Academic Inquiries: Minzu University of China
E-mail: bjiss@muc.edu.cn
Phone: 86-010-68932708

Minzu University of China

CS 313 Computer Organization

Summer 2020

Basic Information
Class hours: Monday through Thursday, 2 hours each day
Discussion: Friday, 1 hour (60 minutes)
Review Section: Saturday, 1 hour (60 minutes)
Office Hour: 2 hours (According to professor's teaching plan)
Field trip: According to professor's teaching plan
Credit: 4
Total contact hours: 60 (50 minutes each)
Instructor: TBA

Prerequisites
Digital logic, Programming language C

Course Description
This course focuses on the basic issues of computer organization and computer design. Computer organization is concerned with the way the hardware components are connected together to form a computer system. Computer design is concerned with the development of the hardware for the computer taking into consideration of a given set of specifications. In this course, students will learn the principle and hardware implementation of computer components, and how to completely design a correct single processor computer. The contents of this course include principles of computer systems architecture, organization and design; computer arithmetic algorithm and hardware implementation for integer numbers; MIPS instruction set architecture; Measuring performance of instruction set and CPU architecture, ALU design; register file design; single-cycle processor data path and control unit design; Memory systems and the memory hierarchy; cache and virtual memory; Design of computer input/output; and Introduction to Parallelism, Multiprocessors and their Benchmarks and Performance Models.

Features of This Course
This course includes a variety of compelling features, certain to engage and challenge students, making learning an enriched experience. These compelling features include:

- The latest technology, pictures, drawings, and text are combined artfully to produce a visually appealing and easy-to-understand course. Includes material highlighting the emergence of mobile computing and the Cloud. Covers parallelism in depth with examples and content highlighting parallel hardware and software topics. Features the Intel Core i7, ARM Cortex-A8 and NVIDIA Fermi GPU as real-world examples throughout the book
- Discusses and highlights the "Eight Great Ideas" of computer architecture: Performance via Parallelism; Performance via Pipelining; Performance via Prediction; Design for Moore's law; Hierarchy of Memories; Abstraction to Simplify Design; Make the Common Case Fast; and Dependability via Redundancy.
- Innovative Computing Cases engage students with examples of how particular technologies are used in creative ways and how computers are utilized in fifteen different professional industries.

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Learning Outcomes

Upon completion of this course the student will be able to:

- Interpret the principles of computer organization and the hardware components to design a correct single processor computer.
- Demonstrate understanding operations and operands of computer hardware implementation, construct small programs in a given machine instruction set.
- Discuss how hardware support the implementation of high-level programming language, write programs in C, compile them, put all elements together, and have them execute.
- Classify the control unit implementation and the logic design of arithmetic operations for computer including addition, subtraction, multiplication, division and floating point.
- Analyze memory technologies in a common framework for memory hierarchy， measure and improve cache performance.
- Analyze the behavior of parallel processors and evaluate the performance of multiprocessor computers with the methods of pipelining, parallelism and prediction.

Course Text

David A. Patterson, John L. Hennessy: Computer Organization and Design, 5th Edition, Morgan Kaufmann

Attendance

Attendance is expected for all lectures and in class activities. Random attendance will be taken.

Assignments

100 points (20% of total grade) random assignments including labs will be completed. These assignments are to be completed individually. They are due at the beginning of class on the due date. Late assignments will NOT be accepted. There is NO makeup work allowed for missed assignments.

Assessment

Final letter grades are determined from your final cumulative score that is computed using the following breakdown:

Assignments There will be 5-6 times assignments worth a total 20%.
Term Test There will be four in class term tests worth a total 40% (10% for each test).
Final Exam There will be a 2-hour final exam worth 40%.

Final Grade Scale

The letter grade you get for the course is based on the following grading scheme:

Grade	Percent	GPA
A+	97-100	4.0
A	94-96	3.8
A-	90-93	3.6
B+	87-89	3.47
B	84-86	3.33
B-	80-83	3.2
C+	77-79	3.07
C	74-76	2.93
C-	70-73	2.8
D+	67-69	2.67
D	64-66	2.53
D-	60-63	2.4
F	<60	0

We do not curve individual assignments or exams. At the end of the semester after all of the scores are recorded then thresholds are set given the difficulty of the course work during the semester. Thresholds are raised if the course work was easier or lowered if it was harder. By adjusting and setting thresholds at the end of the semester we can account for varying difficulty among semesters to ensure consistency of grading across semesters. If you have a question about your grades, please meet with your instructor.

Course Schedule

Week 1

Computer Abstractions and Technology
Computer Language and Software System, Computer Hardware System, Technologies for Building Processors and Memory, from Uniprocessors to Multiprocessors Readings: History of computer development
Instructions: Language of the Computer I
Operations and Operands of the Computer Hardware, Signed and Unsigned Numbers, Representing Instructions in the Computer
Test 1

Week 2

Instructions: Language of the Computer II
Logical Operations, Instructions for Making Decisions, Supporting Procedures in Computer Hardware, Communicating with People, Parallelism and Instructions, Translating and starting a Program, Array versus Pointers
Test 2
Lab Assignment: Programming with C

Week 3

Arithmetic for Computers
Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Algorithms, Parallelism and Matrix Multiply
Readings: SIMD Extensions and Advanced Vector Extensions in x86
Test 3

Week 4

The Processor
Building a Datapath, A Simple Implementation Scheme, an Overview of Pipelining, Pipelined Datapath and Control, Control Hazards, Exceptions, Parallelism via Instructions Readings: Logic Design Conventions
Lab Assignment: Paralleling Programming or Hardware design simulation
Test 4

Week 5

Large and Fast: Exploiting Memory Hierarchy
Memory Technologies, Basics of Caches, Measuring and Improving Cache Performance
Virtual Machines and Memory, Dependable Memory Hierarchy, A Common Framework for Memory Hierarchies, Parallelism and Memory
Parallel Processors from Client to Cloud
SISD, MIMD, SIMD, SPMD and Vector
Multicore and Other Shared Memory Multiprocessors and their Benchmarks and Performance Models

Final Exam

Academic Integrity

When completing an assignment for this course, students are expected to do original work for the assignment and to not reuse work they may have done in previous courses or other settings unless the instructor grants specific prior approval.

Cheating is defined as the giving or receiving of aid (written, oral, or otherwise) in order for a student to receive undeserved credit on class work, homework, tests or any other assignment that is his or her own responsibility. Plagiarism violates the central core of education philosophy. It involves stealing another person's work and claiming it as one's own. It occurs whenever one directly copies another person`s intellectual effort and integrates it into his/her class work without giving proper credit to the author.

Paraphrasing is defined as "a restatement of a text or passage fiving the meaning in another form" (Webster's New Universal Unabridged Dictionary, 1996). When one paraphrases but intentionally omits authorship of the work, this, too is a serious violation of academic honesty. All students have an individual responsibility to understand what cheating, plagiarism, and paraphrasing are. The student must also be aware that the consequences for doing the above listed offences are severe. Whenever you have doubt about what constitutes cheating, plagiarism, or paraphrasing, contact your instructor.

With the advent of the Internet, the potential for cheating by simply cutting and pasting information into a paper is tempting. Be aware that these dishonest activities will not be tolerated, and instructors have access to increasingly sophisticated search engines to "test" the validity of student work.