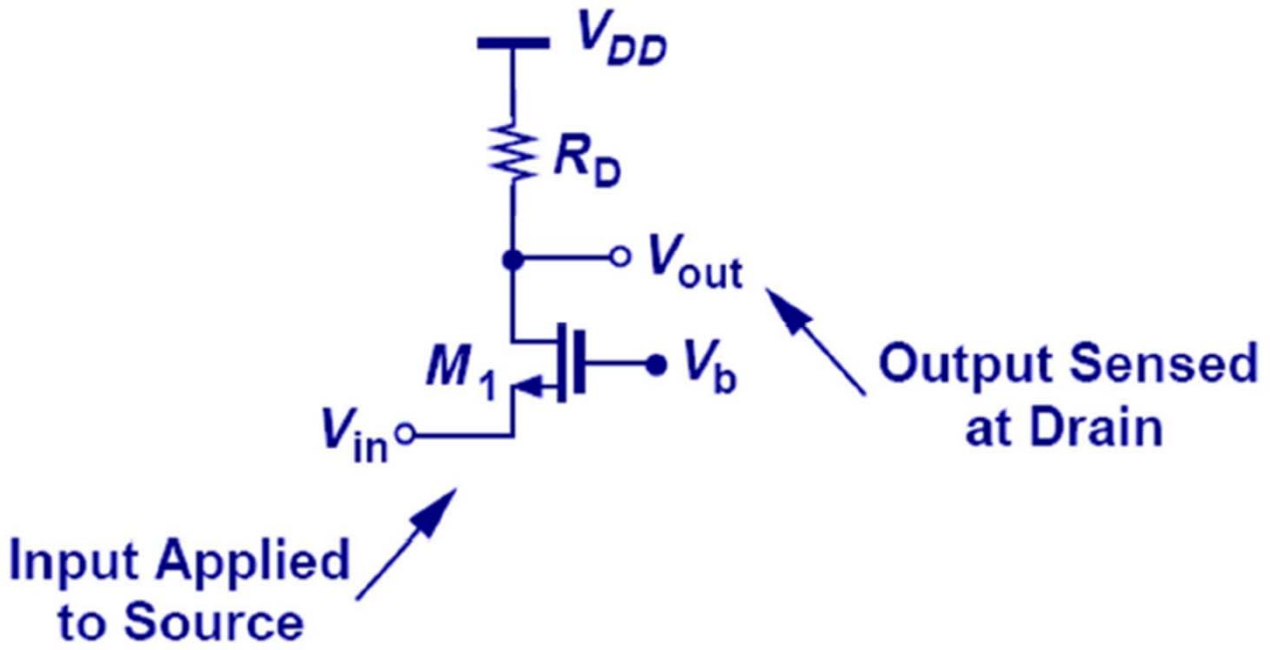
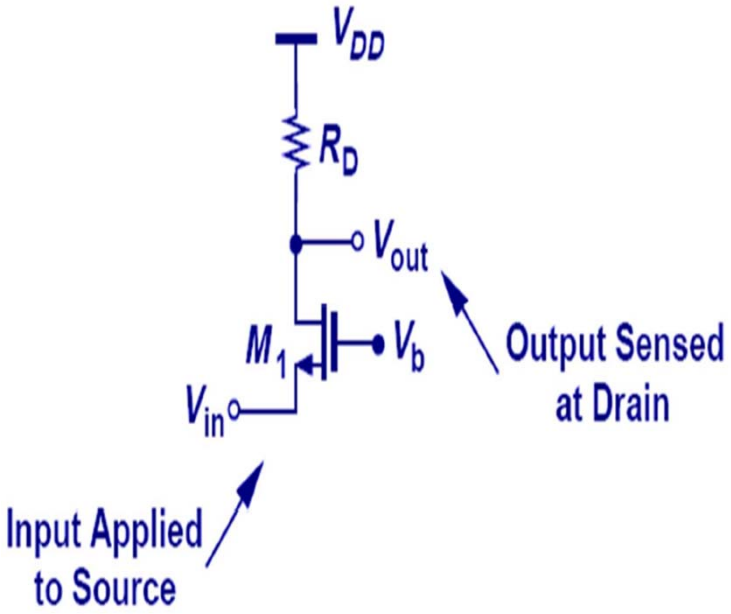
- Common-Gate Amplifier

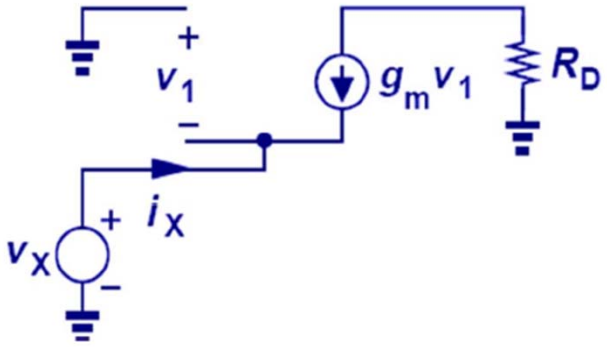


Lect. 7: CMOS Amplifiers (3)

- Common-Gate Amplifier



R_{in} = ?

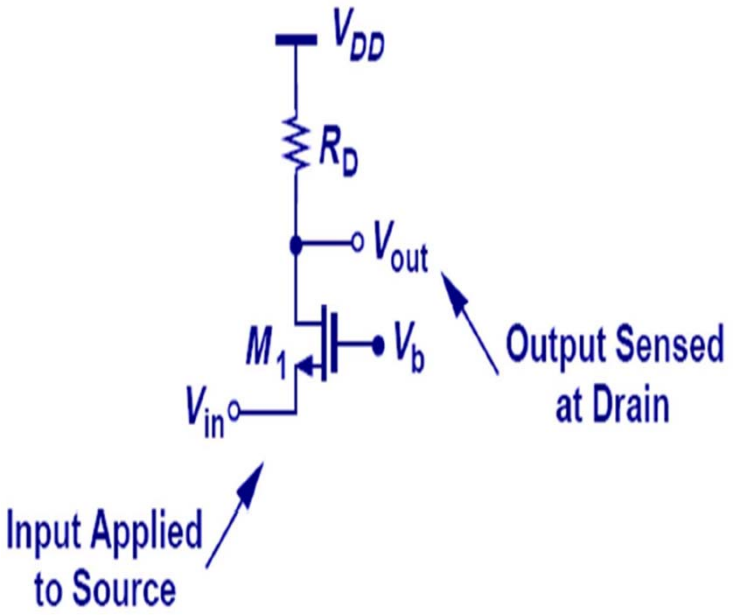


$$R_{in} = \frac{1}{g_m}$$

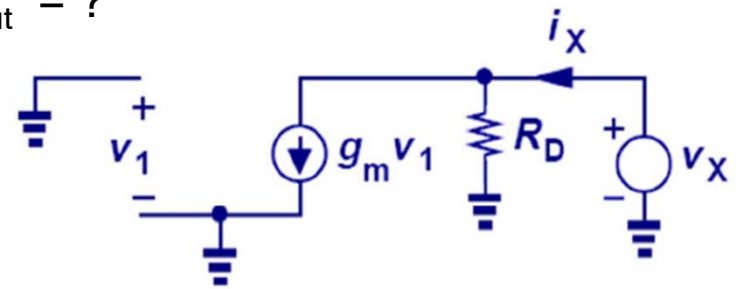
With r_O? $R_{in} = (1 + R_D/r_O)/(g_m + 1/r_O)$

Lect. 7: CMOS Amplifiers (3)

- Common-Gate Amplifier



R_{out} = ?



$$R_{out} = R_D$$

With r_O?

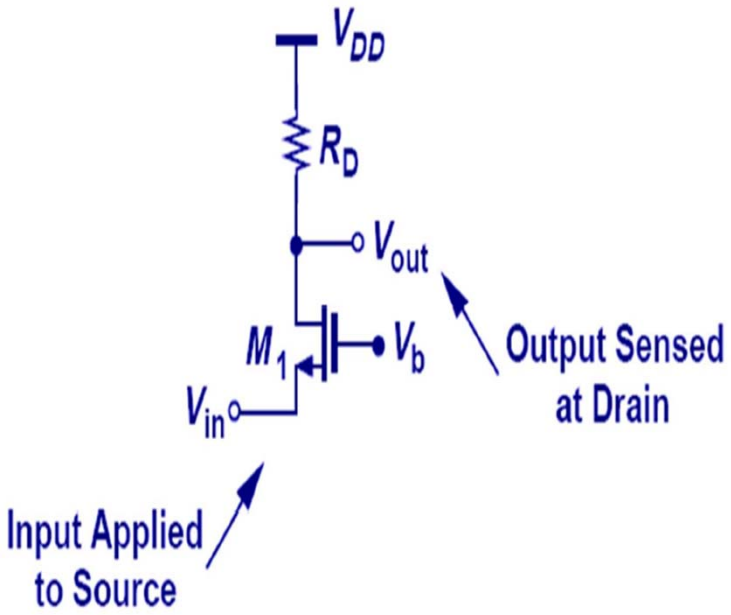
Gain (without r_O)? $A_v = g_m R_D$

Gain (with r_O)?

$A_v = (g_m R_D + R_D/r_O) / (1 + R_D/r_O)$

Lect. 7: CMOS Amplifiers (3)

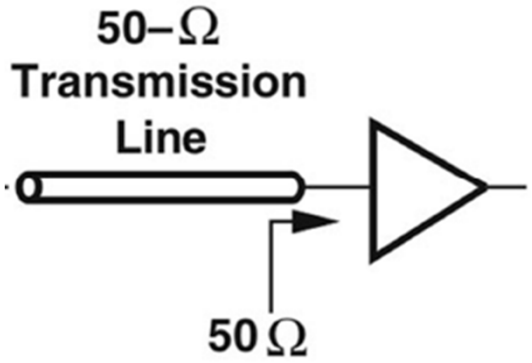
- Common-Gate Amplifier



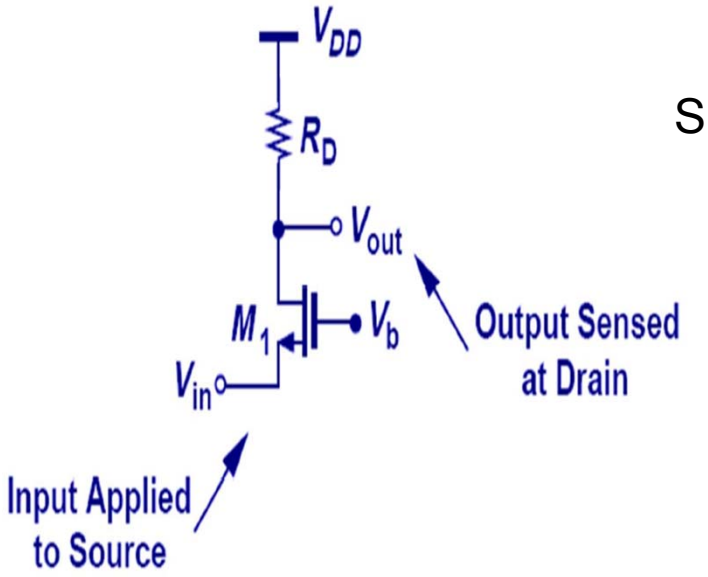
Small R_{in}, Large R_D, Large A_v

- Application for large A_v with small R_{in}?

- High-frequency amplifiers required R_{in} of 50ohm for **impedance matching**



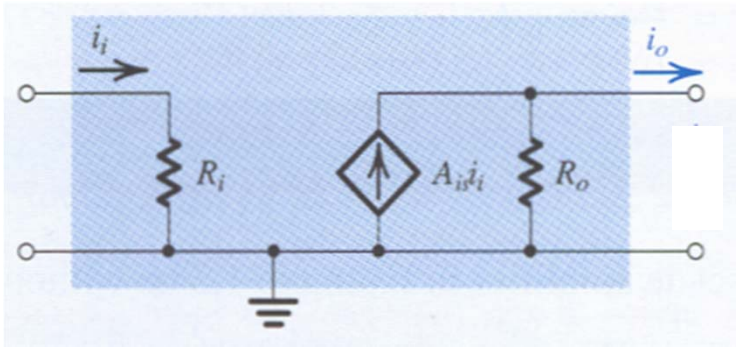
Lect. 7: CMOS Amplifiers (3)



Small R_{in}, Large R_D, Large A_v

- CG as Current Amplifier

Small R_i and large R_o desired for current amplifier

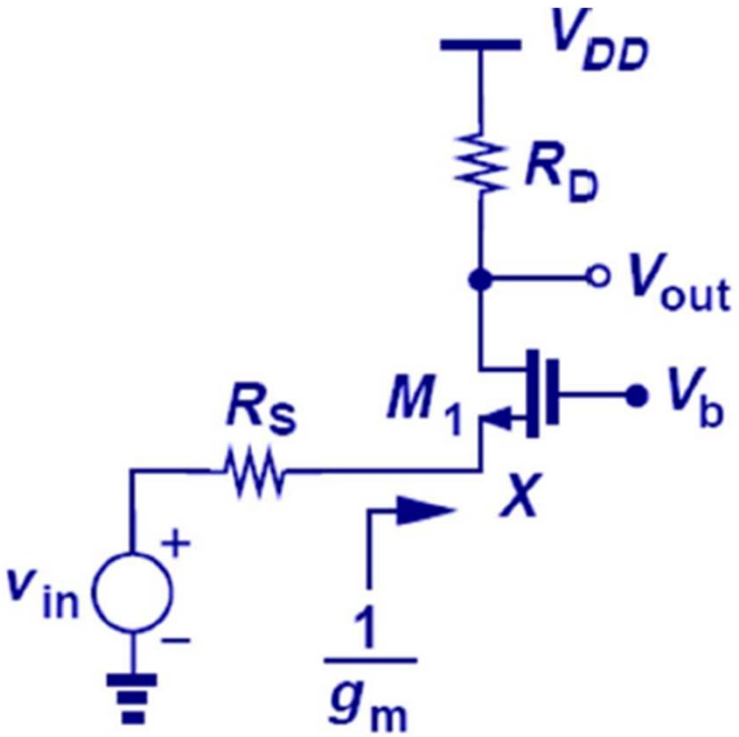


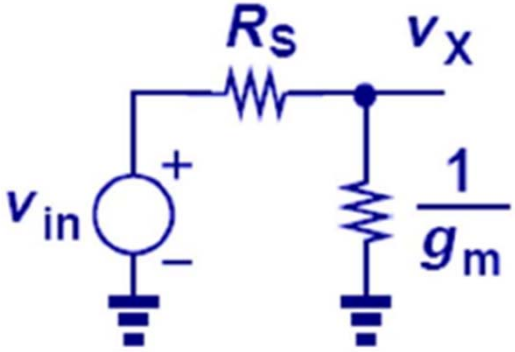
A_{is}: Short-circuit current gain

What is A_{is} for CG? ➔ Current Buffer

Lect. 7: CMOS Amplifiers (3)

- Common-Gate Amplifier with Source Resistance



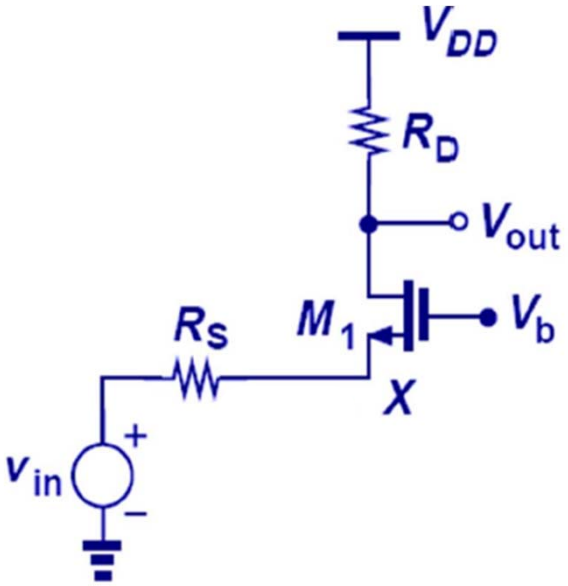


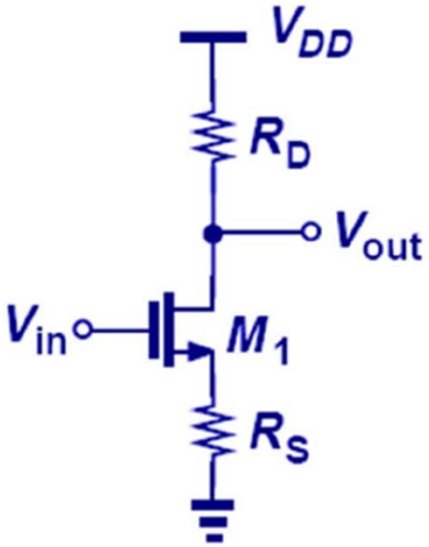
$$A_v = \frac{R_D}{\frac{1}{g_m} + R_S}$$

- Gain reduction

Lect. 7: CMOS Amplifiers (3)

- CG with Source Resistance vs CS with Degeneration



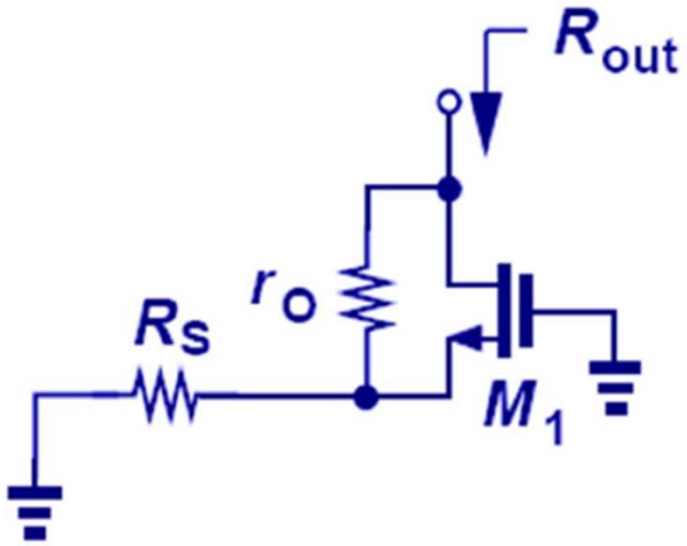


$$A_v = \frac{R_D}{\frac{1}{g_m} + R_S}$$

$$A_v = -\frac{R_D}{\frac{1}{g_m} + R_S}$$

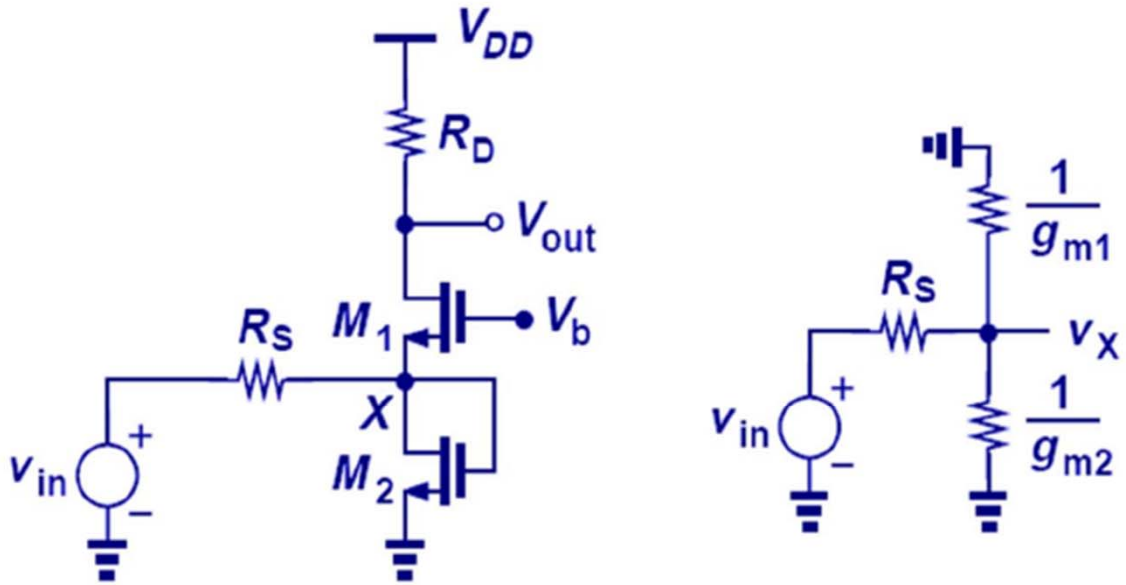
Lect. 7: CMOS Amplifiers (3)

- R_{out} for CG with Source Resistance



$$R_{out} = (1 + g_m r_O) R_S + r_O$$

- CG with Diode-Connected MOS



$$\frac{v_{out}}{v_{in}} = \frac{g_{m1}R_D}{1+(g_{m1}+g_{m2})R_S}$$

Lect. 7: CMOS Amplifiers (3)

Homework: Determine the voltage gain (assume $\lambda = 0$) and
output impedance (assume λ is not zero) for following CG amp.