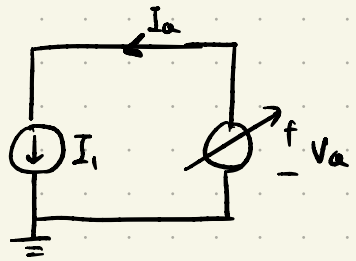
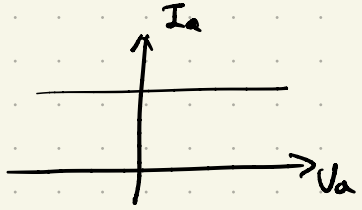
Lec 1. Introduction. Cascode Current sources

- Cascode current source

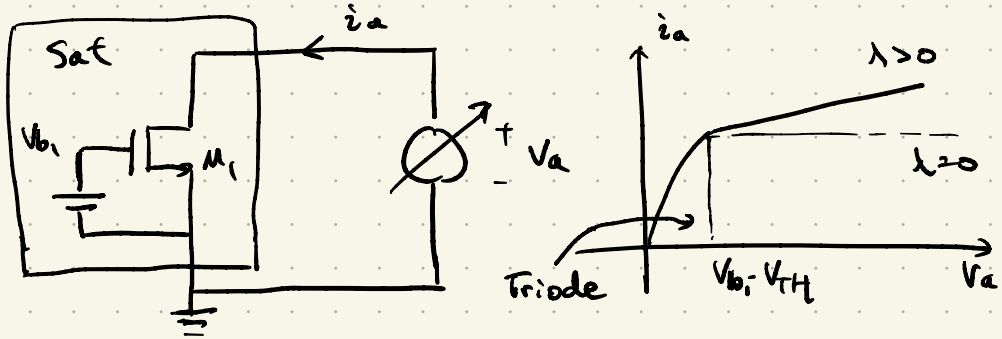


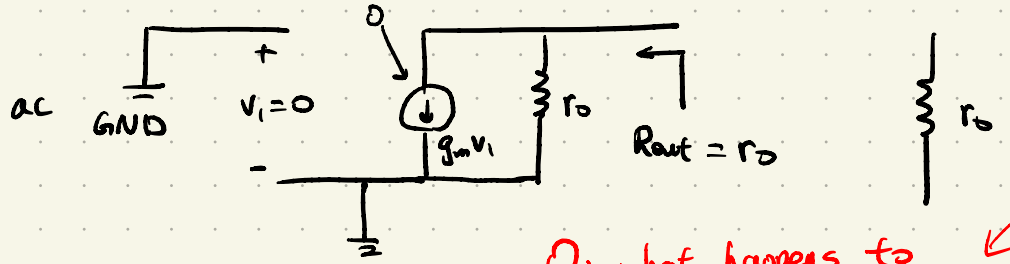
Ideal current source



Observations

① Let's build a current source





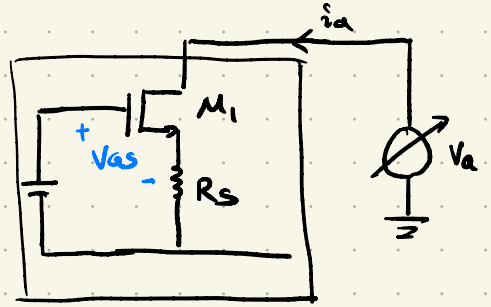
A:

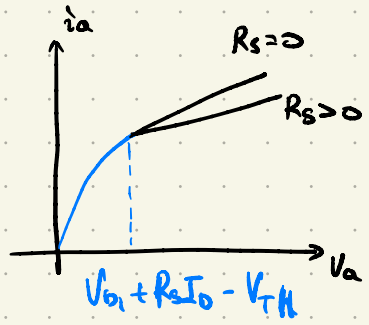
$g_m = \sqrt{2\mu_n C_{ox} \frac{W}{L} I_D}$

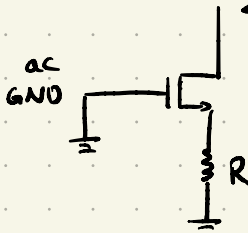
$\Rightarrow$ $R_{out}' = \sqrt{2}\, R_{out}$

Q: what happens to Rout if width W_1, W_2 are doubled? (I_D the same)

② How do we improve this current source





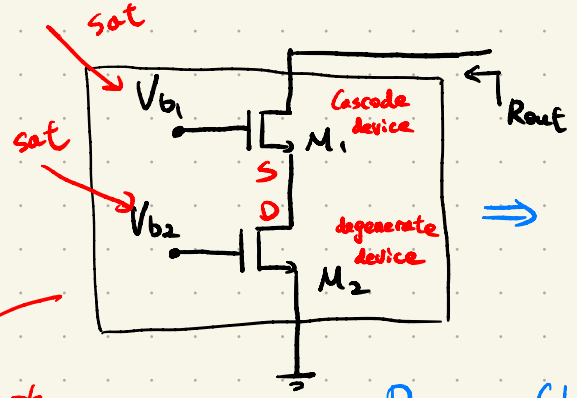


$R_{out} = (1 + g_m r_o) R_S + r_o$

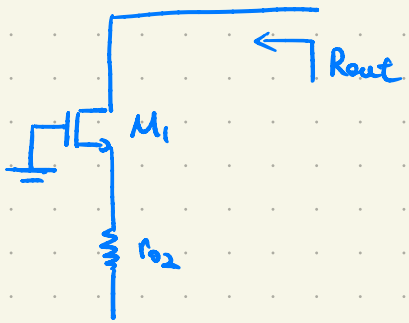
Intrinsic Gain

degeneration: slope ↓ but range ↓

③ Cascode current source



$\Rightarrow$



$R_{out} = (1 + g_{m1} r_{o1}) r_{o2} + r_{o1}$

$\approx g_{m1} r_{o1} r_{o2}$

$\neq$

M_2 degen. M_1 $\Leftrightarrow$ M_1 increases the r_o of M_2