



LEHMAN
COLLEGE

Department of Computer Science
Lehman College, City University of New York
Summer 2020

CMP 334: Computer Organization

Lecture Schedule: Mondays, Tuesdays, Wednesdays, and Thursdays, 10:00 am - 1:25 pm

Lecture Location: <https://us02web.zoom.us/j/81031575857>

Instructor: Steven Fulakeza

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Phone: (516) 240-5131

Office Hours: Mondays, Tuesdays, Wednesdays, and Thursdays 9:00 am - 10:00 am and 1:25 pm - 2:25 pm.

Office Location: <https://us02web.zoom.us/j/81031575857>

CMP 334 Course Description: 4 hours, 4 credits

Introduction to digital logic-expressions, gates, flip-flops, adders, busses, multiplexers
Introduction to assembly language and assembly level organization - data representation, instruction formats, addressing modes, interrupts. Memory systems - caches (mapping and management policies) and memory hierarchies, latency and bandwidth, virtual memory (pagetables, TLB). Input/Output- busses, channels and DMA. Performance considerations- pipelining, RISC architecture, branch prediction, introduction to instruction level parallelism.

Prerequisite:

- CMP 167 (Programming Methods I), CMP 232 (Elementary Discrete Structures & Applications to Computer Science) or Departmental permission.

Course Objectives:

At the end of the course, students should be able to:

- Understand unsigned and signed fixed-width binary arithmetic including overflow conditions and comparisons.
- Understand the relationship among Boolean algebra, truth-tables, and combinational circuits
- Design a 4-input combinational circuit from an informal description of its function.
- Understand the function of basic hardware components such as: flip/flops, registers, buses, adders, clocks, and control logic.

- Understand how these components are built from digital logic gates.
- Understand how the data-path and control of a processor are built from these components.
- Understand how computer pipelining can improve processor performance, the hazards that can impede such improvements, and the hardware and software techniques used to minimize the negative impacts of these hazards.
- Use computer performance equations and Amdahl's law to predict the performance impact of changes to hardware configurations such as faster clocks, better floating-point units, processor pipelining, hazard mitigation, cache organization etc.
- Understand the implications of today's multi-core processor chips including synchronization and memory consistency.
- Create simple assembly language programs.
- Understand (in some detail) how computer hardware executes such programs.

Textbook:

- Computer Organization and Design : The Hardware / Software Interface Hennessy and Patterson (any 4th or 5th edition: MIPS, ARM, or RISK V)
http://textbooks.elsevier.com/web/product_details.aspx?isbn=9780128017333)

Recommended Textbooks:

- Computer Organization and Architecture - Null and Lobur
- Computer Organization and Architecture – Stalling

Resources

- Course website <http://comet.lehman.cuny.edu/sfulakeza/>
- Slides will be posted both on the course website.

Grade Policy:

Your grades will be computed based on the following:

Activity	Percentages
Homework Assignments & Blackboard Quizzes	30%
Midterm Exam	35%
Final Exam	35%

Makeup exam might be given only when a student's absence is unavoidable. In such a case, the student must file formal written request.

Homework Assignments

Several homework assignments will be given during lectures and some work will be posted on Blackboard and the course website. Students need to work on the homework to prepare for exams but may not need to submit the homework assignments to the instructor. **Some selected homework problems will be assigned as formal assignments to be submitted for grading.** Students must work on their own assignments unless stated

otherwise. Students handing in similar work will both receive a 0 and face possible disciplinary actions. **No late assignments will be accepted.** Homework assignments must be submitted on Blackboard. No emailed work will be accepted.

Exam Schedule:

- Midterm Exam due date: 07/27/2020 by 10:00 am
- Final Exam due date: 08/06/2020 by 11:59 pm

The exams will consist of two parts:

- A multiple-choice part that will be completed on Blackboard
- A written part, which will be posted on Blackboard and the course website. The exam must be submitted on Blackboard. No emailed work will be accepted.

Academic Integrity and Plagiarism Policy

Statement may be found in student handbook. For more information, refer to <http://www.lehman.cuny.edu/student-affairs/documents/Final-Student-Handbook-Lehman-College-9-19-18.pdf>

Note: All incidents of cheating will be reported to the Vice President of Student Affairs.

Attendance

Students are expected to attend lectures regularly and promptly. In the event of illness, or injury, students should notify me. Students who miss a class are responsible for learning materials presented in class and reading relevant textbook portions. If you need help, please do not hesitate to contact me.

Accommodating Disabilities

Lehman College is committed to providing access to all programs and curricula to all students. Students with disabilities who may need classroom accommodations are encouraged to register with the Office of Student Disability Services. For more information, please contact the Office of Student Disability Services in Shuster Hall, Room 238, phone number, 718-960-8441.

Technology, Blackboard and Email

We will be using a Blackboard site for much of the class activities. It can be accessed through the Lehman website at www.lehman.cuny.edu. You will also need to have access to your Blackboard account. You can contact the IT Center if you have any problems accessing your account.

I will be communication with you regularly throughout the semester using your email address that is available on Blackboard. Make sure you have access to your email. If you have, any questions about your Lehman email address or your password, or if you have any problems accessing the site please call the computer helpdesk at 718-960-1111.

Tentative Course Schedule:

- **Day 1:** Introduction, and Syllabus. Computer Abstractions, Technology and Overview
- **Day 2:** Introduction to assembly language programming
- **Day 3:** Representation of integers base 2, 10, and 16, conversion between bases. Binary addition and subtraction.
- **Day 4:** Boolean algebra, truth tables, gates, digital logic circuits,
- **Day 5, 6 & 7:** Combinational circuit design process, combinational circuits: inverters, decoders, multiplexors, adders, and the ALU (Arithmetic / Logical Unit). Computer performance equations:
- **Day 8:** More assembly language programming.
- **Day 9 & Day 10:** Varieties of processor architectures, instruction formats, instruction execution. Processor performance problems. Implicit (instruction-level) parallelism, pipeline processors, pipeline hazards (structural, data, control), branch prediction, super-scalar processors. Pipeline performance problems.
- **Day 11:** Memory hierarchy: cache, main memory, magnetic disks. Locality of reference (temporal and spatial). Multi-level caches, latency and bandwidth, cache performance problems. RAID architecture:
- **Day 12:** Virtual memory, TLB (Translation Look-aside Buffer), MMU (Memory Management Unit), program execution Working Set, page replacement algorithms.
- **Day 13 & 14:** Explicit parallelism: Flynn hierarchy, message passing vs shared memory, synchronization (mutual exclusion, locks, atomic instructions), memory coherence, cache consistency.
- **Day 15:** Buffer
- **Day 16:** Final Exam due

Classroom Policies

- Take responsibility for your education and grades – Students have a common myth that because they pay tuition, they deserve to receive a passing credit. Students earn grades in accordance with course grading policies.
- Attend every class and get to class on time
- Submit all your work on time
- When having any academic difficulties, always seek assistance from your instructor