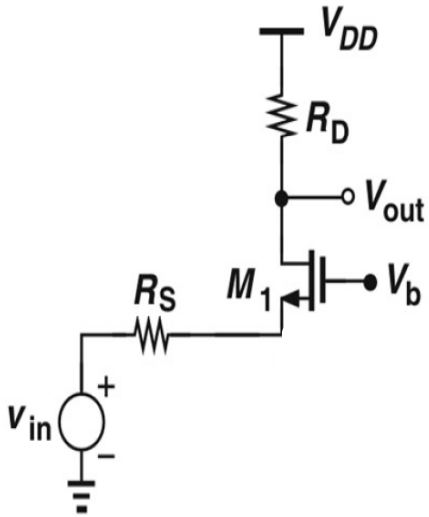
Lect. 26: Cascode Amplifier (Razavi 9.1)

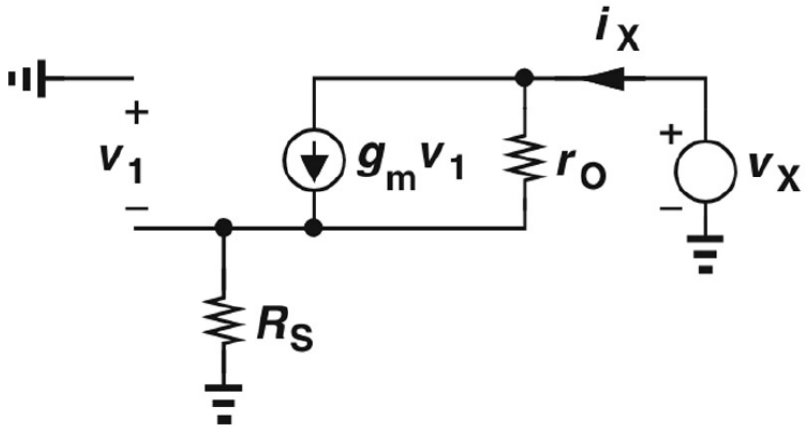
Common-Gate Amplifier



$R_{out} = R_D$

(r_o , R_s ignored)

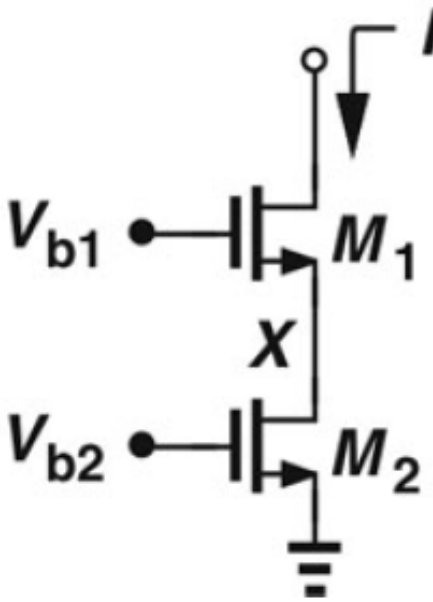
Influence of r_o and R_s?



$v_x/i_x = r_o (1 + g_m R_s) + R_s$

➔ $g_m r_o R_s$

Lect. 26: Cascode Amplifier



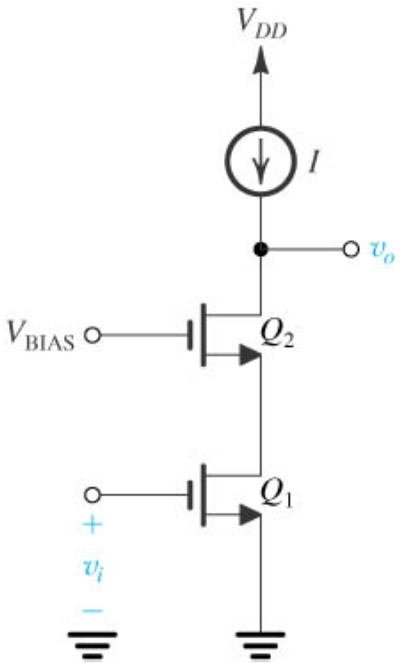
$R_{out} \sim g_{m1} r_{o1} r_{o2}$

Cascode configuration

➔ Very high output resistance

Lect. 26: Cascode Amplifier

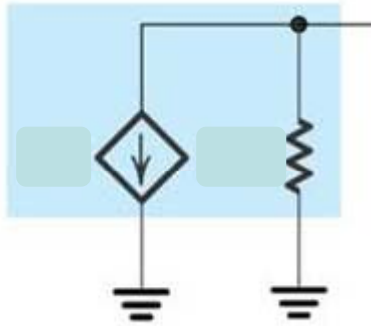
Cascode amplifier



R_{in} :

R_{out} : $g_{m2}\, r_{o2}\, r_{o1}$

G_m, Transconductance Gain ➔ g_{m1}



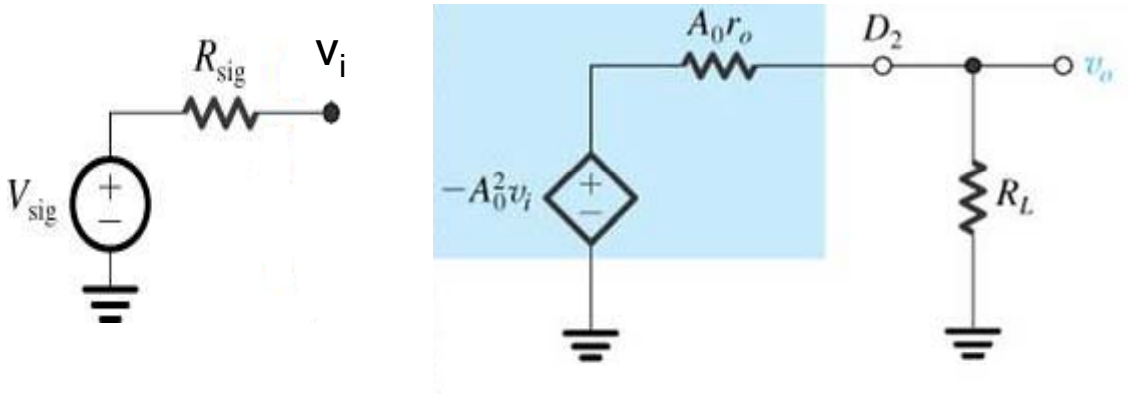
Voltage Gain: - G_m x R_{out}

$$\therefore A_{vo} \sim -g_{m1} r_{o1} g_{m2} r_{o2}$$

If Q_1 and Q_2 are identical, $A_{vo} \sim -(g_m r_o)^2$

Lect. 26: Cascode Amplifier

Cascode Amplifier



$$A_o = g_m r_o$$

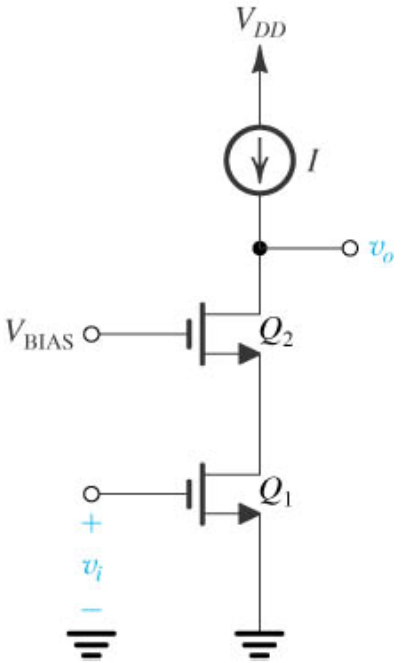
Compared with CS,

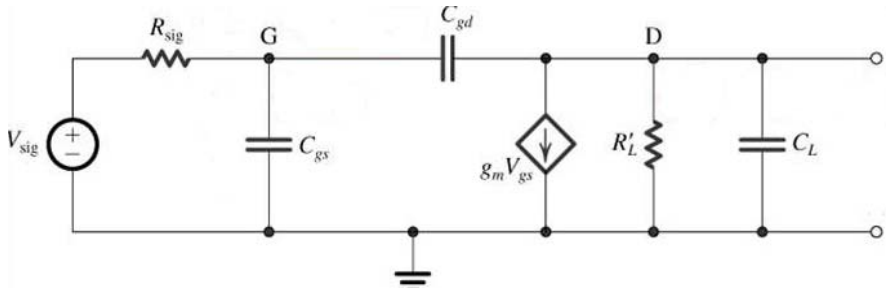
R_{out}: r_o ➔ $A_o r_o$

A_{vo}: $- g_m r_o$ ➔ $- (g_m r_o)^2$

Lect. 26: Cascode Amplifier

Miller Effect?





Remember Miller effect is due to C_{gd}

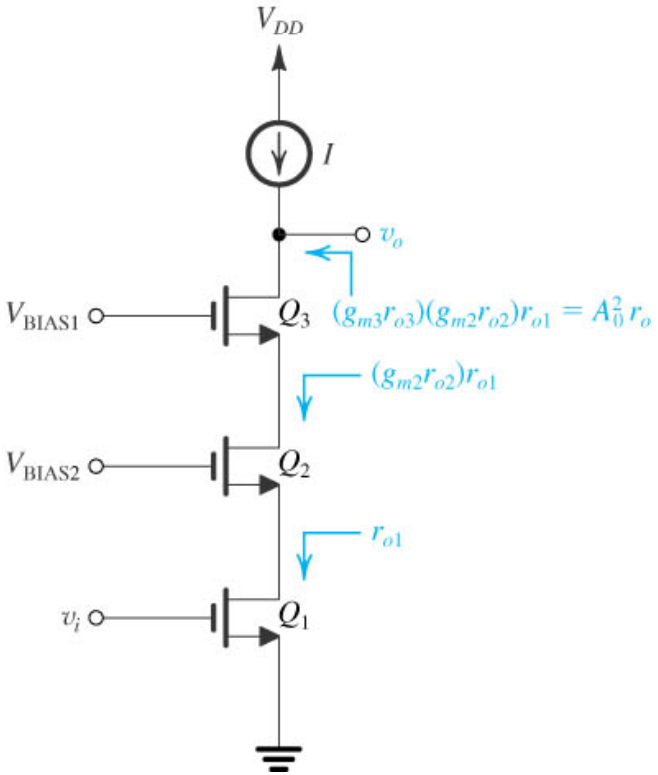
$$R_{d1} = ?$$

$$R_{d1} = r_{o1} \| \frac{1}{g_{m2}}$$

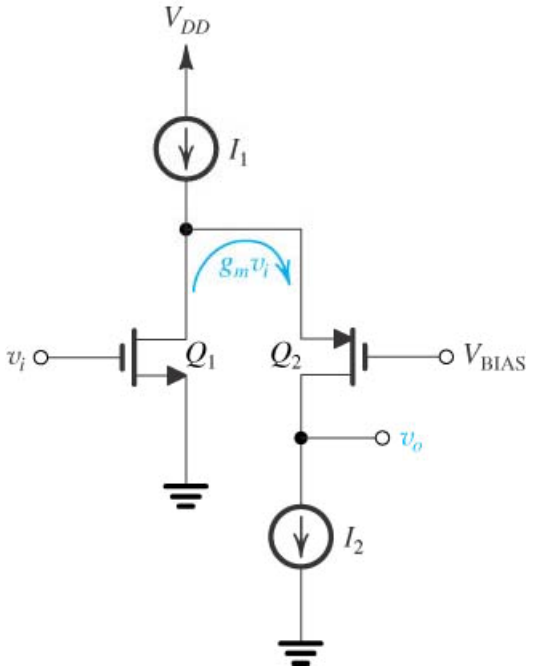
Reduction of Miller effect with small R_{d1}

Lect. 26: Cascode Amplifier

Double Cascode



Folded Cascode



Higher output resistance

But limited range for output swing