CSCE 230: Computer Organization

Fall 2016

Lectures:

MWF 9:30am – 10:20am in Hamilton 112
MWF 11:30am – 12:20pm in Henz 53

Recitations (TWR 3:30-4:20):

T (AvH 106) WR (AvH 19)

Laboratories (TWR 4:30-6:20, 6:30-8:20):

All in Avery 21 EXCEPT 6:30 R in Avery 20

Catalog Description:
Computer Organization (4 cr) Lec 3, rct 1, lab 2. Introduction to organization and structure of computer systems. Boolean Logic, Digital Arithmetic, Processor Organization, Machine Language Programming, Input/Output, Memory Organization, System Support Software, Communication, and Ethics.

Instructors:

Dr. Charles Riedesel
259 Avery Hall (402) 472-3486
chuckr@unl.edu
http://cse.unl.edu/~riedesel
(follow link to appointments)

Dr. Witawas Srisa-an
(Assisting with Comp Sci Option)
105 Schorr Center (402) 472-5004
witty@cse.unl.edu
http://cse.unl.edu/~witty/
(with link to schedule)

GTAs:

Guolong Zheng
gzheng@cse.unl.edu

Mohammud Mosiur Rahman Lunar
mlunar@cse.unl.edu

UTAs:

Devin Hastings
d-hastings@live.com

Tyler Bienhoff
tbienhoff@gmail.com

Andrew Schwarz
Schwarzyz@gmail.com

Trudy Pham
trudyxp@gmail.com

Mathew Reny
mat@reny.io

Matthew Bennett
Matt.bennett4478@gmail.com

Michael Fay
michaelfay@huskers.unl.edu

Yichang Liang
lycbel@gmail.com

Endi Xu
Andyxu940831@hotmail.com

Web Sites:

http://cse.unl.edu/~riedesel/pub/cse230
http://piazza.com

Prerequisites:
Grade of "P" or "C" or better in any "flavor" of CSCE 155, or detailed knowledge of a high-level programming language.

Prerequisites by Topic:
- *Mastery of:* mathematical problem solving skills, mathematical maturity and competence to the level of introductory calculus.
- *Familiarity with:* programming, logarithms, integer and floating point numbers.
- *Exposure to:* recursion, operating systems services.

Textbook:
Computer Organization and Embedded Systems, 6th edition, by C. Hamacher, Z. Vranesic, S. Zaky, and N. Manjikian, McGraw Hill, 2011. ISBN: 978-0073380650.

Course Objectives:
- *Mastery of:* Boolean algebra, logic equations, binary numbers (including negatives), fixed-point binary arithmetic, hexadecimal notation, logarithms, exponential numbers.
- *Mastery of:* I/O devices, processor organization, instruction set architecture (with hands-on experience in micro-processor design and implementation).
- *Familiarity with:* logic gates and diagrams, floating point arithmetic, memory devices and hierarchies, micro-operations & micro-architectures.
- *Familiarity with:* assembler language principles, flow of control, stacks, subroutines, assemblers, linkers, loaders, the syntax & semantics of short assembler programs.

Course Goals:
How does a modern digital computer interpret programs written in a high-level programming language into the streams of electronic signals that actually do the thinking, the arithmetic, the keeping track of data, the sequencing of actions, and the input/output? What is the hardware-software interface? What system design considerations go into defining and designing it? In this course you will gain an understanding of the interface by first writing programs in a low-level assembly language that is close to the machine language, then developing the logic design of a workable processor and all its components. In the process you will gain practical experience with computer-aided design tools.

Topics Covered:
1. *Arithmetic and Logic Level:*
    a. Boolean algebra, truth tables, logic equations, logic gates, combinational logic, sequential logic & memory devices, clocks, waveform diagrams
    b. Signed and unsigned binary numbers, floating point numbers, BCD, Hexadecimal, ASCII
    c. Signed and unsigned fixed-point arithmetic, floating-point arithmetic, ALU structures

2. *System Level Organization:* CPU, memory systems (main memory, cache, virtual memory), storage technologies, I/O devices & processes (programmed, DMA, channel), busses.
3. *Micro-Architecture Level:* data paths and components, micro-operations, memory interfacing, the fetch/execute cycle, processor control & sequencing, interrupts, rudimentary pipelining.
4. *Instruction Set Architecture Level:* instruction types and formats, opcodes, operands, immediate values, addressing modes, flow of control, branching and procedure calls.
5. *Assembler Language Level:* syntax, directives vs. instructions, assemblers, linkers, loaders, semantics of simple programs, stack management, procedure calls, interrupt handling.

Policies:

- *Late Work:* All work must be completed when due and all tests/quizzes must be taken when given. Exceptions must be arranged in advance.
- *Attendance:* Attendance will be taken each class period and is factored into the grade as a very minor component. Excused absences may be possible for legitimate reasons.
- *Academic Integrity:* All students are expected to adhere to the policies stated in http://cse.unl.edu/ugrad/resources/academic_integrity.php. Cheating is a very serious offense and the CSE Department has laid down strict guidelines for dealing with this problem. The penalty for cheating may include an automatic F grade for the course and expulsion from the program. The Department requires me to report every offense to the Chair for further consideration. The key to avoiding cheating is to be totally open and transparent about any and all collaborations, noting that appropriate teamwork and collaboration will be highly encouraged and rewarded.

Grading:

- *(15%) Homework*: Recognizing that peer study is an effective learning tool, you are encouraged to work in groups to discuss the homework but be sure to write your own solutions and indicate whom you worked with. The ability to solve homework problems will pay off in other components of the course grade. Some assignments given in the Recitation may also count as homework. On average you can expect homework to be assigned every other week, and they will be due at the beginning of class in one week.
- *(15%) Laboratory:* The lab section will provide supplemental learning to the material covered in lectures, and give you hands-on practices along with better understanding of what you've learned at lectures. There are three major parts in the lab section: assembly programming, logic design, and a group project.

  There will be 8 lab assignments (subject to change) to guide the lab section, one per week, before the group projects. Each lab assignment has specific objectives and tasks. The final group project(s) will be assigned after these lab assignments, details will be given later; traditionally it involves implementing a processor on a FPGA board. However, Dr. Witty will be working with a group of Computer Science

students on an experimental set of projects related to systems level programming that may be more valuable and appreciated for that major.

What to Do Before Lab
Each lab assignment has a pre-lab section, which helps you get prepared for the lab section. The pre-lab section normally involves reading materials (mostly the textbook), answering questions, or working out parts of the design that will be used in the lab section.

The pre-lab section is included in each lab assignment, and is required to submit at the beginning of each lab in paper.

What to Turn in
At the beginning of each lab: pre-lab assignment in paper. Print it out from Blackboard and complete it before labs.
After each lab: codes, questions or other files required to finish the task in lab assignment. Hand in files through CSE web handin system: http://cse.unl.edu/~handin/. Different lab assignments have different requirement at this part. The due time of this part will be shown in the handout of each lab.

Grading
Each of the 8 labs is worth 100 points, 800 points in total. The distribution of points on each part can be found at the lab assignment. No making up for missed lab, or late assignment beyond one day after the deadline, except for valid excuse and appropriate notices in advance. Late assignment within one day after the deadline or incomplete submission (submit wrong files or incomplete files) will get 10 points off each time. The group project will be worked on during lab time, but the grading will be in its own category (see next).

- *(20%) Group Project:* Completed in groups, the project will involve the design, implementation, and testing of a processor implementing a subset of the instructions found in modern processors. You will be asked to complete several component parts before integrating them into your final design. The project provides an excellent opportunity to put into practice what you will learn in this course and the associated lab. Each group will be asked to make a written and oral report of the work done for the project. The technical report must address societal impact of the design, and the process of writing the technical report and project design must adhere to professional ethical codes (e.g., IEEE standards) in terms of correct credit acknowledgements, proper citations of previous designs and algorithms, and responsible team management and evaluation.

- *(20%) Tests:* These will be generally aligned with chapters of the textbook and announced at least a week in advance. Tests for some chapters may be combined or included in the final examination to save class time.

- *(3%) Quizzes:* These very short pop quizzes are intended to provide feedback to me (and you!) about how well you are understanding the material being discussed in the class. If you consistently perform poorly in these, I expect you to seek extra help from me or the TAs.

- *(20%) Final exam:* This will be a comprehensive exam given during the scheduled time for this course. The scope will be announced during the last week of classes.

- *(5%) Attendance and Participation:* You may earn credit for Effort (seeking help, attending recitations, completing all homework, doing well in pop quizzes), Participation (attending lectures, asking good questions in class, doing the surveys for the research being done – see below), and Altruism (helping others in recitation or by posting responses to questions through Piazza; bringing to my attention good websites, animations, etc. that would enhance the classroom experience for this course).

Below is the grade distribution for those who like tables:

No.	Description	Percentage
1	*(Individual)* Homework	15%
2	*(Team)* Laboratory	15%
3	*(Team)* Group Project	20%
4	*(Individual)* Tests	20%
5	*(Individual)* Quizzes	5%
6	*(Individual)* Final Exam	20%
7	*(Individual)* Attendance and Participation	5%

Students with Disabilities:
Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

Other Items:
- The CSE Department has an anonymous contact form that you may use to voice your concerns about any problems in the course or department if you do not wish to be identified. See http://cse.unl.edu/contact-form.
- It is CSE Department policy that all students in CSE courses are expected to regularly check their email so they do not miss important announcements.
- TA office hours are in the Student Resource Center (SRC) which is at Avery 13A. See http://cse.unl.edu/src
- This syllabus may be updated and expanded as the semester progresses.