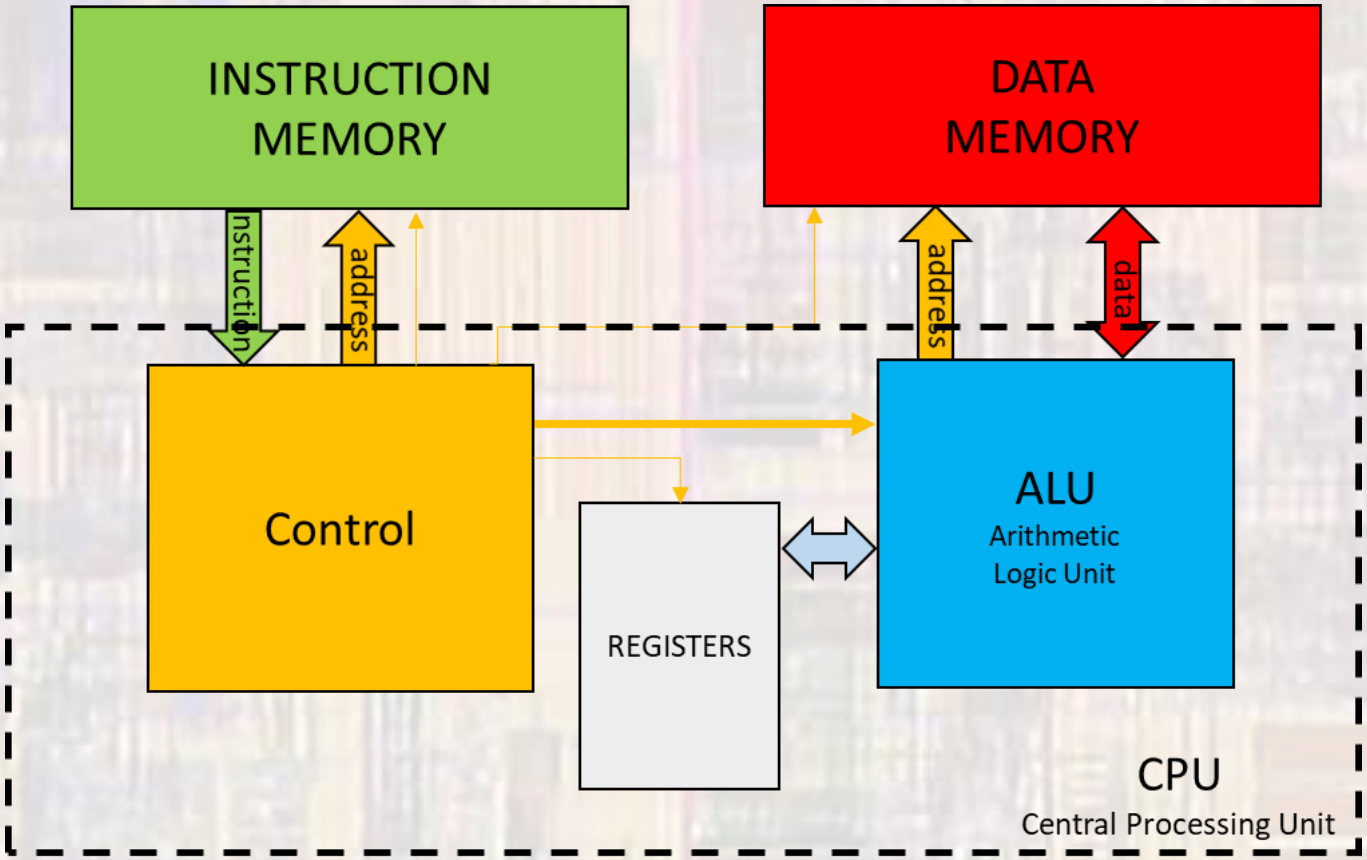
Processor Structure

Last updated 6/14/23

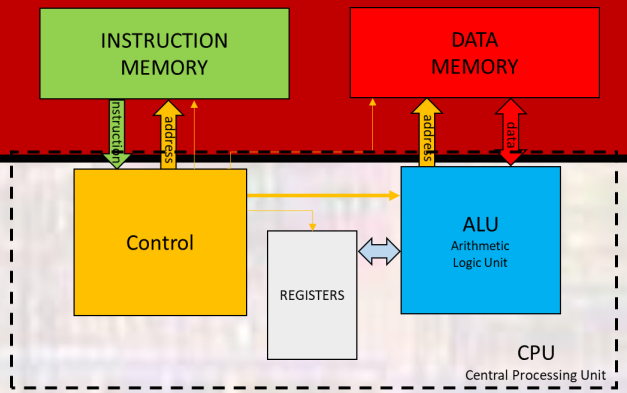
These slides introduce the hardware used in a computer processor

Processor Structure

- Components (Harvard Architecture)

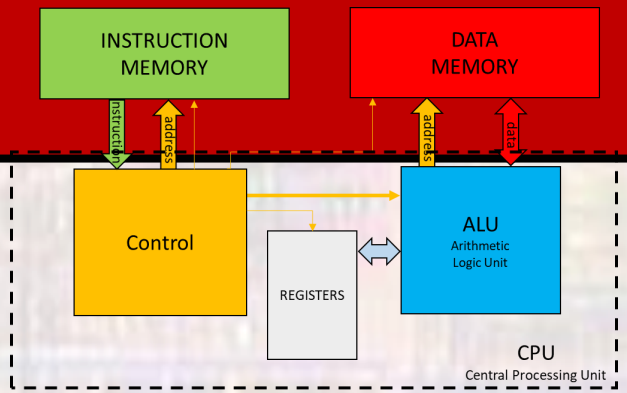


Processor Structure



- Instruction Memory
  - Long term storage for the program
  - Typically, FLASH memory
    - Read “mostly” – usually written once, read many times
    - Non- volatile: retains its values even when power removed
    - Allows the processor to run at startup without any action
  - Logical Structure
    - Program instructions stored in an encoded binary format
      - Called Machine Language
    - Instructions stored as Words – can be 8b, 16b, 32b, …
  - Physical Structure
    - Regardless of Word size – data is stored as bytes
    - Read access is limited to Word size boundaries

Processor Structure



- Data Memory
  - Short term storage for program data
  - Typically, RAM memory
    - Read/Write
    - Volatile: loses its values when power removed
    - Does not power up to a known state (not all 0's)
  - Logical Structure
    - Data stored in raw binary format
      - Could be signed or unsigned
    - Data stored as Words – can be 8b, 16b, 32b, …
  - Physical Structure
    - Regardless of Word size – data is stored as bytes
    - Read/Write access is limited to Word size boundaries

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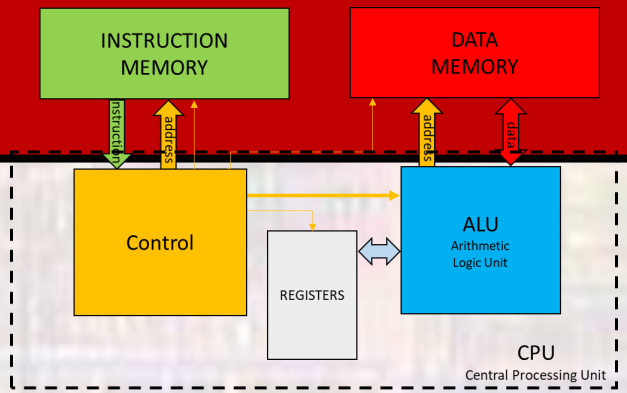

- Registers
  - Short term storage for data
  - Typically, logic circuit based (Flip-Flop)
    - Very fast
    - Large per-bit size vs. memory-based storage
    - Read/Write
    - Volatile: loses its values when power removed
    - Does not power up to a known state (not all 0's)
  - Logical / Physical Structure
    - Data stored in raw binary format
      - Could be signed or unsigned
    - Data stored as Words – can be 8b, 16b, 32b, …
  - This is the only data the ALU can operate on
    - Data must be moved to the registers to be operated on by the ALU

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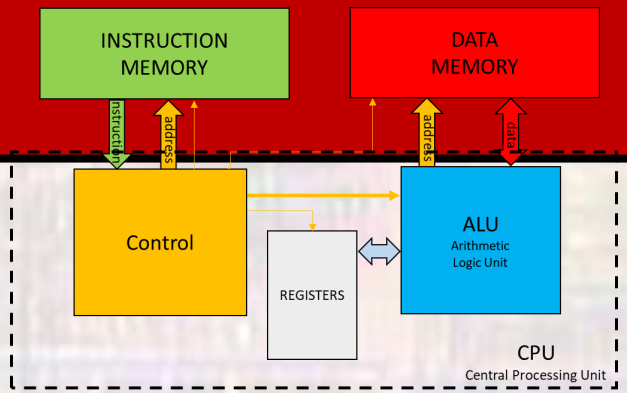

- ALU
  - Arithmetic Logic Unit
  - Applies arithmetic operations to Register data
    - Supports operations like +, -, *, /, AND, OR, …
    - Data must be moved to the registers to be operated on by the ALU
  - Used to move data between the Data Memory and the Registers
  - Logic circuit based
  - Logical / Physical Structure
    - Data stored in raw binary format
      - Could be signed or unsigned
    - Data stored as Words – can be 8b, 16b, 32b, …

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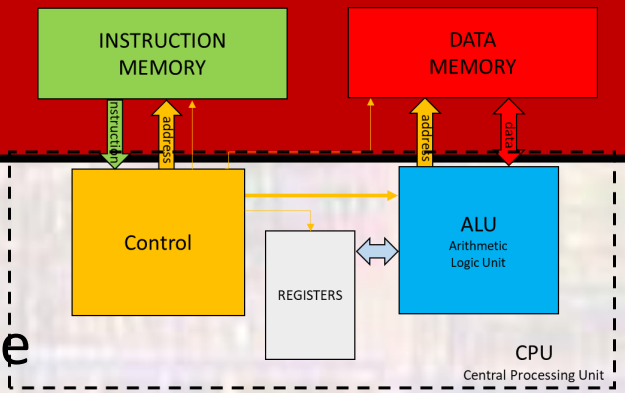

- Control
  - Manages the operation of the hardware
    - Keeps track of the current program location (in Instruction Memory)
    - Fetches and decodes each new program instruction
    - Signals to the ALU what operation to perform
      - Arithmetic operation on Registers
      - Load data from Data Memory to a register
      - Store data from a Register to Data Memory
  - Logic circuit based

Computer Terminology

- Memory Structure
  - Modified Harvard – upper-level common memories