NATIONAL RESEARCH UNIVERSITY

Computer Architecture and Operating Systems
Lecture 8: Memory-Mapped I/O (MMIO)

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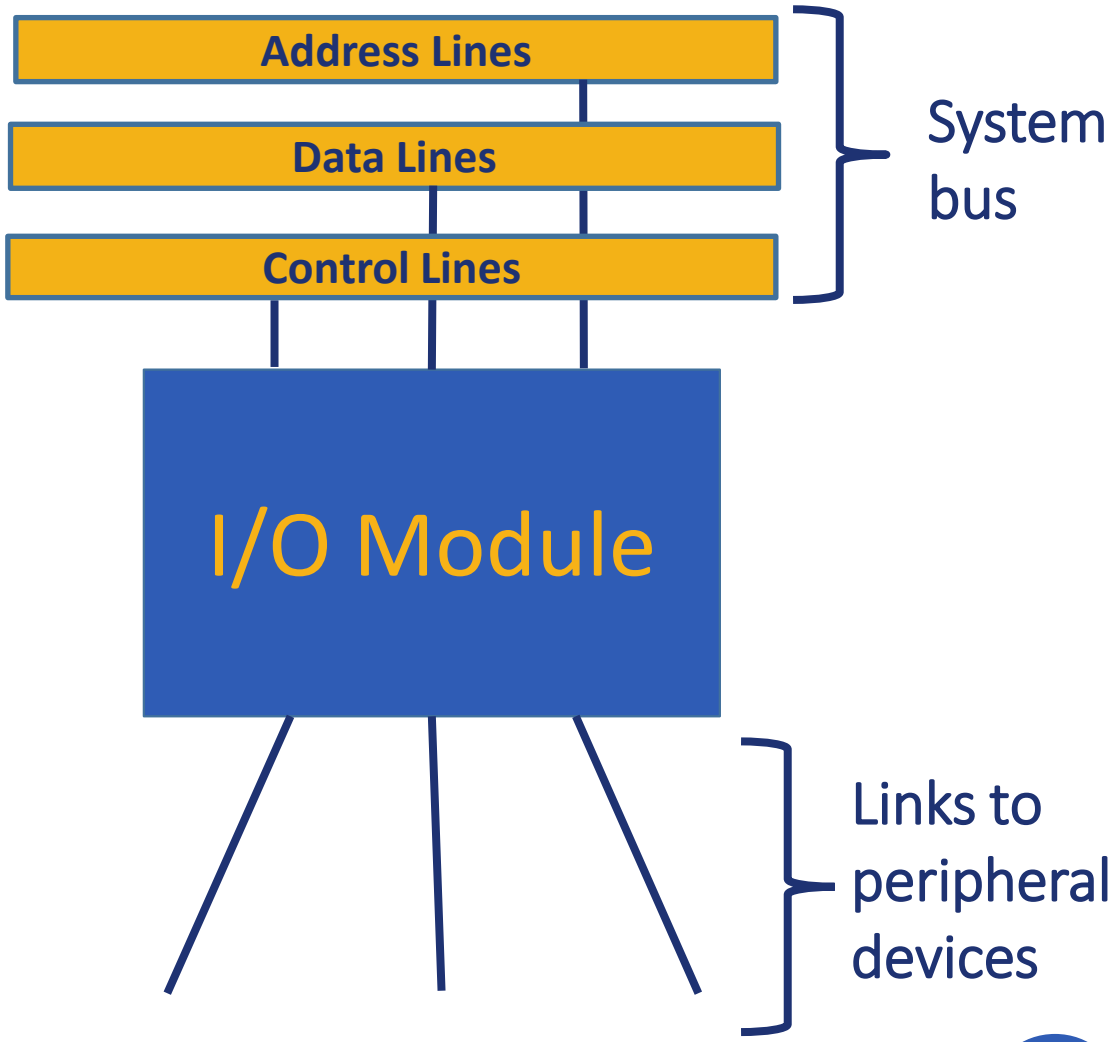
I/O Devices

- Human readable
  - Suitable for communicating with users
  - Video displays, printers
- Machine readable
  - Suitable for communicating with equipment
  - Magnetic disks, SSDs, sensors
- Communication
  - Suitable for communicating with remote devices such as a terminal or another computer
  - Network interface card

I/O Module

- Attach to the processor by a link to an I/O module
  - The link is used to exchange control, status, and data between the I/O module and the external device
- Peripheral device
  - An external device connected to an I/O module



Memory-Mapped I/O

- **Memory-Mapped I/O** is an I/O scheme in which portions of the address space are assigned to I/O devices, and reads and writes to those addresses are interpreted as commands to the I/O device.
- **Direct Memory Access (DMA)** is a mechanism that provides a device controller with the ability to transfer data directly to or from the memory without involving the processor.

Memory-Mapped I/O

- **Interrupt-Driven I/O** is an I/O scheme that employs interrupts to indicate to the processor that an I/O device needs attention.
- **Polling** is the process of periodically checking the status of an I/O device to determine the need to service the device.
- **Device driver** is a program that controls an I/O device that is attached to the computer.

Any Questions?

```
            .text
__start:    addi t1, zero, 0x18
            addi t2, zero, 0x21
cycle:      beq t1, t2, done
            slt t0, t1, t2
            bne t0, zero, if_less
            nop
            sub t1, t1, t2
            j cycle
            nop
if_less:    sub t2, t2, t1
            j cycle
done:       add t3, t1, zero
```