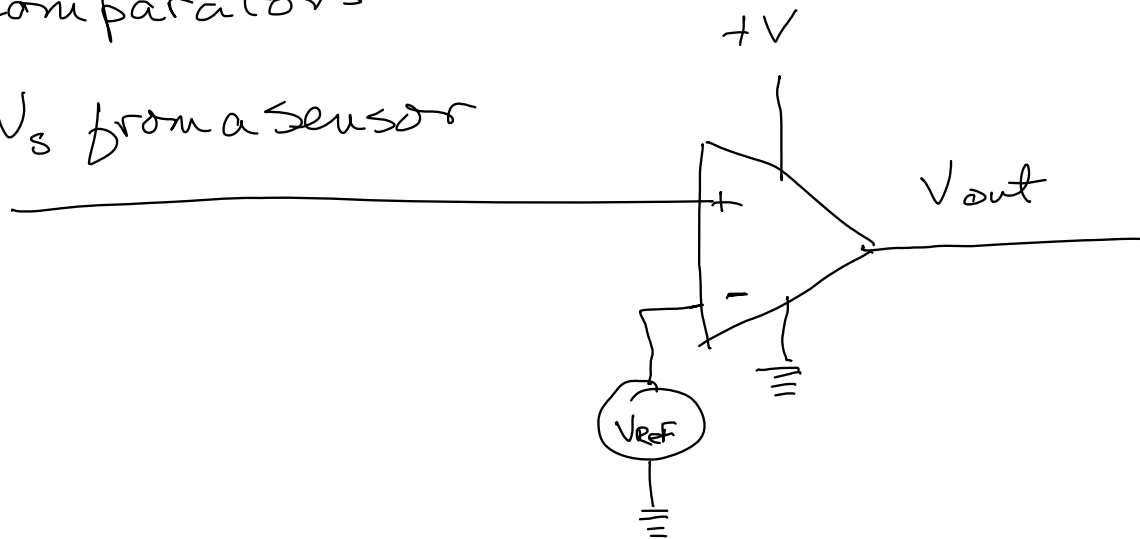


Comparator

V_s from a sensor



$V_{out} = 0$ when $V_s < V_{ref}$
 $V_{out} = V$ when $V_s \geq V_{ref}$

Build an analogue to digital converter

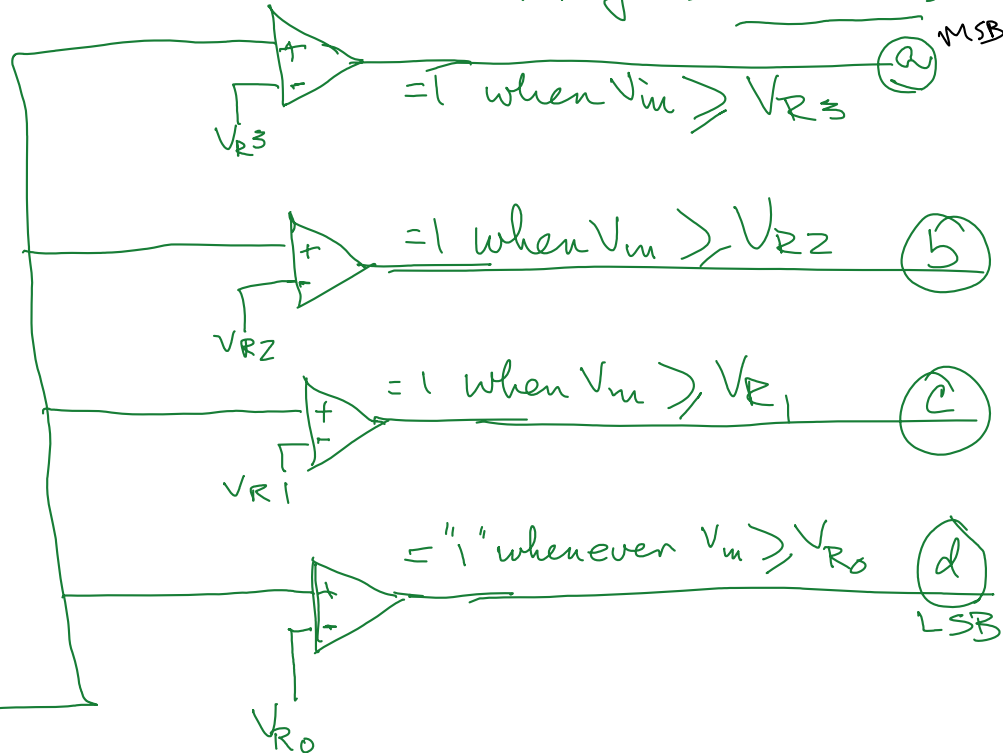
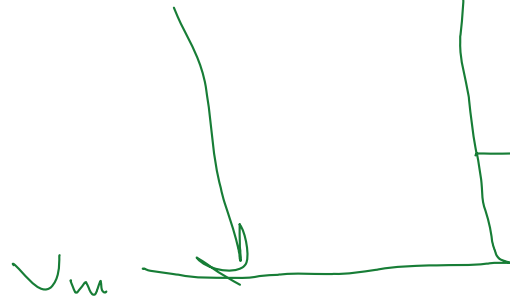
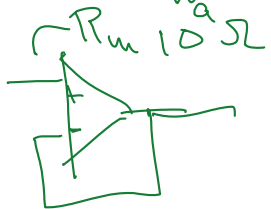
November-03-20 14:05

$V_{in} \Rightarrow$ if higher than some $V \rightarrow$ go from 0000 to 0001

Compare V_{in} with V , and if $V_{in} \geq V$, Set output to "1"

Power Supply $\Rightarrow +V = 5V, -V = 0V \Rightarrow$ Automatic TTL

Could put
FET buffer Amp



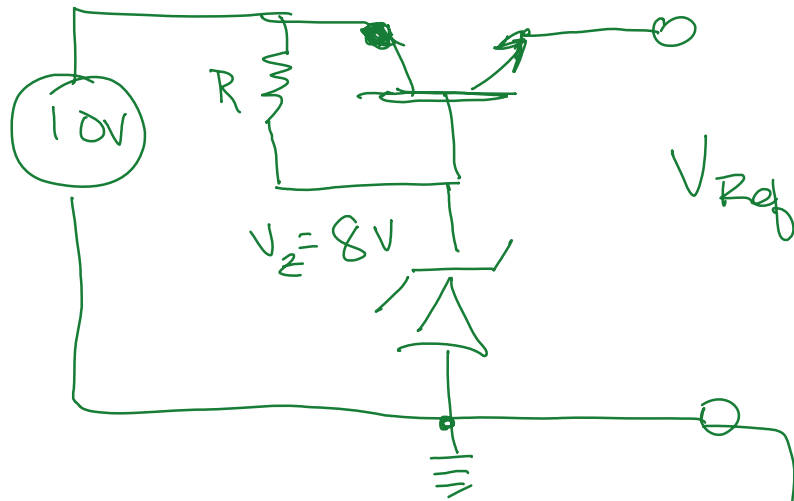
Reference Voltages

How much current
flows into an
op amp

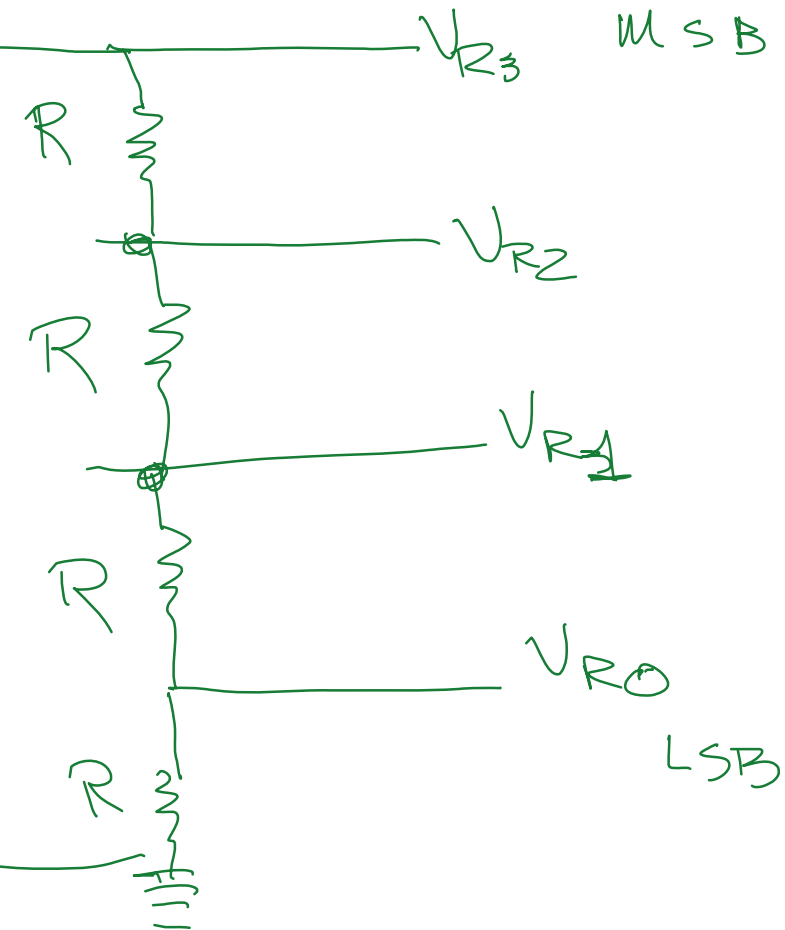
(1) Adjust V_- to make $= V_+$

(2) no current flows
into the op amp

How do we make V_{Ref}
Max Voltage = 8V



Divide V_{Ref}



Out Put of Comparators

← 0 or 5V

$V_{in} < V_{R0}$	outputs $a \rightarrow d = 0$	→	a	b	c	d
$V_{in} \geq V_{R0}$	output $d \rightarrow 1$	→	0	0	0	0
$V_{in} \geq V_{R1}$	output $c \rightarrow 1$	→	0	0	0	1
$V_{in} \geq V_{R2}$	output $b \rightarrow 1$	→	0	0	1	1
$V_{in} \geq V_{R3}$	output $a \rightarrow 1$	→	0	1	1	1
		→	1	1	1	1

Wanted
a binary
Word
Count

Output Voltages
MSB a b c d LSB

0	0	0	0
0	0	0	1
0	0	1	1
0	1	1	1
1	1	1	1

A B C
MSB 0 0 0 LSB

0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0

$$A = abcd$$

$$B = \bar{a}\bar{b}cd + \bar{a}bcd$$

$$C = \bar{a}\bar{b}\bar{c}d + \bar{a}bcd$$

$$N=3$$

2^N converter

$$\frac{8V}{2^3} = \frac{8V}{8} = 1V/\text{step}$$

$$1\text{step} = \text{LSB}$$

$$\pm \frac{1}{2} \text{LSB} \Rightarrow \pm \underline{0.5V}$$

$$R_{\text{es}} \quad \frac{100}{2^3} = 12.5\%$$

$$A = abcd$$

$$B = \bar{a}\bar{b}cd + \bar{a}bcd$$

$$C = \bar{a}\bar{b}\bar{c}d + \bar{a}bcd$$

A

	cd			
	00	01	11	10
ab				
00				
01				
11			1	
10				

$$A = abcd$$

B

	cd			
	00	01	11	10
ab			1	
00			1	
01				
11				
10				

$$B = \bar{a}cd$$

C

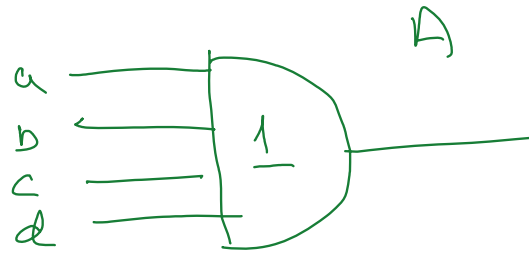
	cd			
	00	01	11	10
ab		1		
00				
01			1	
11				
10				

Can't
Simplify
Diagonal

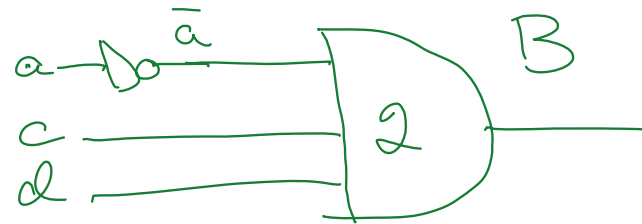
$$B = \bar{a}cd$$

$$C = \bar{a}\bar{b}\bar{c}d + \bar{a}bcd$$

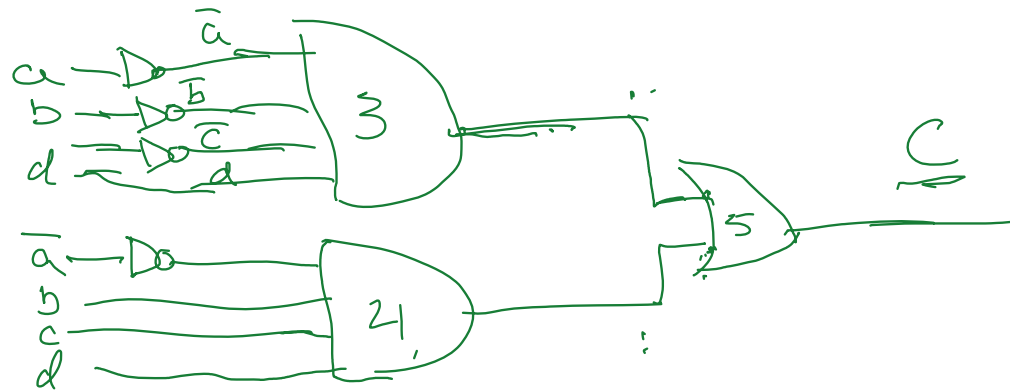
$$A = abcd$$



$$B = \bar{a}cd$$



$$C = \bar{a}\bar{b}\bar{c}d + \bar{a}bcd$$



Built V_{ref}
divided it

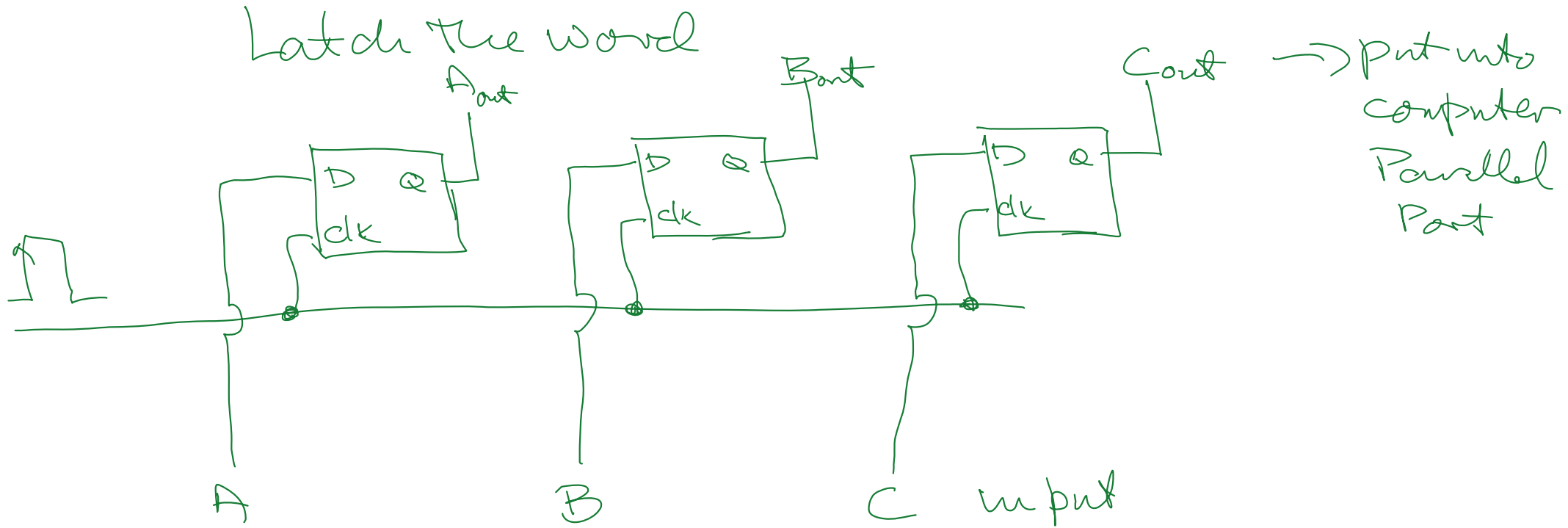
Comparators

Voltage changes $\Rightarrow$ bit change (a b c d)

Converted a b c d to a binary count

What have we left off?

Want to Read binary count & don't want it
changing when we read it



But → I just sampled the output
Anti alias filter the input V_m

Comparators connected to voltages with $V > V_i$ produce one polarity,
All connected to $V < V_i$ produce the opposite polarity.
Combinational logic is then used to determine the value of the input
voltage from this pattern.

– a parallel or flash ADC

Go fast converter (ns)
Accurate and expensive

