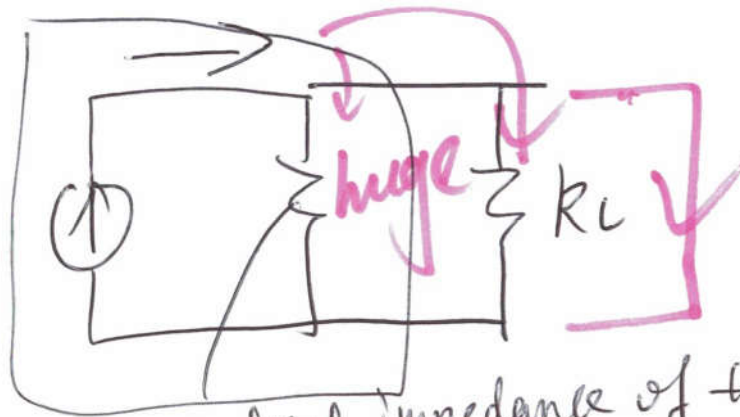
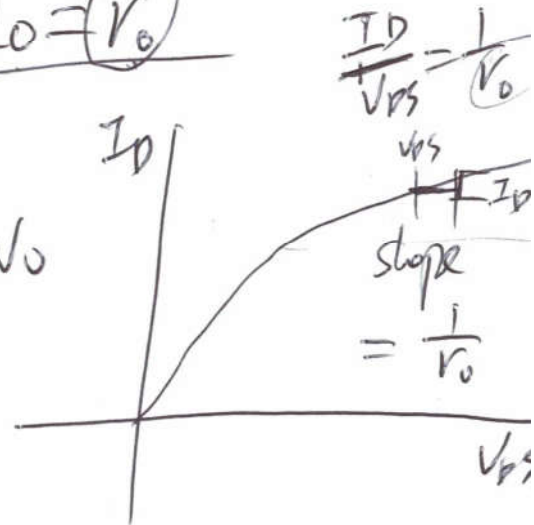
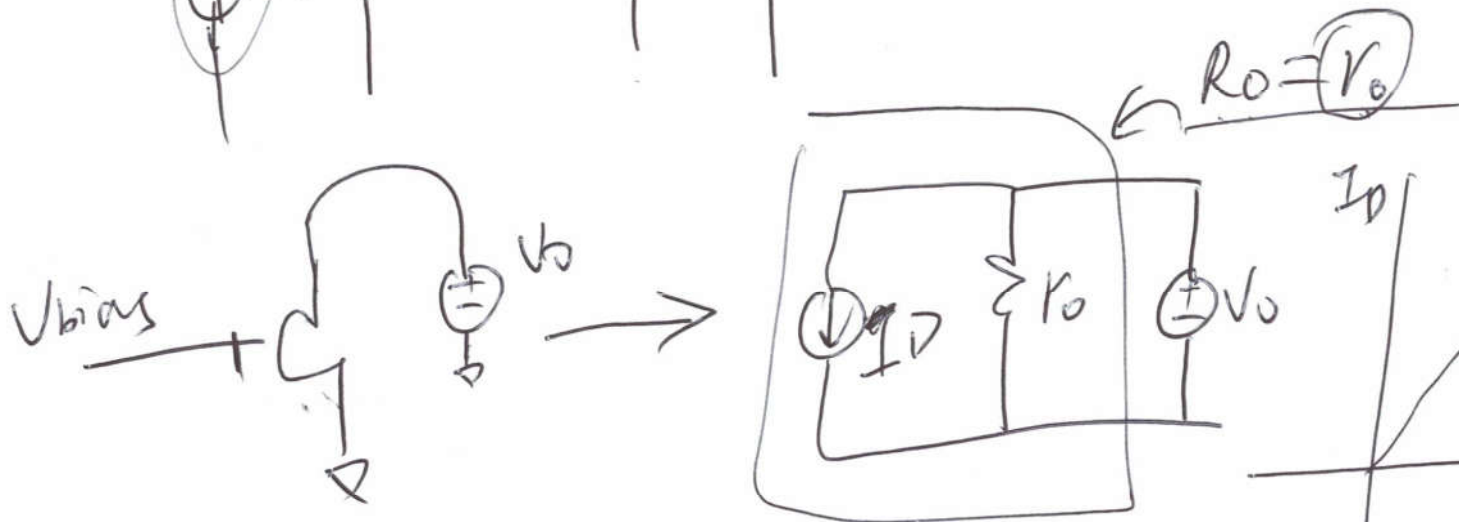
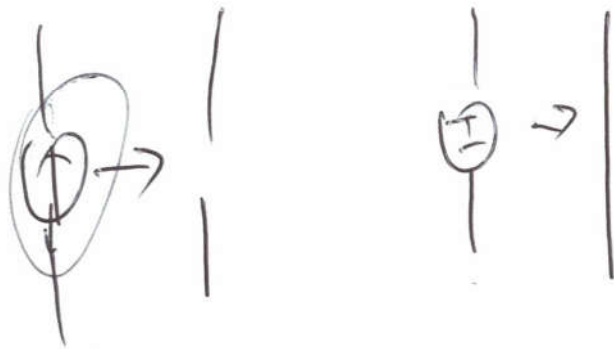


# A current source model



output impedance of the current source is huge

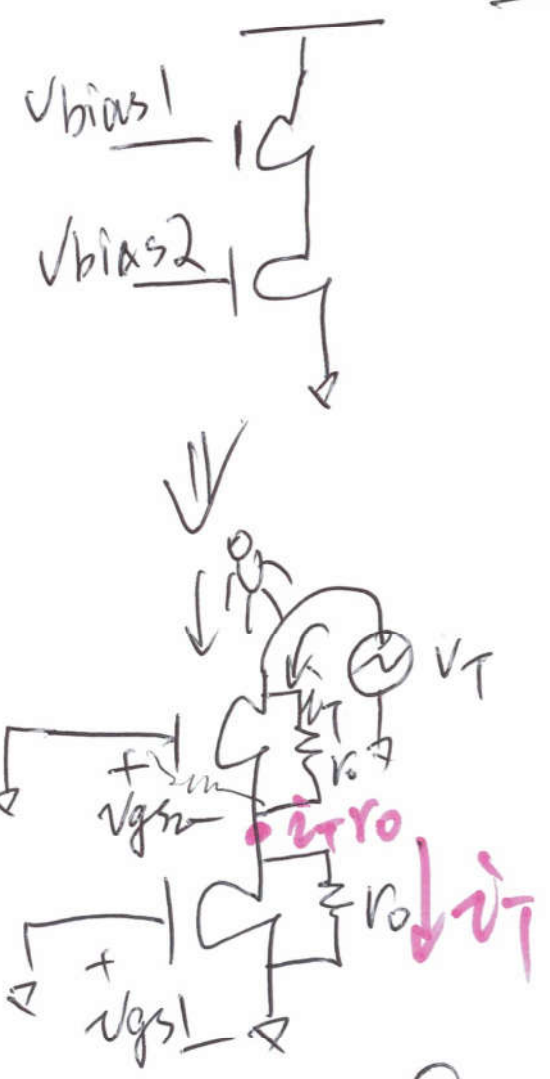


$$\frac{I_D}{V_{DS}} = \frac{1}{r_0}$$

$$\text{slope} = \frac{1}{r_0}$$

# Cascode current mirror

P636-P652  
CMOS Book



$$R_o = \frac{V_T}{i_T}$$

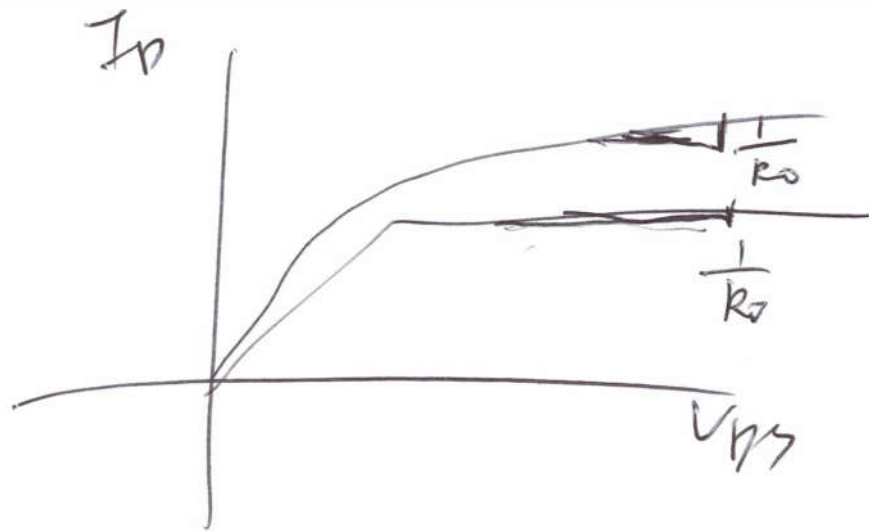
$$\begin{cases} V_{GS2} = 0 - i_T r_o = -i_T r_o & \textcircled{1} \\ i_T = g_m V_{GS2} + \frac{V_T - (-V_{GS2})}{r_o} & \textcircled{2} \end{cases}$$

$$\begin{aligned} \textcircled{2}: i_T &= g_m i_T r_o + \frac{V_T + V_{GS2}}{r_o} && (g_m r_o + 2) r_o \\ &= -g_m i_T r_o + \frac{V_T - i_T r_o}{r_o} && \approx \frac{g_m r_o^2}{1} \end{aligned}$$

$$1 = -g_m r_o + \frac{V_T - i_T r_o}{r_o}$$

$$r_o = -g_m r_o^2 + \frac{V_T}{i_T} \Rightarrow R_o = \frac{V_T}{i_T} = g_m r_o^2 + 2r_o$$

②



(3)