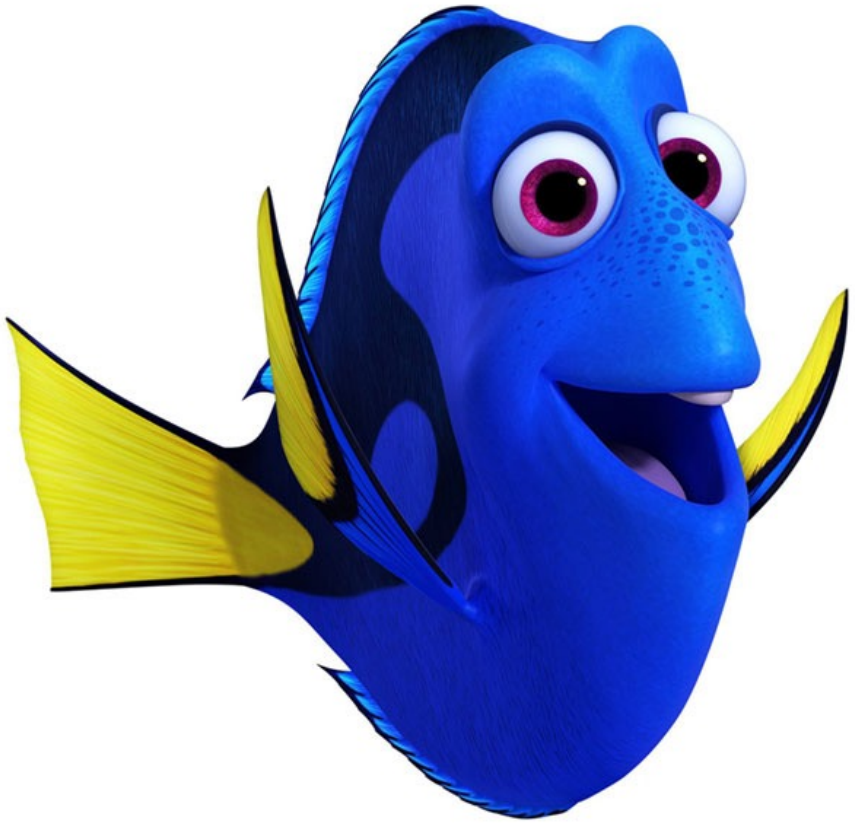
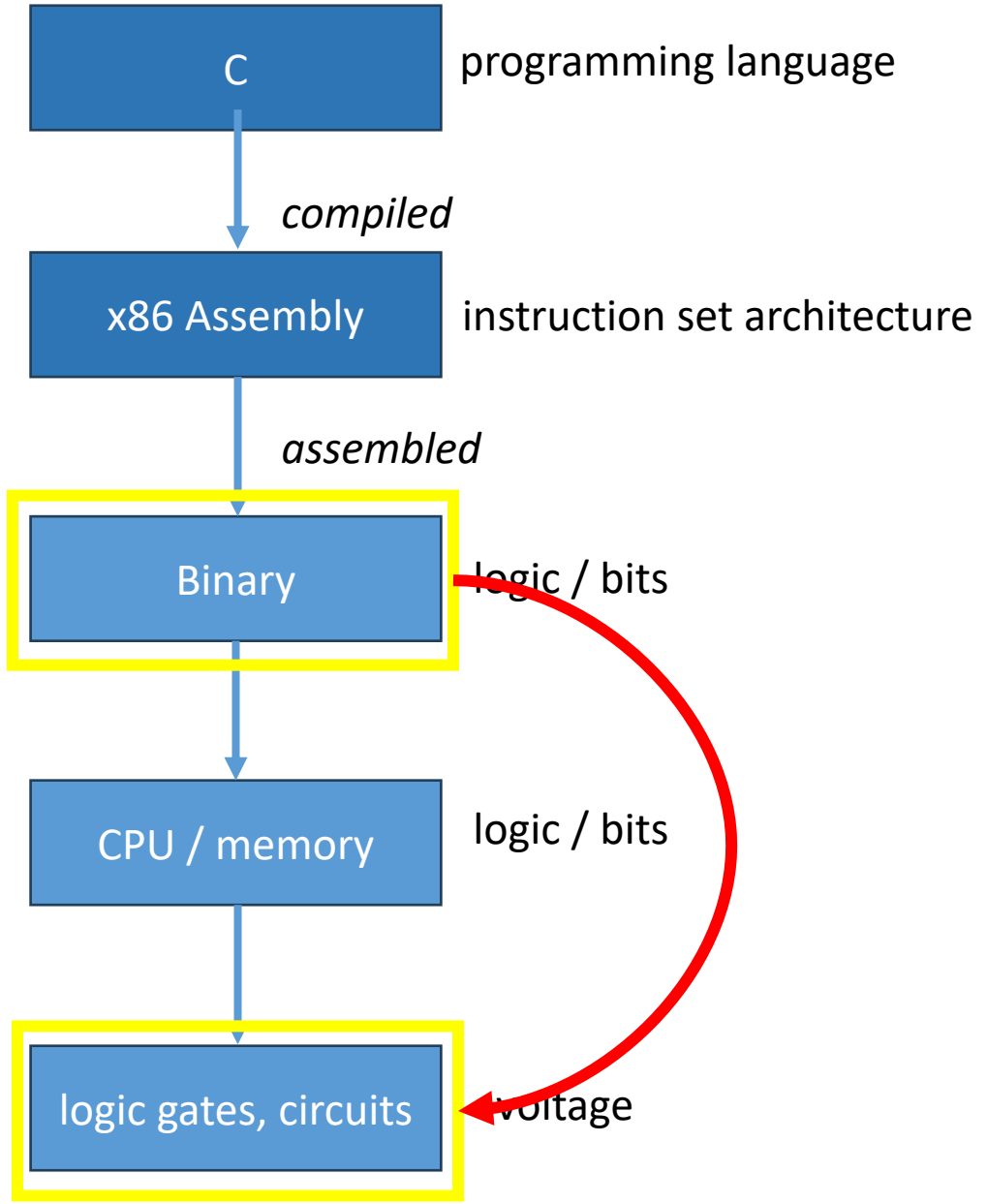


Welcome! ***Discuss now with your neighbor*:**

In the reading, we learned about how immigrants made circuit boards in their kitchens. Is tech really “high tech” or is it just pretending to be while obscuring the labor that went into it?

Where are we?

Wk	Lecture	Lab
1	Intro to C	C Arrays, Sorting
2	Binary Representation, Arithmetic	Data Rep. & Conversion
3	Digital Circuits	Circuit Design
4	ISAs & Assembly Language	”
5	Pointers and Memory	Pointers and Assembly
6	Functions and the Stack	Binary Maze
7	Arrays, Structures & Pointers	”
Spring Break		
8	Storage and Memory Hierarchy	Game of Life
9	Caching	”
10	Operating System, Processing	Strings
11	Virtual Memory	Unix Shell
12	Parallel Applications, Threading	”
13	Threading	pthreads Game of Life
14	Threading	”



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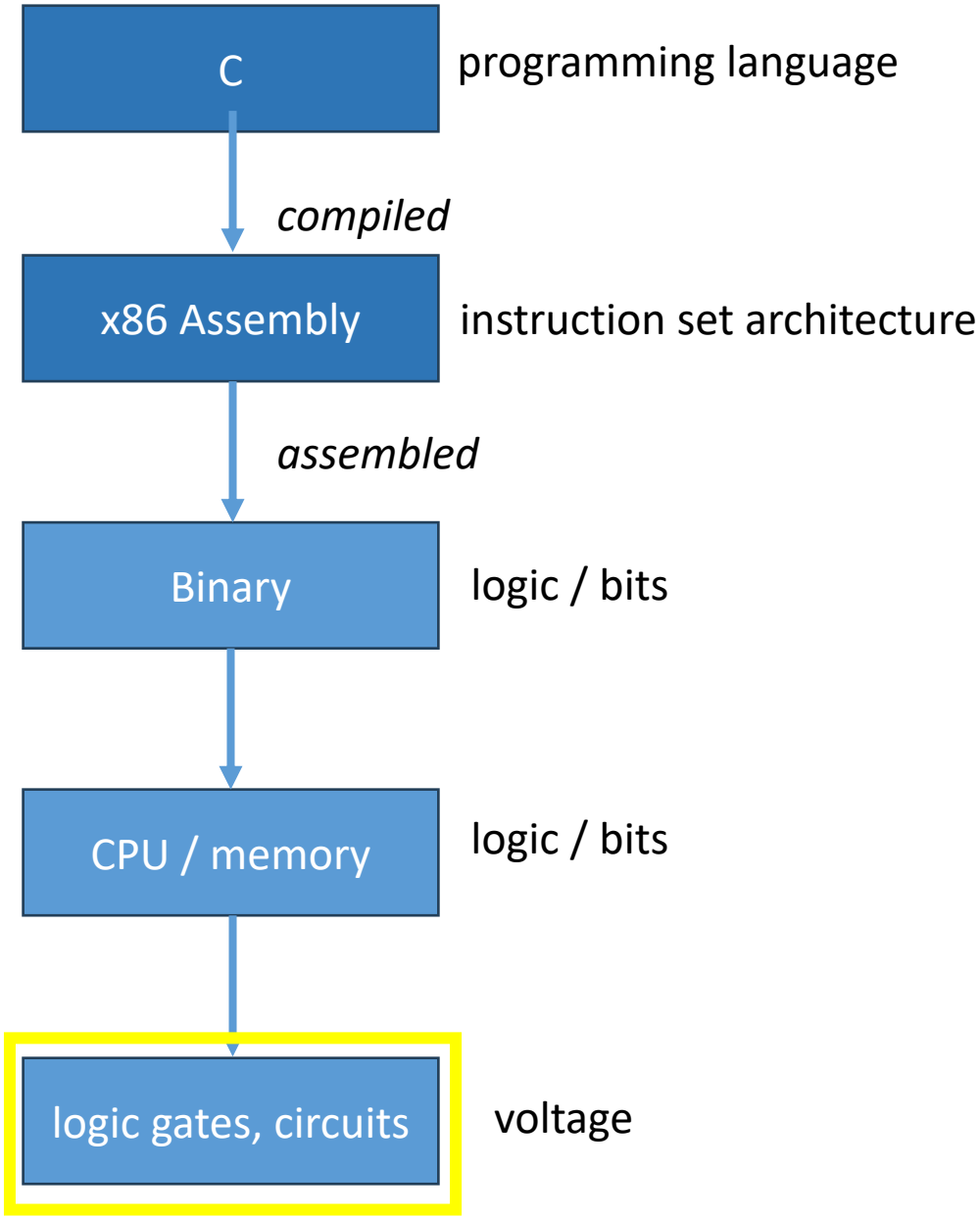


CS31: Introduction to Computer Systems

Week 3, Class 1

Digital Logic

02/06/24

Dr. Sukrit Venkatagiri

Swarthmore College

Reading Quiz

Modern computers have adopted the ___ architecture for their designs.

A. Harvard

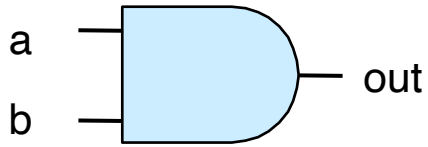
B. von Neumann

C. memory-secure

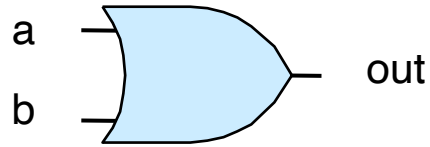
D. workstation

Which of these symbols represents an AND gate?

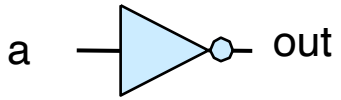
A.



B.



C.



D. None of these are an AND gate.

Which of these symbols represents an AND gate?

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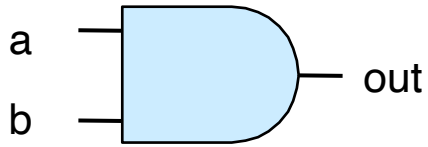

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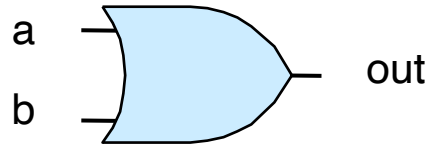
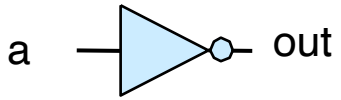


C.



D. None of these are an AND gate.

Which gate exhibits this truth table?

A. AND

B. OR

C. NAND

D. XOR

E. None of these

A	B	Output
0	0	0
0	1	1
1	0	1
1	1	0

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Today

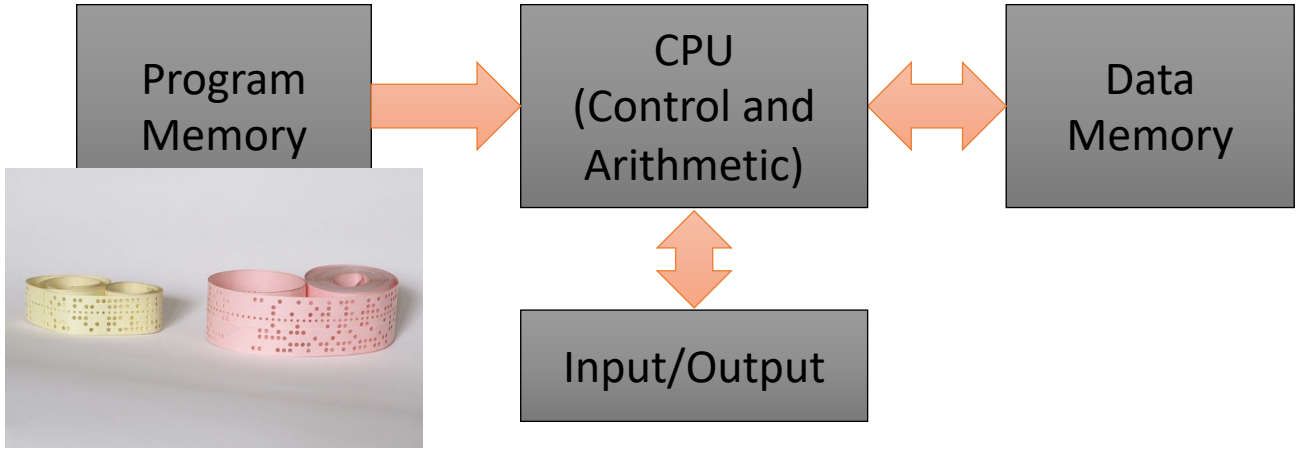
- Hardware basics
  - Machine memory models
  - Digital signals
  - Logic gates

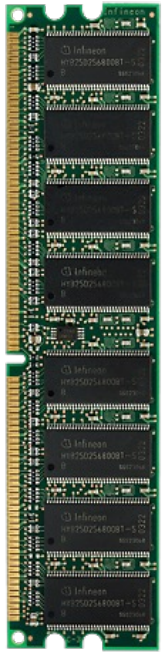
Drawing Circuits: Borrow some paper if you need to!

- Manipulating/Representing values in hardware
  - Adders
  - Storage & memory (latches)

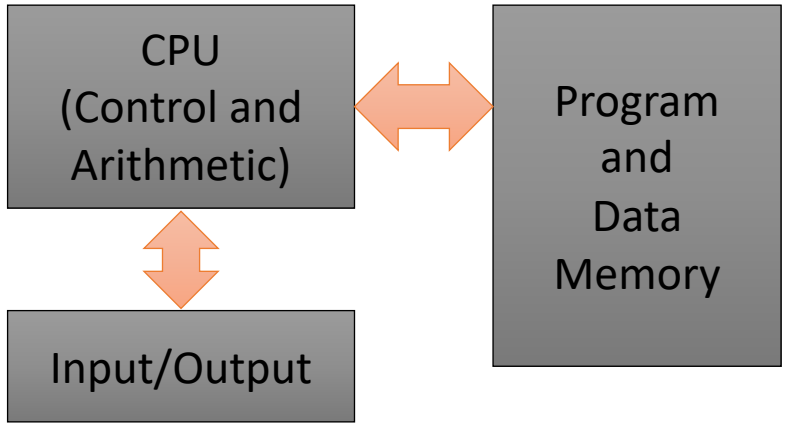
Hardware Models (1940's)

- Harvard Architecture:

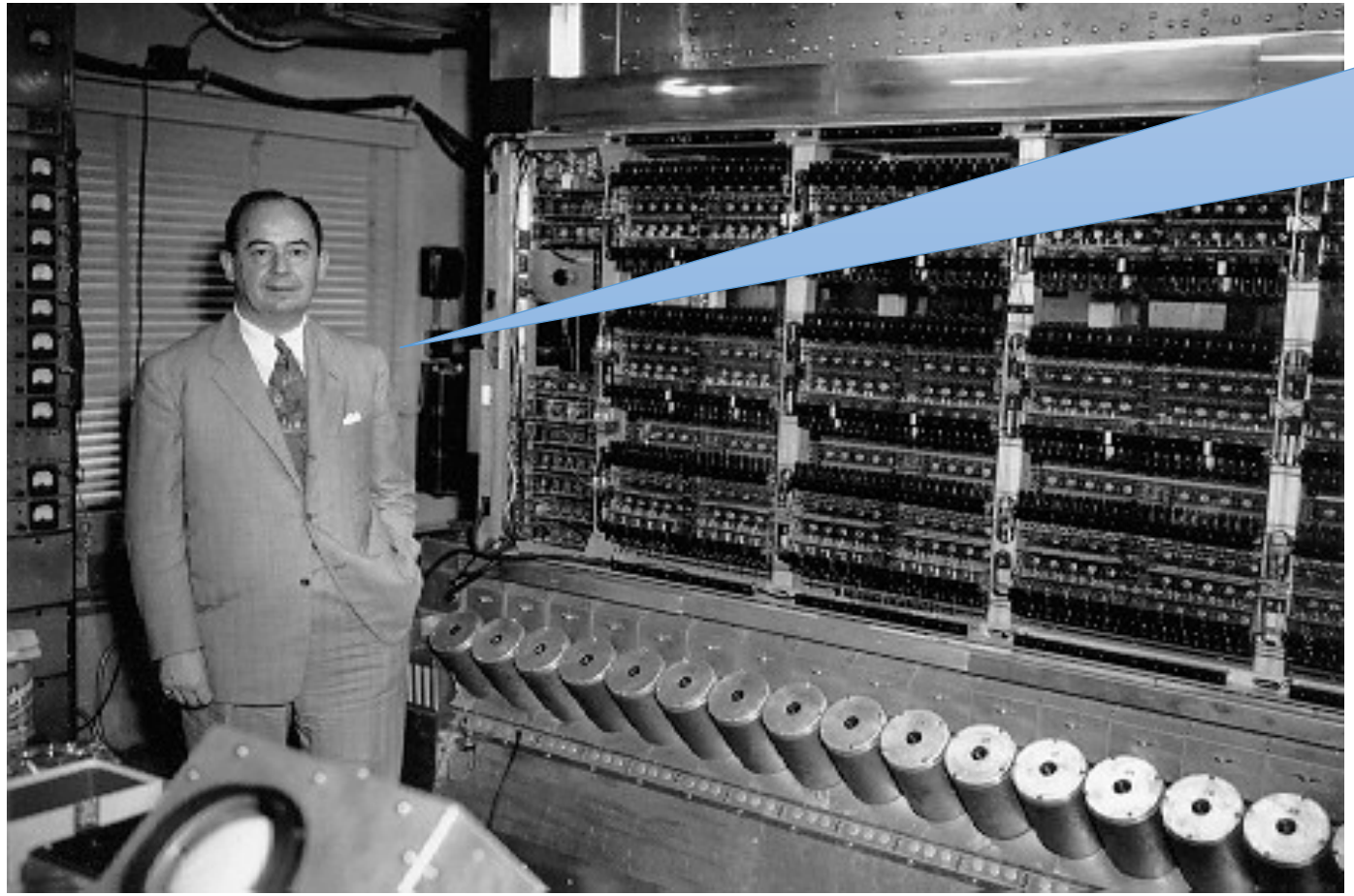




- Von Neumann Architecture:



Von Neumann



John von Neumann

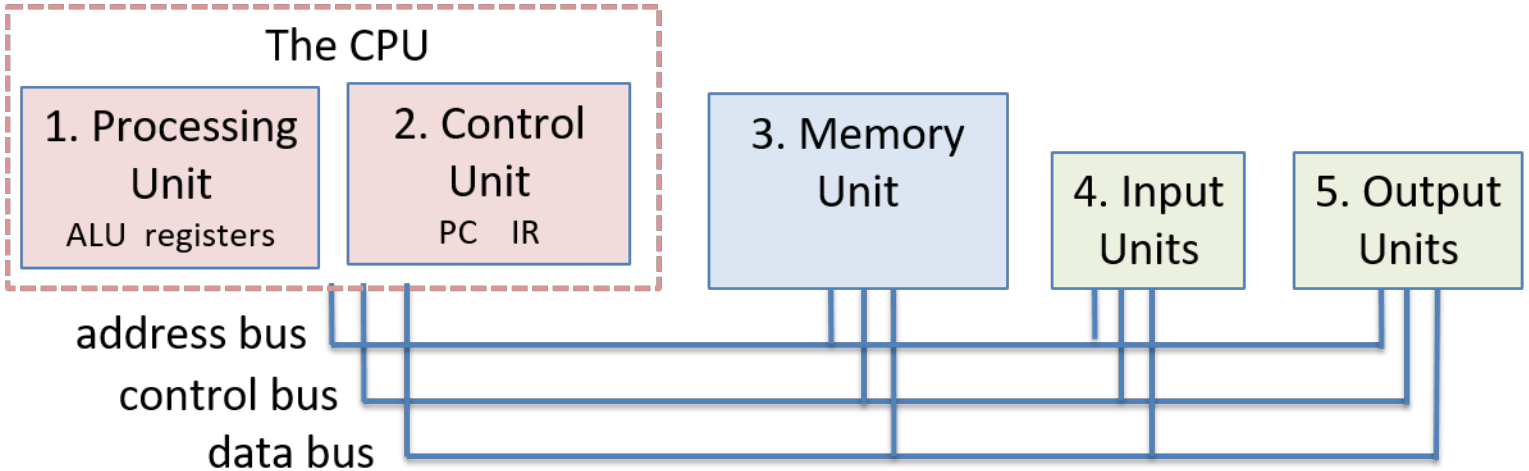
"The father of modern machines"

Stored Program Concept

EDVAC 1945

Von Neumann Architecture Model

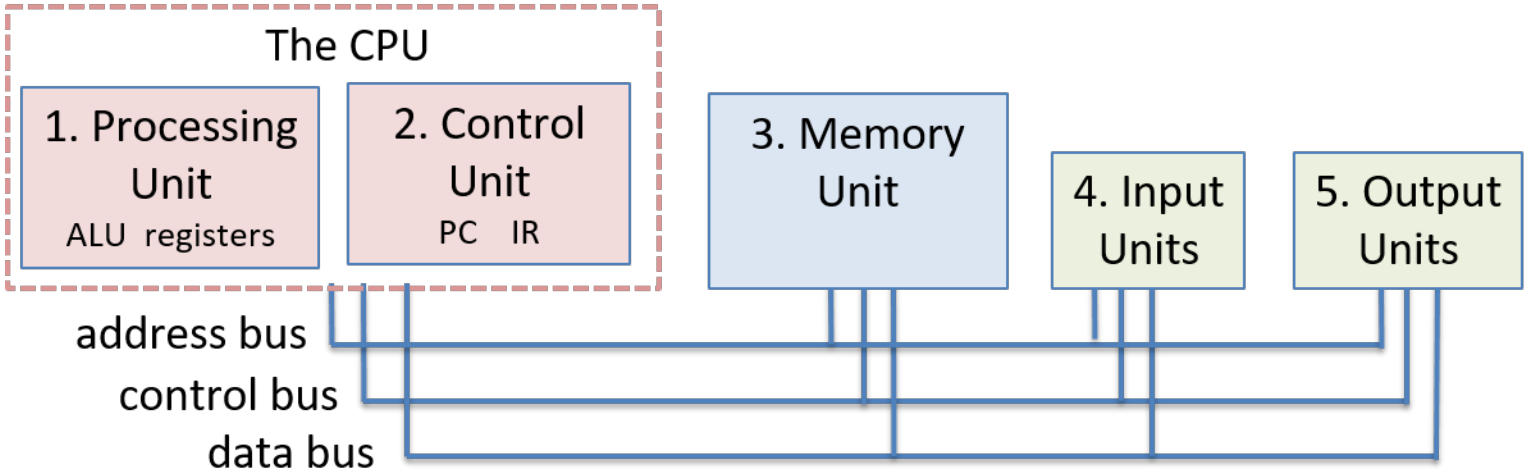
- Computer is a generic computing machine:
  - Based on Alan Turing's Universal Turing Machine
  - Stored program model: computer stores program rather than encoding it (feed in data and instructions)
  - No distinction between data and instructions memory
- 5 parts connected by buses (wires):
  - Memory, Control, Processing, Input, Output



The CPU

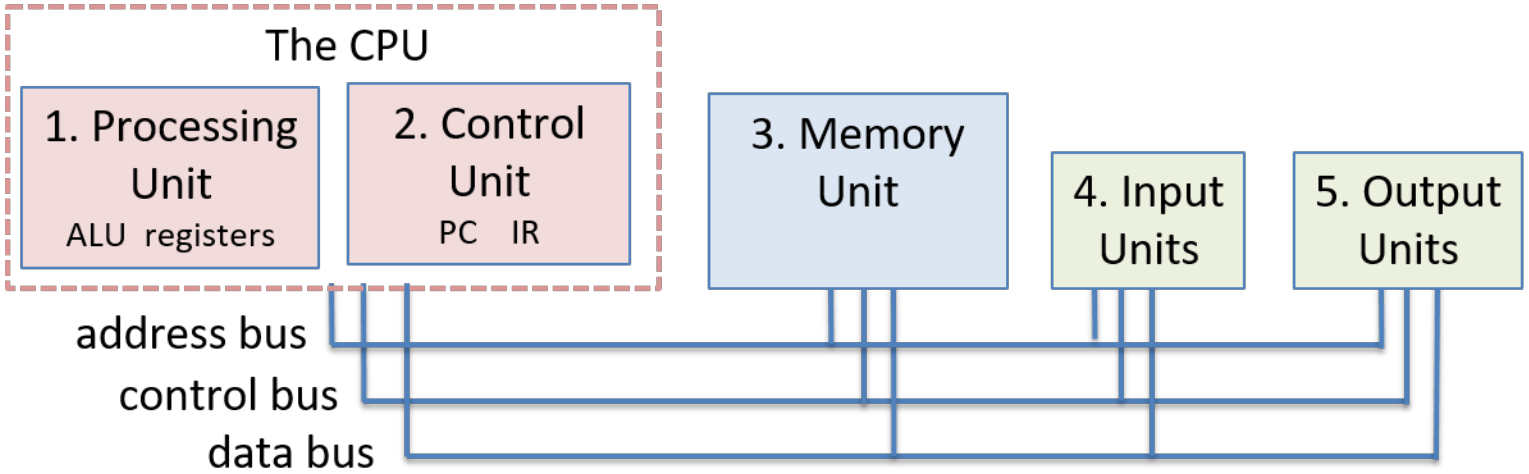
1. Processing Unit: Execute instructions to produce a result
   - ALU (arithmetic logic unit): set of circuits for arithmetic (ADD, SUB, etc.)
   - Registers: temporary storage for instructions (scratch space)

2. Control Unit: Keep track of which instruction to execute next and what that instruction says to do.



Memory

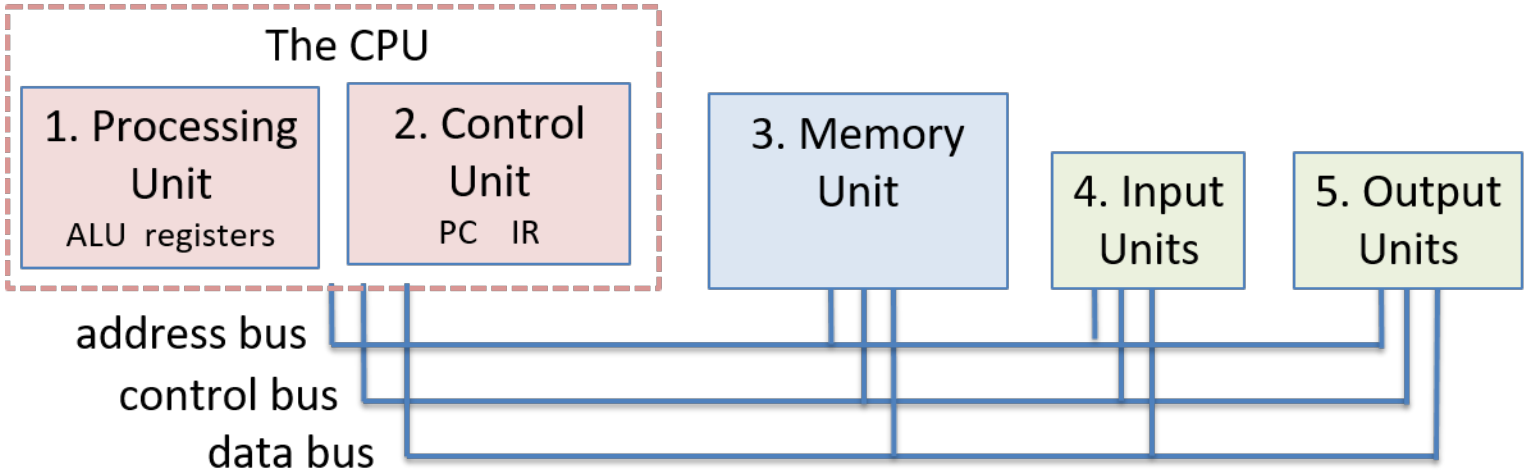
3. Data and instruction storage in “main memory” (RAM)
   - Each byte in memory has a unique address



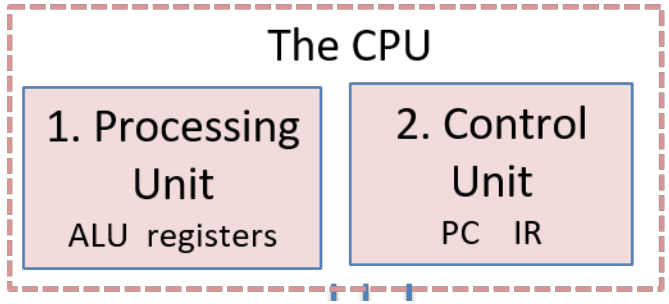
I/O

4. Input: Data coming into the CPU from outside sources
   - keyboard, mouse, network, hard drive

5. Output: Data leaving the CPU to the outside world
   - video display, audio, network, hard drive, printer



Goal: Build a CPU (model)



<u>Three main classifications of hardware circuits:</u>

1. ALU: implement arithmetic & logic functionality
   - Example: adder circuit to add two values together

2. Storage: to store binary values
   - Example: set of CPU registers (“register file”) to store temporary values

3. Control: support/coordinate instruction execution
   - Example: circuitry to fetch the next instruction from memory and decode it

People — Mostly Immigrants — Made Circuit Boards in the 70's at Home (!)

Making Circuit Boards Today