Department of Computer Science

CPTG 245
Computer Organization and
Machine Language Programming (4 units)
Fall Quarter, 2024

Time and Location
Lecture: 9/23/2024 – 12/12/2024, MTR 10:00 A.M. – 10:50 A.M., PSC 147.
Lab: W 12:00 P.M. – 2:50 P.M., PSC 147.

Textbook (Required): Hwang, Enoch, *Digital Logic & Microprocessor Design with Interfacing*, Cengage, 2018, 2nd Edition.

Instructor
Dr. Hwang. Office PSC 255. E-mail: ehwang@lasierra.edu. Office hours: Email me anytime to make an appointment or if you have any questions. Appointments can be either in my office or on Zoom.

Course Description
Bulletin Course Description: Numbering systems and computer arithmetic. Computer operations, memory organization, addressing modes, and interrupt handlers. Machine language instructions and assembly language programming.

This course will introduce to the students how the computer operates at the lowest machine level. Students will learn how data is encoded as sequences of 0s and 1s, and how these encodings are interpreted either as instructions to be executed or data to be manipulated. Basic logic building blocks and simple digital logic components for manipulating the 0s and 1s will be introduced. Finally, students will learn how to use the 0s and 1s to write machine language instructions for the computer to execute.

Prerequisite: CPTG 122 – Introduction to Computer Science II.

Student Learning Outcomes
The computer science curriculum at La Sierra University provides opportunities to reach various goals under the broad mission statement: "To Seek, To Know, To Serve." This is the first course in the computer science program that introduces students to the basic hardware building blocks at the lowest machine level in a computer system.

Achievement at this introductory level will be specifically demonstrated through the following:

- Students will develop logical thinking skills by learning how to write computer programs using machine and assembly language. (SLO 1, 3 & 4)

- Students will be able to correctly analyze problems, develop computer algorithms for solving the problems, and implement the solution by writing computer programs in machine and assembly language. (SLO 1)

- Students will learn the basic logical building blocks for computer circuits, and how they connect to form simple digital components such as the adder and multiplexer. (SLO 3)

- Students will learn how machine instructions are stored and executed. (SLO 3 & 4)

- Students will communicate effectively by completing weekly programming assignments and through class discussions. (SLO 2)

Topics (Numbers in parenthesis are chapter/section numbers in the textbook.**)**

1. Week 1,2: System Overview and Data Representation.
   - The von Neumann Model (Slides).
   - CPU, memory, I/O, buses, storage.
   - Bits, nibbles, bytes, words, double words.
   - Numbering systems and bases. (2.1)
   - Signed number system, two's complement. (2.2)

2. Week 3: Logical Operations and Digital Circuits.
   - Binary switch. (2.3)
   - Logic operators. (2.4)
   - Logic gates and circuit diagrams. (2.5)
   - Truth tables. (2.6)

3. Week 3: Combinational Circuits. (3)
   - Analysis of combinational circuits. (3.1)
   - Synthesis of combinational circuits. (3.2)

4. Week 4: Combinational components. (4)
   - Multiplexer (4.2)
   - Adder. (4.3)

5. Week 5: Sequential (Memory) Circuits. (5)
   - Latches (5.1 – 5.6)
   - Clock (5.8)
   - Flip-Flops (5.9)

6. Week 6-10: Machine and Assembly Language Programming.
   - LC-3 (Slides).
   - LC-3 datapath
   - Instruction Set Architecture (ISA)
   - Opcodes.
   - LC-3 instruction set summary
   - LC-3 instruction set details
   - The Stack
   - More details on LC-3 instructions
   - Even more details on LC-3 instructions
   - LC-3 Assembly Language
   - LC-3 simulator and assembler: download from local server, from external server

Requirements and Evaluation

Tests: 2 Midterms: Monday October 14 and Tuesday November 5. Final: Tuesday December 10, 2024, 11:00 A.M. – 1:00 P.M.

Quizzes: There will be pop quizzes on materials that have just been covered in class.

Homework assignments: There will be approximately one homework assignment each week. These assignments must be turned in at the beginning of the class period on the given due date. Late assignments are not accepted unless you have a medical or emergency excuse.

Labs: Weekly lab exercises to be done during the lab period and due before the next lab.

Final Project: A final programming project due on the last day of class.

Attendance and Class Participation
This course will include much computer programming and designing digital logic circuits. Students are expected to be on-time for class and ready to actively engage the material. Proper class preparation, active participation in class, and thoughtful conversation on the topic being discussed are expected. Since so much of what we learn takes place in dialogue with each other, the presence of each student is valued and necessary at every class period. To be excused from a class, you must provide an official note documenting the reason(s) for your absence. It is still your responsibility to catch up on any material that you have missed.

Grading
Homeworks 10%
Labs 10%
Quizzes 10%
Project 10%
Problem solving speed subjective observation 10%
Midterms 2 @ 15% each
Final 20%

Grading Scale

After the grades for the above requirements and their percentages have been calculated for each student, the final grades will be based on the following scale:

95 – 100%	A
90 – 94.9%	A-
87 – 89.9%	B+
83 – 86.9%	B
80 – 82.9%	B-
77 – 79.9%	C+
73 – 76.9%	C
70 – 72.9%	C-
67 – 69.9%	D+
60 – 66.9%	D
0 – 59.9%	F

"Incomplete" grades are given only in extremely unusual circumstances. See *La Sierra University Undergraduate Bulletin* for the University's policy concerning required procedures and course completion.

Additional Information

A. Discrimination and Harassment Policy

Faculty members are committed to supporting students and upholding the University's Title IX policy. Under Title IX discrimination based upon sex and/or gender is prohibited. This includes any act of sexual misconduct or sexual assault. In addition, our Title IX policy prohibits dating violence, domestic violence, stalking and sexual exploitation.

If you experience an incident of sex or gender based discrimination, sexual assault or sexual misconduct, we encourage you to report it to our Title IX Office.

You may talk to a faculty member, but understand that faculty members MUST report to the Title IX Coordinator what you share.

If you would like to speak with someone who may be able to afford you confidentiality, you may contact our Counseling Services located in the Student Wellness Services facility.

You may also want to visit our Wellness Center. Please know that all services at our Wellness Center are subject to confidentiality.

B. Academic Honesty

Because scholars communicate, consider ideas, and contrast understandings in writing, it is important to be able to rely on each other in an atmosphere of openness, trust, and clarity. The proper use of citations allows colleagues to double-check one's interpretation of someone else's work, or to follow-up in greater depth if interested in a particular idea. For this reason, academic honesty is of critical importance. It is important to use quotation marks where needed and to cite the source of all significant ideas, concepts, paraphrases, and quotations.

Because we need to be able to rely on each other's work with confidence, please make sure that you provide proper attribution of all ideas, paraphrases, and quotations inserted into your papers **and programs**. A purposeful or careless breach of academic integrity will result in penalties.

To be sure that you have no misunderstandings about the definitions of academic honesty or academic dishonesty, refer to your La Sierra University Student Handbook. The University has significant penalties for academic dishonesty, so please take this suggestion seriously. La Sierra University's policy and other important information regarding academic honesty can be found at https://lasierra.edu/academic-integrity/ .

C. *Special Assistance:*

It is the policy of La Sierra University to accommodate students with disabilities. Any student with a documented disability who requires reasonable accommodations should contact Office of Accessibility Services in Sierra Vista Hall at (951) 785-2452 or https://lasierra.edu/accessibility-services/ For those who need proctoring for testing accommodations, hours are Thursdays 8:30am-12pm and 1-4:30pm and Friday 8:30-12PM.

Important Dates
    10/4(Last day to withdraw with no record on transcript), 11/15 (Last day to withdraw with a "W"), 11/25 – 11/29 (Thanksgiving holiday).

Resource Links

- DE0 board pinouts
- DE1 board pinouts, user manual
- DE2 board pinouts
- ASCII Table
- LC-3 datapath
- LC-3 simulator: download from local server, from external server
- LC-3 instruction set summary
- LC-3 instruction set details