

CIS216/216L

Computer Organization and Design

Spelman College Computer & Information Sciences Fall 2026

COURSE ADMINISTRATION

Instructor: Dr. Ebuka P. Oguchi
ebukaoguchi@spelman.edu

Office Hours: Friday 3pm – 5pm

Course Lecture Hours: Monday, Wednesday, Friday 2:00p - 2:50 p, Tapley 223

Course Lab Hours: Monday 3:00p - 4:15p Tapley 223

COURSE INFORMATION

Course Description

This course explains the fundamental organization and operation of computer systems, from the stored-program concept and the representation of instructions and data to the fetch-decode-execute cycle and processor datapath design. Topics include binary and hexadecimal number systems, signed number representation, computer arithmetic, multiplication and division hardware, floating-point representation, assembly language programming, machine language, and instruction set architecture. The course also covers processor components, memory organization, procedures and stack operations, control-unit design, combinational and sequential logic circuits, Boolean algebra, and arithmetic logic unit design. Laboratory activities include assembly language programming using MIPS and QtSPIM, together with selected breadboard-based implementations of digital hardware components.

Learning Objectives

Upon completing the course, a student will be able to:

- Describe the functions and interactions of the major components of a computer system.
- Explain the relationship among high-level programming languages, assembly language, machine code, and computer hardware.
- Describe how data and instructions are represented in binary and manipulated using assembly language.
- Explain the Instruction Set Architecture and its importance in computer system design.
- Translate high-level programming statements into corresponding assembly-language and machine-code instructions.
- Write, test, and debug assembly-language programs using MIPS and QtSPIM.
- Explain signed-number representation, computer arithmetic, multiplication, division, and floating-point representation.
- Describe the fetch-decode-execute cycle, processor datapath, and control-unit operation.
- Perform selected digital-circuit experiments using breadboards and integrated circuits.
- Derive sum-of-products Boolean expressions from truth tables containing up to four variables.
- Simplify Boolean expressions using Boolean algebra and design combinational logic circuits that implement the simplified expressions.
- Explain the design and operation of the arithmetic logic unit.
- Describe the operation of basic sequential logic circuits and storage elements.

Additional Topics: Subject to the pace of the course and the time remaining in the semester, additional topics in computer organization and architecture may be introduced.

Prerequisites: CIS 215

Course Credits: 4

Computer Resources

Students are strongly encouraged to have access to a personal laptop computer for assembly-language programming, ZyBooks activities, laboratory assignments, and other course-related work. The laptop should be capable of running QtSPIM and accessing Canvas and other required online resources.

Required Textbooks

Patterson, D. A., and Hennessy, J. L. *Computer Organization and Design: The Hardware/Software Interface*, 6th ed. Morgan Kaufmann, 2020.

Method of Instruction

Instruction will consist of classroom lectures, discussions, exercises, laboratories, and assembly programming assignments.

- **Assigned Readings and In-Class Exercises:** Students are expected to complete all assigned readings before class to support their understanding of the material and participation in class activities.
- **Homework Problems:** Students are expected to complete all assigned problem sets. Problems may be drawn from the textbook or provided separately by the instructor. Some assignments will require the use of a computer.
- **Laboratory Assignments:** Students are expected to begin laboratory assignments during the scheduled laboratory period. Some assignments may require additional work outside the laboratory period. Laboratory activities will include ZyBooks exercises and breadboard-based circuit implementations. Although students may collaborate with laboratory partners during experiments, each student must submit an individual laboratory report containing the procedures, results, analysis, and conclusions.

- **Programming Assignments:** Programming assignments will be completed primarily in MIPS assembly language using the QtSPIM simulator. Students are strongly encouraged to install QtSPIM on their personal laptops. The simulator is available for Windows, macOS, and Linux from the official SPIM website: <https://spimsimulator.sourceforge.net/>

COURSE GRADING INFORMATION

Evaluation Summary

Three Exams	30%
Three homework & Three Labs assignments	25%
Final Exam	25%
Quizzes	15%
In-Class Participation	5%

Grading Scale

Numeric	Letter
93-100	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
60-69	D
Below 60	F

COURSE SCHEDULE AND IMPORTANT DATES

Tentative weekly course of instruction

The instructor retains the right to change the schedule of study as needed. Problem sets, programming assignments, laboratory exercises, and supplementary materials associated with each topic will be posted on Canvas and ZyBooks.

Week	Topics
1	Course introduction; computer abstraction and organization
2	Performance, stored-program concept, and computer components
3	Number systems: binary, hexadecimal, signed numbers, and two's complement
4	Boolean algebra, truth tables, and logic gates
5	Combinational circuits, adders, multiplexers, and ALU design
6	Introduction to MIPS ISA and QtSPIM
7	MIPS arithmetic, logical, shift, and data-transfer instructions
8	Conditional branches, loops, and machine-code translation
9	Procedures, registers, stack, and memory organization
10	Multiplication algorithms and multiplication hardware
11	Division algorithms and restoring division hardware
12	Floating-point representation and IEEE 754 arithmetic
13	Processor datapath and instruction execution
14	Control unit, fetch–decode–execute cycle, and sequential logic
15	Breadboard circuitry, integrated circuits, and hardware implementation
16	Review and final examination

Course Emphasis: This course includes substantial assembly language programming assignments, primarily using MIPS and QtSPIM, together with selected breadboard-based hardware implementation exercises. The course also emphasizes the theoretical and mathematical foundations of computer organization.

Additional Topics: Subject to the pace of the course and the time remaining in the semester, additional topics in computer organization and architecture may be introduced.

COURSE POLICIES

Attendance and Tardiness Policy

Students are expected to attend every lecture and laboratory session, arrive on time, and remain for the full class period. Students are responsible for all material, announcements, demonstrations, assignments, and deadlines covered during class, regardless of attendance.

Because many course activities involve assembly-language demonstrations, hardware exercises, and breadboard experiments, missed classes may be difficult to reproduce outside the scheduled period. Excessive unexcused absences may affect a student's ability to complete the course successfully and may result in withdrawal in accordance with college policy.

Quizzes may be administered at the beginning of class. Students who arrive after a quiz has begun may not receive additional time. Makeup quizzes will be granted only for documented excused absences consistent with college policy. Students with an excused absence should contact the instructor as soon as reasonably possible.

Cell Phone and Electronic Device Use

Cell phones and other electronic devices must be silenced during class. Activities unrelated to the course, including texting, social media use, personal browsing, and phone calls, are prohibited during lectures, examinations, quizzes, and laboratory sessions.

Laptops and tablets may be used for course-related activities, including QtSPIM, ZyBooks, Canvas, note-taking, and laboratory work. The instructor may restrict device use when it interferes with instruction or student participation.

Late Assignment

Assignments must be submitted by the stated deadline. Late work will not ordinarily be accepted unless the student has received prior approval from the instructor or has a documented excused absence.

Requests for extensions should be submitted before the deadline whenever possible. Approval of an extension does not automatically change the deadlines of other assignments. The instructor may decline to accept late work when accepting it would compromise the integrity of the assignment, particularly after solutions have been discussed or released.

Technical difficulties should be reported promptly and do not automatically excuse a late submission. Students are responsible for confirming that the correct file has been uploaded successfully to Canvas or the designated submission platform.

Academic Integrity

At the heart of Spelman College's mission is academic excellence, together with the development of intellectual, ethical, and leadership qualities. These goals require an academic environment founded on honesty, trust, responsibility, and mutual respect.

Students are expected to comply with the Spelman College Code of Conduct and Academic Integrity Policy. All submitted work must represent the student's own effort unless collaboration is explicitly authorized.

Students may discuss laboratory procedures and general problem-solving approaches with approved partners. However, each student must independently prepare and submit her own laboratory report, assembly-language program, calculations, explanations, and conclusions. Copying source code, reports, circuit diagrams, answers, or screenshots from another student or external source is prohibited.

Unauthorized assistance during quizzes, examinations, programming assignments, and laboratory assessments is prohibited. Students must not distribute examination questions, assignment solutions, or restricted course materials without permission. Any use of generative artificial intelligence, code-

generation tools, or online solution services must follow the instructions provided for the specific assignment. When such tools are not explicitly authorized, their use to produce submitted work is prohibited.

Suspected violations will be addressed according to Spelman College policy and may result in academic penalties and referral to the appropriate college authority.

Class Cancellation Policy

If a class or laboratory session is cancelled, the instructor will communicate revised instructions through Canvas or official college email.

Unless otherwise stated, material scheduled for the cancelled class will move to the next class meeting. Assignments, quizzes, laboratory activities, and examinations may also be rescheduled. Students are responsible for reviewing official course announcements and following the revised schedule provided by the instructor.

Disability Accommodations

Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the college's programs or services, you should contact Student Access Center (SAC) as soon as possible. To receive any academic accommodation, you must be appropriately registered with SAC. The SAC works with students confidentially and does not disclose any disability-related information without their permission. SAC serves as a clearing house on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please contact the SAC at 404-270-5289 (voice), located in MacVicar Hall, Room 106.

COLLEGE POLICIES

Excused Absence Policy

Students who miss a class, laboratory, quiz, examination, or assignment deadline because of circumstances beyond their control should notify the instructor as soon as reasonably possible.

Students experiencing health concerns, family emergencies, or other significant challenges should also contact the appropriate college office, such as Health Services, Counseling Services, or the Office of Undergraduate Studies. The college office may verify the circumstances and notify the instructor when an excused absence or academic accommodation is appropriate.

A request for accommodation may be forwarded by the Office of Undergraduate Studies based on information from Health and Counseling Services or another verified source. However, the instructor determines the appropriate accommodation and the length of any extension, consistent with college policy and the circumstances of the absence.

An excused absence does not automatically waive course requirements. Depending on the nature of the missed work, the instructor may provide a makeup assessment, an alternative assignment, an adjusted deadline, or another reasonable arrangement. Makeup examinations and laboratory activities must be completed within the period established by the instructor.

Students are responsible for communicating promptly, reviewing missed course material, and completing all approved makeup work by the revised deadline.

Copyright and Fair Use Statement

Copyright law and fair-use principles protect the rights of authors and other creators. Course materials may include copyrighted textbook content, articles, software, images, videos, diagrams, source code, and other instructional resources. These materials are provided solely for private study, scholarship, research, and educational use consistent with Title 17 of the United States Code.

Students may download or retain one copy of course materials for their personal, noncommercial educational use. Course materials may not be modified, reproduced, republished, uploaded, sold, transmitted, publicly posted, or distributed without authorization from the copyright holder.

Students may not share lecture slides, recorded class sessions, examination questions, solutions, programming assignments, laboratory instructions, or other restricted course materials through public websites, social media, file-sharing platforms, or online solution services without the instructor's permission.

The college and instructor are not responsible for unauthorized or improper use of copyrighted materials by students.

Incomplete Policy

An incomplete grade, designated **IP**, may be assigned when documented extenuating circumstances, such as serious illness, death of an immediate family member, or a significant family emergency, prevent a student who is otherwise passing the course from completing the final examination or remaining course requirements by the end of the semester.

An incomplete is not granted solely because a student has fallen behind, missed several assignments, or wishes to improve a final grade. In consultation with the appropriate Dean, the instructor determines whether an incomplete is appropriate and completes the required documentation.

The instructor will specify the remaining work, the conditions for completion, and the applicable deadline. All incomplete work must be completed by the deadline established in the college academic calendar unless an extension is formally approved.

A student who cannot complete the required work by the established deadline must request an extension before that deadline. If the work is not completed and no extension is approved, the **IP** grade will automatically convert to an **F**.