Boston University Metropolitan College

Computer Architecture

MET CS472 A1
College of Arts & Sciences, Room 324
685–725 Commonwealth Avenue
6:00 – 8:45

Dave Hendrickson
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TA/Grader: Alexander Warren (warrenaj@bu.edu)
Karen Palmer (kspalmer@bu.edu) (special presentations only)

Course Description
Computer organization with emphasis on processors, memory, and input/output. Includes pipelining, ALUs, caches, virtual memory, parallelism, measuring performance, and basic operating systems concepts. Assembly language instruction sets and programming as well as internal representation of instructions. (In short, enable you to understand the internal workings of computers, what makes them fast, and what the primary design challenges are.)

Books
Computer Organization & Design: The Hardware/Software Interface
David A. Patterson and John L. Hennessy
Sixth Edition (ISBN 978-0128201091) Print or electronic.
Available at the BU bookstore or online. *No other edition is acceptable*!

Courseware
Blackboard (https://learn.bu.edu/) 21fallmetcs472_a1

Prerequisites
MET CS231 or CS232. **Do not ignore this!** You must be proficient in some language, comfortable with algorithms and handling arrays and structures or classes of data. Assembly language is helpful but not mandatory.

Grades

There will be a midterm (30%) and a final (40%) which will together account for 70% of the grade. Both will be online exams. There will be also three programming projects (in the language of your choice) for the other 30%. Late submissions will be accepted with a 10% pro-rated penalty for each week late up to a limit of two weeks *except for the final project*.

Attendance is not a part of your grade. However, you are expected to take the exams at the scheduled time. If that is impossible, you must take the exam before the rest of the class. If you are a "no show" you get a zero.

In general, an "A" will be awarded for work that totals 92-100% of the possible points, "A-" for 90-92%, "B+" for 88-90%, "B" for 82-88% and so on down to F for below 60%. Grades may be scaled upwards based on class scores (though rarely to get an A), but not downwards.

Grades are YOUR responsibility. If you need a particular grade to get into the M.S. program, receive tuition reimbursement or stay academically eligible, then it is YOUR responsibility to perform at that level. "A" work will get you an "A" and "F" work (or cheating) will get you an "F". I must distinguish between exceptional work and that which falls short of that level. Do not expect the typical grade to be an A**. Grades of D or F are almost always the result of cheating or not doing projects.**

I try to be friendly and to inject humor into the lectures, but don't mistake that for anything less than a zero-tolerance policy toward cheating. Cheating and plagiarism will not be tolerated at all. They will result in an F for the course. Not an F for the assignment or the exam. An F for the course. YOU CHEAT, YOU FAIL, subject to procedural review.

Please take the time to review the Student Academic Conduct Code: http://www.bu.edu/met/metropolitan_college_people/student/resources/conduct/code.html.

All projects in this course are INDIVIDUAL. Feel free to discuss ideas with your classmates, but **any** shared code will mean an F for the course. **No exceptions!** It is not acceptable for someone else to do your work, whether that be a classmate, a spouse, a tutor, or anyone. Do not share even one line of code.

Backups

Buy a USB drive (they are cheap) and **back up your work on projects daily**. (Or just email the code to yourself.) There are no project extensions or waived late penalties for a disk crash.

BU Community COVID-19 Public Health Policies

All students returning to campus will be required to be vaccinated against COVID-19, and upload information about their status (including applications for a medical or religious exemption or an extension) to the Patient Connect portal. In addition to the vaccine requirement, students must follow all other safety protocols, including the face covering policy, and screening, contact tracing, and testing requirements. At the beginning of each class you will be asked to show a green Healthway compliance badge on your mobile device to the instructor, and wear your face mask over your mouth and nose at all times.

Learning Outcomes

By successfully completing this course you will be able to:

- Use binary and hexadecimal numbers, and two's complement signed numbers
- Understand Instruction Set design and the internal representation of instructions
- Apply the internal representation of instructions to their behavior in processors
- Understand key concepts in processor design (datapaths, control, pipelines)
- Build on the basic concepts to more advanced (multicores, superpipelines, superscalar)
- Articulate how caches bridge the chasm between processor and DRAM performance
- Understand Virtual Addresses and how to translate them to Physical Addresses
- Apply basic principles of logic design to create a simple Arithmetic Logic Unit (ALU)
- Understand how ALUs perform arithmetic from addition/subtraction to multiplication
- Apply Computer Architecture principles to other disciplines (OS and compiler design, some elements of Software design, hardware design)

Class Meetings, Lectures & Assignments

Lectures, Readings, and Assignments subject to change, and will be announced in class as applicable within a reasonable time frame.

Date	Topic	Readings	Projects
Sept 7	Course Overview, Number systems, Signed numbers	Chap. 1.2, 2.4, 2.5, 2.9, skim rest Chap 1	n/a
Sept 14	MIPS Instructions – Assembly Language & Internal Representation	Chapter 2 (skip asm programming, focus on internal rep)	Project 1 Assigned (Due Oct. 5)
Sept 21	Measuring Computer Performance, CISC/RISC, Memory Hierarchy - Caches (Part 1)	Chap. 5.1, 5.3, 5.4 (ignore math), 5.8	
Sept 28	Memory Hierarchy - Caches (Part 2)		Project 2 Assigned (Due Nov. 2)
Oct. 5	The Processor: Datapath and Control	Chapter 4.1 - 4.4	Project 1 Due
Oct. 12	NO CLASS – (Monday classes meet due to holiday)		
Oct. 19	MIDTERM EXAM		
Oct. 26	Midterm Results, Pipelines (Part 1)	Rest of Chap. 4	
Nov. 2	Pipelines (Part 2)		Project 2 Due Project 3 Assigned (Due Nov. 30)
Nov. 9	Advanced Architectures - Superscalar, Superpipelining		
Nov. 16	Parallelism, Multicores, OS Concepts, Virtual Memory, Advanced Caches	Chapter 6, Chap 5.6	
Nov. 23	Logic Design, Computer Arithmetic and ALUs	App. B: pp. 1-14	
Nov. 30	Wrap-up		Project 3 Due
Dec. 7	Final Exam Review		
Dec. 14	FINAL EXAM		