Building to a Computer
Fetch, Decode, Execute

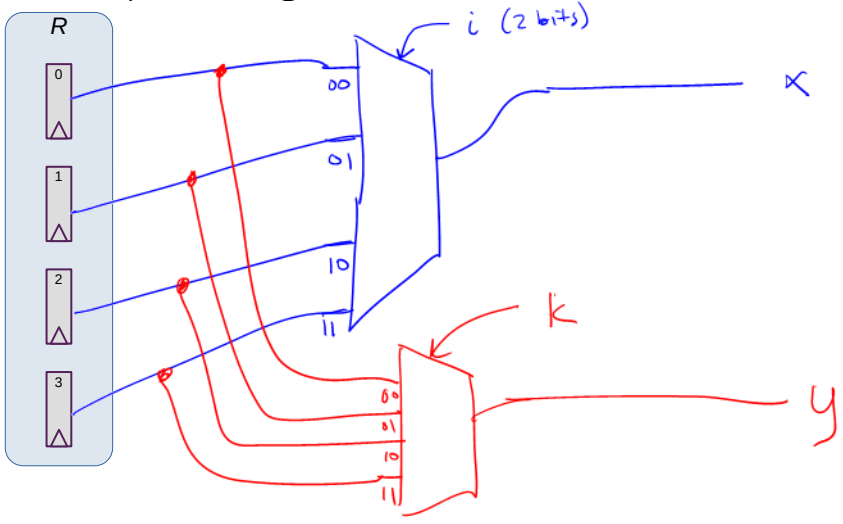
CS 2130: Computer Systems and Organization 1
February 6, 2026

Announcements

- Homework 2 due Monday

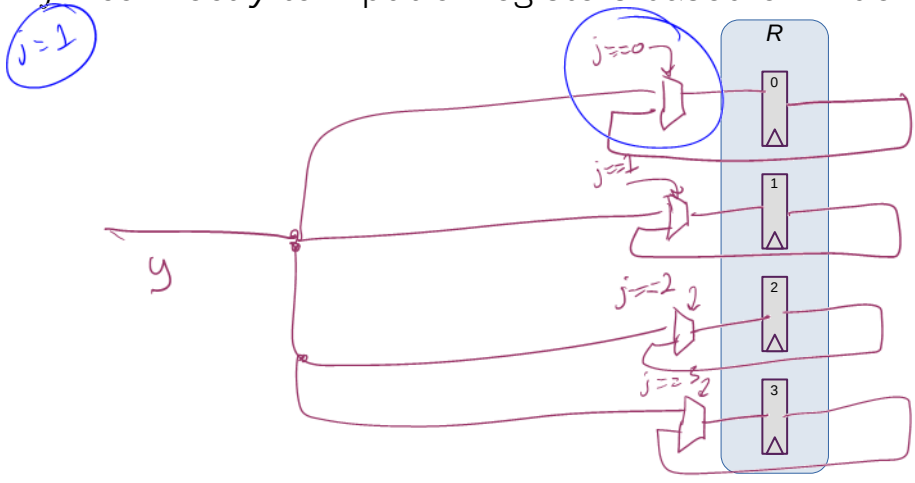
Reading

`x = R[i]` - connect output of registers to x based on index i



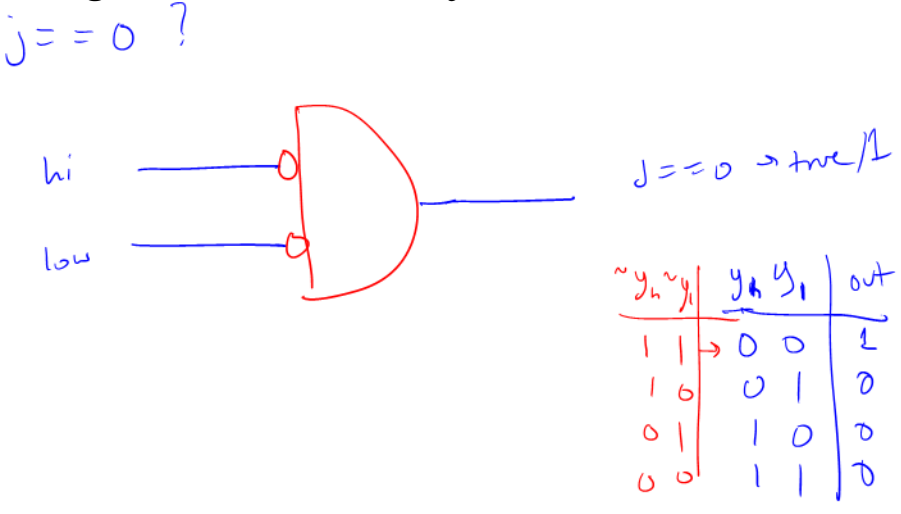
Writing

`R[j] = y` - connect `y` to input of registers based on index *j*



Aside: Creating ==0 gates

How do we build gates that check for $j == w$?



Need one more thing to build computers

Memory and Storage

1 byte = 8 bits

≈ KiB

1024 bits

Registers

- 6 gates each, ≈ 24 transistors
- Efficient, fast
- Expensive!
- Ex: local variables

$2^0 - 2^1$

These do not persist between power cycles

Memory and Storage

Memory ≈ GiB

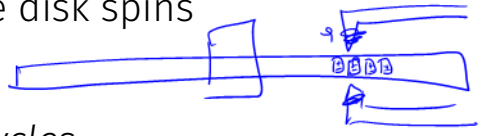
- Two main types: SRAM, DRAM
- DRAM: 1 transistor, 1 capacitor per bit
- DRAM is cheaper, simpler to build
- Ex: data structures, local variables

These do not persist between power cycles

Memory and Storage

Disk ≈ GiB-TiB

- Two main types: flash (solid state), magnetic disk
- Magnetic drive
  - Platter with physical arm above and below
  - Cheap to build
  - Very slow! Physically move arm while disk spins
- Ex: files



Data on disk does persist between power cycles

Putting it all together

Our story so far

- Information modeled by voltage through wires (1 vs 0)
- Transistors
- Gates: `&` `|` `~` `^`
- Multi-bit values: representing integers, floating point numbers
- Multi-bit operations using circuits
- Storing results using registers, clocks
- Memory

Code

How do we run code? What do we need?

Consider the following code:

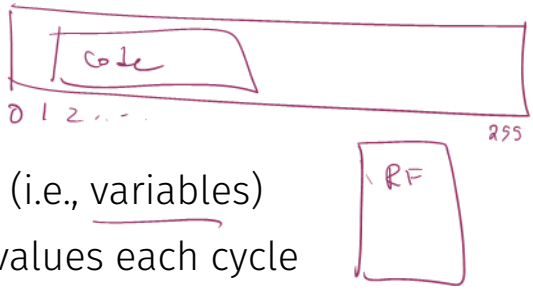
```
...
8:   x = 16
9:   y = x
10:  x += y
...
```

What is the value of x after line 10?

Bookkeeping

What do we need to keep track of?

- **Code** - the program we are running
  - RAM (Random Access Memory)
- **State** - things that may change value (i.e., variables)
  - Register file - can read and write values each cycle
- **Program Counter (PC)** - where we are in our code
  - Single register - byte number in memory for next instruction



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