University of Illinois at Urbana-Champaign
Dept. of Electrical and Computer Engineering

ECE 220: Computer Systems and Programming

Instructor: Ujjal Kumar Bhowmik
Section: BL, 12:30-1:50PM, ECEB 1002
Office Hours: 3-4PM, Tuesday, ECEB 2022
Course Website:
https://courses.grainger.illinois.edu/ece220/sp2024/

ECE220 – Course Objectives

- Understand the low-level concepts such as I/O, subroutine, stack in LC-3
- Understand the basic data organization such as array, pointer, recursion, simple data structure, linked-list, tree and how they are laid out in memory.
- Be able to write C program to accomplish simple task and be familiar with testing and debugging of simple programs.
- Understand the basics of C++

Course Overview:

- Programming Studio on Fridays (10 makeup pts/lab worksheet towards MPs)
- MPs: due every Thursday (100 pts each, late penalty 2pts/hour)
- Quizzes: 6 programming quizzes, lowest score dropped
- Exams: 2 midterms and a final Exam (paper format)
- Textbook: Patt & Patel, Introduction to Computing Systems: from bits to gates to C/C++ and beyond, 2nd or 3rd Edition.
- Academic Integrity

Grading Policy

Grading Mechanics:

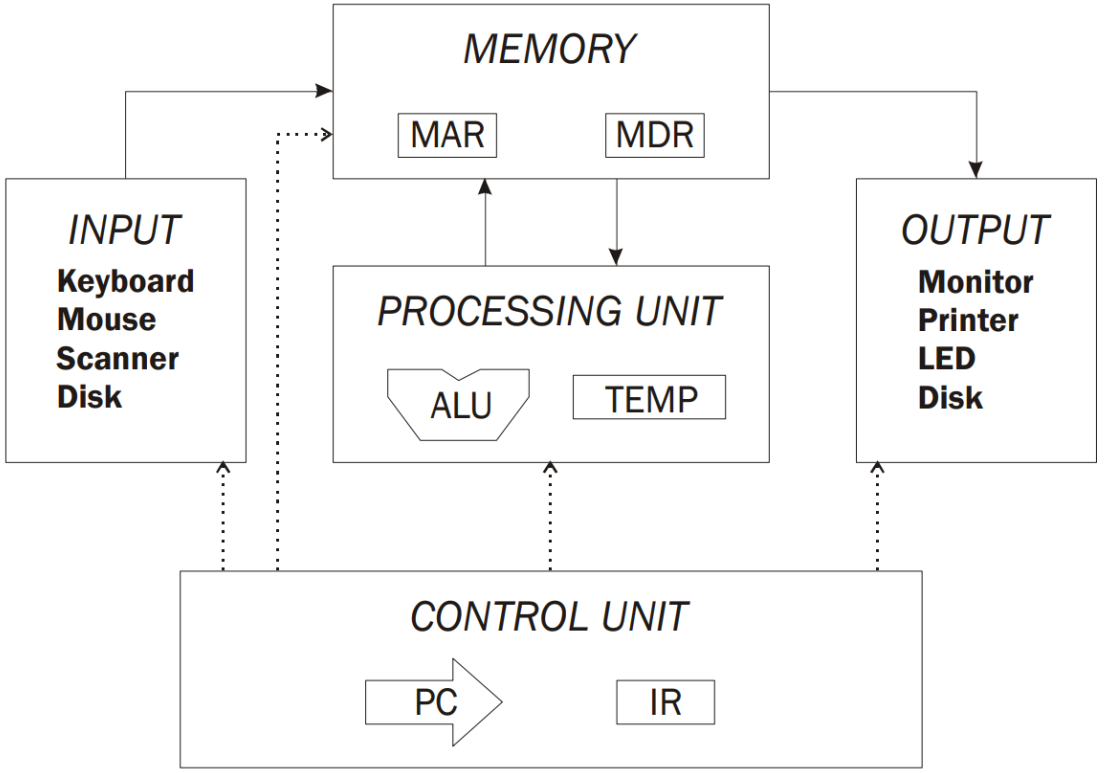
- **Programming Assignments (12 MPs):** 15%
- **Quizzes (6 quizzes, lowest grade dropped)**: 20%
- **Midterm 1:** 20%
- **Midterm 2**: 20%
- **Final Exam:** 25%

Course Logistics & Tools

- Course Web page: course info, MP write-up, exam info, etc.
- Github: MP/LAB release and submission
- Gradescope: lab worksheets
- Campuswire: discussion board
- CBTF: Quiz proctoring
- Resources: CARE, counseling center, DRES

LC3 Review – Von Neumann Model

1. Memory
2. Processing Unit
3. Input
4. Output
5. Control Unit



LC3 Instruction Set Architecture (ISA)

Instruction Set

Data Types: 16-bit 2's complement integers

Addressing Modes (how the location of operand is specified):

Non-memory addresses – immediate (part of instruction), register

Memory address – PC-relative, base+offset, indirect

Opcodes (16-bit, bits 12-15 used to specify the opcode):

Operate instructions: ADD, AND, NOT

Data movement instructions: LD, LDI, LDR, LEA, ST, STR, STI

Control instructions: BR, JSR/JSRR, JMP, RET, TRAP, RTI

Condition codes: N (negative), Z (zero), P (positive)

Review: LD, LDI, LDR, and LEA

```
.ORIG x3000
LD      R6, LABEL
LDI     R6, LABEL
LDR     R2, R6, #1
LEA     R2, LABEL
LABEL .FILL x4000
.END

; Assume the following
; Address       Data
; x4000         x5000
;    …             …
; x5000         x6000
; x5001         x6001
```

Review:

- Initialize a register to zero:
- Copy the content of one register to another:
- Perform Subtractions (8-3):
- Perform Multiplication (5x4):