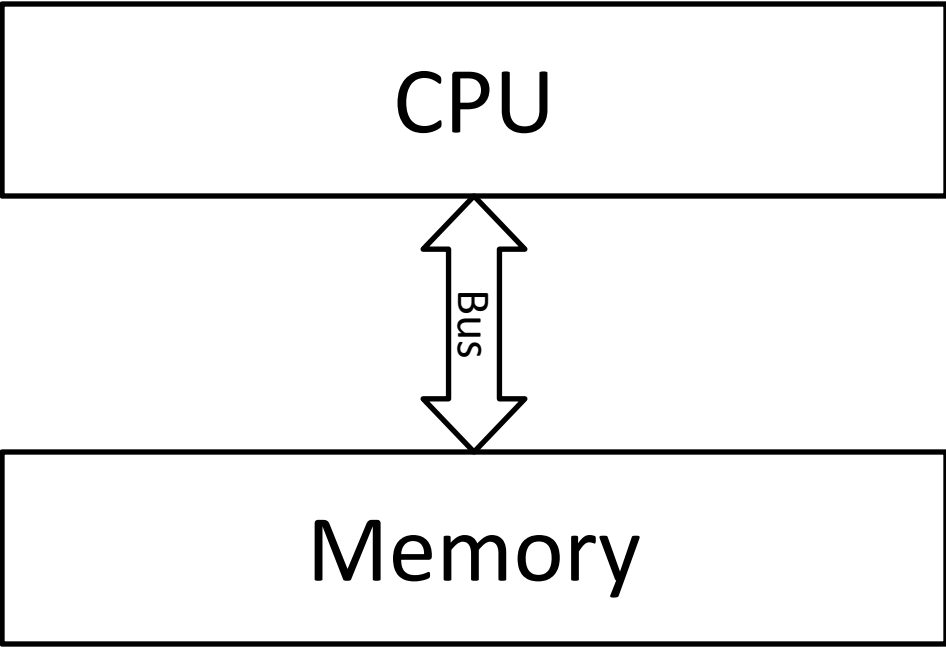# Basic Computer Architecture

CS520

Department of Computer Science

University of New Hampshire

CPU

- Central Processing Unit
- Contains:
  - Control Unit: decides what to do
  - Arithmetic/Logic Unit (ALU): does things
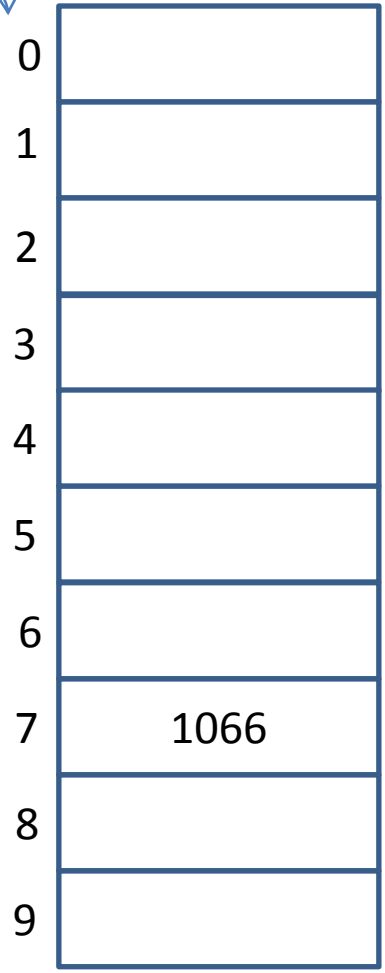 - Registers: holds values

Memory

- Stores instructions and data
- Array of cells
- The index of a cell is its **address**.
- Two concepts:
  - address of cell
  - contents of cell

address

Memory

0	
1	
2	
3	
4	
5	
6	
7	1066
8	
9	

The memory cell with *address* 7 has *contents* 1066.

Contents of Memory

- Just bits.
- There is no tag indicating what kind of value (e.g. integer, floating-point, instruction, etc.) is in a cell.

Example Instruction

- Add contents of memory cell 10117 to register 6, interpreting the two operands as integer values.

- Note: the instruction must supply the interpretation of the bits being manipulated!

- This allows us to do tricky things, like store an integer into memory and then interpret it later as an instruction.

Fetch/Execute Cycle

- Fetch
    1. Determine address of next instruction.
    2. Fetch the next instruction.
    3. Decode the next instruction.
    4. Fetch operands.
- Execute
    5. Execute instruction.
   6. Store results.
    7. Go to 1.

Program Counter

- There is a dedicated register that tracks the address of the memory cell that contains the next instruction to be executed.

- The generic name for this register is the **program counter (PC).**

- On the Intel IA-32 architecture, for example, the program counter is called the **eip** register (**e**xtended **i**nstruction **p**ointer).

Von Neumann Machine

- The stored-program design is attributed to the mathematician John Von Neumann*, so the design is also known as a **Von Neumann machine.**
- Storing the program in memory enables:
  - Compilers and linkers
  - Self-modifying programs
  - Just-in-time translation
    - e.g. Java bytecode to Intel machine code

* This attribution is controversial.

Von Neumann Bottleneck
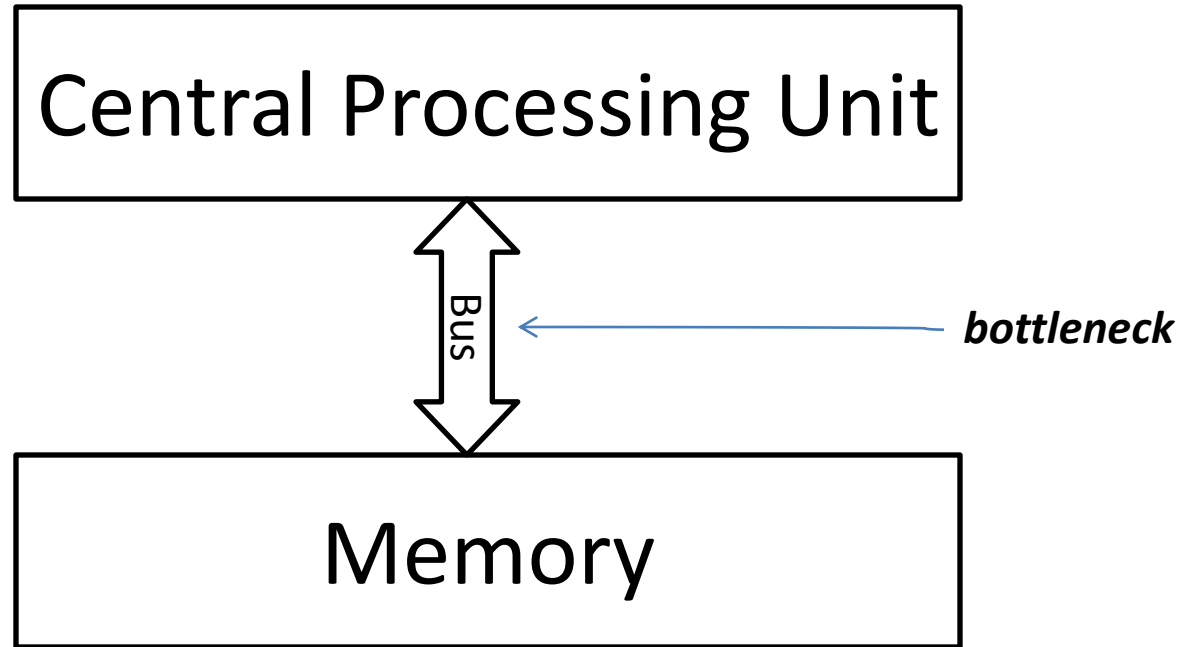
- All data and instructions must pass via the bus.
- Memory is much slower than CPU.