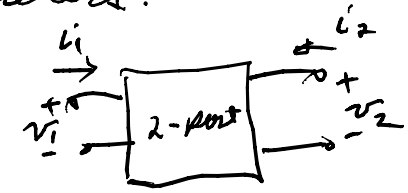
P. B-4 h Parameters:

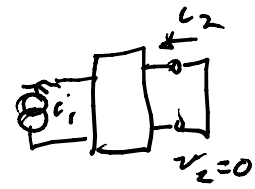
h_{fe} = small signal β



$$i = \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = Y \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$

$$\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = H \begin{bmatrix} i_1 \\ v_2 \end{bmatrix}$$

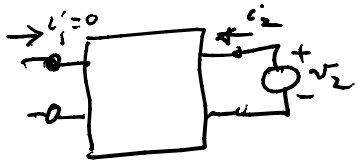
$$h_{21} = \left.\frac{i_2}{i_1}\right|_{v_2=0}$$

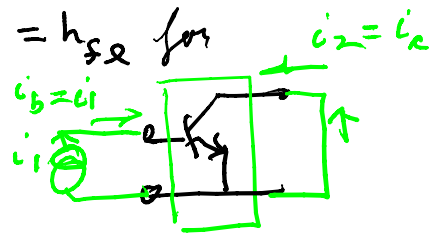


$$i_2 = h_{21} \cdot i_1 + h_{22} \cdot v_2$$

$= h_{fe}$ for

$$h_{22} = \left.\frac{i_2}{v_2}\right|_{i_1=0}$$





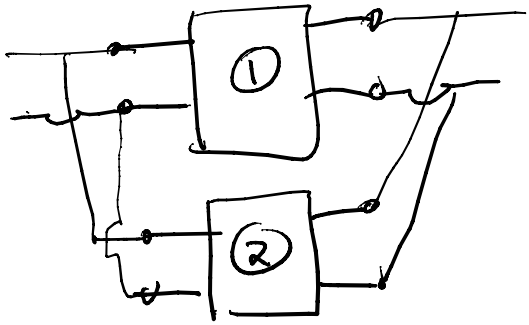
= open circuit output admittance

$$h_{11} = v_1/i_1 \Big|_{v_2=0 \Rightarrow \text{short}}$$ = short circuit input impedance

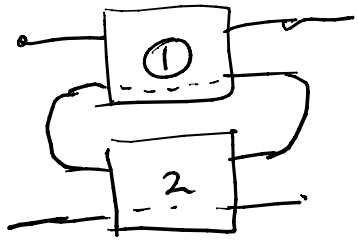
for G
P. B-5

$$\begin{bmatrix} i_1 \\ v_2 \end{bmatrix} = G \begin{bmatrix} v_1 \\ i_2 \end{bmatrix}$$

$$g_{21} = \left.\frac{v_2}{v_1}\right|_{i_2}$$ = open circuit voltage gain

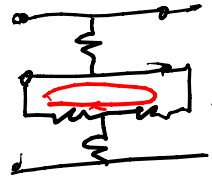


$\Leftarrow$ adds $Y = Y_1 + Y_2$



$\Leftarrow$ adds $Z = Z_1 + Z_2$

(need preserve eqs. before & after connect



} no longer has the same Z

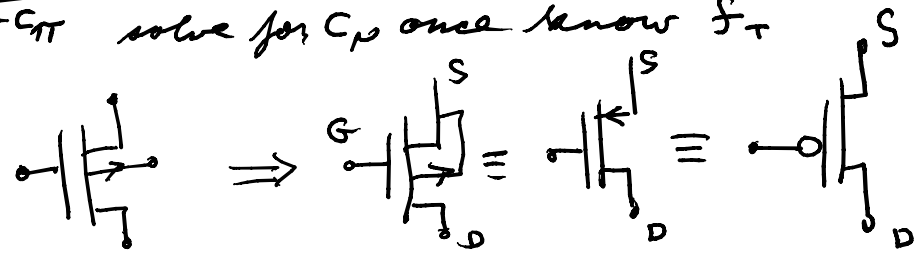
C_μ & C_π $\qquad$ C_{je0} = emitter junction C

p.490 $\qquad C_\pi = C_{de} + C_{je}$ $\qquad C_{je} = 2C_{je0}$

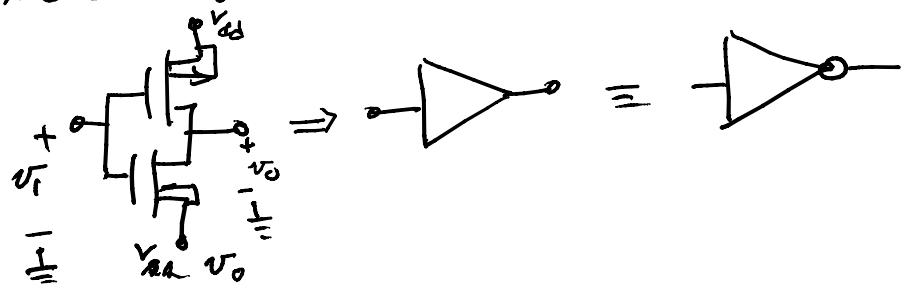
$C_{de} = \tau_f g_m$

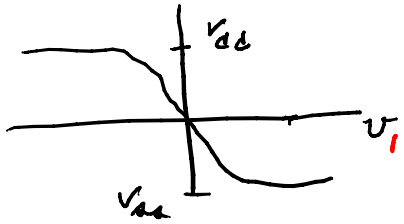
$\omega_T = \dfrac{g_m}{C_\mu + C_\pi}$ solve for C_μ once know f_T

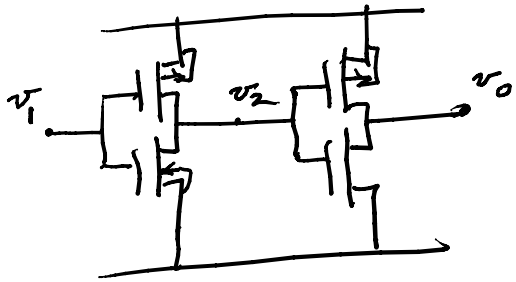
Notation

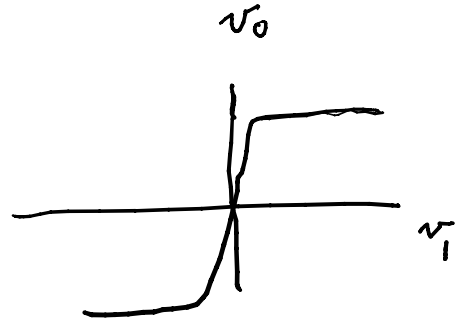


For the inverter



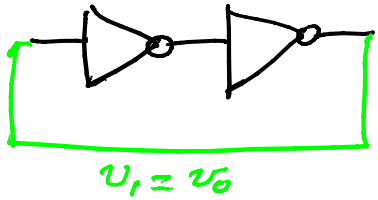


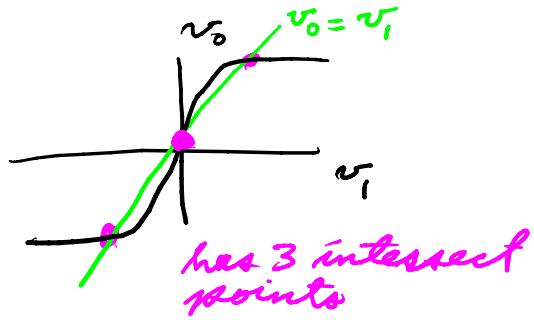


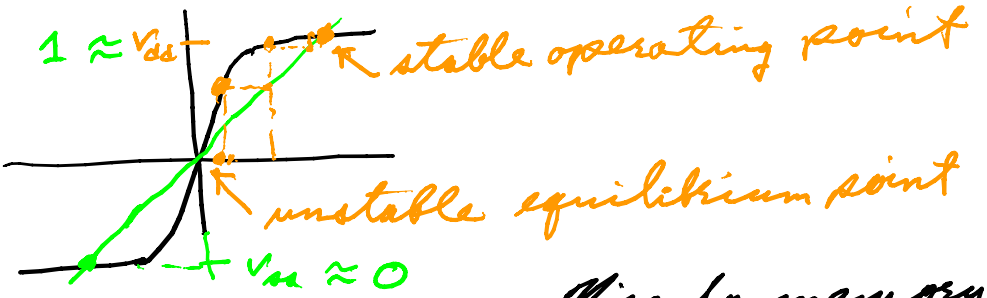


transfer curve of a cascade of inverters

Connect output to input

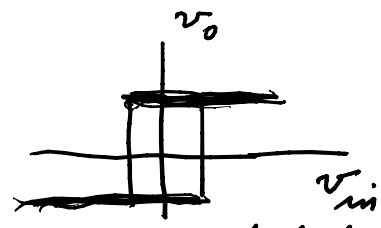




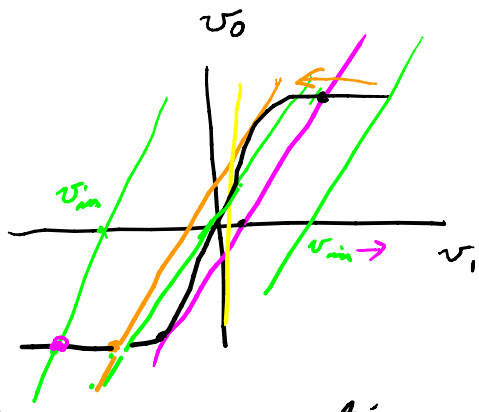


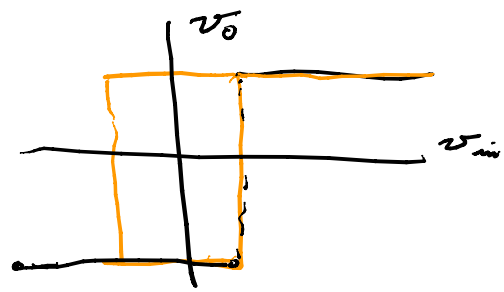
Nice for memory if can get signals in

To create hysteresis with this



a type of Schmitt trigger

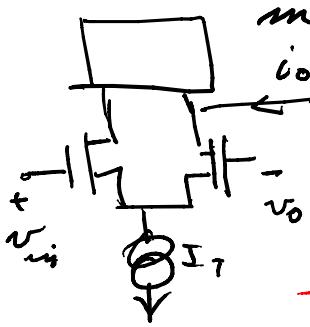




Load line equation

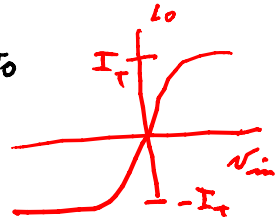
$$v_o = m v_1 + v_{in} \qquad m > 0$$

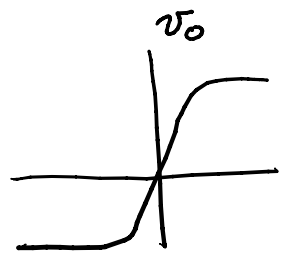
$$v_1 = \frac{v_o - v_{in}}{m}$$



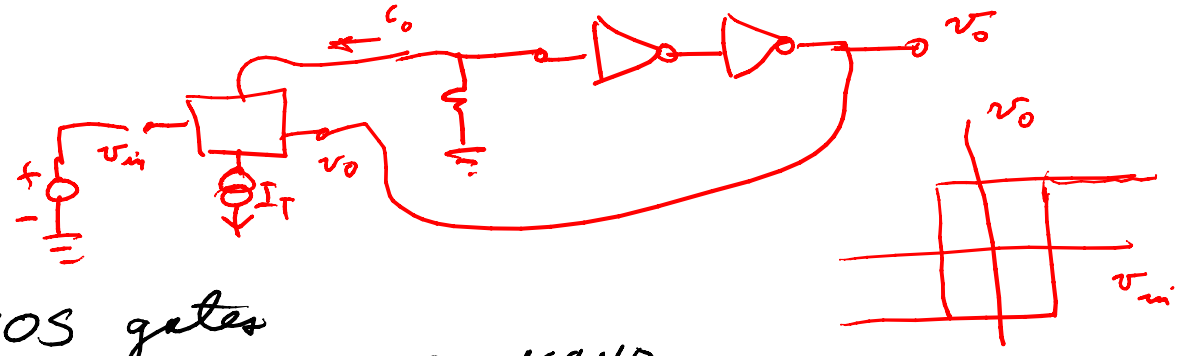
$$i_o = I_T f(-(v_o - v_{in}))$$

$$= -I_T f(v_o - v_{in})$$



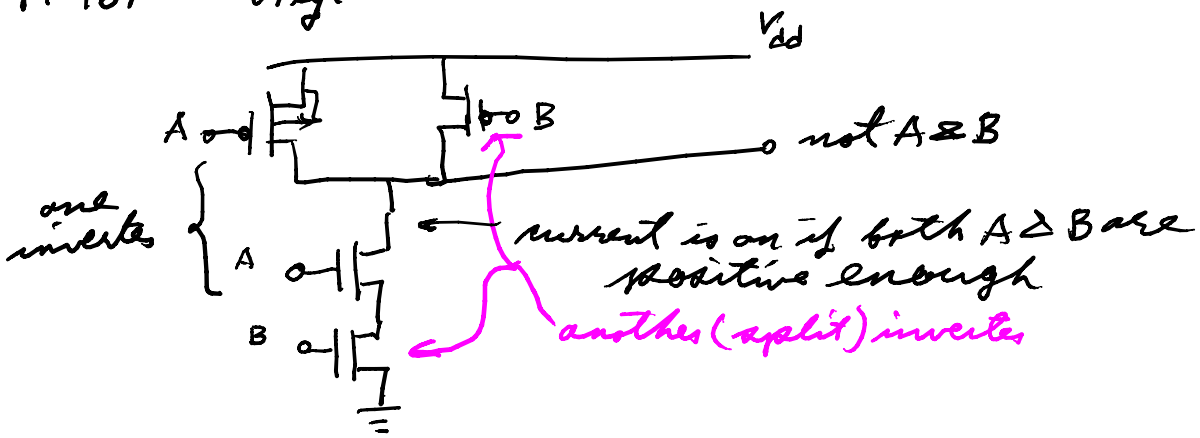


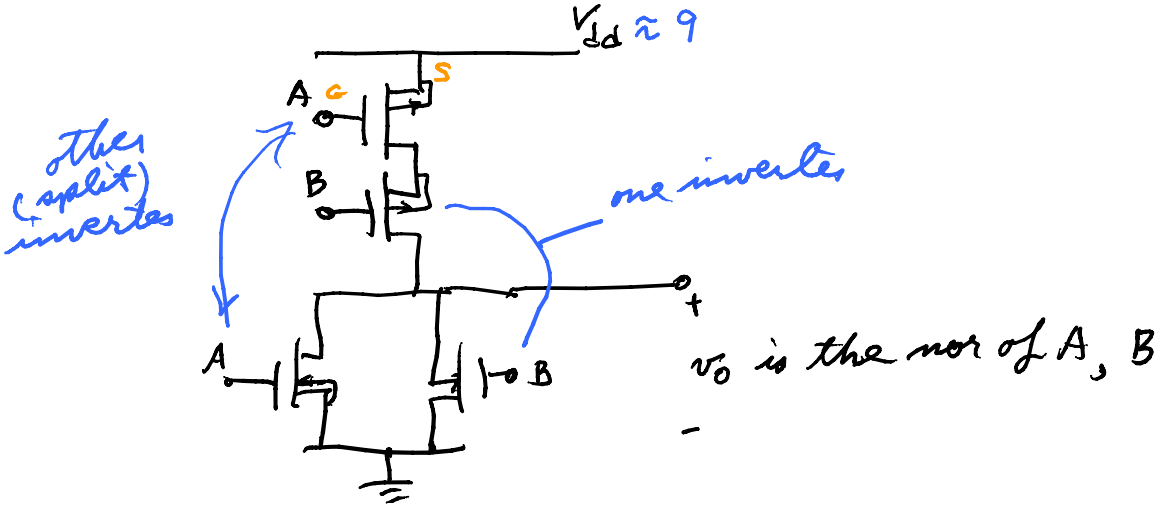
v_1 = input to cascade of inverters



CMOS gates

p. 967 Fig. 10.13 = NAND





v_o is the nor of A, B