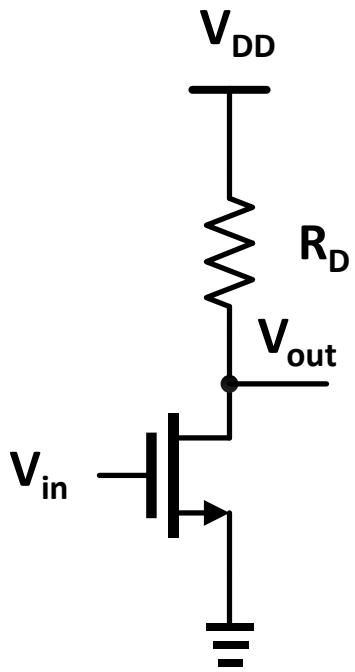
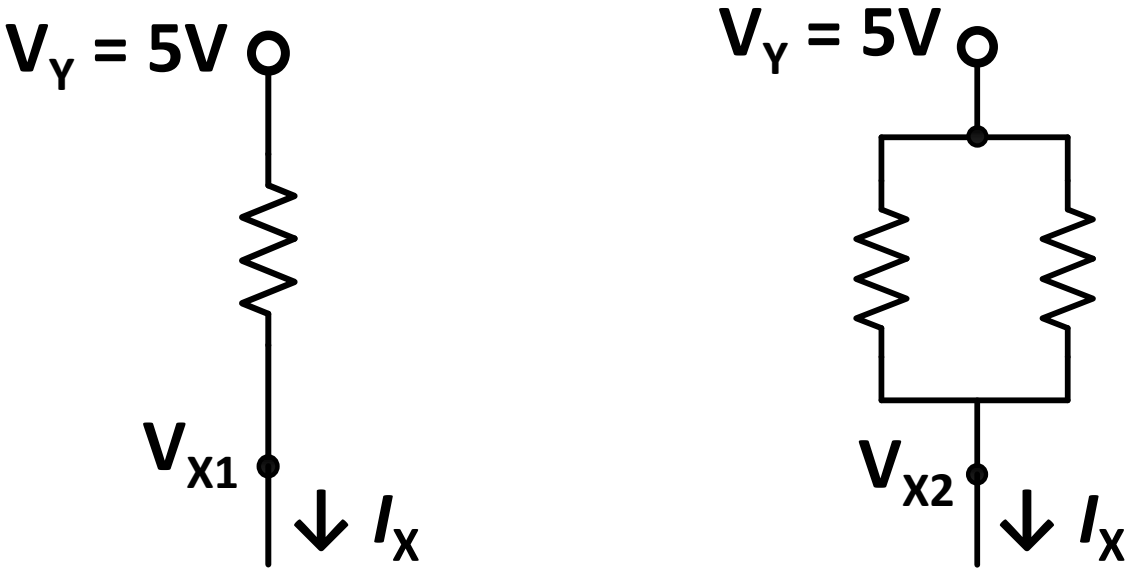
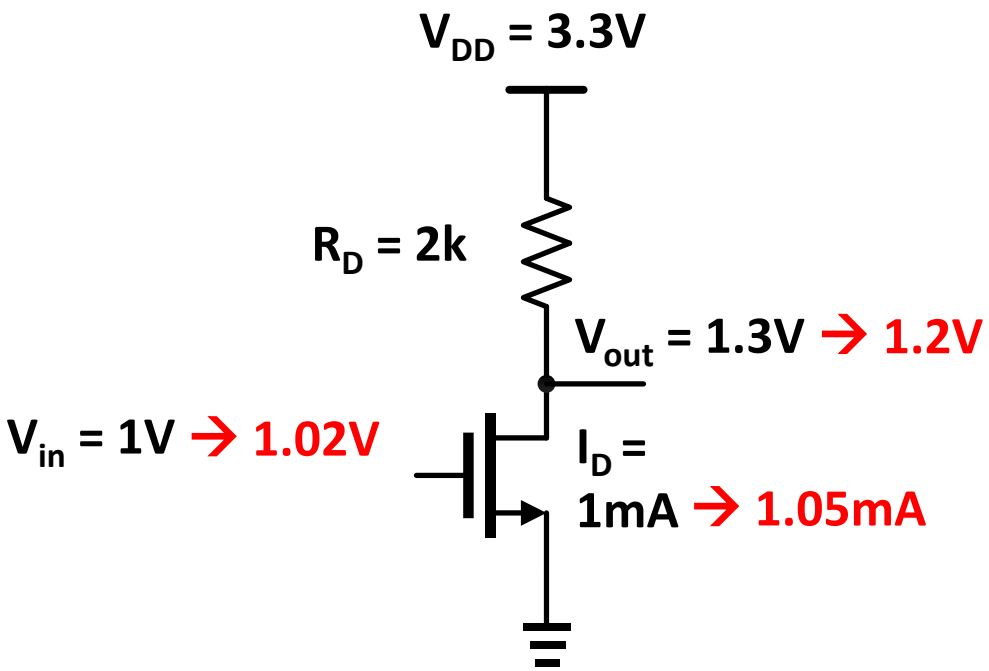
Gain Reduction due to Additional Path?

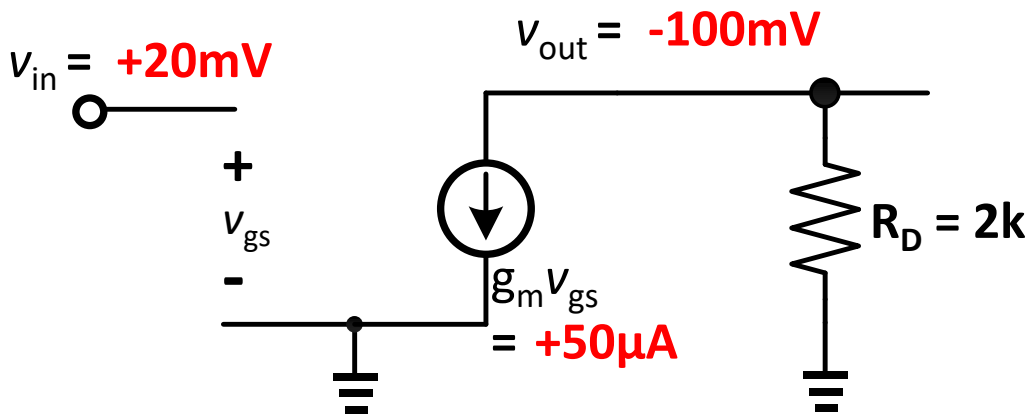


Parallel Resistor

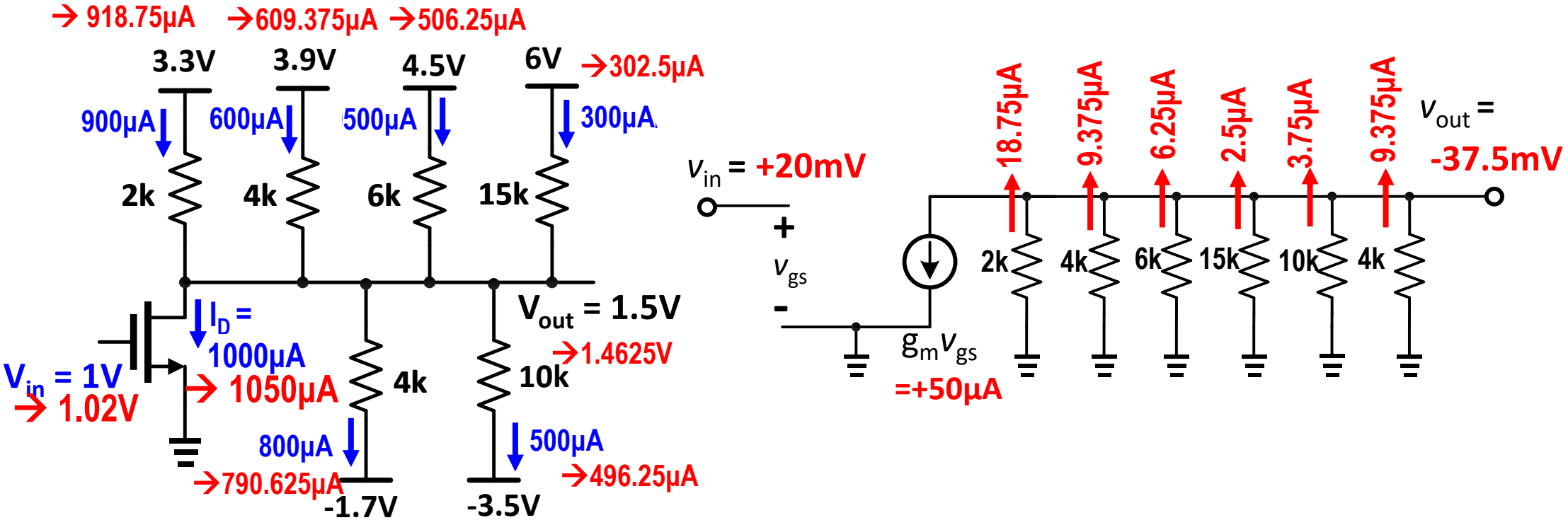


Small Signal Model vs. What Really Happens

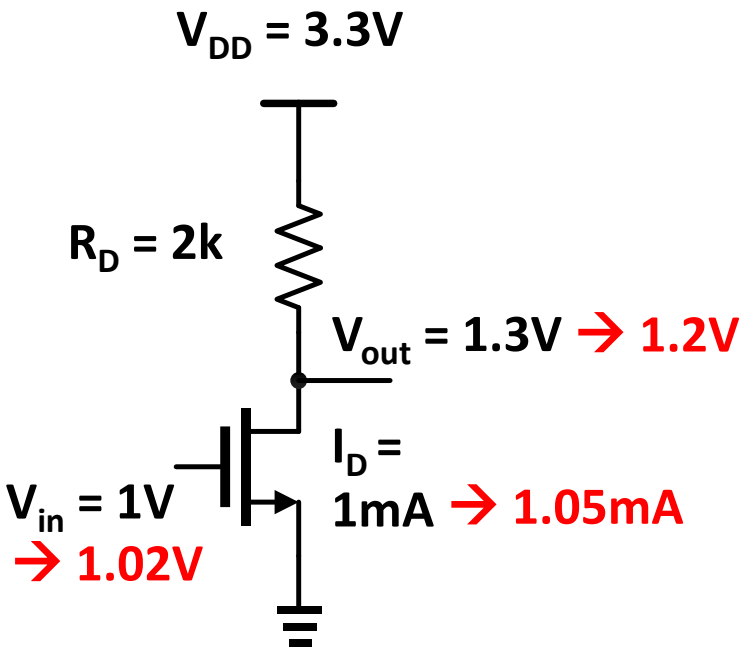




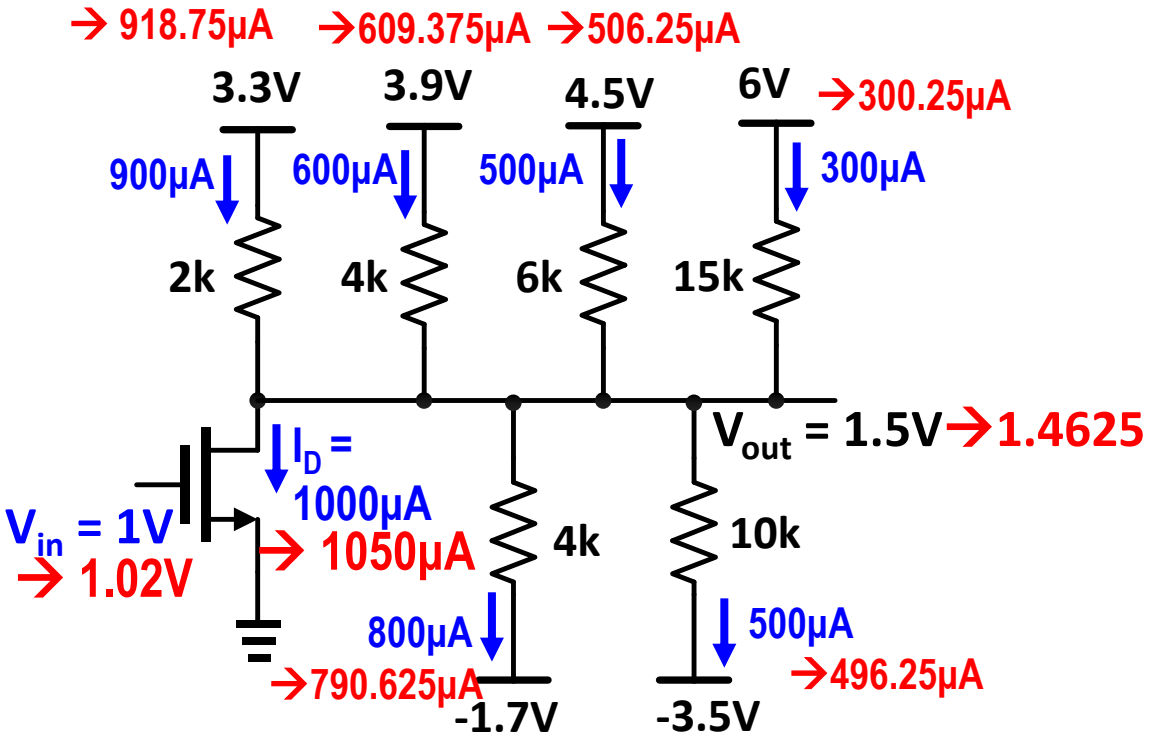
In Small Signal Model, Fixed Voltage Node is just Ground



Added Path Reduces Voltage Change



$$\text{Gain} = -g_m R_D$$



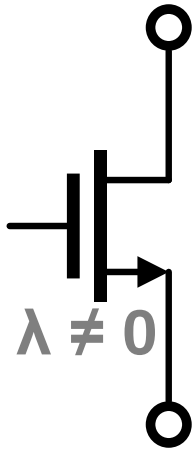
$$\text{Gain} = -g_m(R_1//R_2//R_3//R_4//R_5//R_6)$$

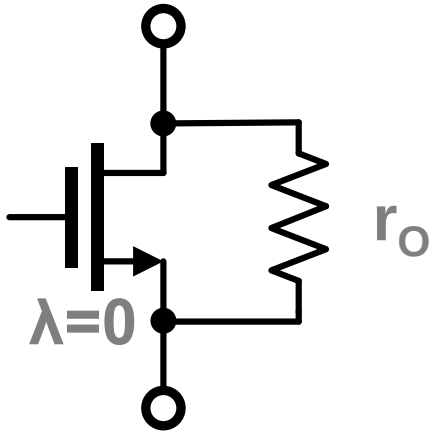
Channel Length Modulation Consideration in Large Signal Model

$$I_D = \frac{1}{2}\mu C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2(1 + \lambda V_{DS})$$

$$= \frac{1}{2}\mu C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2 + \lambda V_{DS}\frac{1}{2}\mu C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2$$

$$= I_{D0} + \lambda I_{D0} \times V_{DS} = I_{D0} + \frac{1}{r_O}V_{DS}$$





Gain of CS Amplifier

- w/ and w/o channel length modulation

