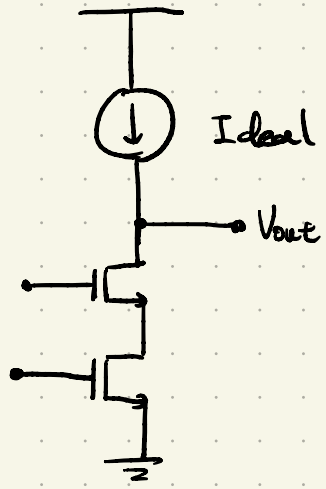
Lec 4 Cascode Example, Cascode Amp with PMOS Input

Example 1:



$$A_V \approx -g_{m1} r_{o1} g_{m2} r_{o2}$$

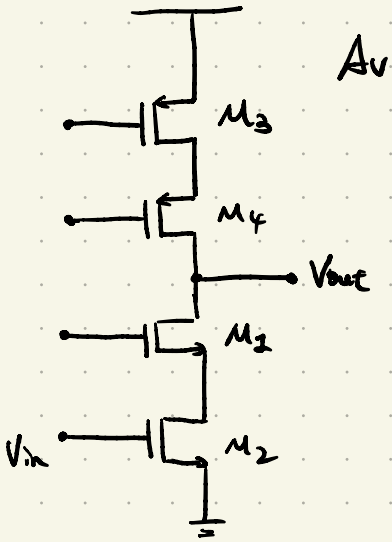
$$g_m = \sqrt{2 \mu_n C_{ox} \frac{W}{L} I_D}$$

$$r_o = \frac{1}{\lambda I_D}$$

Case I	Case II
Bias Current is halved	The widths are doubled
$g_{m1}, g_{m2} \downarrow$ by $\sqrt{2}$	
$r_{o1}, r_{o2} \uparrow$ by 2	
$A_V \rightarrow 2A_V$	$A_V \rightarrow 2A_V$

"The voltage gain from the gate of the cascode device to the output is very low"

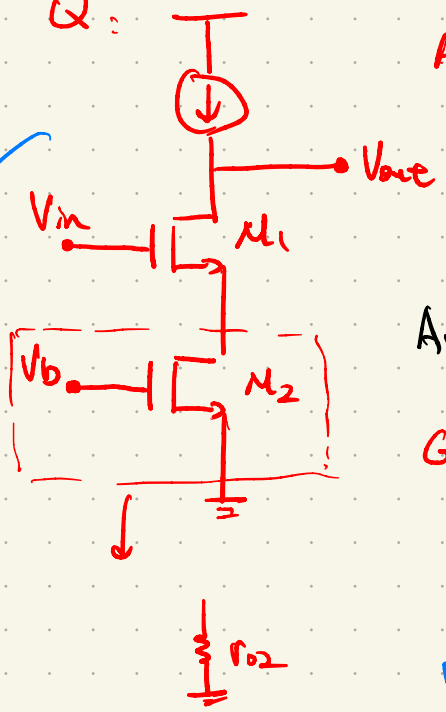
Example 2



$$A_V \approx -g_{m2}\left[(g_{m1} r_{o1} r_{o2}) \| (g_{m4} r_{o4} r_{o3})\right]$$

$I_D \rightarrow \frac{I_D}{2}$	
$A_V \rightarrow 2A_V$	$A_V \rightarrow 2A_V$

Q:



$A_V = ?$

$G_m = \cancel{g_{m1}}$

$R_{out} = r_{o1} + r_{o2} + g_m r_{o1} r_{o2}$

$A_V = -g_{m1}(r_{o1} + r_{o2} + g_m r_{o1} r_{o2})$

$$G_m = \frac{g_{m1}}{1 + g_{m1} r_{o2}}$$

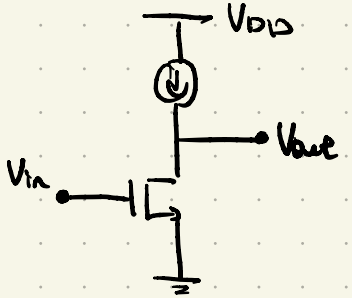
(degen)

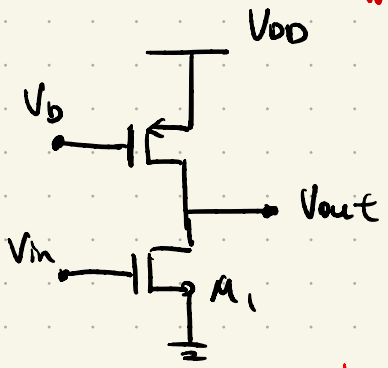
↓

reduced considerably

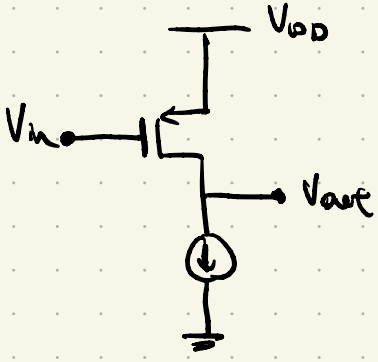
Cascode Amps with P-Type Input

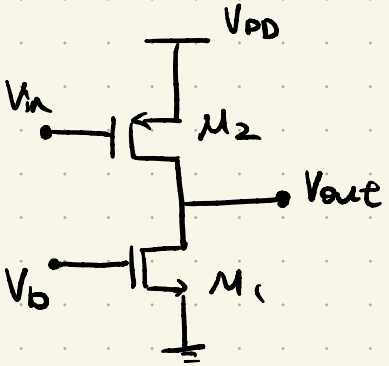
Observation



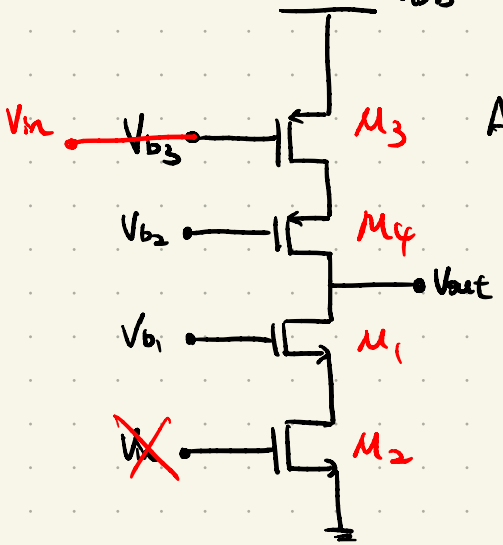


$A_V = -g_{m_1}(r_{o1} \| r_{o2})$





$A_V = -g_{m_2}(r_{o1} \| r_{o2})$



$A_V = -G_m R_{out}$

$A_V \cong -g_{m3}[(g_{m_1} r_{o1} r_{o2}) \| (g_{m4} r_{o4} r_{o3})]$