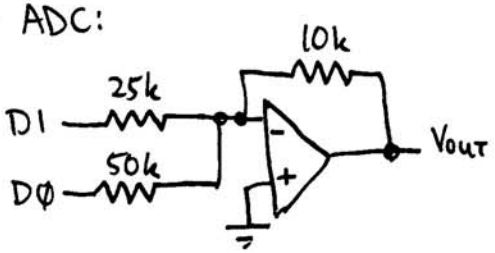
PHYSICS 316a - 2008 CLASS 14 FRIDAY 10-31-08 SUMMARY

Digital to Analog Conversion

Example of 2-bit ADC:

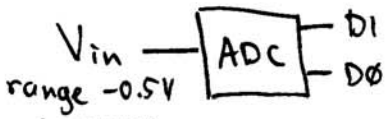
D1	DØ	Vout
0	0	0
0	1	1V
1	0	2V
1	1	3V

1 ↔ 5V



Analog to Digital Conversion

Example: 2-bit ADC:



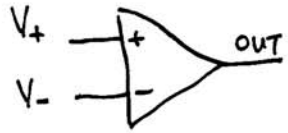
range -0.5V to 3.5V

Vin	D1	D0
-0.5 to 0.5V	0	0
0.5 to 1.5V	0	1
1.5 to 2.5V	1	0
2.5 to 3.5V	1	1

⇒ Resolution = $\frac{\text{range}}{2^n}$ ← # of bits

Conversion time ≡ time between when we ask the ADC to do a conversion & when it finishes.

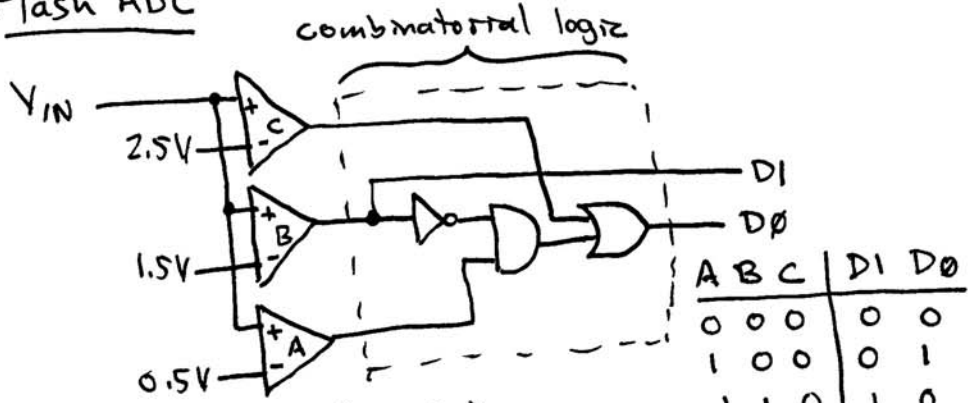
There are many types of ADCs. The two we'll discuss both use a comparator:



$V_+ > V_- \Rightarrow$ OUT = 1

$V_+ < V_- \Rightarrow$ OUT = 0

Flash ADC



A B C	D1 DØ
0 0 0	0 0
1 0 0	0 1
1 1 0	1 0
1 1 1	1 1

Advantage: very fast (e.g. for video)

Disadvantage: lots of hardware (# of comparators = $2^n - 1$)

Successive Approximation ADC

e.g. for 3-bit converter

V_{IN}	D2	D1	DØ
-0.5 to 0.5V	0	0	0
0.5V to 1.5V	0	0	1
1.5V to 2.5V	0	1	0
2.5V to 3.5V	0	1	1
3.5V to 4.5V	1	0	0
4.5V to 5.5V	1	0	1
5.5V to 6.5V	1	1	0
6.5V to 7.5V	1	1	1

⇒ Completes conversion in n-cycles a good tradeoff between speed, number of bits, & cost

First guess: 3.5V
- if too high ⇒ D2 = 0
- if too low ⇒ D2 = 1
- Say V_{IN} = 2.1V ⇒ too high

Second guess: 1.5V
- if too high ⇒ D1 = 0
- if too low ⇒ D1 = 1
- V_{IN} = 2.1V ⇒ too low

Third guess: 2.5V
- if too high ⇒ DØ = 0
- if too low ⇒ DØ = 1
- V_{IN} = 2.1V ⇒ too low

⇒ final result is 011