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

- Decoder
- Multiplexer (mux)
- None of the above
Warmup question from the reading: is the following a decoder or a multiplexer?

- Decoder: 0%
- Multiplexer (mux): 0%
- None of the above: 0%
Warmup question from the reading: is the following a decoder or a multiplexer?

- Decoder
- Multiplexer (mux)
- None of the above
Combinational Logic

Building blocks: encoders, decoders, multiplexers
Goal for the next 2 weeks: Simple Processor
Toolbox: Building Blocks

Processor datapath

Instruction Decoder
Arithmetic Logic Unit
Adders
Multiplexers
Encoders
Decoders
Gates
Memory
Registers
Flip-Flops
Latches

Abstraction!
Multi-bit Multiplexers

Select one of several inputs as output.

$2^n$ data inputs

8-to-1 MUX

1 data output

$n$ selector lines
Multi-bit Multiplexers

Select one of several inputs as output.

$2^n$ data inputs

$n$ selector lines

1 data output

Example: selector lines ABC = 011

Output F = $D_3$
Multi-bit Multiplexers

Select one of several inputs as output.

A MUX is conceptually an encoder (\(2^n\) inputs to n outputs) + selection.
8-to-1 MUX
with gates
MUX + voltage source = truth table

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Decoders

Decodes input number, asserts corresponding output.

- \( n \)-bit input (an \textit{unsigned} number)
- \( 2^n \) outputs
- Built with code detectors.
3-bit decoder with gates
Decoders and multiplexers

A decoder has an \( n \)-bit input and \( 2^n \) outputs. Only 1 output active at once.

A multiplexer has \( 2^n \) inputs, \( n \) selector wires, and 1 output.
Buses and Logic Arrays

A bus is a collection of data lines treated as a single logical signal.

= fixed-width value

An array of logic elements (logical array) applies same operation to each bit in a bus.

= bitwise operator