Computer Programming

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Session: Computer Architecture

Quick Recap of Relevant Topics

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- Dumbo model of computing
- Named drawers for storing/retrieving values
- Workbench registers for computing
- Input and output using carts

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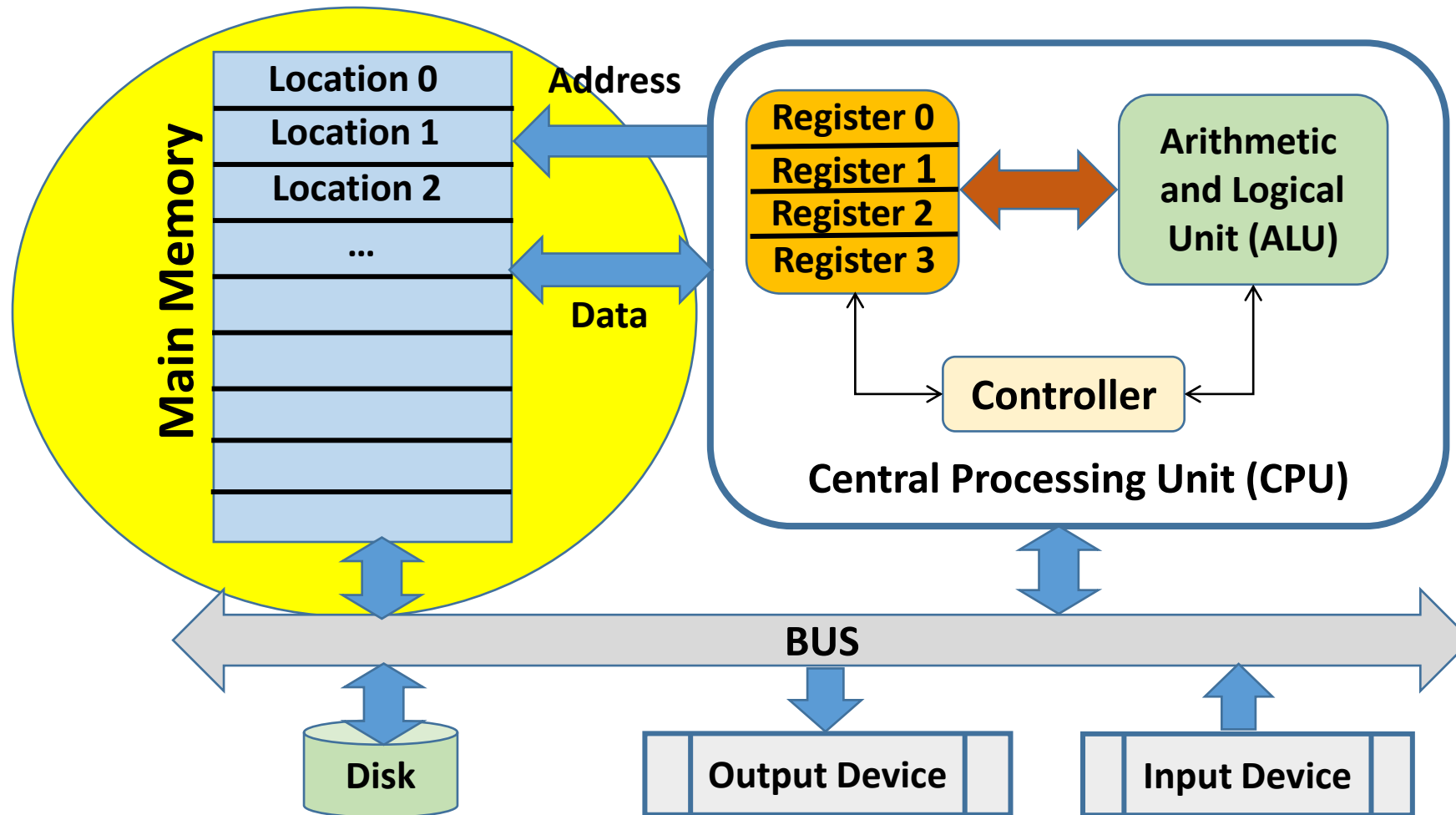
Overview of This Lecture

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- What is it that we will actually be programming
  - From Dumbo to a real computer (almost a Dumbo!)
- Simplified architecture of a computer
- Functionalities of different parts
- Bits and bytes of information

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# A Simple Real Computer
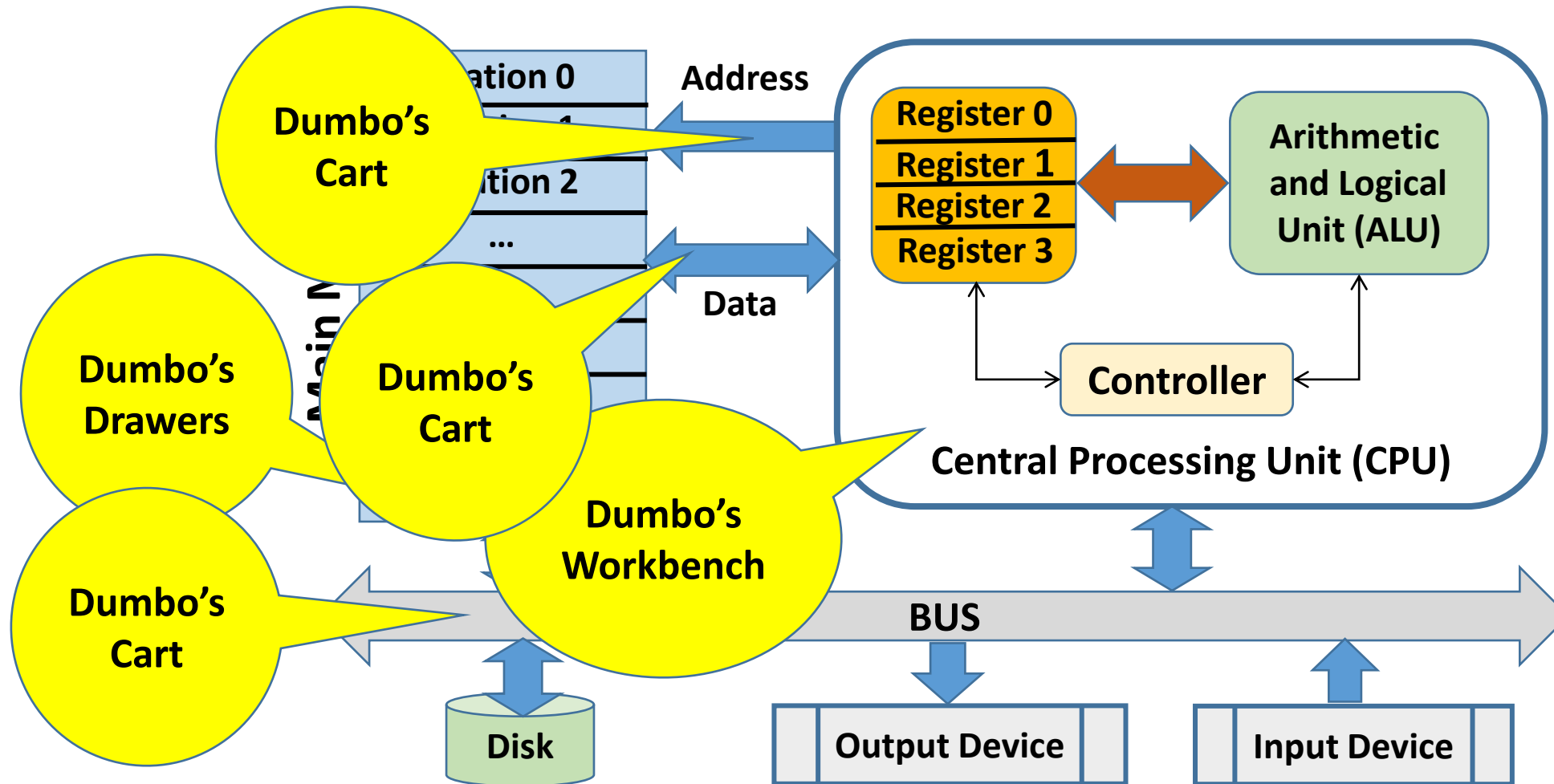
Parts of a Computer

Main Memory

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- Usually called "Random Access Memory" (RAM) or simply "Memory"

- Large number of addressable locations

- Each location stores exactly one value at a time
  - **Even if you don't store a value at a location, "garbage" value exists**

- Writing to a location destroys value originally there

- Reading a location makes a copy, does not destroy value
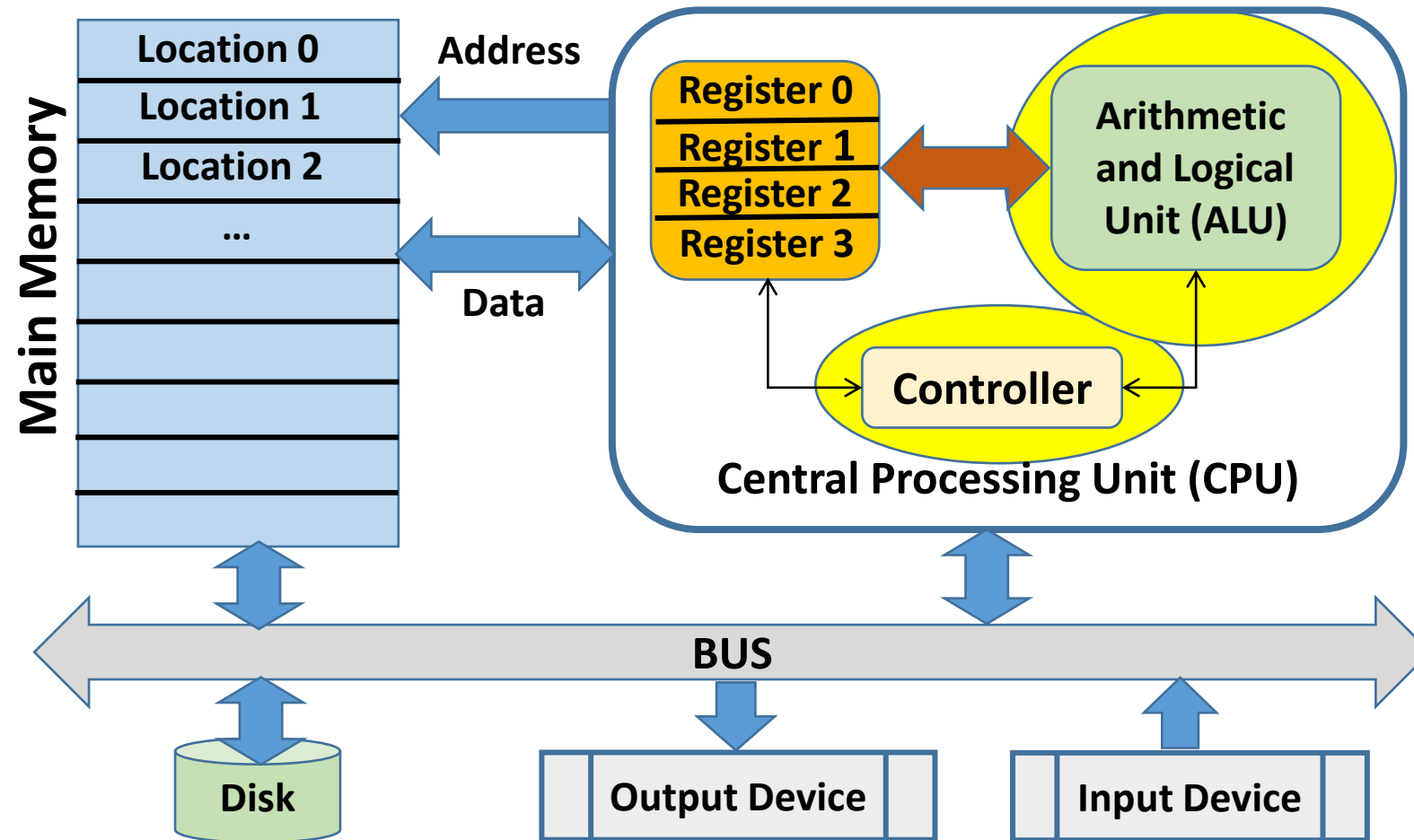
Parts of a Computer

Registers

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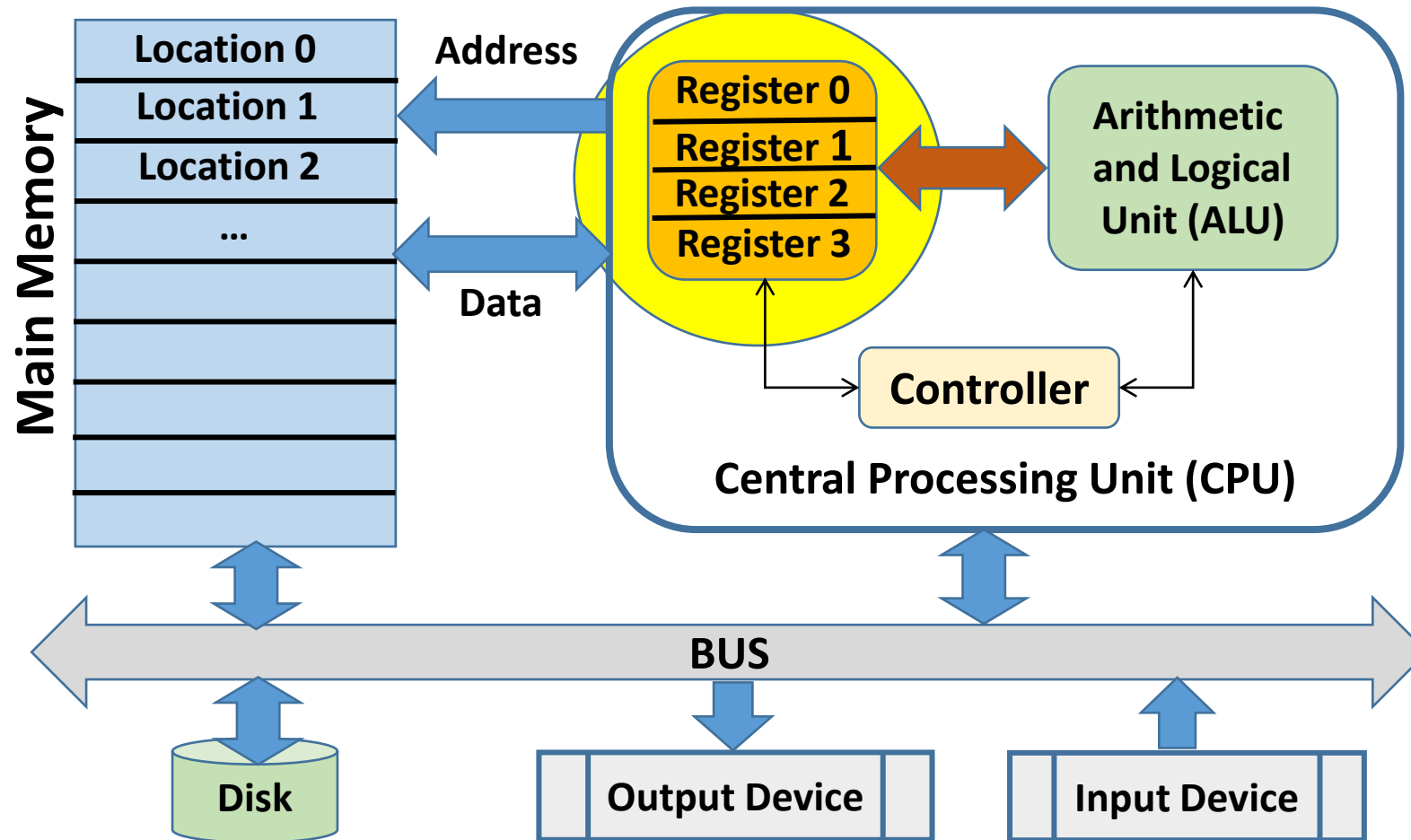
- Much faster, costlier and smaller than main memory

- Won't see much of these in our programs
  - Works behind the scenes

- Advanced programming can refer to registers directly
  - We won't get to cover this in this course
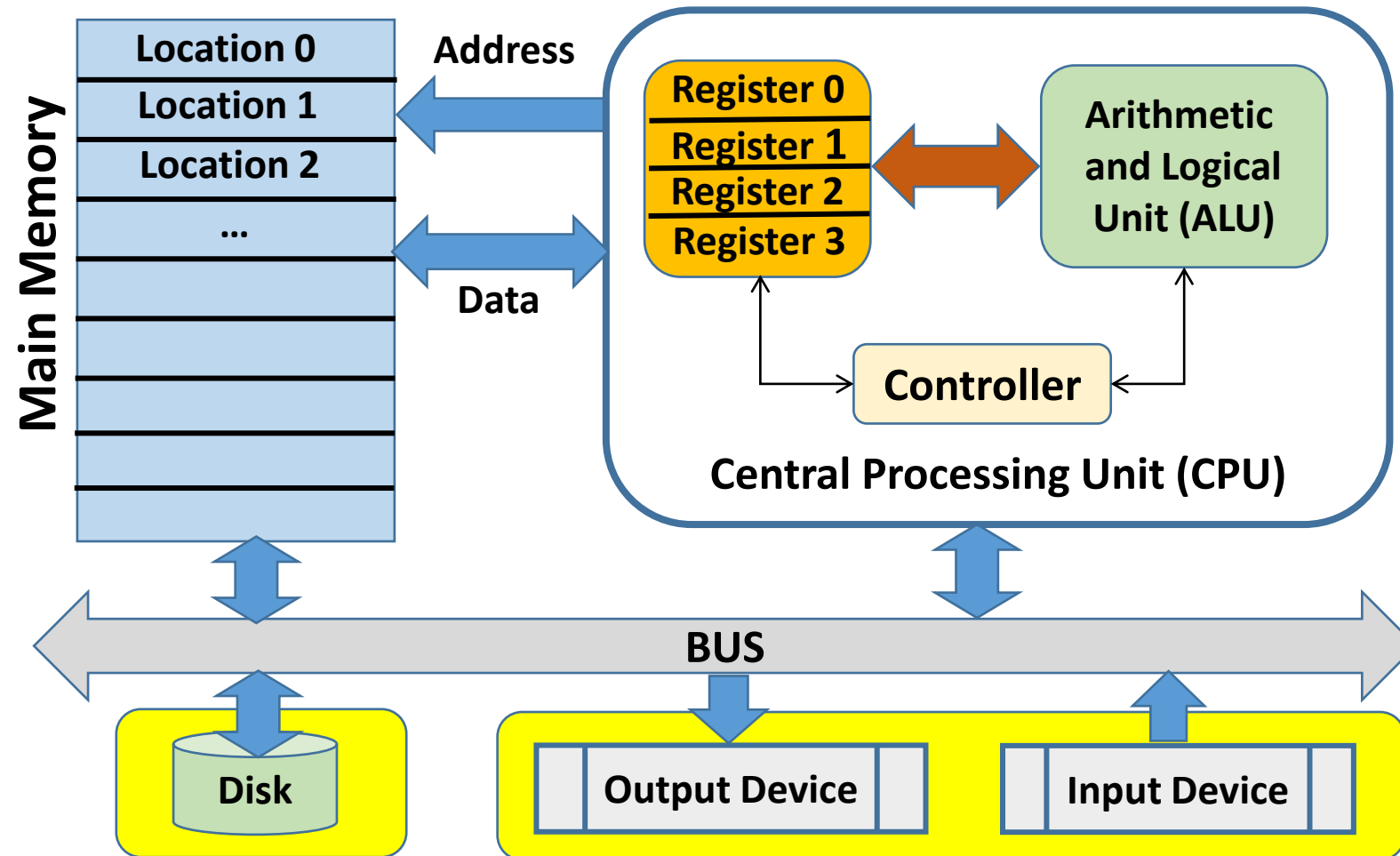
Parts of a Computer

ALU and Controller

- Arithmetic Logic Unit (ALU)
  - Workhorse of computer
  - All arithmetic (add, multiply …) and logical (and, or …) operations happen here
  - Takes operands from registers, stores result in registers

- Controller
  - Sequences various actions involved in executing instructions
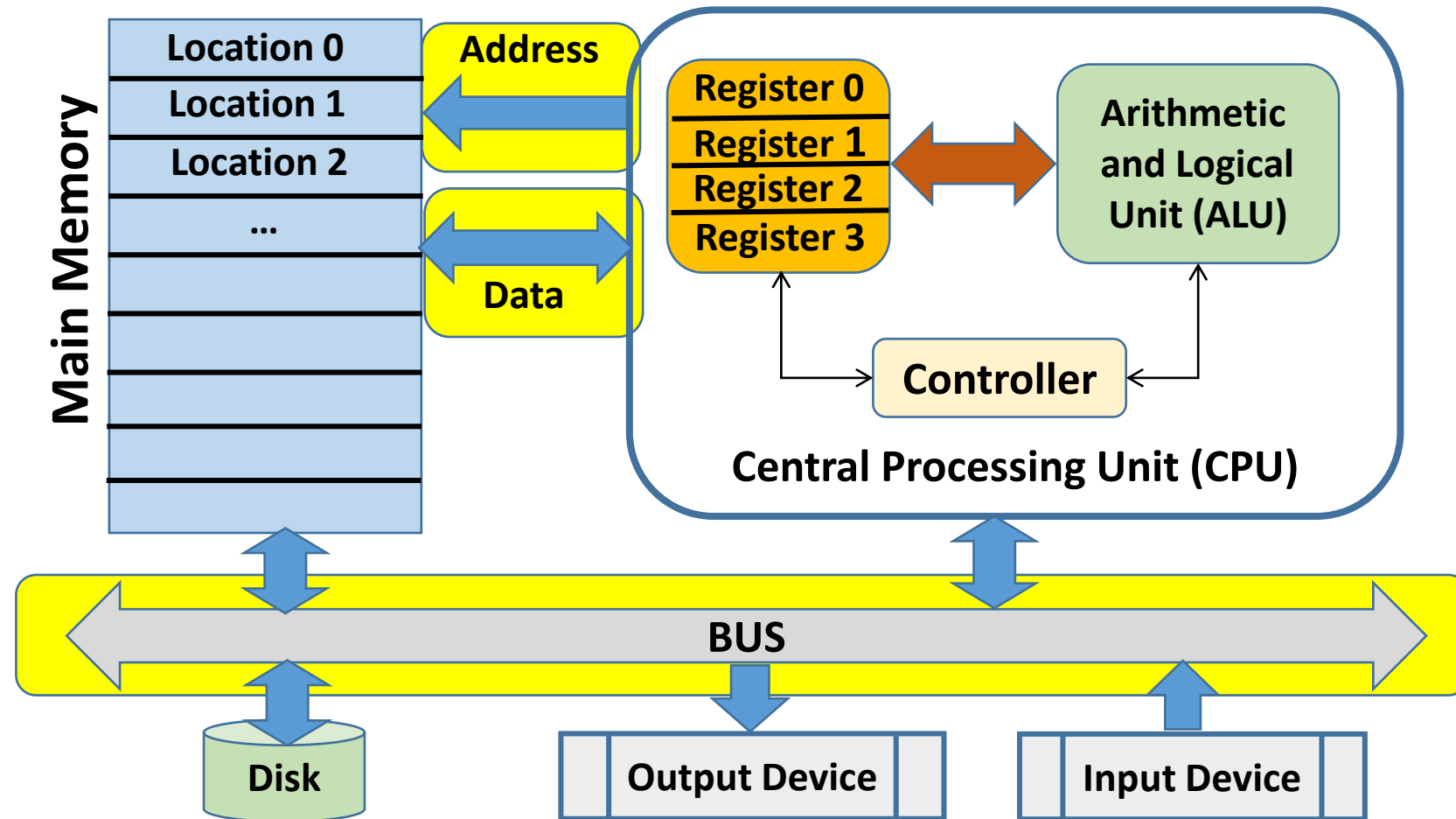
Parts of a Computer

Disks and Input/Output Devices

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- Disks
  - Longer term storage for files (programs, data, logs, outputs …)
  - Like main memory, but much slower, larger, cheaper
  - More later when we study about files

- Input/Output (aka I/O) Devices
  - Allows computer to interact with world outside
  - Input device: Keyboard for us
  - Output device: Console (screen) for us
  - Computers can interact with other kinds of I/O devices too!

Parts of a Computer

Main Memory		Address
Location 0		
Location 1		
Location 2		
...		Data

Register 0
Register 1
Register 2
Register 3

Arithmetic and Logical Unit (ALU)

Controller

Central Processing Unit (CPU)

BUS

Disk

Output Device

Input Device

Buses

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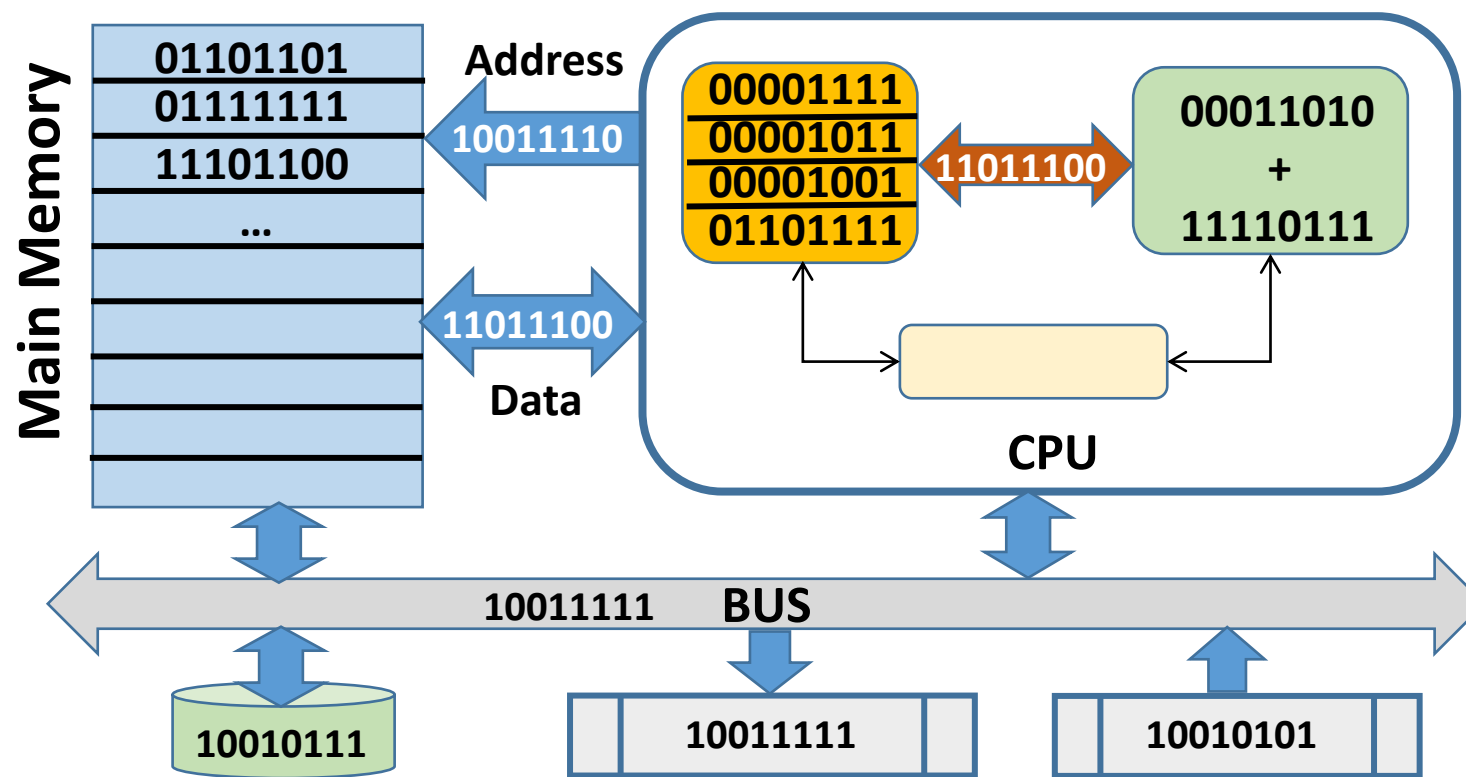- Highways for transfering information between different parts
- Address bus, data bus, I/O bus, external device bus (Universal Serial Bus)
- We won't see these in our study
  - Works behind the scenes

How is Information Represented?

- All information represented as sequences of 0's and 1's

- Snapshot:

Internal Representation of Information

- Electronic circuits in a computer can efficiently store and process two states of electrical signals
  - Call them '0' and '1'

- Information represented using '0' and '1'
  - Binary representation
  - '0' and '1' called **bits (binary digits)**

- Information accessed in chunks of 8 bits: a byte
  - Memory access, I/O access, register access, addresses, …

- Important to understand how numbers, characters, strings … are represented using bits and bytes
  - Topic of another lecture …

Summary

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- Architecture of a simple real computer
    - Main memory
    - Registers
    - ALU
    - Input/Output devices
    - Disk
    - Bus
- Representing information: Bits and bytes