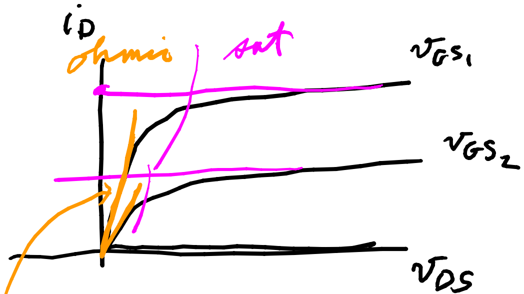
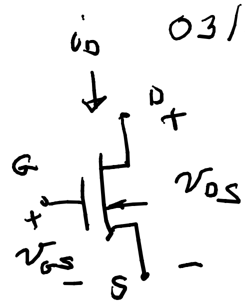
EE 303
03/07/07





NMOS

looks like a voltage controlled resistor

i_D vs v_{DS} slope depends on v_{GS}

in ohmic region

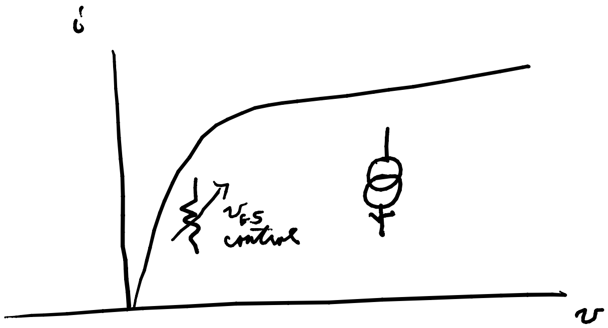
$$i_D = \frac{KP}{2}\frac{W}{L}\left(2(v_{GS}-VTO)v_{DS} - v_{DS}^2\right)(1+\lambda v_{DS})$$

gives slope for "current source"

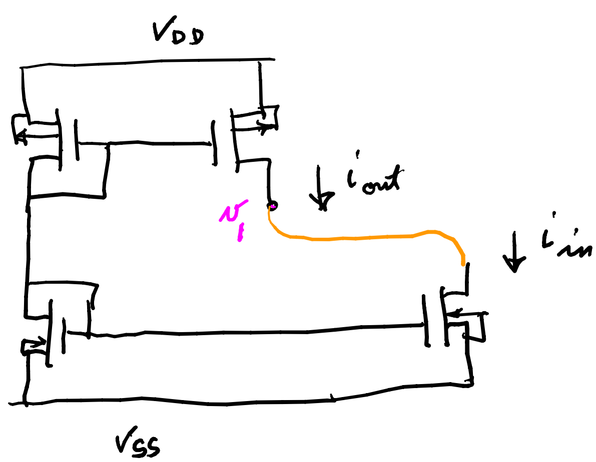
for small v_{DS}, i.e. $v_{DS}^2 \leq$ epsilon, small

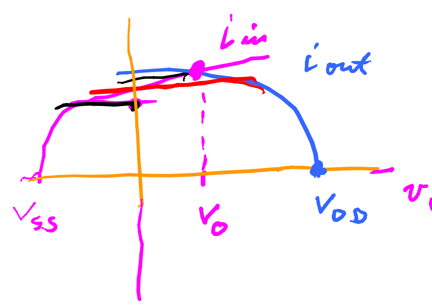
$$i_D \approx \left\{KP\cdot\frac{W}{L}(v_{GS}-VTO)\right\}v_{DS} = G(v_{GS})\cdot v_{DS}$$

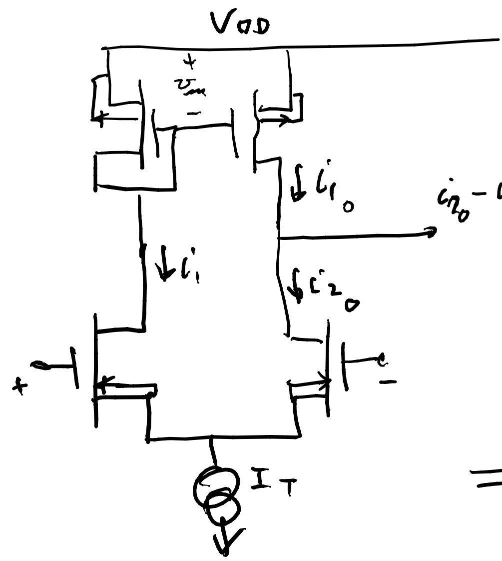
a resistor



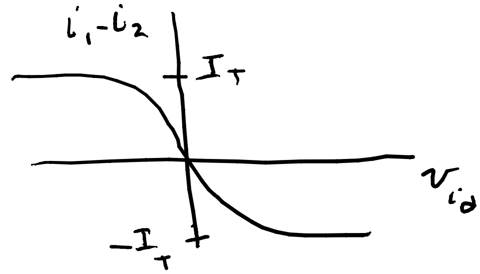
Putting two current sources



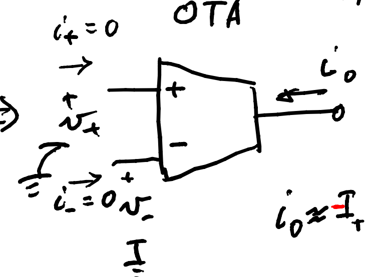




$i_{2_0} - i_{1_0} = i_0$



$\Rightarrow$



OTA

operational transconductance amplifier

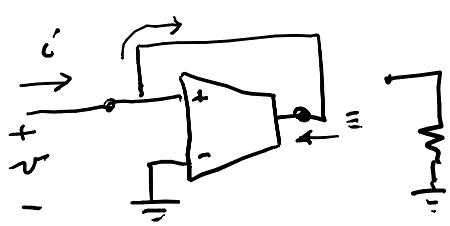
$i_0 \approx I_T \tanh\left(\frac{v_{id}}{2V_T}\right)$ if BJT

for small signals

$i_0 = -g_m v_{id}$

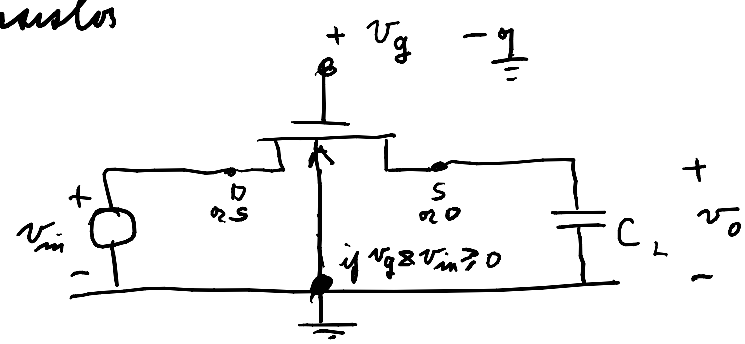
Connect output to input

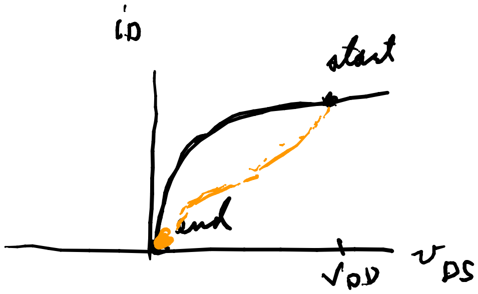
$i = f(v) = -g_m v$

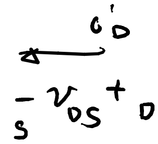


this is a negative resistor, resistance $= -1/g_m$

Pass transistor





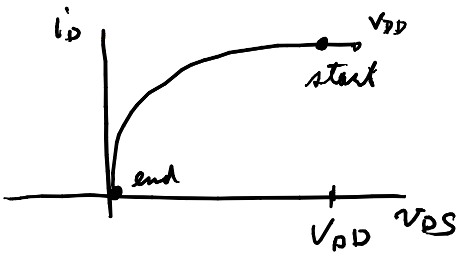


case $v_0 = $ "1" $= V_{DD}$

$v_G = $ "1" $= V_{DD}$

$v_{in} = $ "0" $=$ gnd $= 0$

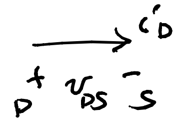
transitions from 1 to 0 at output



case $v_O =$ "0" $= 0$

$v_{in} =$ "1" $= V_{DD}$

$v_G =$ "1" $= V_{DD}$



transitions from 0 to 1 at output

the pass transistor acts as a switch

curves for $v_g = 0$