Lecture18:
CMOS amplifiers (5)

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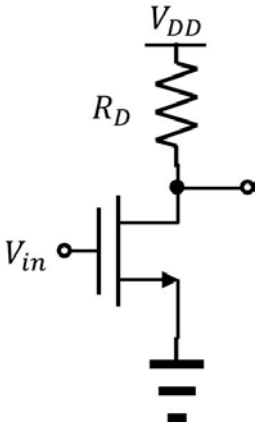
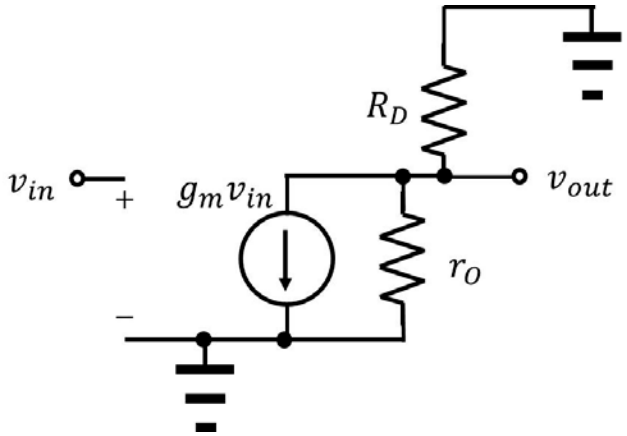
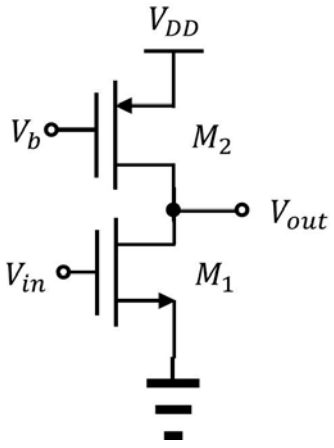
Review of previous lecture

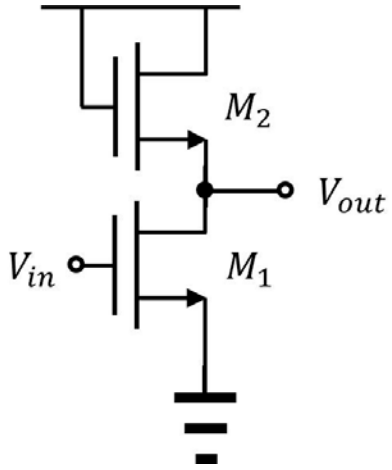
- Some selected lecture contents





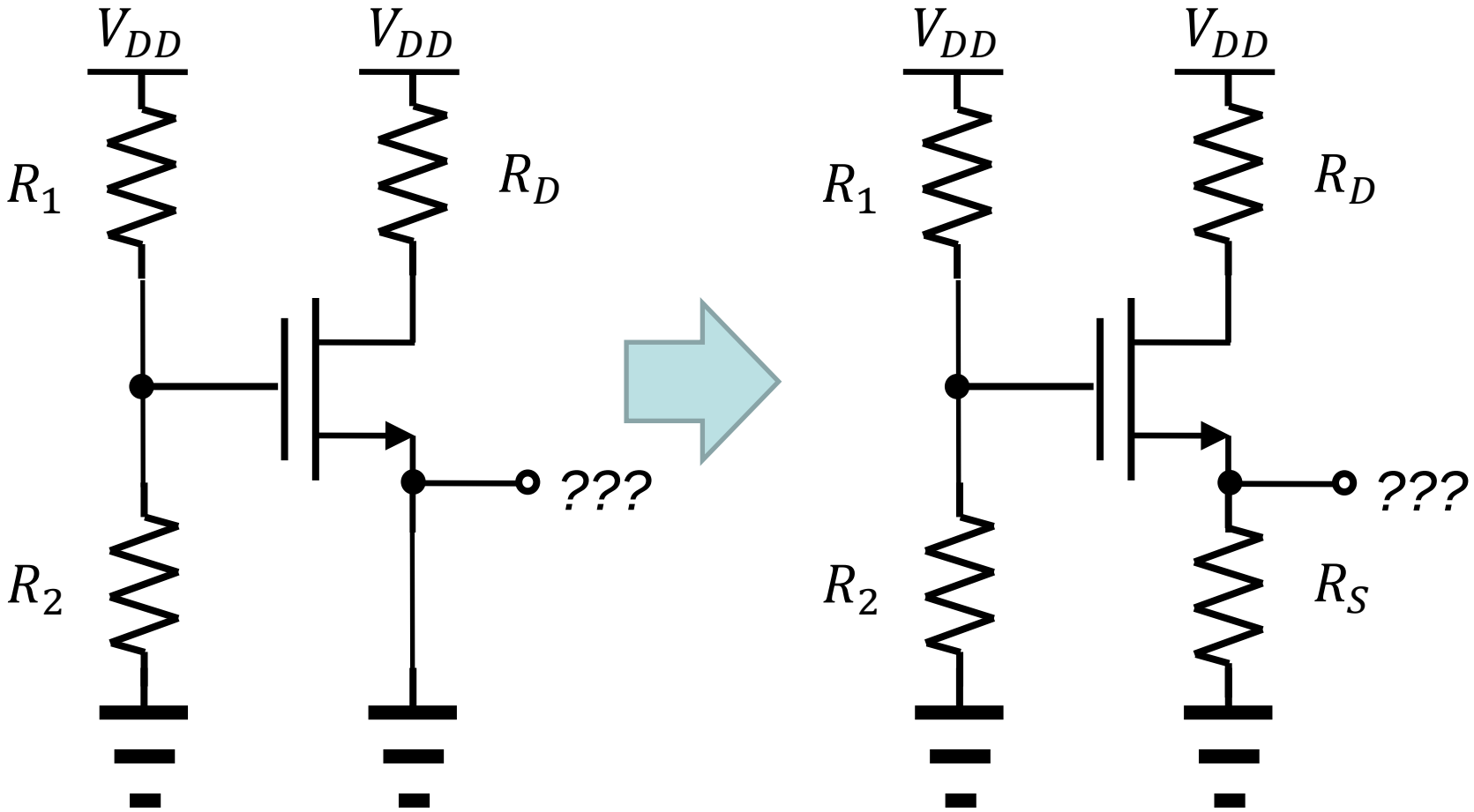
$$A_v = -g_m(R_D||r_O)$$





Source degeneration (1/2)

- A resistor placed in series with the source terminal



Source degeneration (2/2)

- Now we have to find the source voltage.
  - (Saturation current of the MOSFET) = (Current flowing through R_S)
  - After a simple manipulation, we can find

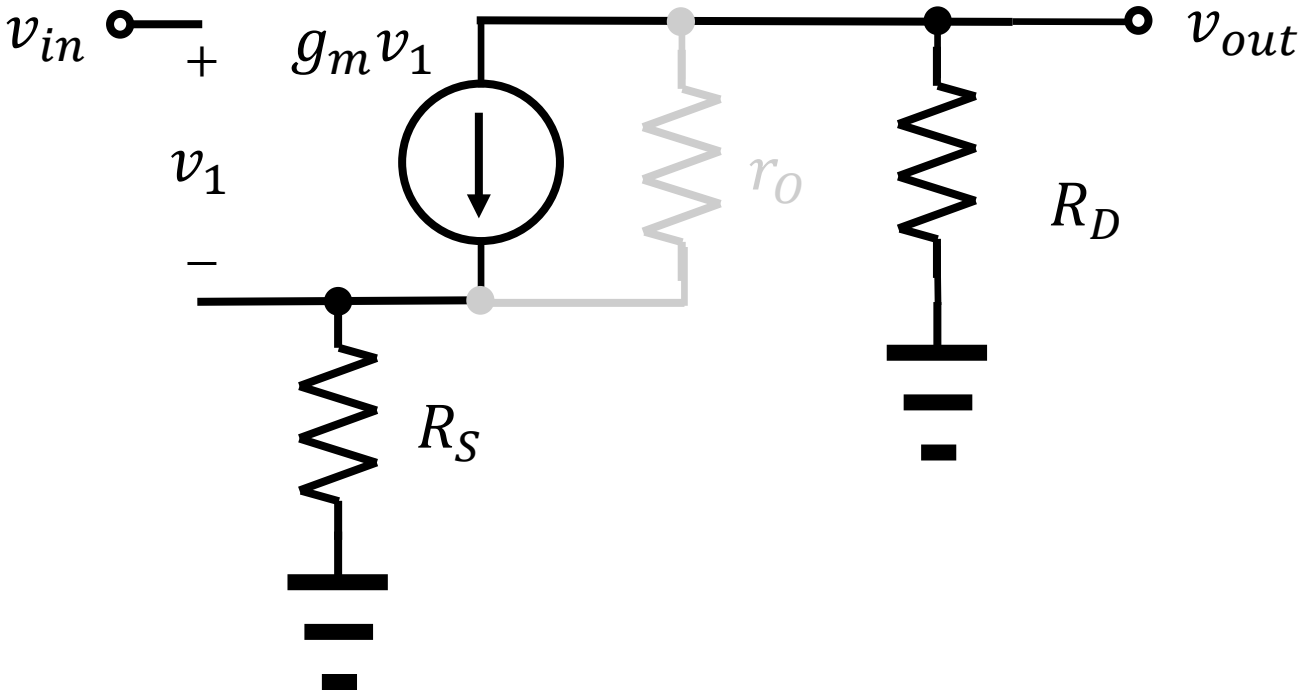
$$V_S = V_G + V_1 - V_{TH} - \sqrt{V_1^2 + 2(V_G - V_{TH})V_1}$$

  - Here,

$$V_1 = \frac{1}{\mu_n C_{ox} \frac{W}{L} R_s}$$

Effect of R_S (1/2)

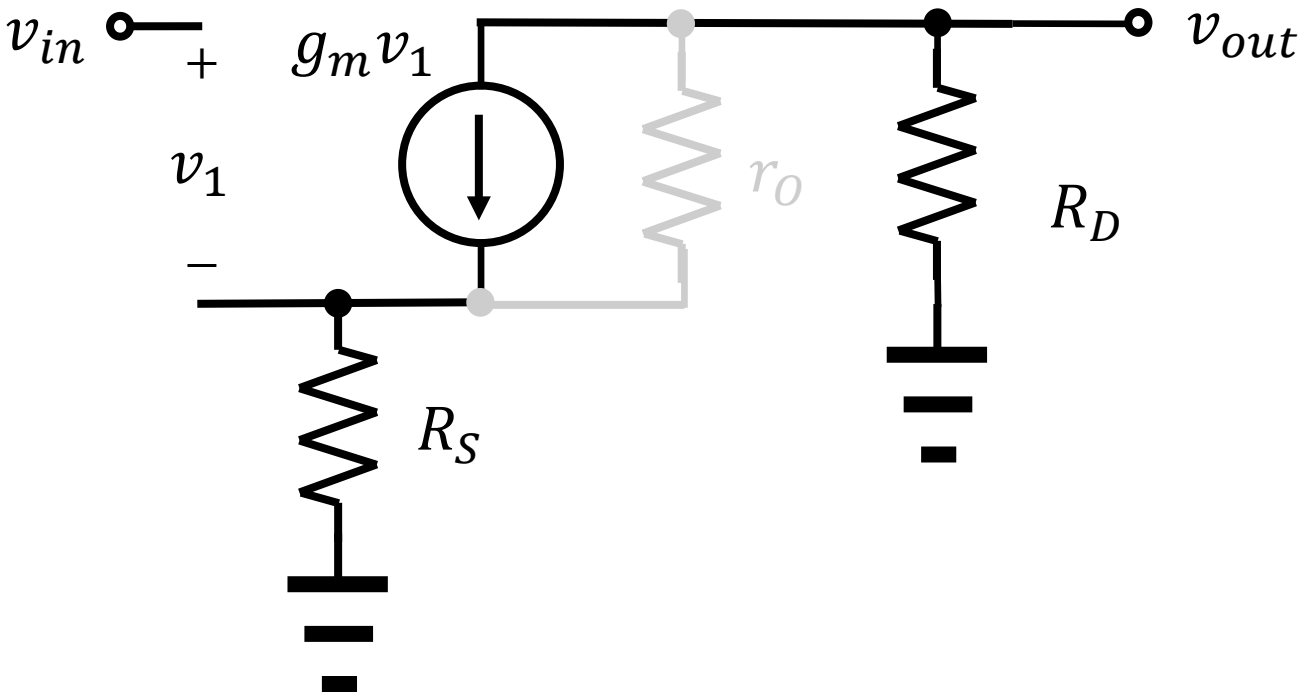
- Reduction of the gate-source voltage
  - Therefore, also reduction of the gain.
- For a while, neglect the channel-length modulation.



Effect of R_S (2/2)

- After a simple manipulation,

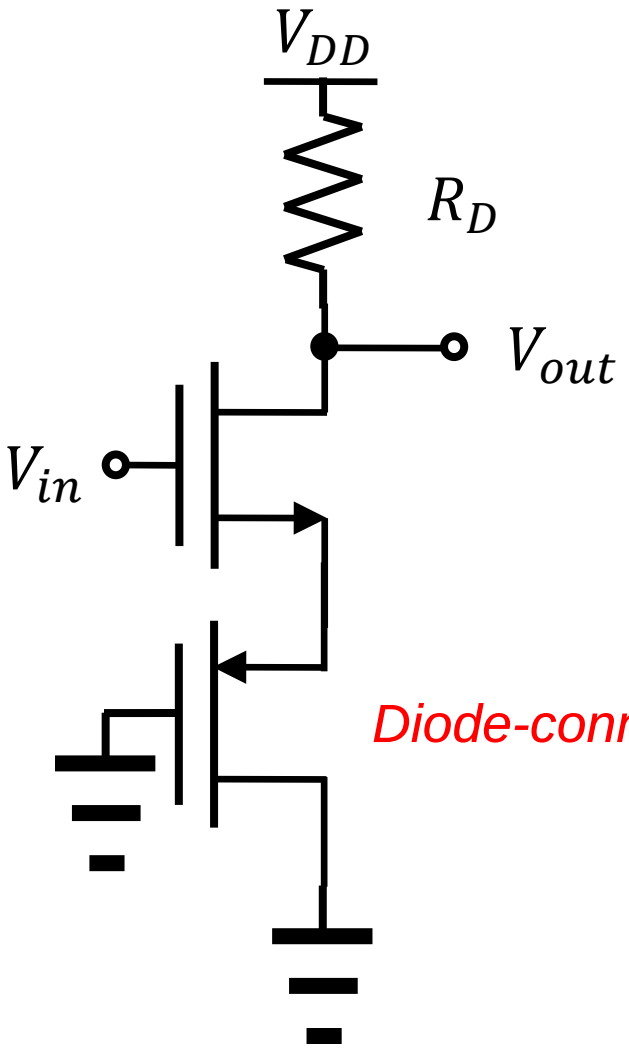
$$A_v = -\frac{g_m R_D}{1 + g_m R_S}$$



Example 17.20

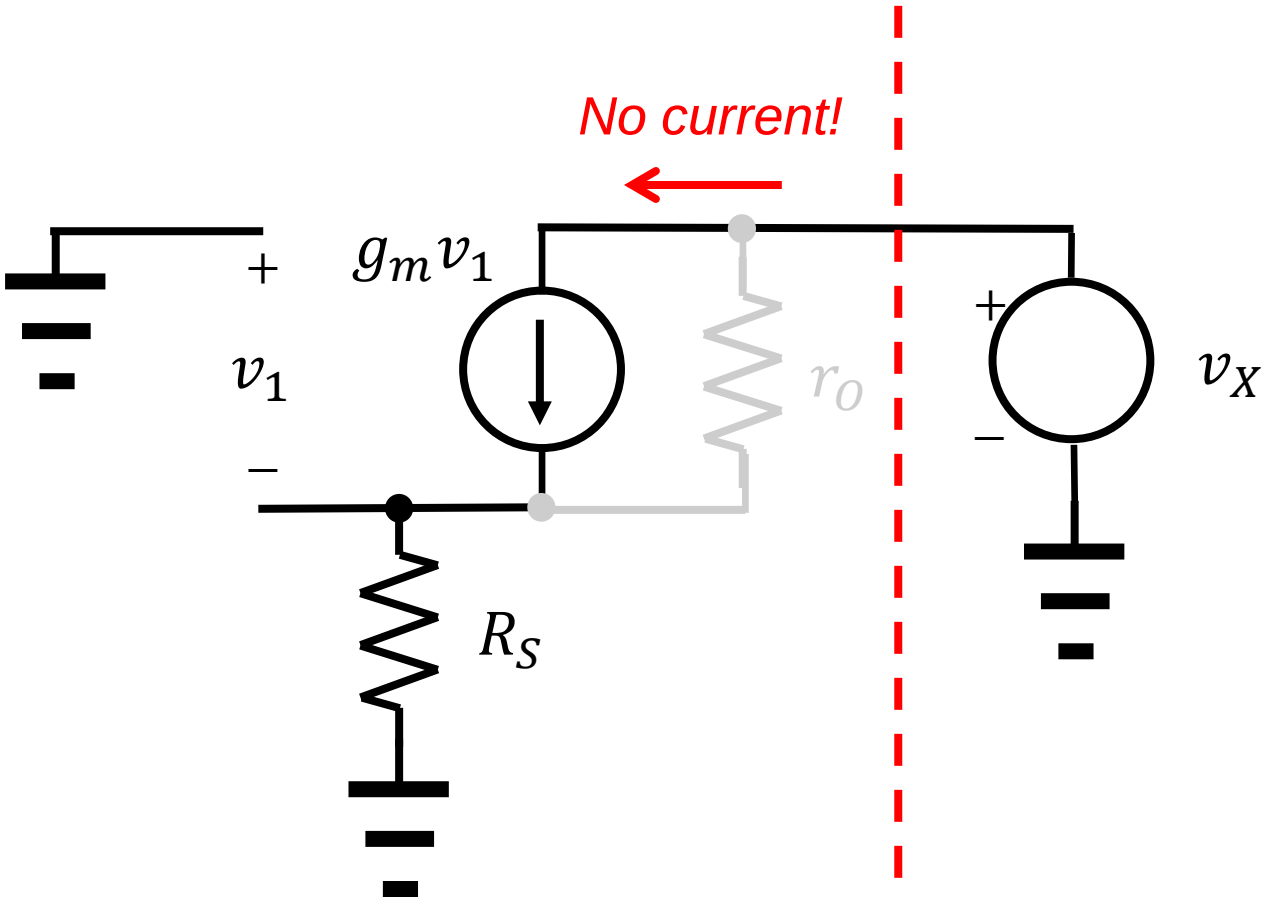
- CS with degeneration

$$A_v = -\frac{R_D}{\frac{1}{g_{m1}} + \frac{1}{g_{m2}}}$$



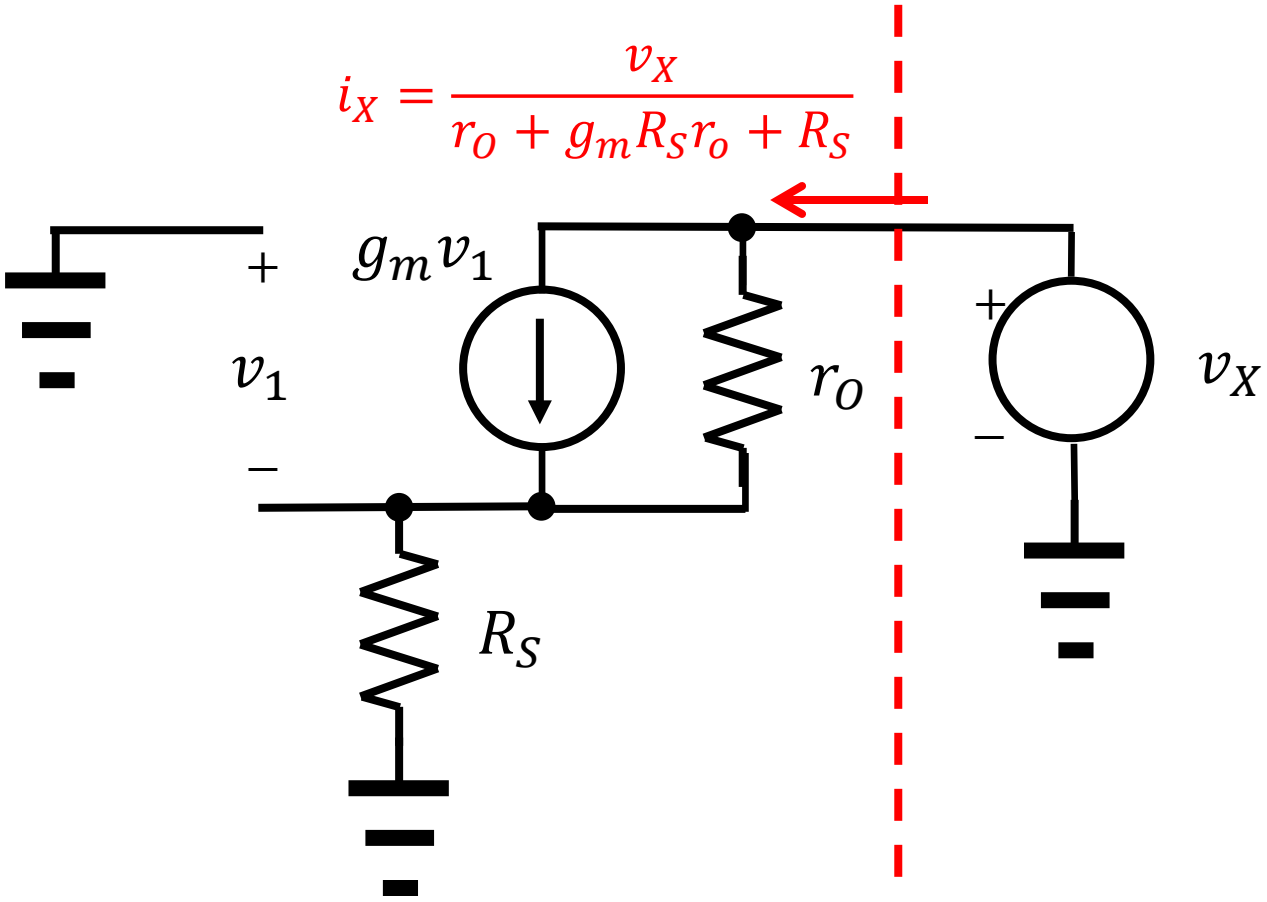
Output impedance of CS (1/2)

- Still neglecting the channel-length modulation
  - No current!



Output impedance of CS (2/2)

- Now considering the channel-length modulation
  - Output resistance is $r_O + (g_m r_O + 1)R_S$.



Examples 17.23 and 17.24

- Compute the output resistance.
  - What is the difference?