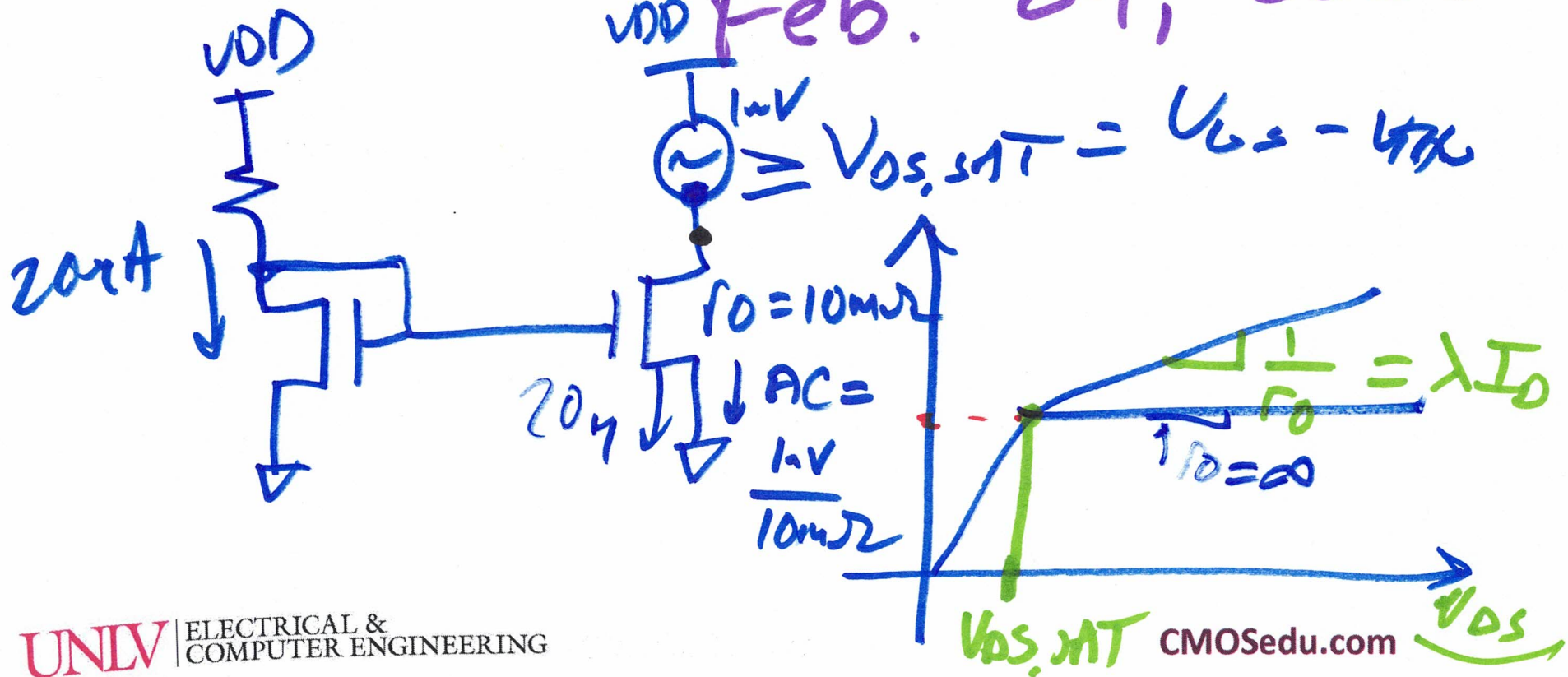


EE 420 / ELG 620

# Analog IC Design

## Lecture 9

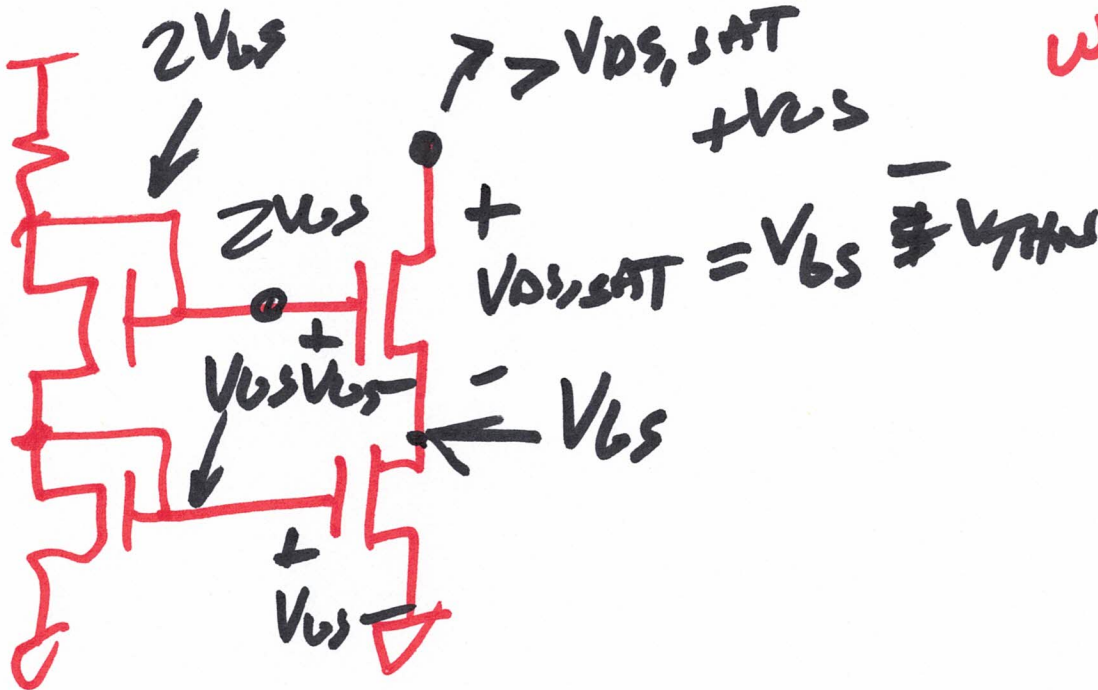
Feb. 24, 2020

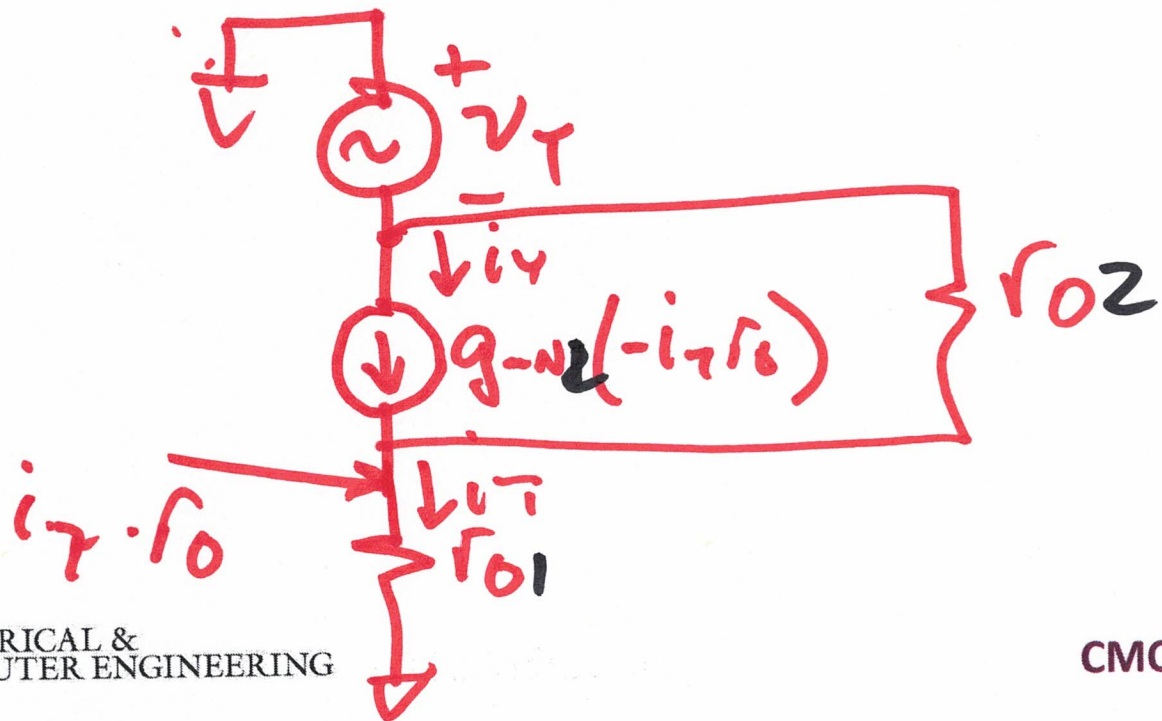
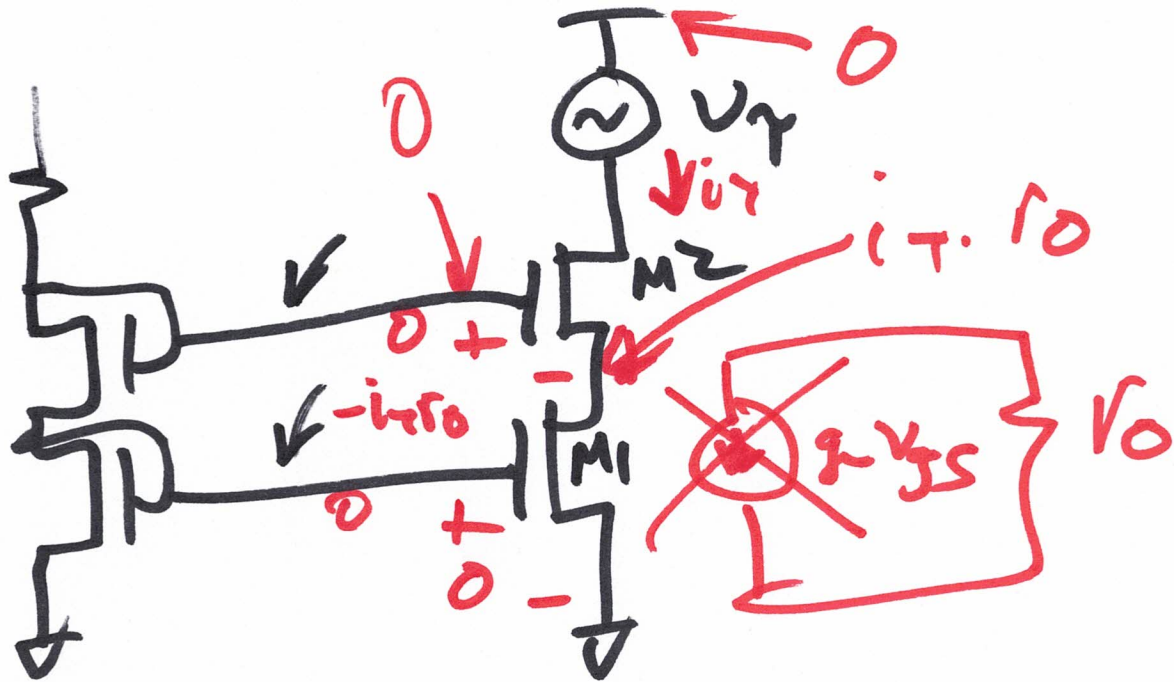


# CASCODE CASCODE

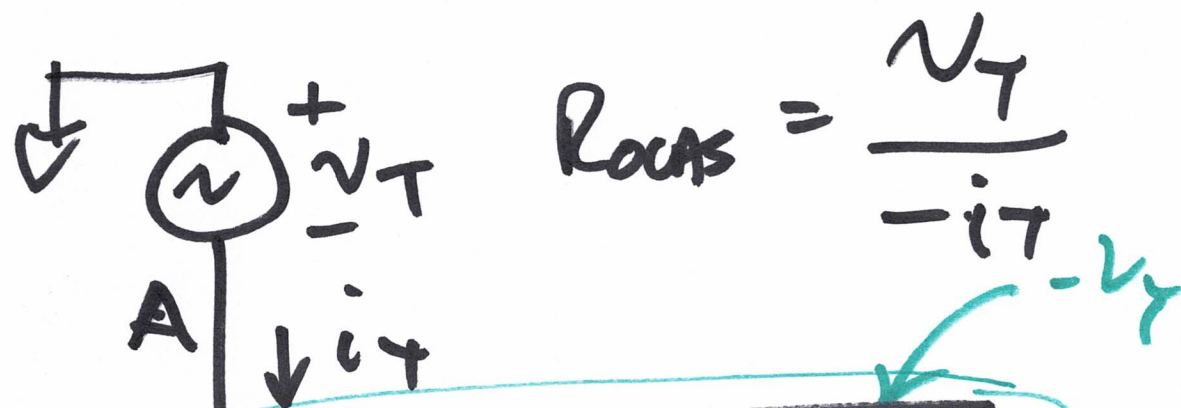
common - grid  
with

Common  
Cathode





3)



$$i_T = g_m(-i_T r_{o1}) + \frac{-v_T - i_T r_{o1}}{r_{o2}}$$

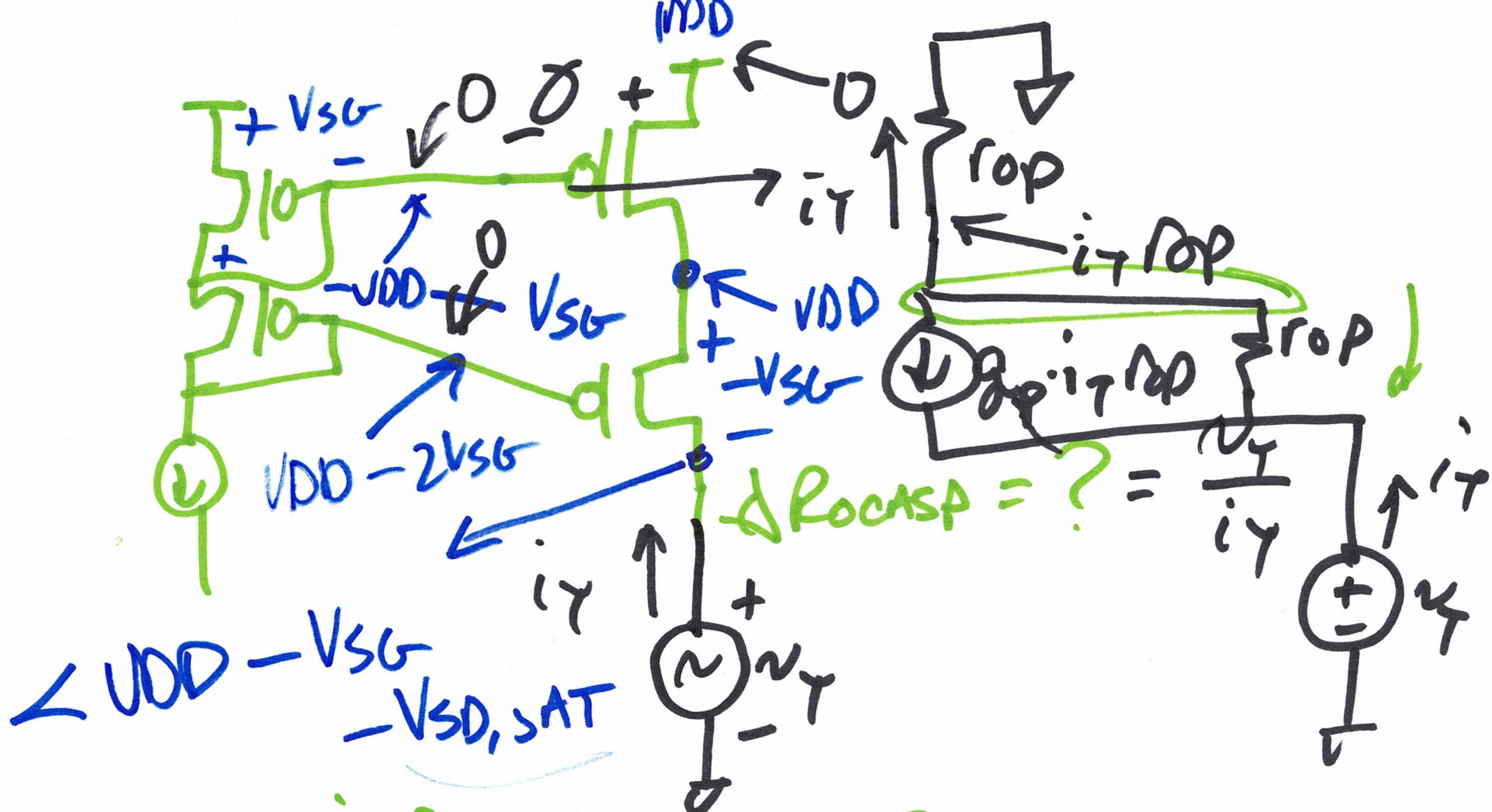
$R_{out} \approx g_m r_o^2$  CASCADE

$$i_T \left( 1 + g_m r_{o1} + \frac{r_{o1}}{r_{o2}} \right) = \frac{-v_T}{r_{o2}}$$

$$R_{out} = \frac{-v_T}{i_T} = r_{o2} + g_m r_{o1} r_{o2} + r_{o1}$$

4)





$$\Delta R_{ocASP} = ? = \frac{V_T}{i_T}$$

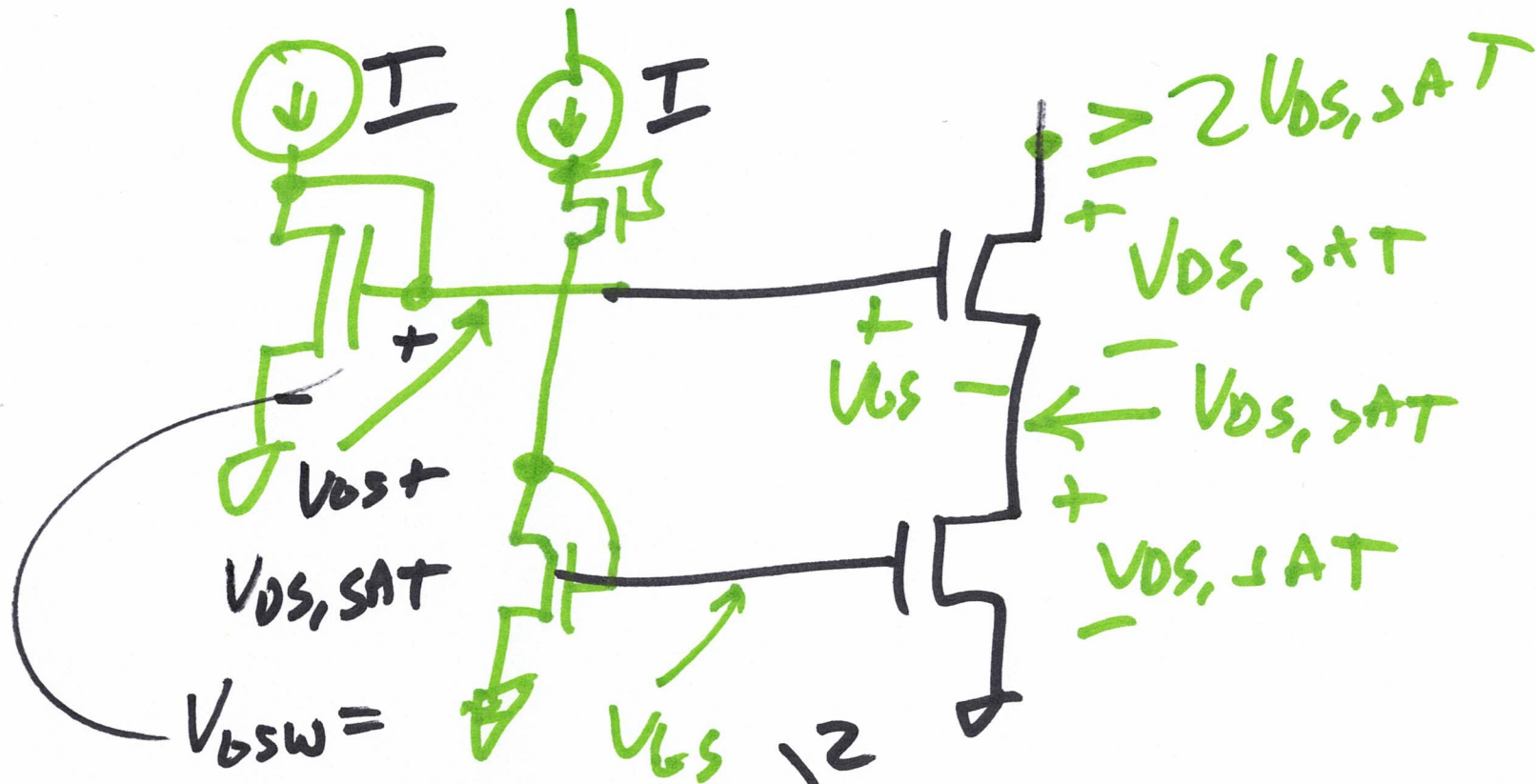
$$i_T + g_{mp} i_T r_{op} + \frac{i_T r_{op} - V_T}{r_{op}} = 0$$

$$V_T = (r_{op} + g_{mp} r_{op}^2 + r_{op})$$

$$\frac{V_T}{i_T} \approx g_{mp} r_{op}^2$$

5)

# Wide-Swing Cascode



$$\begin{aligned}
 \frac{K_P \cdot W}{2 L_X} (V_{GS} + V_{DS,sat})^2 &= I = \frac{K_P \cdot W}{2 L} (V_{GS} - V_{THN})^2 \\
 &= \frac{K_P \cdot W}{2 L_X} \cdot (2V_{DS,sat})^{V_{DS,sat}}
 \end{aligned}$$

$$X = 4$$