Warmup question from the reading: is the following a decoder or a multiplexer?

- Decoder
- Multiplexer (mux)
- None of the above
Goal for the next 2 weeks: **Simple Processor**

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**Toolbox: Building Blocks**

- **Processor datapath**
  - Instruction Decoder
  - Arithmetic Logic Unit
  - Adders
  - Multiplexers
  - Encoders
  - Decoders
- **ISA**
- **Microarchitecture**
  - Gates
- **Digital Logic**
  - Registers
  - Memory
  - Adders
  - Instruction Decoder
  - Multiplexers
  - Encoders
  - Decoders
- **Operating System**
- **Compiler/Interpreter**
- **Devices (transistors, etc.)**
- **Solid-State Physics**

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**Multi-bit Multiplexers**

Select one of several inputs as output.

- 2^n data inputs
- 1 data output
- n selector lines

Example: selector lines ABC = 011, output F = D3
Multi-bit Multiplexers

Select one of several inputs as output.

2^n data inputs

8-to-1 MUX

F

1 data output

n selector lines

A MUX is conceptually an encoder (2^n inputs to n outputs) + selection

8-to-1 MUX with gates

MUX + voltage source = truth table

Decoders

Decodes input number, asserts corresponding output.

n-bit input (an unsigned number)

2^n outputs

Built with code detectors.
### Decoders and multiplexers

**Decoders**
- A decoder has an $n$-bit input and $2^n$ outputs. Only 1 output active at once.

**Multiplexers**
- A multiplexer has $2^n$ inputs, $n$ selector wires, and 1 output.

### Buses and Logic Arrays

- **Buses**
  - A bus is a collection of data lines treated as a single logical signal.
  - = *fixed-width value*

- **Logic Arrays**
  - An array of logic elements (logical array) applies same operation to each bit in a bus.
  - = *bitwise operator*