

EE 421 / ECG 621

Digital IC Design

Lecture 24

NOV. 22, 2021

Dynamic Random Access
memory

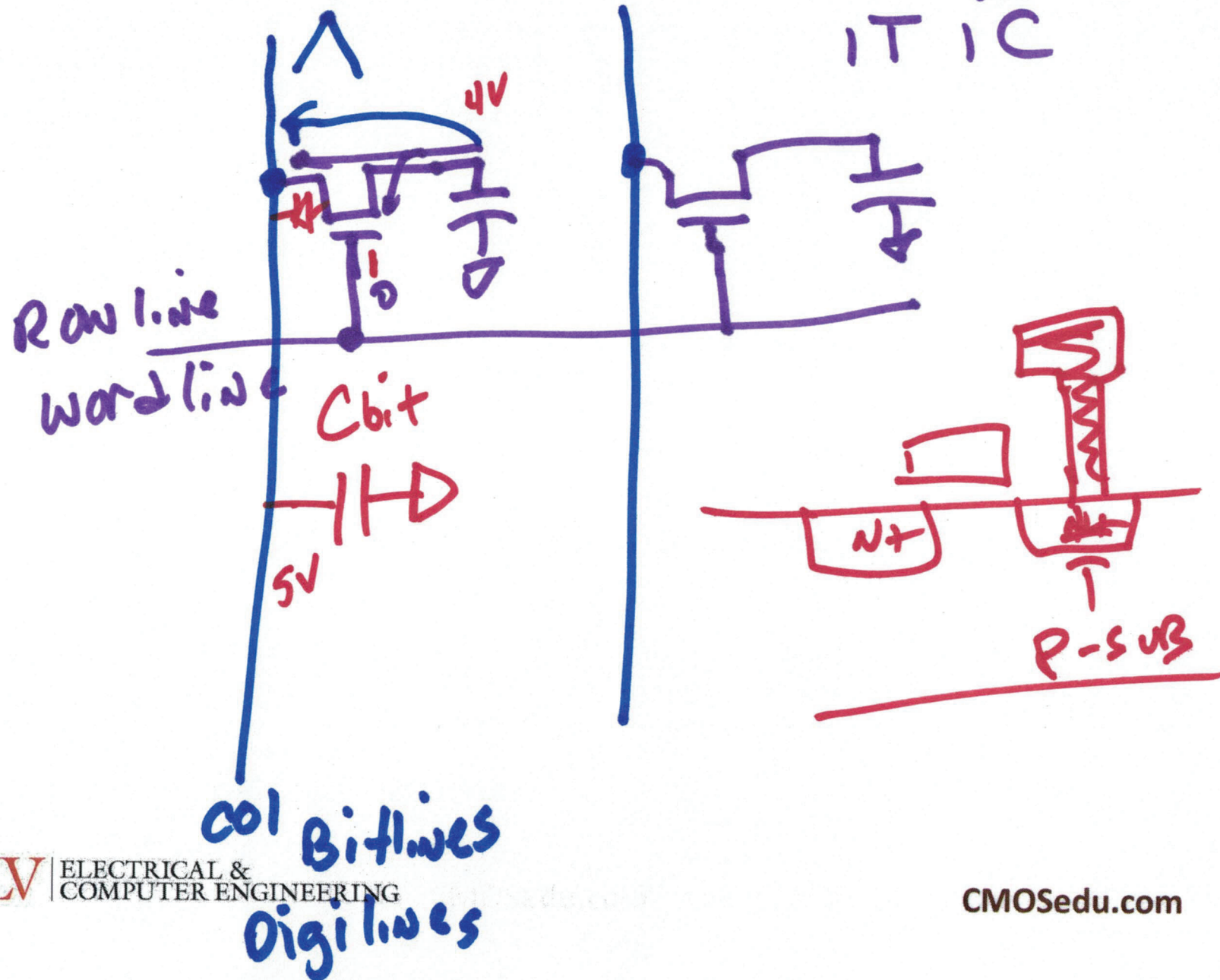
DRAM

aka computer memory

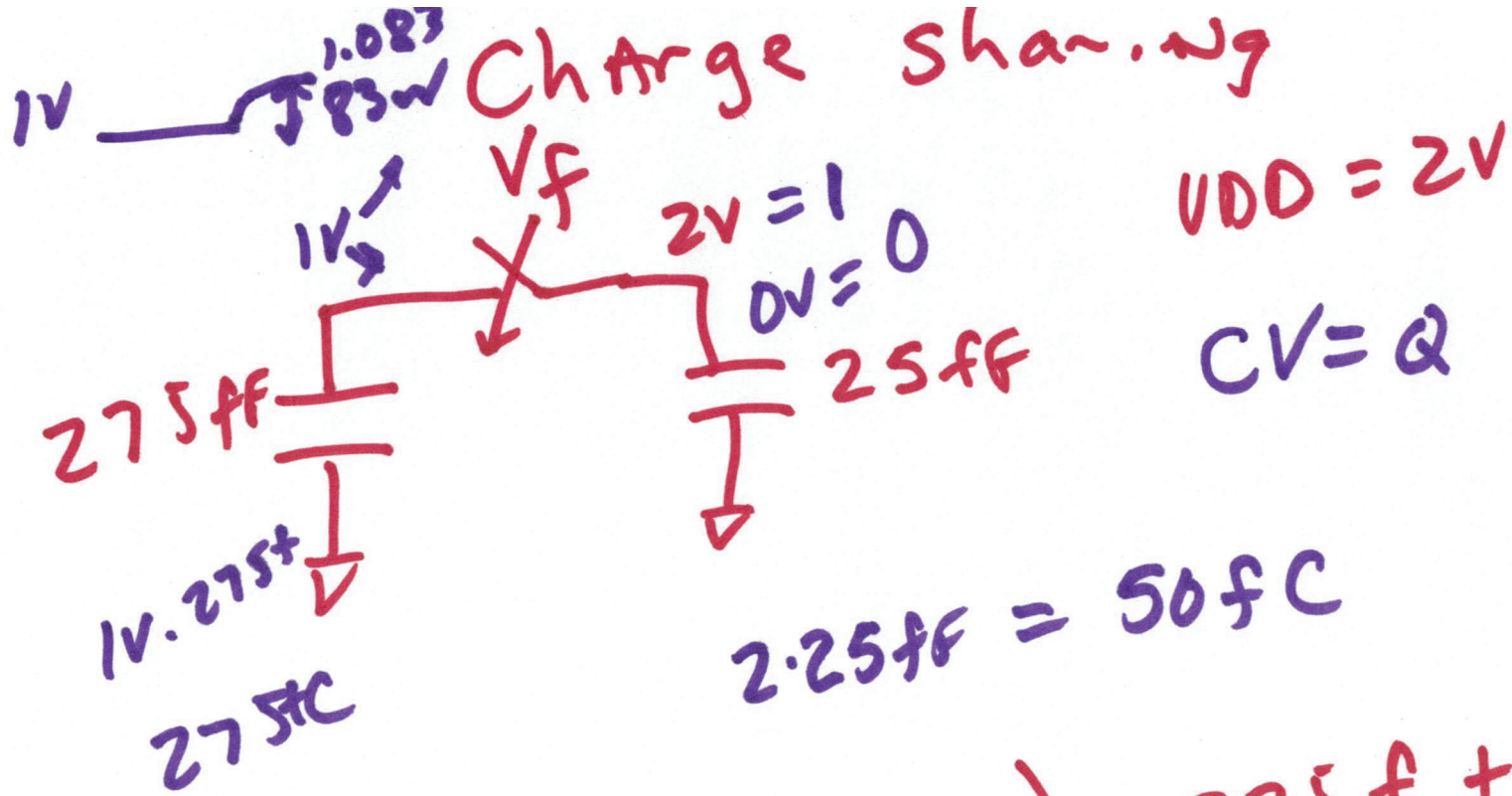
DIMMs

Dual in-line memory
modules

DRAM → 1 TRANSISTOR
1 CAPACITOR
MEMORY



2)

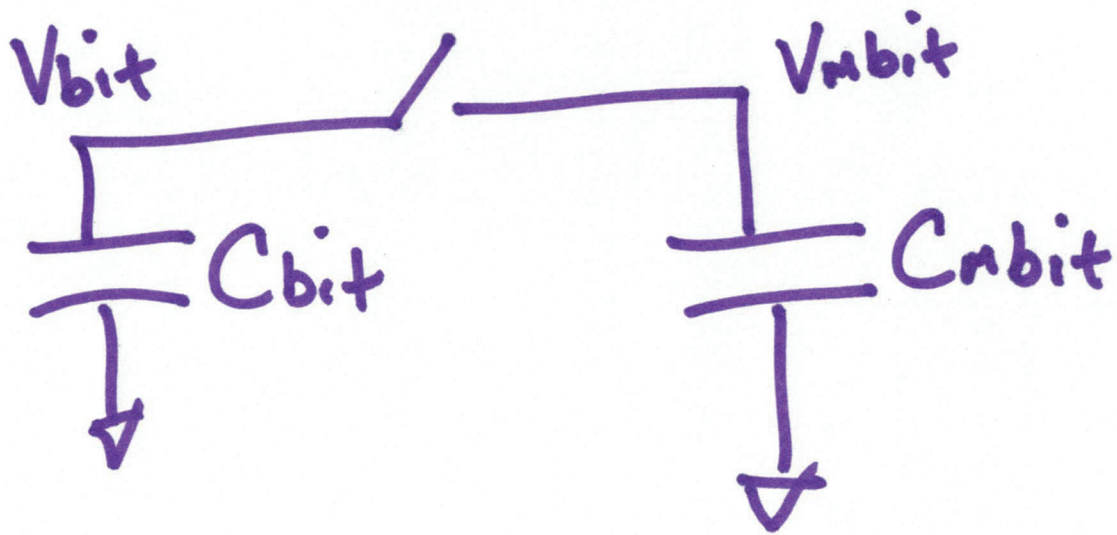


$$V_f (275fF + 25fF) = 275fC + 50fC$$

$$= 325fC$$

$$V_f = \frac{325}{300} = 1.083V$$

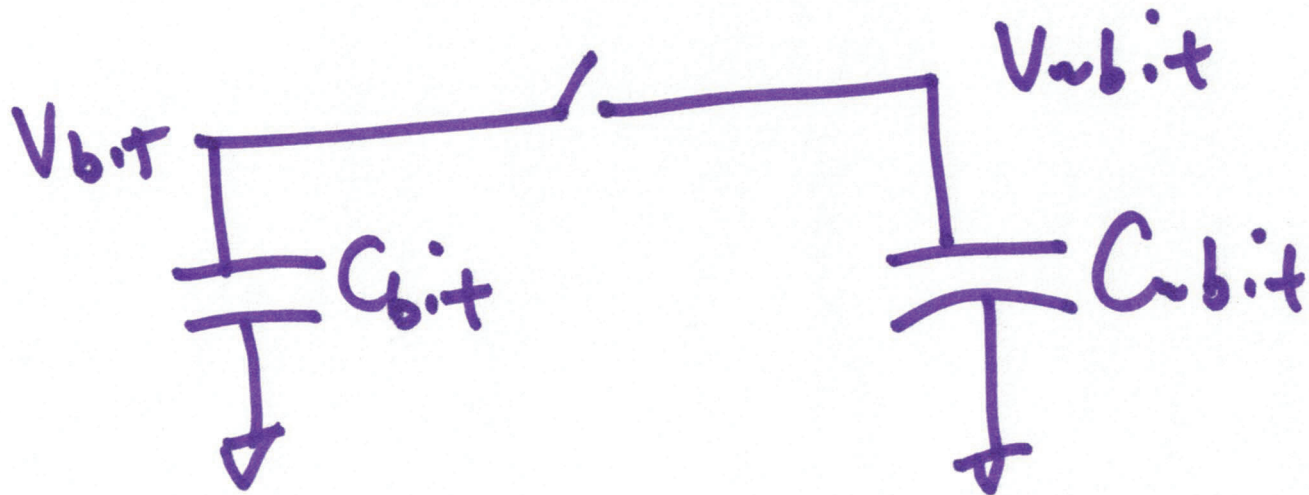
3)



$$C_{bit} \cdot V_{bit} + V_{mbit} \cdot C_{mbit} = V_f (C_{bit} + C_{mbit})$$

$$V_f = \frac{C_{bit} \cdot V_{bit} + V_{mbit} \cdot C_{mbit}}{C_{bit} + C_{mbit}}$$

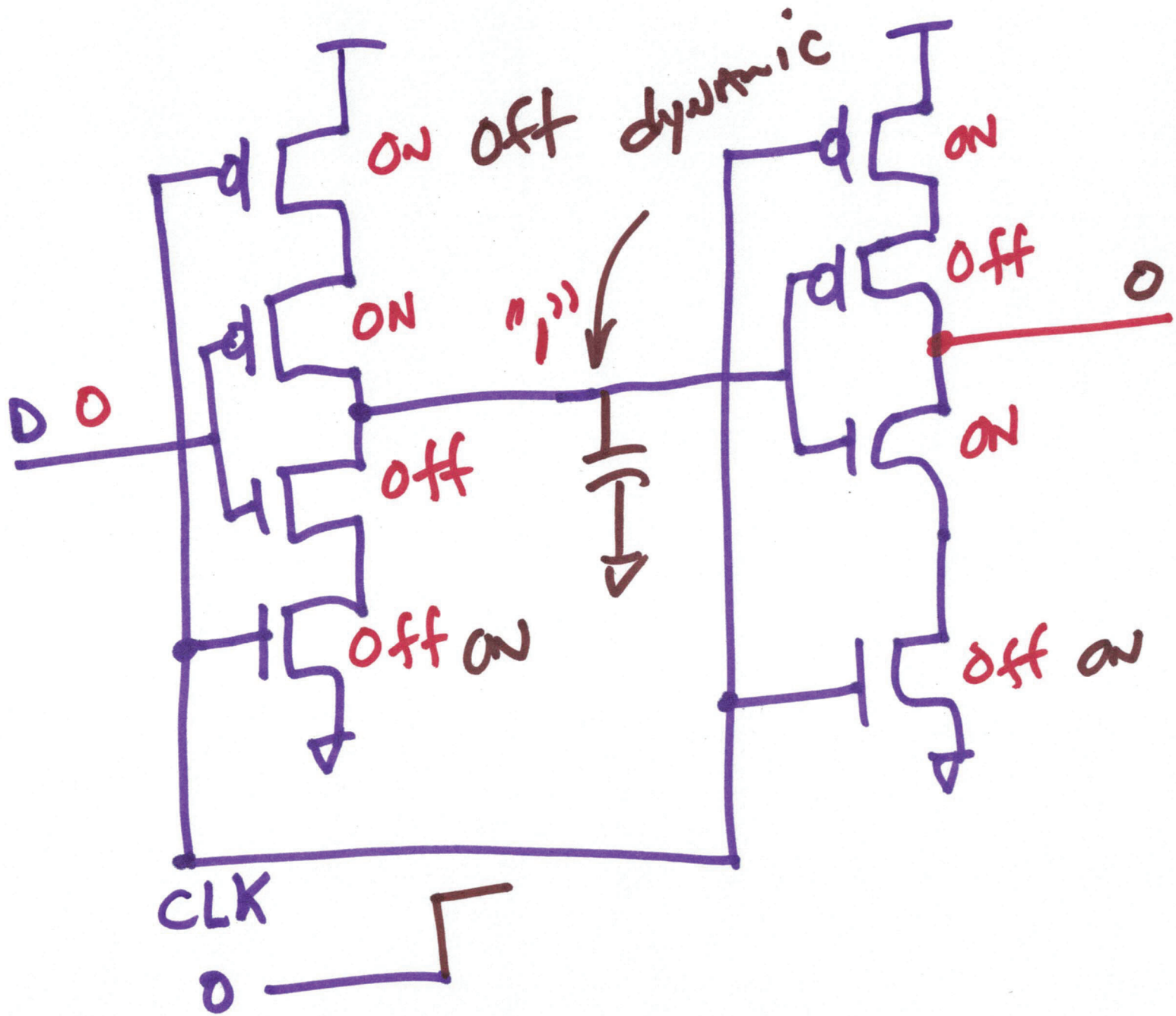
4)



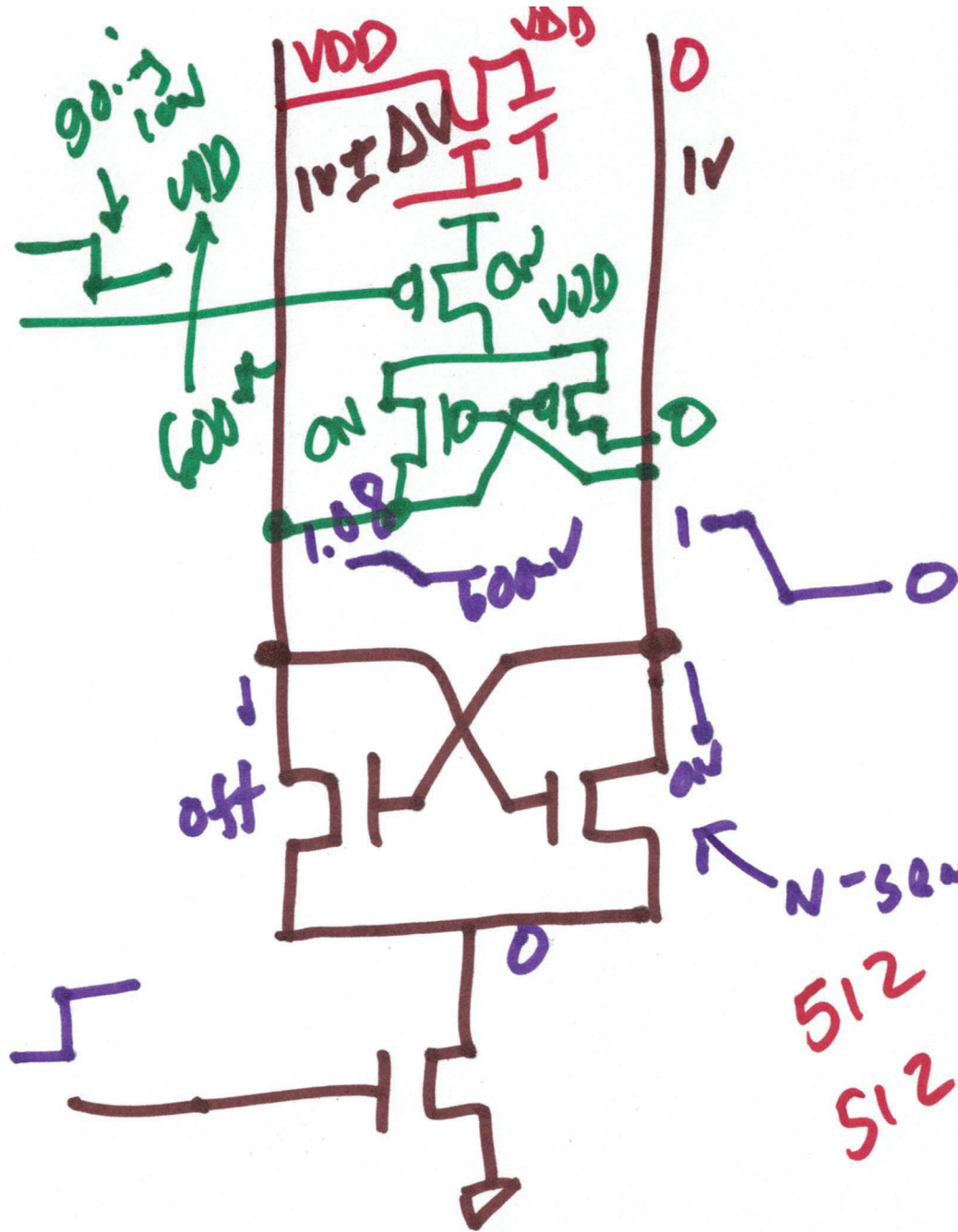
$$\frac{1}{2} C_{bit} V_{bit}^2 + \frac{1}{2} C_{ubit} V_{ubit}^2 =$$

$$\frac{1}{2} (C_{bit} + C_{ubit}) V_f^2 \leftarrow \text{plug-in from previous page}$$

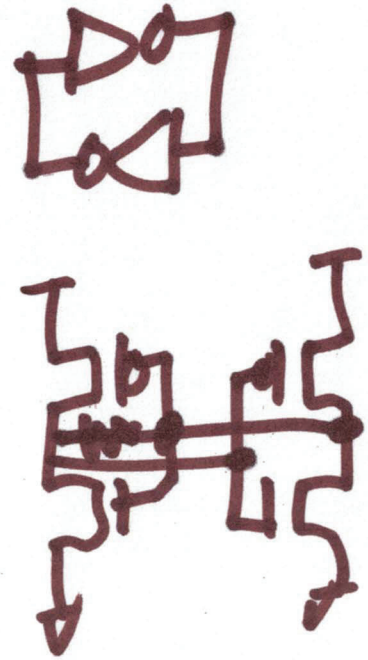
$$\frac{1}{2} \frac{(C_{bit} V_{bit} + V_{ubit} C_{ubit})^2}{C_{bit} + C_{ubit}}$$



6)



Sense - Amp



N-sense amp
 512 RW lines
 512 column lines
 256 Kbits
 50%