LP-300-T
Computer Organization

Spring 2016

Classroom: Online

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Office hours: MWF 12:50– 1:50 p.m.
and by appointment

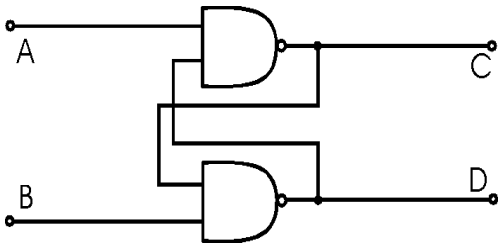
COURSE

- Credit hours: 3
- Catalog description:
  This study of computer organization covers the central processor unit, memory unit and I/0 unit, number systems, character codes and I/O programming. Programming assignments provide practice working with assembly language techniques, including looping, addressing modes, arrays, subroutines, and macros. Microsoft assembler is discussed and used for programming throughout the course.
- Prerequisites: 70-210 Programming and Data Structures

Lewis University is a Catholic University in the Lasallian Tradition. Our Mission is integrated into all aspects of University life, including this course. This course embraces the Mission of the University by fostering an environment in which each student is respected as an individual within a community of learners. In the spirit of the vision of Lewis University, the goals and objectives of this course seek to prepare students to be successful, life-long learners who are intellectually engaged, ethically grounded, socially responsible, and globally aware.

COURSE RATIONALE

- Computer architecture is central to the field of Computer Science, which has grown into major industries and which continues to grow. This course offers students an overview of how computer hardware is designed and organized down the levels of logic gates, microcode and assembly language. Understanding the underlying hardware of a computer system makes for more efficient programmers.



STUDENT LEARNING OUTCOMES

- By the end of the semester, students will understand the basic building blocks and organization of binary digital computers and the Von Neumann and Harvard architectures, from logic gates to digital circuits, micro-code and assembly language. In addition, students will be aware of other architectures and reasons for their use. Students will be able to write simple assembler programs for various different processors such as x8086 and MIPs. Additional processors will also be discussed including Atmel, and ARM. Students will be able to understand binary, octal, and hexadecimal number systems and how to convert between them. Tools such as hex editors and assemblers will be used throughout the course so students know how to utilize such tools going forward.
- Student learning outcomes are evaluated through a weekly quiz, various programming assignments, and a mid-term and final exam.

STUDENT LEARNING OUTCOMES (Specific)

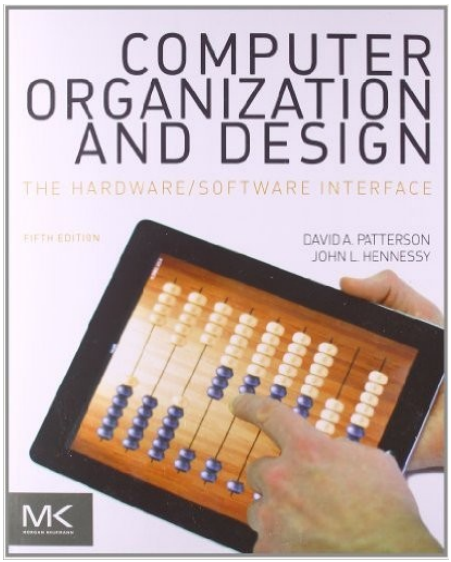
- Write computer programs in x8086 assembler.
- Write computer programs in MIPs assembler.
- Reverse engineering techniques with tools such as hex editors and OllyDgb disassemblers.
- Convert between binary, hex, and decimal number systems.
- Understand all the digital logic gates, perform bitwise operations.
- Understand in depth the Von Neumann and Harvard architectures and security implications of sharing memory between program and data store.
- Understand the basic digital logic circuits that make up computer hardware, including half adders, full adders, multiplexors, demultiplexors, parity checkers, counters, flip-flops and registers.
- Understand how micro-code comprises macro-code by manually tracing instructions as the micro-instruction sequencer asserts bus lines high or low.

RELATIONSHIP TO MISSION

- The demanding field of computer science requires that students gain significant experience, ***knowledge*** and ***wisdom*** in a variety of fields while working together in ***association*** in a productive team-oriented environment. I have ***faith*** that students will follow the letter and spirit of this class syllabus, which ***justifies*** the time I am spending preparing and teaching this course!

TEXTBOOK AND INSTRUCTIONAL MATERIAL

- David Patterson and John Hennessy, "Computer Organization and Design, Fifth Edition: The Hardware/Software Interface 5th Edition", Morgan Kaufmann, 2013
  - ISBN-13: 978-0124077263 - ISBN-10: 0124077269
- Supplemental (NOT REQUIRED!): Richard C. Detmer, "Introduction to 80x86 Assembly Language and Computer Architecture", Jones & Bartlett, 2009
  - ISBN 978-0763772239
- **Coursepack and Blackboard**: Students must login before each class to read latest updates and course announcements. Students must follow along in the provided printed coursepack.



ONLINE STANDARDS

Have to write this yet...

STUDENT RESPONSE TIME

Students are expect to respond to communications within 24 hours.

TECHNICAL & MEDIA REQUIREMENTS

The following software packages must be obtained and installed on students' computers.

- Microsoft Visual Studio Express 2013 (free for download)
- SPIM MIPS Simulator (free for download)
- PDF Viewer (free for download)
- Modern Internet Browser (for Blackboard online course)

COURSE OUTLINE AND SCHEDULE

Introduction (Weeks 1 & 2)
Course Overview
Analog, Digital, Binary, Trinary, Octal
Hex Editors
Logic Gates – AND, OR, NOT, NAND, NOR, XOR, BUFFER
Truth Tables
Binary, Hex, Decimal number systems and conversions
Transistors to Logic Gates
Digital Logic, Boolean Algebra
Schematics

Digital Electronics (Week 3)
Simple circuits – Combinatorial logic, Sequential Logic
Half Adder, Full Adder, Multiplexor, Demultiplexor, Parity Checker, Alarms
Flip-Flips - Memory, Timers, Counters, Registers

Designing a Small Computer (4)
Von Neumann Computer Organization: ALU, Memory, I/O, Address Bus, Control Bus, Registers
Micro-code
Instruction Sets
Assembly Language
Little Endian vs. Big Endian
Von Neumann (RISC and CISC) vs. Harvard vs. Neural vs. LISP vs. Quantum
Reserver Engineering – OllyDbg – Deobfuscation and obfuscation - Malware
A survey of commercial processors

Intel 8086: Real World Architectures (Weeks 5-6)
8086 Architecture – Little Endian
8086 Assembly
- MP 1: Basic I/O
- MP 2: Branching - Looping - Arrays
- MP 3: Data obfuscation

MIPs: Real World Architectures (Weeks 7-8)
MIPs Architecture – Bi-Endian
MIPs Assembly
MIPs Programming
- MP 4: Basic I/O
- MP 5: Branching - Looping - Arrays
- MP 6: Data obfuscation

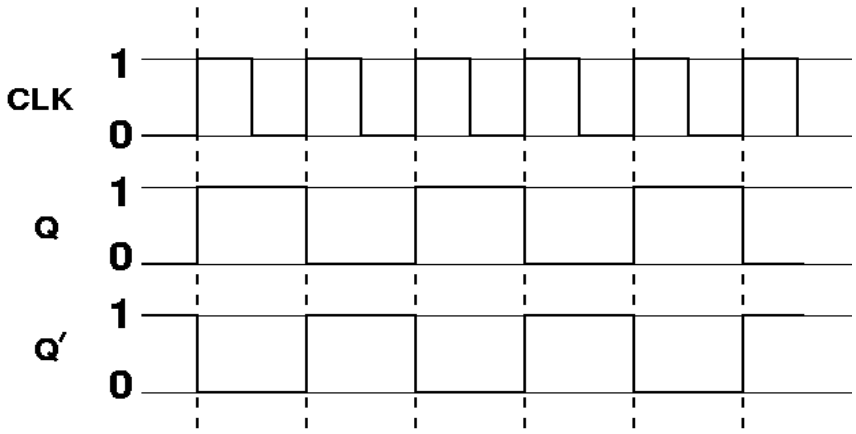
(Optional/Extra Credit)
Atmel AVR Architecture – Harvard / Little Endian / 2-4 byte instructions
Atmel AVR Assembly

Atmel C

MP 7: Basic I/O
MP 8: Branching - Looping - Arrays
MP 9: Data obfuscation

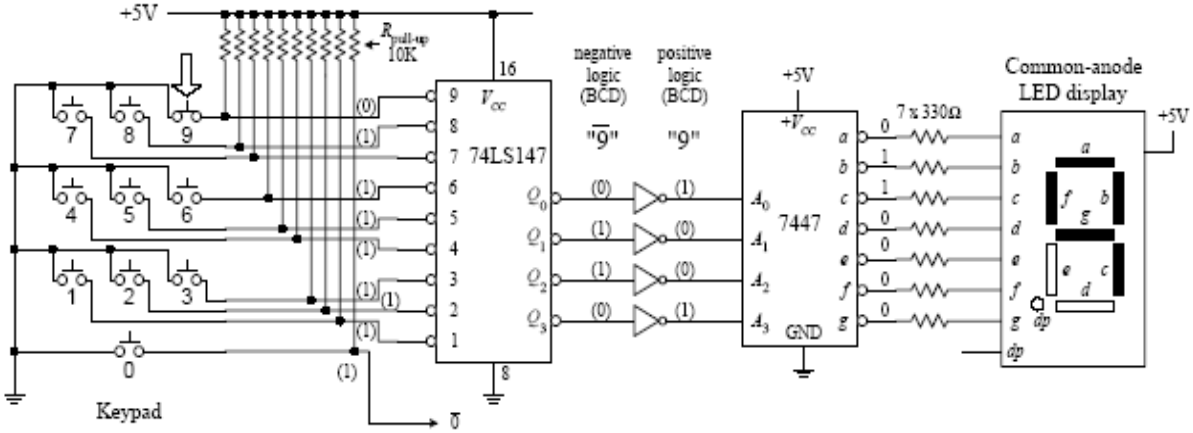
(Optional/Extra Credit)
ARM Architecture – Bi-endian (ARMv6+)
ARM Assembly

MP 10: Basic I/O
MP 11: Branching - Looping - Arrays
MP 12: Data obfuscation



COURSE REQUIREMENTS

- Successful completion of **all** programming assignments, on time, not copied.
- Passing grades on the Mid-term and Final Exam.
- Passing grades on all quizzes.
- Adequate class participation.
- ***Original programming work. No copying source code from the internet or other students or anywhere else.***



GRADING POLICY

- Grades will be based upon successful completion of the course requirements using the point system and scale shown below.

8 Quizzes:	800 points (100 points each)
MP1-MP6:	300 points (50 points each)
Reflection Journal (weekly)	100 points total
	1,200 total points possible

- The following approximate scale is used:
  - A ….. 90% and above
  - B ….. 80 – 89%
  - C ….. 70 – 79%
  - D ….. 60 – 69%
  - F ….. below 60%

COURSE POLICIES AND PROCEDURES

- **Class attendance policy:** This course is primarily graded on in-class projects, therefore, attendance is required. It has been my experience that students who do not attend the lectures have an extremely difficult time with assignments and exams. Each student is responsible for obtaining all class materials or missed lecture notes. Each student is responsible for obtaining access to a computer and compiler. Machine problems and exams are based almost entirely from class lectures.
- **Academic honesty:** Scholastic integrity lies at the heart of Lewis University. Plagiarism, collusion and other forms of cheating or scholastic dishonesty are incompatible with the principles of the University. Students engaging in such activities are subject to loss of credit and expulsion from the University. (2013-2014 Undergraduate Catalog, p. 43).
- **Respect:**

  Expressions of racism, sexism, misogyny, heterosexism, homophobia, trans-phobia, age-ism, able-ism, and religious discrimination (e.g. Islamophobia, anti-Semitism) violate the right that others have to be respected as fellow community members. This learning space is an extension of Lewis University's Sanctified Zone, a place where people are committed to working to end racism, bias and prejudice by valuing diversity in a safe and nurturing environment. This active promotion of diversity and the opposition to all forms of prejudice and bias are a powerful and healing expression of the desire to be Signum Fidei, "Signs of Faith," in accordance with the Lewis Mission Statement. To learn more about the Sanctified Zone, please visit: www.lewisu.edu/sanctifiedzone.

- **Policies regarding make-up examinations and late submission of assignments:** Contact the instructor for scheduling make-up exams. **Late assignments will be lowered by 1 letter grade for each day late.** Assignments more than 5 days late will receive a 0 for a grade.
- **Drop and withdrawal deadlines** (see semester *Course Schedule*)
- **Classroom behavior expectations** (consistent with "Classroom Decorum" statement from *Student Handbook* on page 15). Students are expected to remain respectful to the instructor and other students at all times.
- **Other policies:**
  - **No cell phone use** in the classroom. No texting or checking email on cell phones during class. Your cell phone should be off and stored in a backpack, purse, or pocket.
  - Students are expected to bring a notebook and take notes from instructor during class lecture.

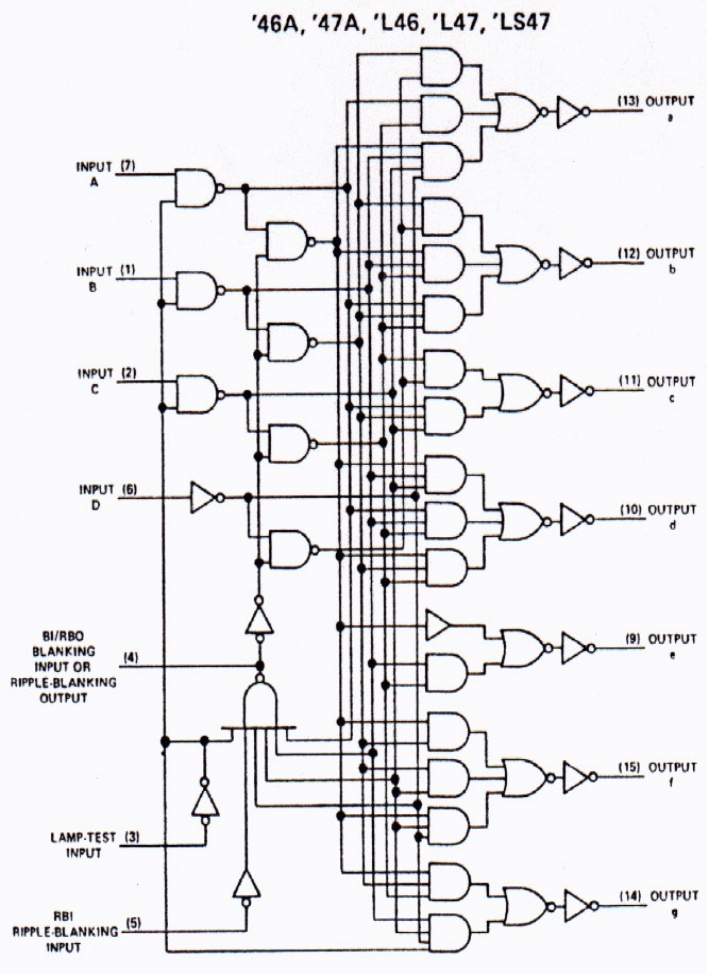
ASSISTANCE

- Assistance: The instructor is available to help students having difficultly. It is the responsibility of the student to approach the instructor to ask for help.
- Assistance is also available through LARC (Leckrone Academic Resource Center) for students requiring special accommodations.
- Students requiring special accommodations must submit documentation to LARC staff prior to the start of class or within the first week of class.

SUPPLEMENTARY MATERIALS

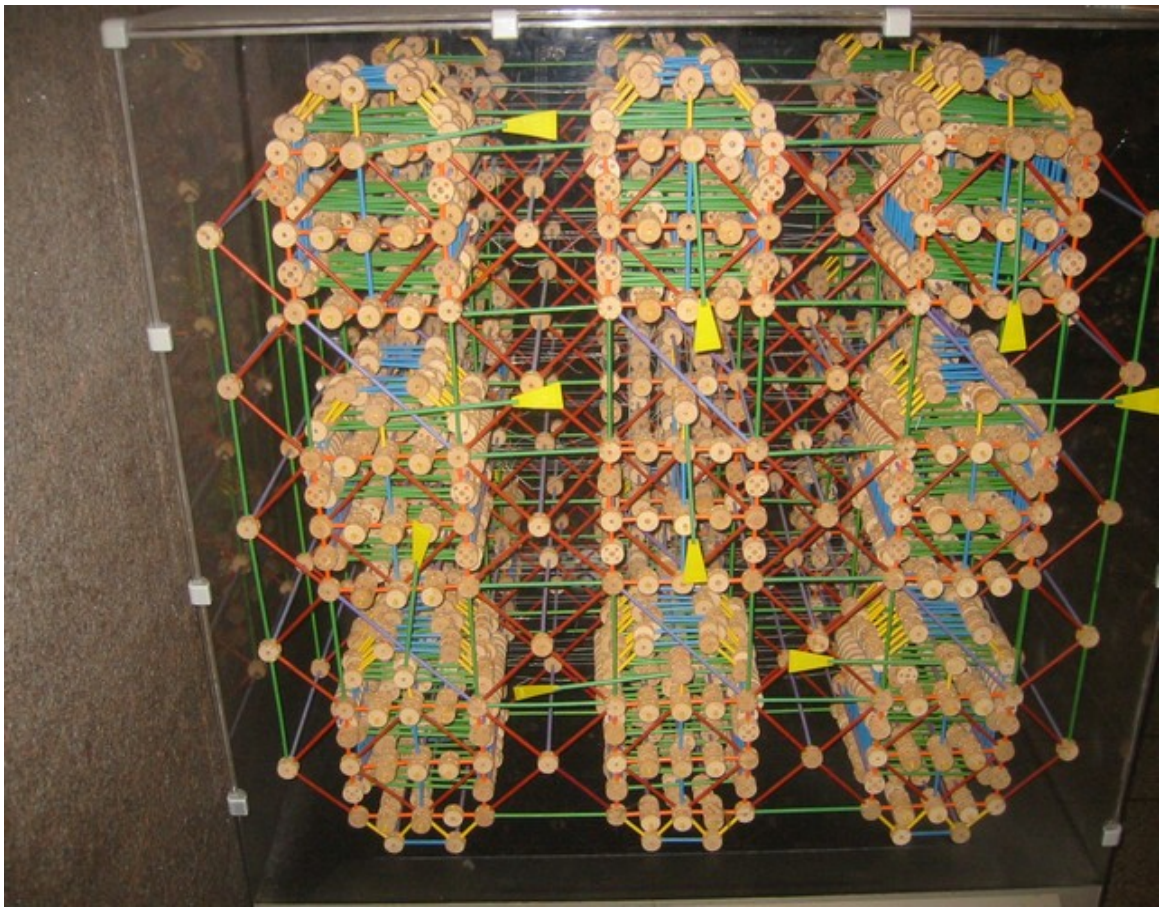
Recommended websites:

- https://www.khanacademy.org/
- http://en.wikipedia.org/wiki/Wikipedia
- https://learn.adafruit.com/
- https://www.sparkfun.com/
- http://www.evilmadscientist.com/
- http://www.atmel.com/default.aspx
- http://www.arm.com/products/processors/
- http://www.avrfreaks.net/
- http://www.newark.com/
- http://www.digikey.com/
- http://www.555-timer-circuits.com/



“Hardware: The parts of a computer system that can be kicked.”
--Jeff Pesis

'They have computers, and they may have other weapons of mass destruction."
--Janet Reno



PLEASE NOTE THAT THIS SYLLABUS IS SUBJECT TO REVISION IF THE NEED ARISES

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www.lewisu.edu/academics/library/index.htm