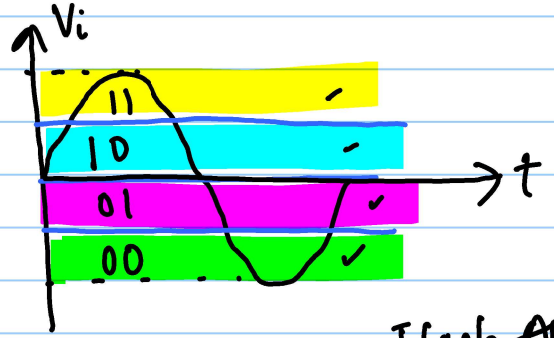
Note Title

Lecture # 44

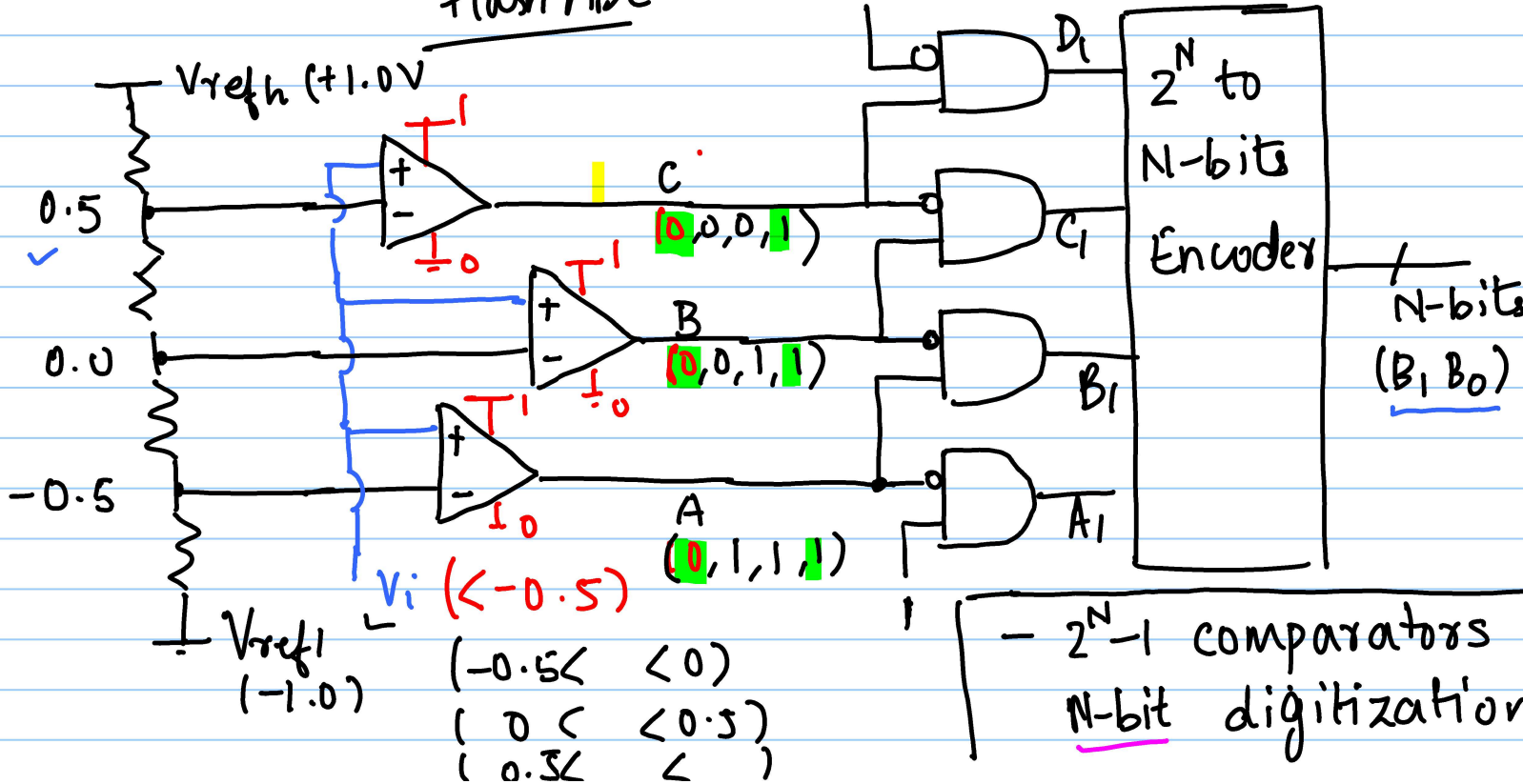


B_1	B_0
0	0
0	1
1	0
1	1

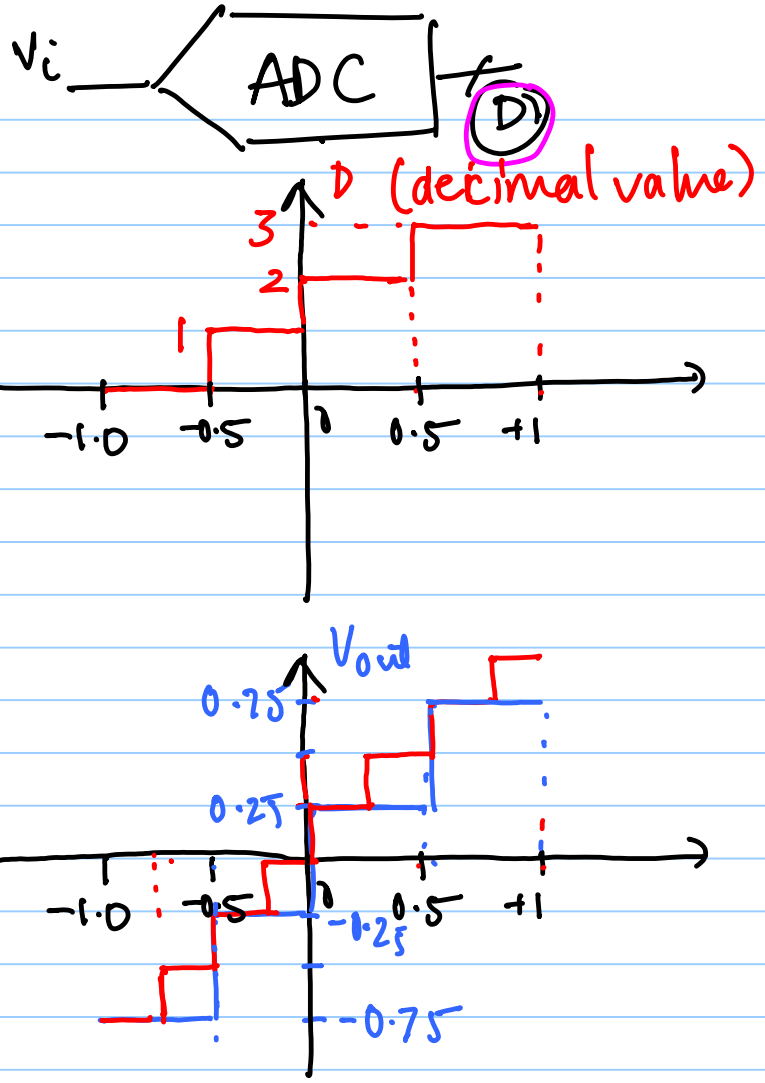
C	B	A
0	0	0
0	0	1
0	1	1
1	1	1

D_1	C_1	B_1	A_1
0	0	0	1
0	0	1	0
0	1	0	0
1	0	0	0

Flash ADC



- $2^N - 1$ comparators are used for N-bit digitization of analog signal.



Binary		Decimal ($2B_1 + B_0$)	Vout
B_1	B_0	D.	
0	0	0	-0.75
0	1	1	-0.25
1	0	2	+0.25
1	1	3	+0.75

$$\text{Decimal value} = 2^{N-1} B_{N-1} + 2^{N-2} B_{N-2} + \ldots + 2^0 B_0$$

$$D = 2^1 B_1 + 2^0 B_0$$

$$= 2B_1 + B_0$$

$$V_{out} = \frac{(V_{refh} - V_{refl})}{2^N} \times D + V_{offset}$$

$$V_{out} = \left(\frac{1-(-1)}{4}\right) \times D + V_{offset}$$

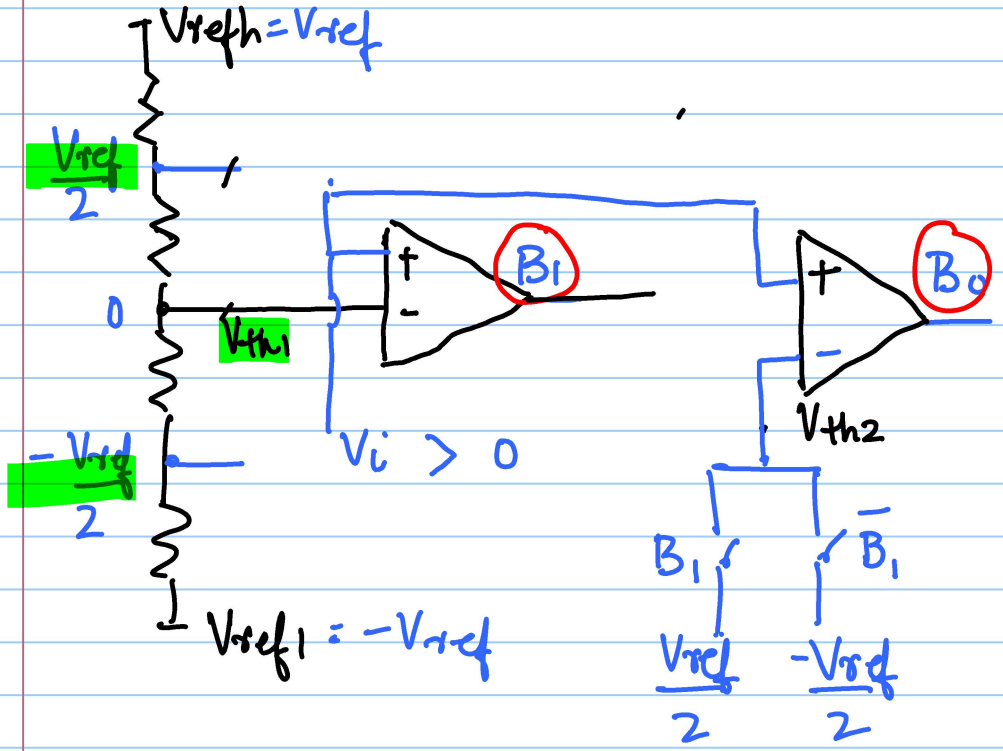
$$= 0.5D + V_{offset}$$

$$= 0.5D - 0.75$$

N is large : N ⟶ 23 bits.
6 - 12 bits.

N = 10, # of comparators $= 2^N - 1 = 1023$.

Two Step Flash ADC



if $V_i > 0 \Rightarrow V_i \gtrless\limits_{=} \frac{V_{ref}}{2}$,

$V_i \not\gtrless\limits_{=} -\frac{V_{ref}}{2}$

$V_i < 0 \Rightarrow V_i \lesssim\limits_{=} -\frac{V_{ref}}{2}$

$V_i \not\lesssim\limits_{=} \frac{V_{ref}}{2}$

if $V_i > \frac{V_{ref}}{2} \Rightarrow B_1 = 1$, $V_{th_2} = \frac{V_{ref}}{2}$

(V_i = 0.6)

B_1 = 1

$V_i \gtrless \frac{V_{ref}}{2} \longrightarrow B_0 = \{0, 1\}$

0.6 $=$ 0.5

B_0 = 1

B_1 B_0

1 1

$V_i < \frac{V_{ref}}{2} \Rightarrow B_1 = 0$, $V_{th_2} = -\frac{V_{ref}}{2}$

(V_i = -0.4)

B_1 = 0

$V_i \gtrless -\frac{V_{ref}}{2} \longrightarrow B_0 = \{0, 1\}$

$=$

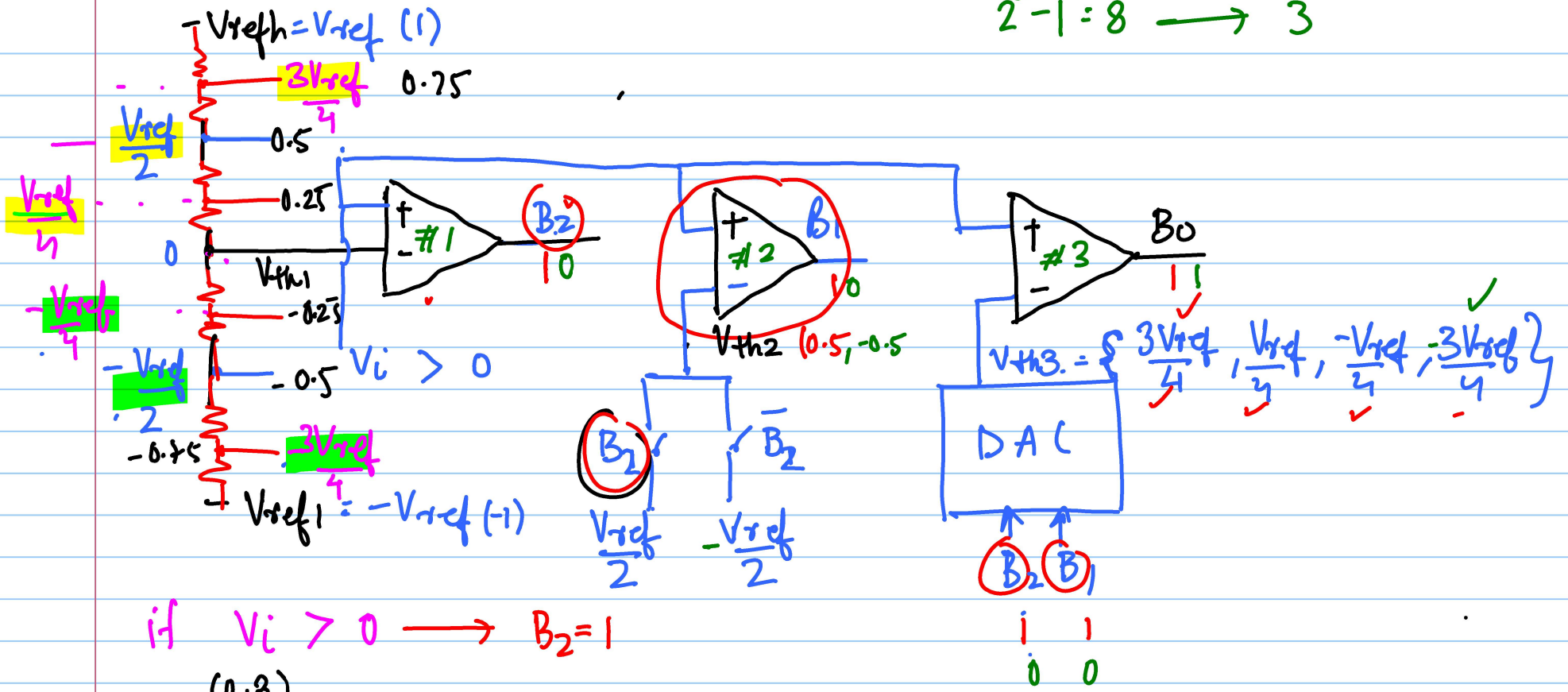
-0.4 -0.5

B_0 = 1

0 1

3-bit ADC (3-step flash ADC)

$2^3 - 1 : 8 \longrightarrow 3$



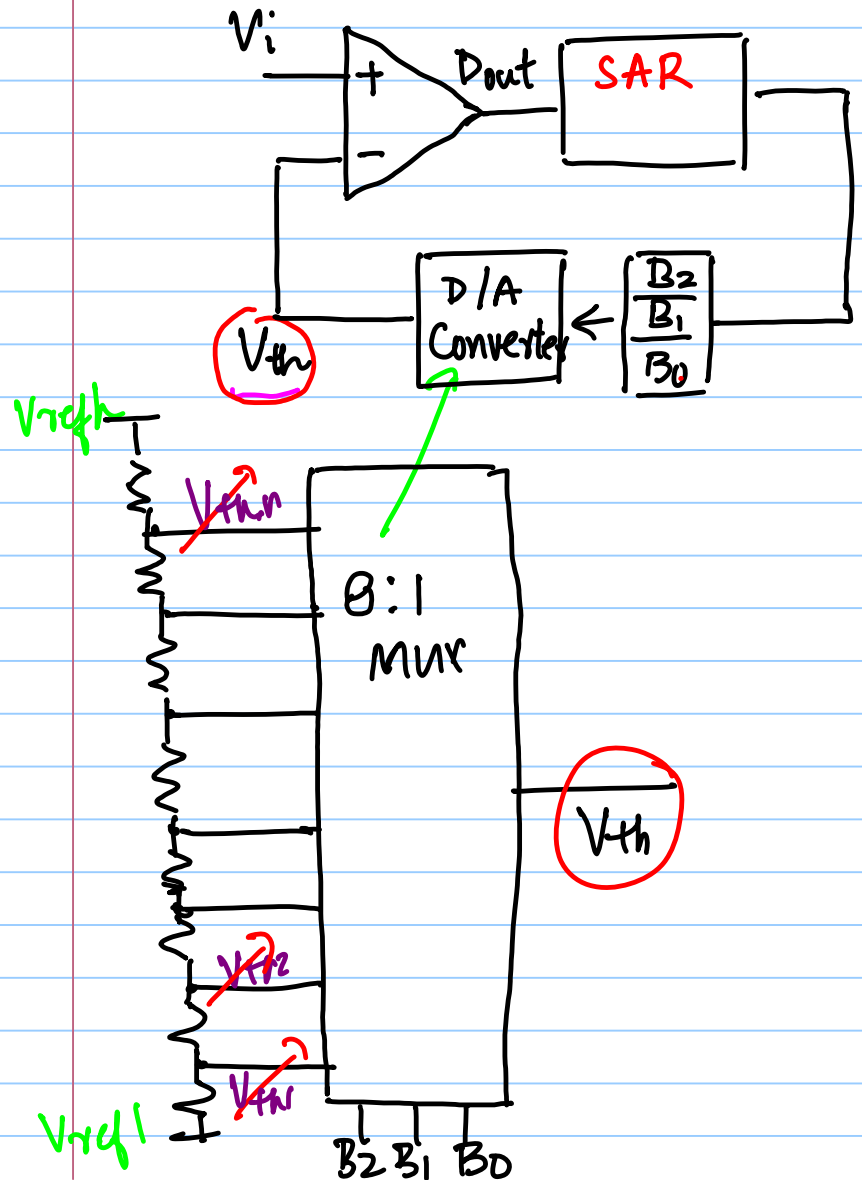
if $V_i > 0 \longrightarrow B_2 = 1$

(0.8)

Digital-to-Analog Converter (DAC)

$V_i < 0 \Rightarrow$

-0.6



SAR: Successive Approximation Register.

For $V_i > 0$ ✓

→ Compare V_i with $\frac{V_{ref}}{2}$ ✓

↳ if $V_i > \frac{V_{ref}}{2}$ then compare with $\frac{3V_{ref}}{4}$ ✓

↳ if $V_i < \frac{V_{ref}}{2}$ then compare with $\frac{V_{ref}}{4}$

For $V_i < 0$ ✓

→ Compare V_i with $-\frac{V_{ref}}{2}$ ✓

↳ if $V_i < -\frac{V_{ref}}{2}$ then compare with $-\frac{3V_{ref}}{4}$ ✓

↳ if $V_i < -\frac{V_{ref}}{2}$ then compare with $-\frac{V_{ref}}{4}$