Hours: M 10:00-11:45, 1:10-2:30; T 1:10-2; W 10-11:45, 1:10-2:30; Th 1:10-2; F 9-11:45

Prerequisite: Computer Organization (CS 1410)

Required Text: *An Introduction to Parallel Programming*, 1st edition, by Peter S. Pacheco. Morgan Kaufmann Publishers, 2011. ISBN: 978-0-12-374260-5.

Course Goals: Very few CS students will become computer architects, but the vast majority of students will be employed as a software "somethings" (software engineer, software tester, programmer, etc.). Unfortunately, efficient software systems can only be produced by people with a thorough understanding of computer hardware and its relationship to software. Therefore, the major goal of this course is to understand the relation between the hardware and software, and how to efficiently use the hardware. To achieve this you will learn about (1) the hardware organization of sequential and parallel computers, (2) the memory hierarchy including cache and virtual memory, (3) utilitization of mult-core processors, (4) utilitization of networked multiprocessors, and (5) utilization of many-core GPUs.

Assignments: The initial assignments will be "pencil-and-paper" exercises, but later in the course we will have programming assignments to understand the computer architectures.

Pedagogic Approach: In class, I'll tend to break up the lecture with active (and group) learning exercises to aid learning. While this is not formally graded, part (5%) of your grade will be based on your participation in (and attendence for) these in-class activities. Students benefit by (1) increased depth of understanding, (2) increased comfort and confidence, (3) increased motivation, and (4) being better prepared to work in groups on the job. This might sound great, but it will require you (and me) to work differently to prepare for class. Before the class, you must read the assigned reading, thought about what I asked you to think about, etc.; otherwise you won't be able to effectively participate during class.

Grading policy: There will be three tests (including the final). Tentative test dates and the weighting of course components are:

In-class Work:	5 %	
Assignments:	29 %	
In-class Test 1:	22 %	(about Oct 3)
In-class Test 2:	22 %	(about Nov 7)
Final:	22 %	(Thursday, Dec 19 from 10-11:50 AM in ITT 328)

Grades will be assigned based on straight percentages off the top student score. If the top student's score is 92%, then the grading scale will be, i.e., 100-82 A, 81.9-72 B, 71.9-62 C, 61.9-52 D, and below 52 F. Plus and minus grades will be assigned for students near cutoff points.

Scholastic Conduct: You are responsible for being familiar with the University' Academic Ethics Policies (http://www.uni.edu/pres/policies/301.shtml). Copying from other students is expressly forbidden. Doing so on exams or assignments will be penalized every time it is discovered. The penalty can vary from zero credit for the copied items (first offense) up to a failing grade for the course. If an assignment makes you realize you don't understand the material, ask questions designed to improve your understanding, *not* ones designed to discover how another student

solved the assignment. The solutions to assignments should be **individual, original** work unless otherwise specified. Remember: discussing assignments is good. Copying code or test-question answers is cheating.

Any substantive contribution to your assignment solution by another person or taken from a publication (**or the web**) should be properly acknowledged in writing. Failure to do so is plagiarism and will necessitate disciplinary action. In addition to the activities we can all agree are cheating (plagiarism, bringing notes to a closed book exam, etc), assisting or collaborating on cheating is cheating. Cheating can result in failing the course and/or more severe disciplinary actions.

Special Notices:

- In compliance with the University of Northern Iowa policy and equal access laws, I am available to discuss appropriate academic accommodations that may be required for students with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances, so arrangements can be made. Students are encouraged to register with Student Disability Services, 103 Student Health Center, to verify their eligibility for appropriate accommodations.

- I encourage you to utilize the Academic Learning Center's free assistance with writing, math, science, reading, and learning strategies. UNI's Academic Learning Center is located in 008 ITTC. Visit the website at http://www.uni.edu/unialc/ or phone 319-273-2361 for more information.

Tentative Schedule for Computer Architecture Fall 2013

Lect #	Tuesday		Thursday	
1	8/27	Comp. Org. Review: HLL view, AL view, von Neumann architecture	8/29	Ch 1: Hardware support for OS; Processes, multitasking and threading
3	9/3	Ch 2: Memory hierarchy and cache memory	9/5	Cache mappings and effects on programs
5	9/10	Virtual memory: paging; multi-level page tables	9/12	More Virtual Memory: page-replacement algorithms, frame-allocation algorithms, segmentation, and paging of segments
7	9/17	ILP: pipelining, data and control hazards	9/19	ILP: superscalar, and VLIW processors
9	9/24	Simultaneous/hardware multithreading (SMT); Flynn's taxonomy: SISD, SIMD, MIMD, vector processor	9/26	Shared (UMA, NUMA) vs. distributed memory Interconnection networks: bisection bandwidth, latency and bandwidth
11	10/1	Review for Test 1	10/3	**Test 1**
13	10/8	C programming & Linux overview	10/10	Parallel programming design
15	10/15	Parallel programming performance	10/17	Multi-core architecture and programming with Pthread
17	10/22	Pthread programming	10/24	Pthread examples
19	10/29	Pthread examples	10/31	Network-connected multiprocessors and distributed-memory programming with MPI
21	11/5	Review for Test 2	11/7	**Test 2**
23	11/12	MPI programming	11/14	MPI examples
25	11/19	MPI examples	11/21	GPU Architecture and Programming Intro.
Thanksgiving Break				
27	12/3	CUDA Programming	12/5	CUDA examples
29	12/10	CUDA examples	12/12	Review for Final Exam
Final: **10-11:50 AM Thursday, December 19 in ITT 328**				