Lecture15:
CMOS amplifier,
common-source (2)

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GIST Lecture on April 30, 2018 (Internal use only)

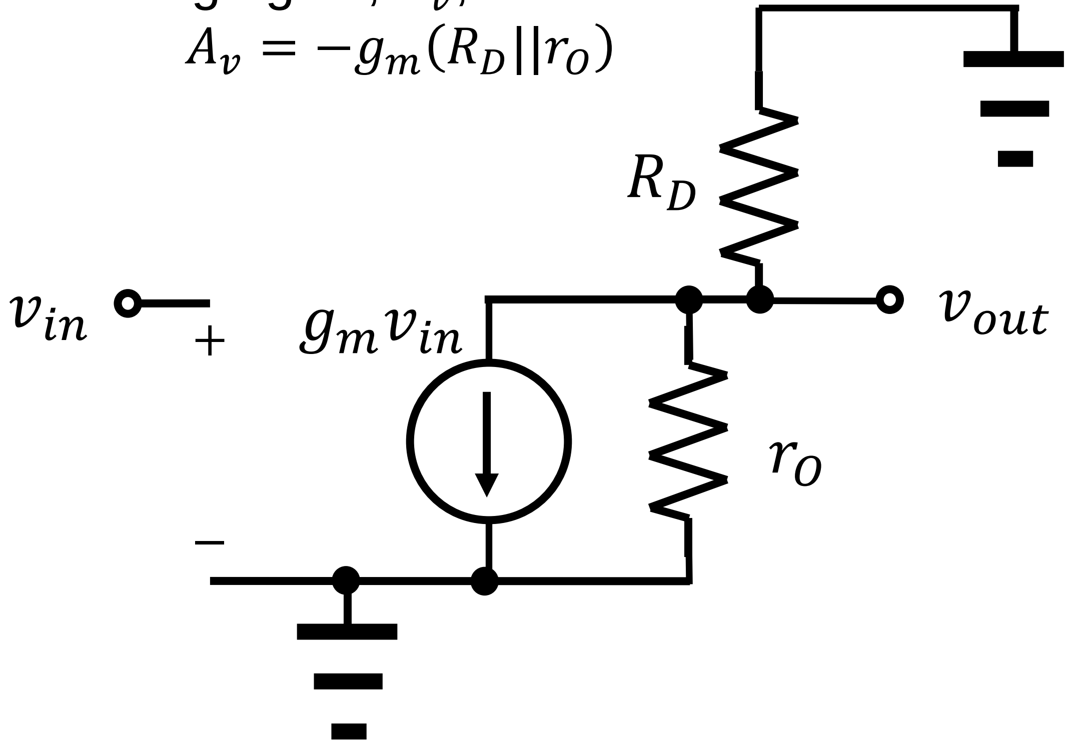
Gain

- Now, calculate the v_{out}.
  - KCL for the v_{out} node gives

$$v_{out} = -g_m(R_D||r_O)v_{in}$$

  - Therefore, the voltage gain, A_v, is

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



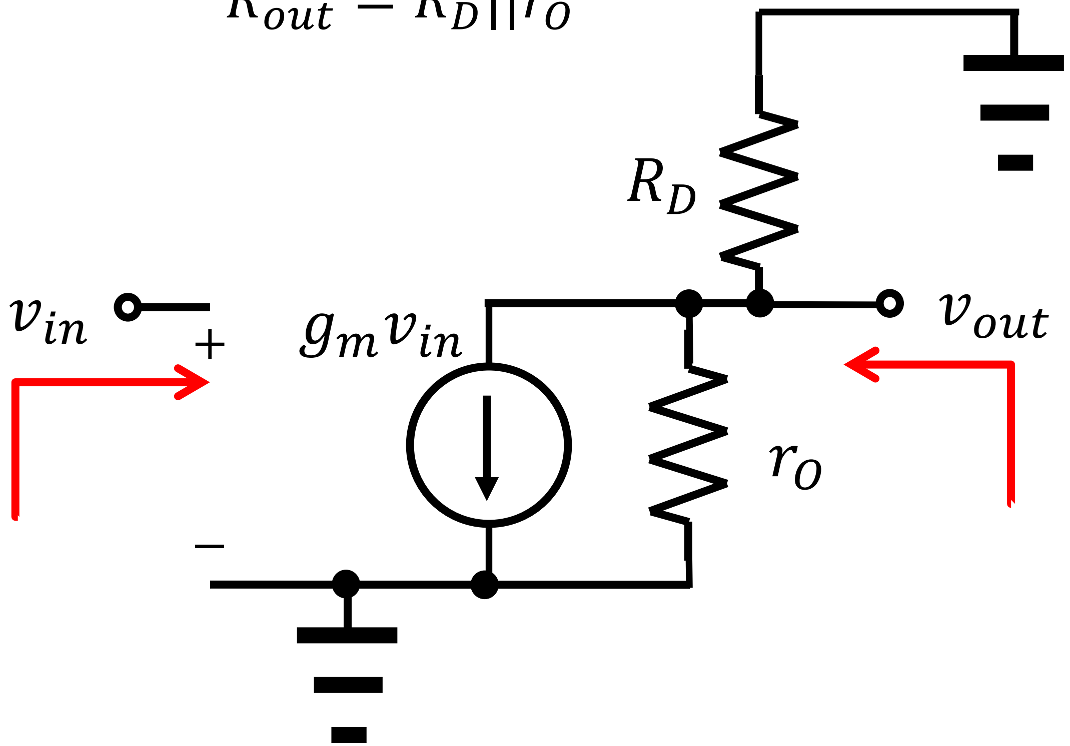
Input/output impedances

- Input impedance

$$R_{in} = \infty$$

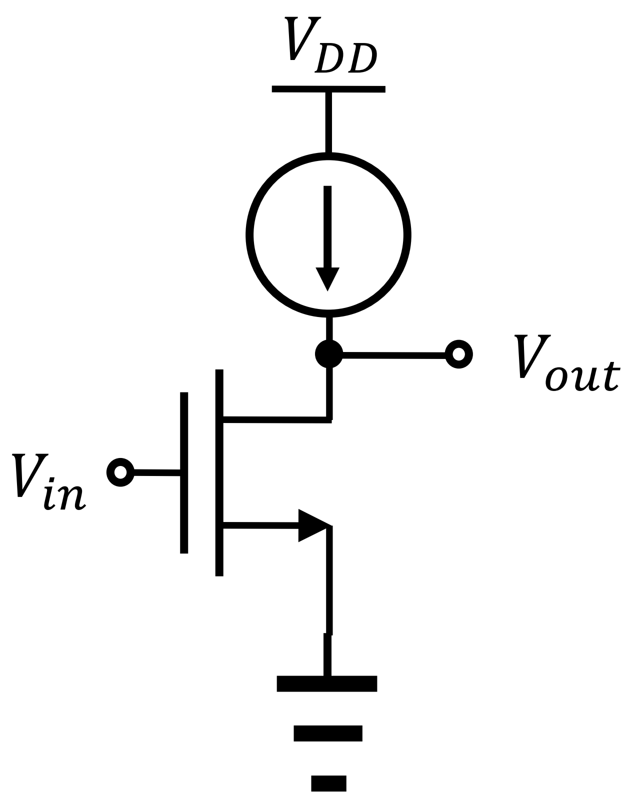
- Output impedance

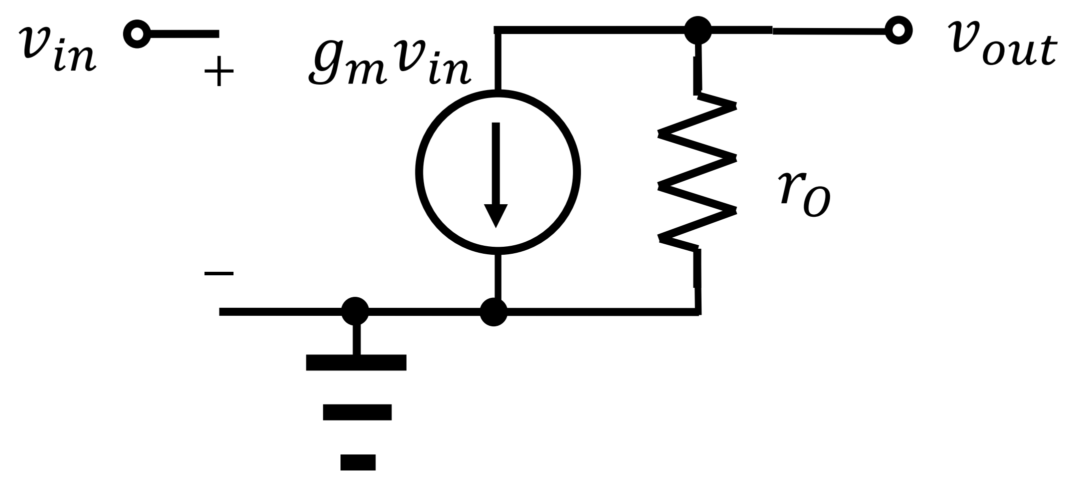
$$R_{out} = R_D || r_O$$



Current-source load

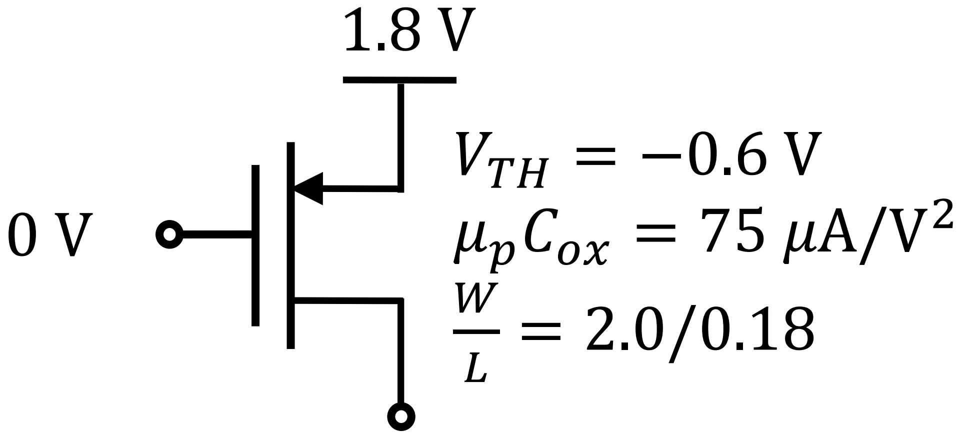
- When $R_D \rightarrow \infty$,
  - The gain can be maximized.





Biasing of PMOS devices

- Use a PMOS as a current source
  - The amount of "gate overdrive" is 1.2 V.
  - It is not 0.6 V.

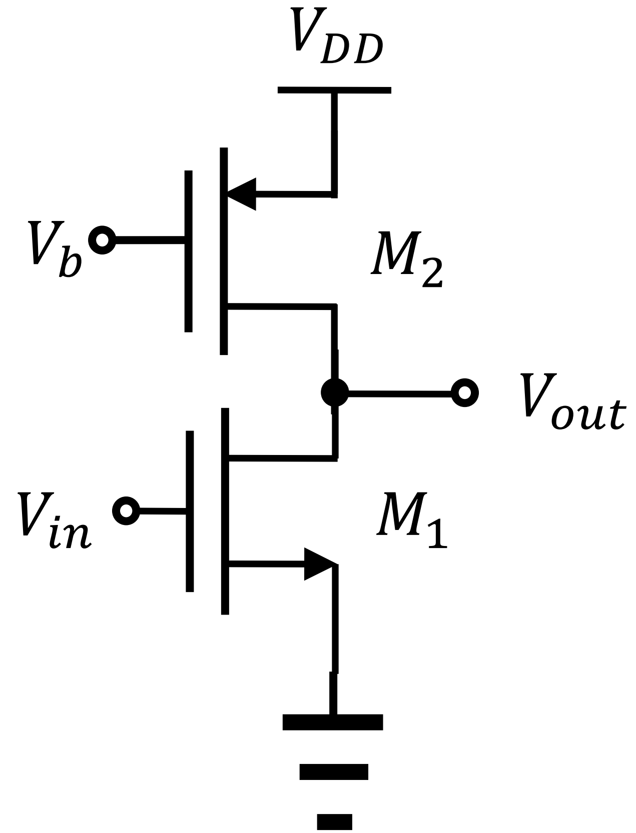


Real current-source load

- Use a PMOS as a current source.
  - It is not an ideal current source.

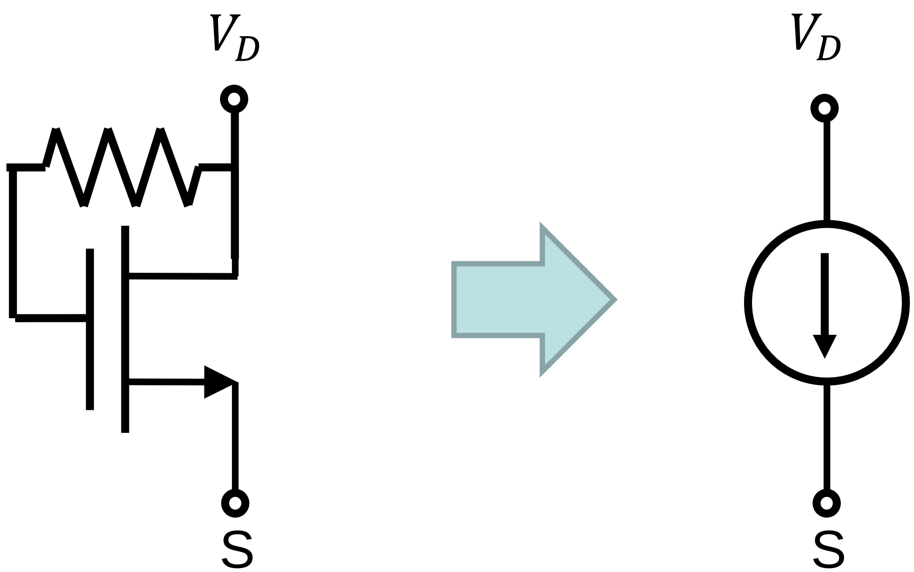
$$v_{out} = -g_{m1}(r_{O1}||r_{O2})v_{in}$$

$$A_v = -g_{m1}(r_{O1}||r_{O2})$$



Self-biasing

- Already covered in Example 6.13.
  - Always in the saturation region.



$$\frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_D - V_S - V_{TH})^2$$

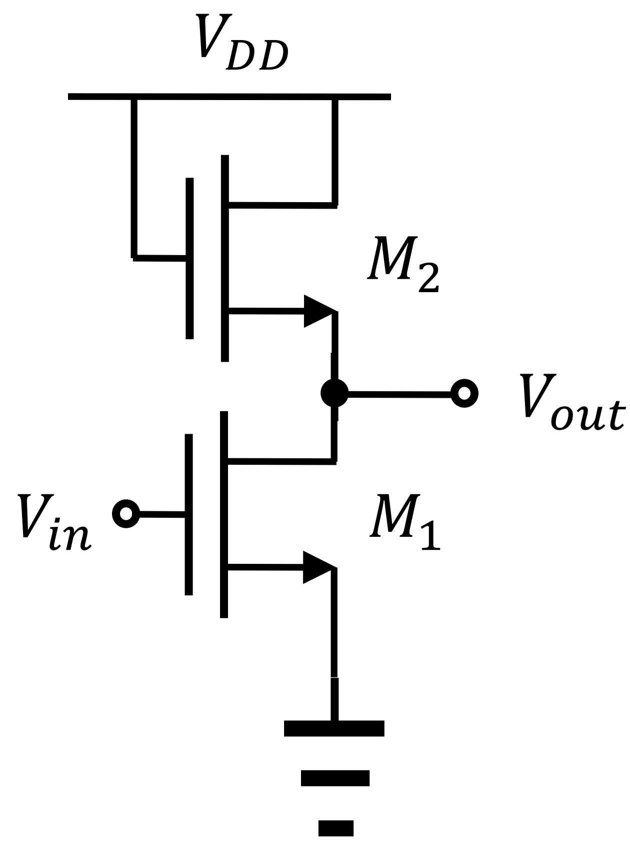
Gate and drain are tied.

In this case,

- Use a diode-connected load.
  - It is not an ideal current source.

$$v_{out} = -g_{m1}\left(r_{O1}||\frac{1}{g_{m2}}||r_{O2}\right)v_{in}$$

$$A_v = -g_{m1}\left(r_{O1}||\frac{1}{g_{m2}}||r_{O2}\right)$$



Homework#7

- Due: 09:00, May 9 (No lecture on May 7)
- Write a program, which reads a netlist file.
  - Only voltages sources and resistors are considered.
  - The program calculates the node voltages and the terminal voltages/currents.
  - Three test netlists will be uploaded. For each of them, show the solution vector.