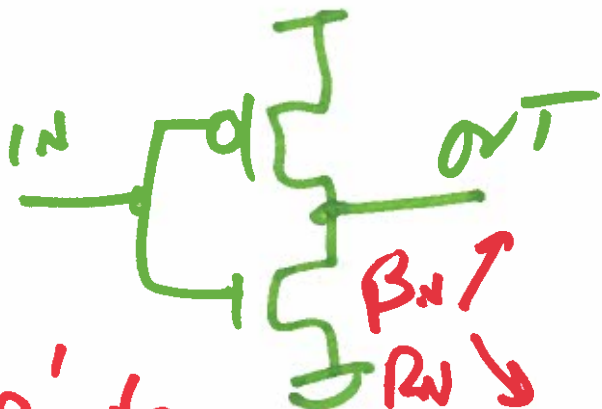


EE 421 / ELG 621

Digital IC Design

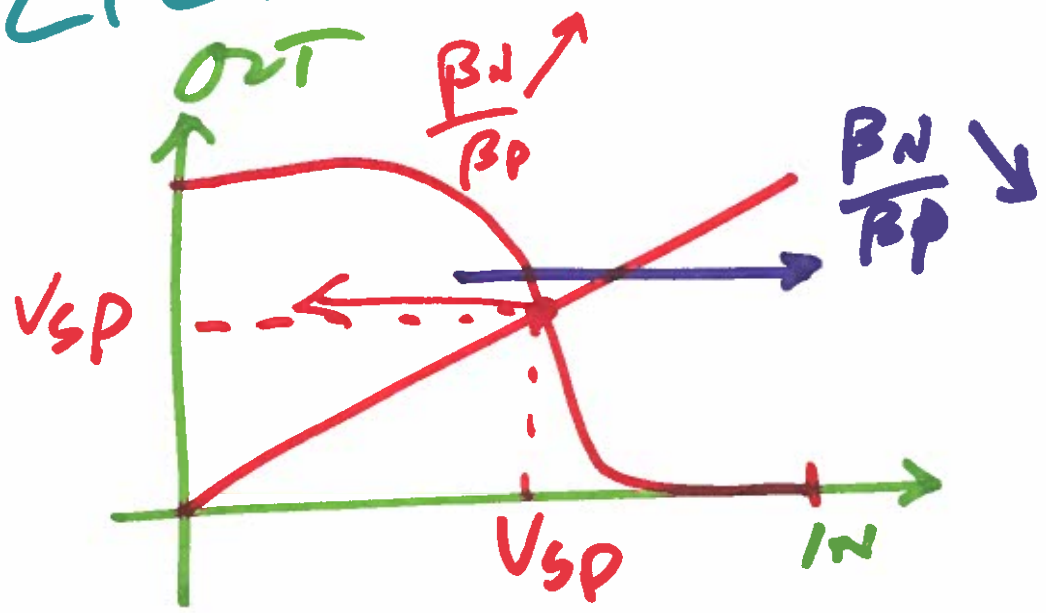
OCT. 30, 2019
Lecture 18

$$\beta_N = K_{PN} \cdot \frac{W}{L}$$



$$R_N = R_N' \cdot \frac{L}{W}$$

$$\beta_N \uparrow$$
$$R_N \downarrow$$
$$\frac{WN}{LW} \uparrow$$

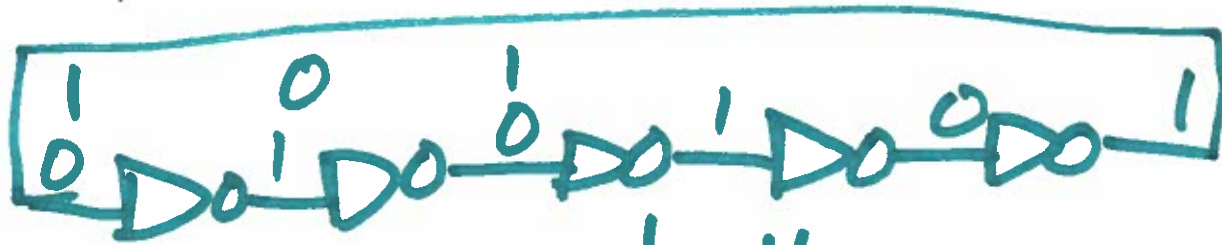


1)

Ring oscillator

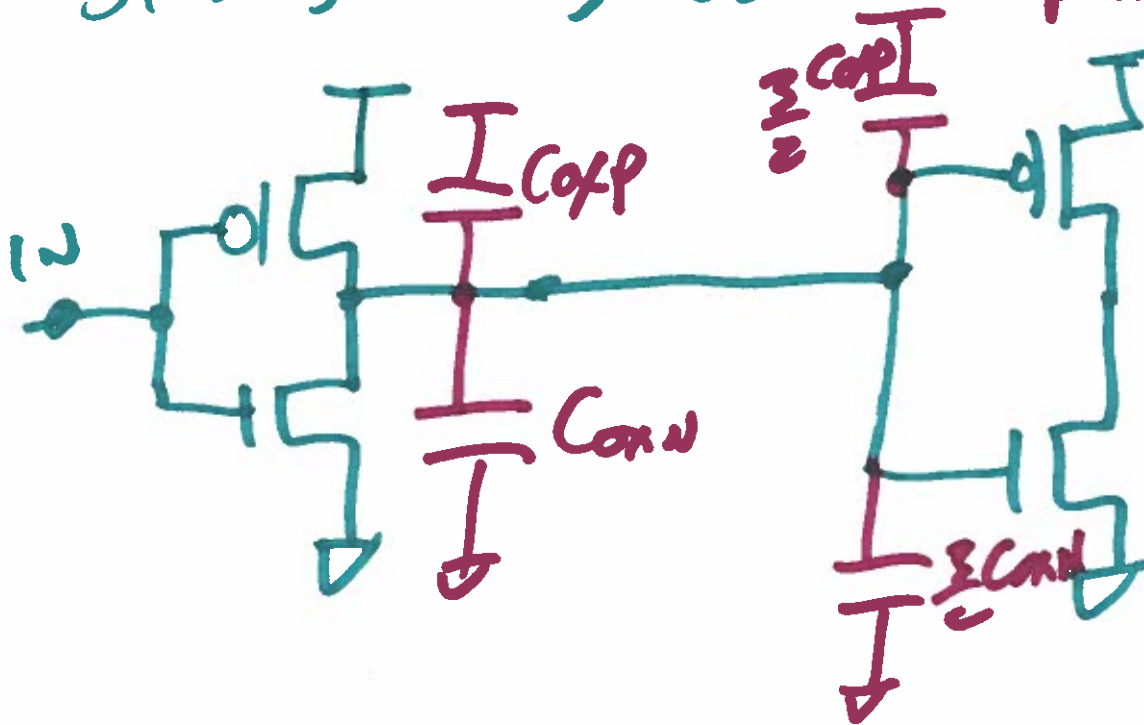
$$\frac{20}{1} \quad \frac{10}{1}$$

$$\frac{124}{.64} \quad \frac{64}{.64}$$



31-stage ring osc. Odd #

$$t_{PHL} = 0.7 \frac{R_N}{2} (C_{oxN} + C_{oxP})$$



$$t_{PHL} = 0.7 \cdot R_N \cdot \frac{2}{2} (C_{oxN} + C_{oxP})$$

2)

$$C_{TOT} = \frac{5}{2} (C_{oxN} + C_{oxP})$$

$$C_{oxN} = 64 \cdot 64 \cdot \frac{2.5 \text{ fF}}{4 \mu^2} = 9 \text{ fF}$$

$$R_N = 20 \text{ k} \cdot \frac{0.6}{6}$$

$$R_P = 40 \text{ k} \cdot \frac{0.6}{12}$$

$$C_{oxP} = 18 \text{ fF}$$

$$C_{TOT} = 2.5 \cdot 27 \text{ fF} = 40.5 \text{ fF}$$

$$= 67.5 \text{ fF}$$

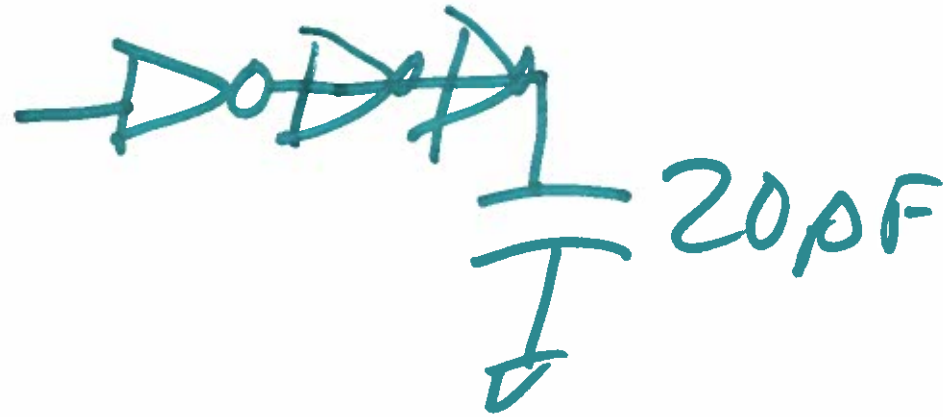
$$t_{pHL} = t_{pLH} = 0.7 \cdot 2 \text{ k} \cdot 67.5 \text{ fF}$$

$$= 94.5 \text{ ps}$$

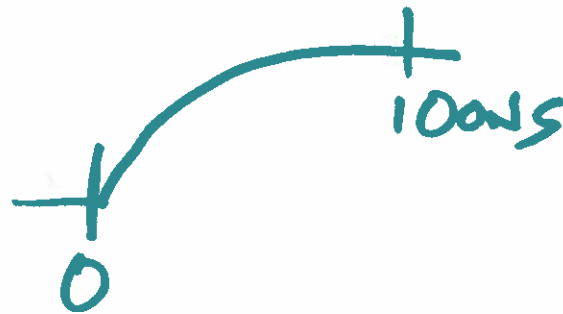
$$f_{osc} = \frac{1}{N(t_{pHL} + t_{pLH})}$$

$$= \frac{1}{31 \cdot 2 \cdot 94.5 \text{ ps}} = 170 \text{ MHz}$$

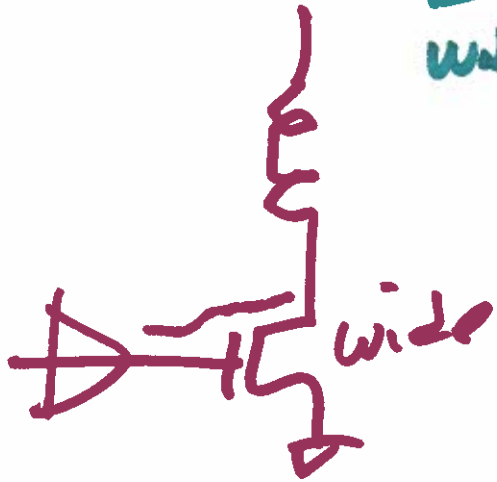
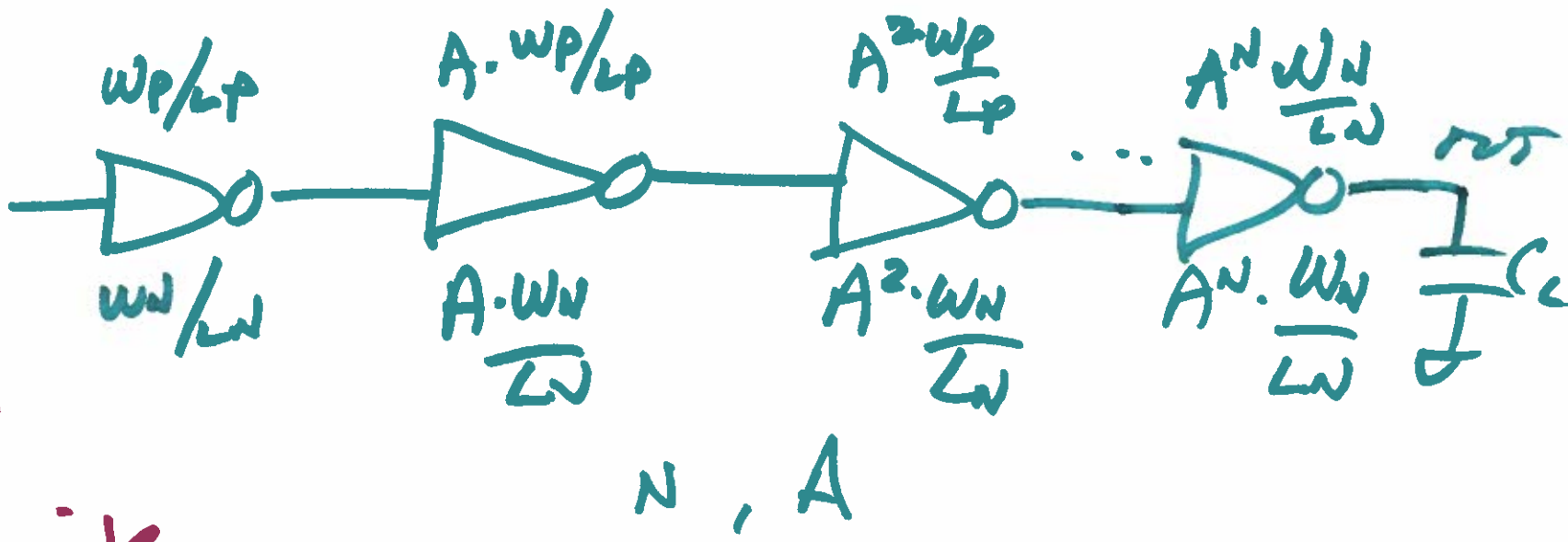
$$R_n = R_p = 2K$$



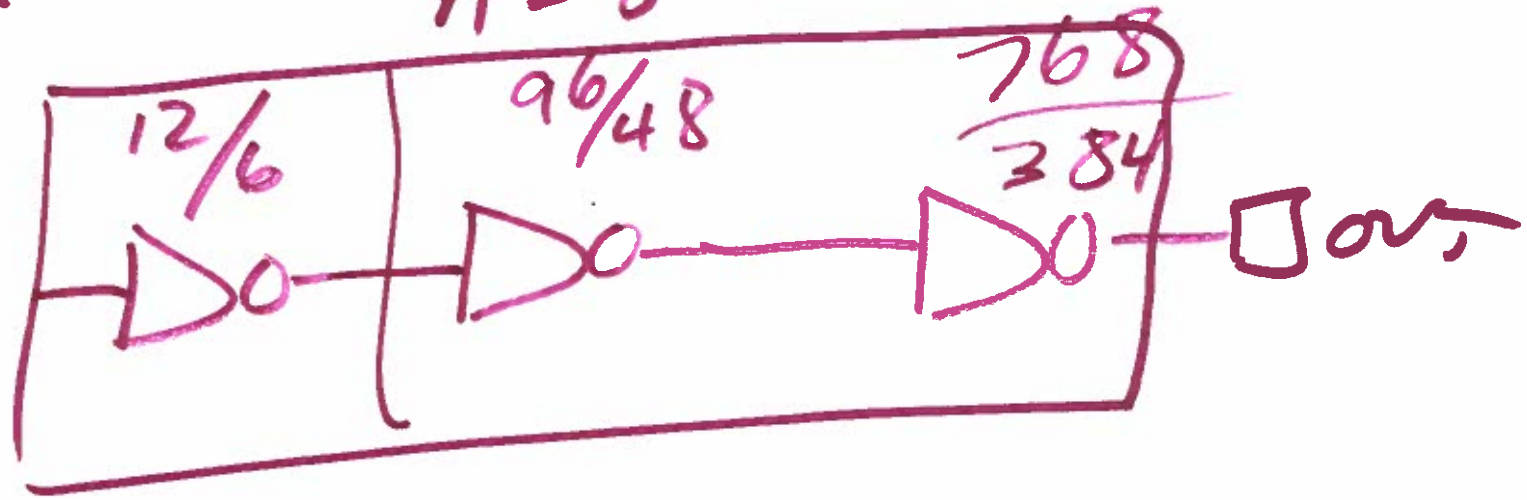
$$0.7 \cdot 2K \cdot 20pF = \underline{\underline{28ns}}$$



Q-



$A = 8$



5)

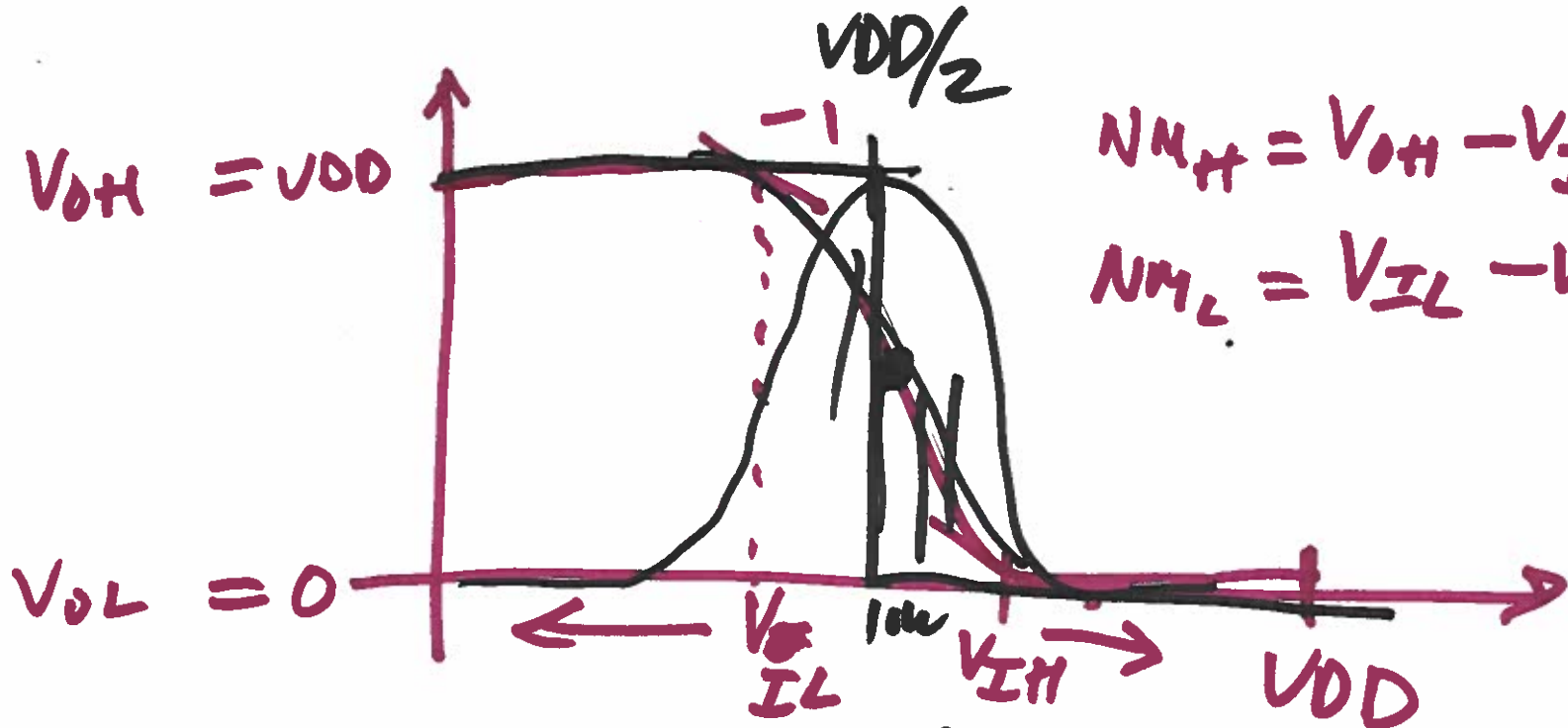
NOISE

Margins

LVDS

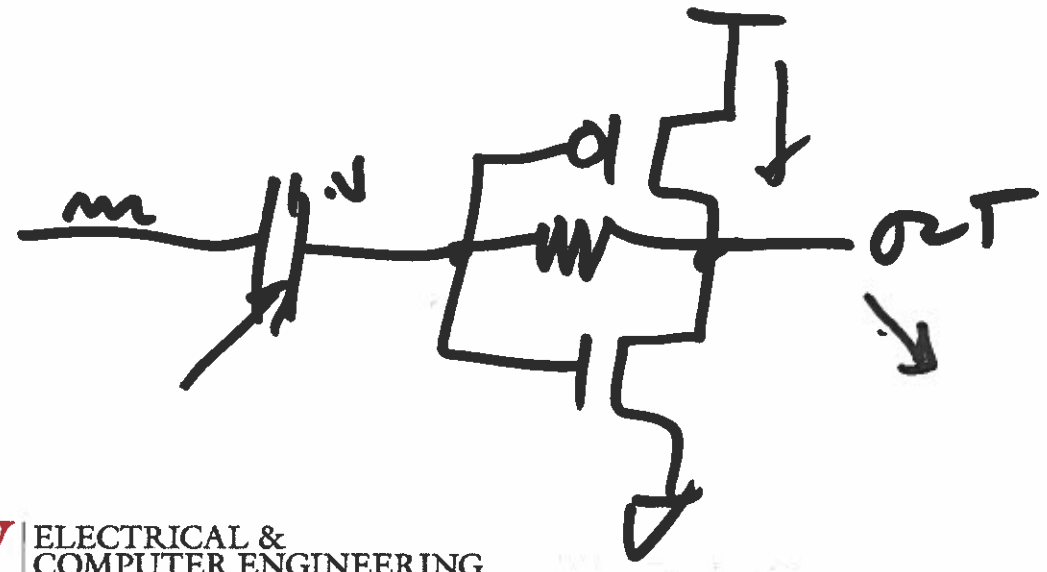
CSI

100mV

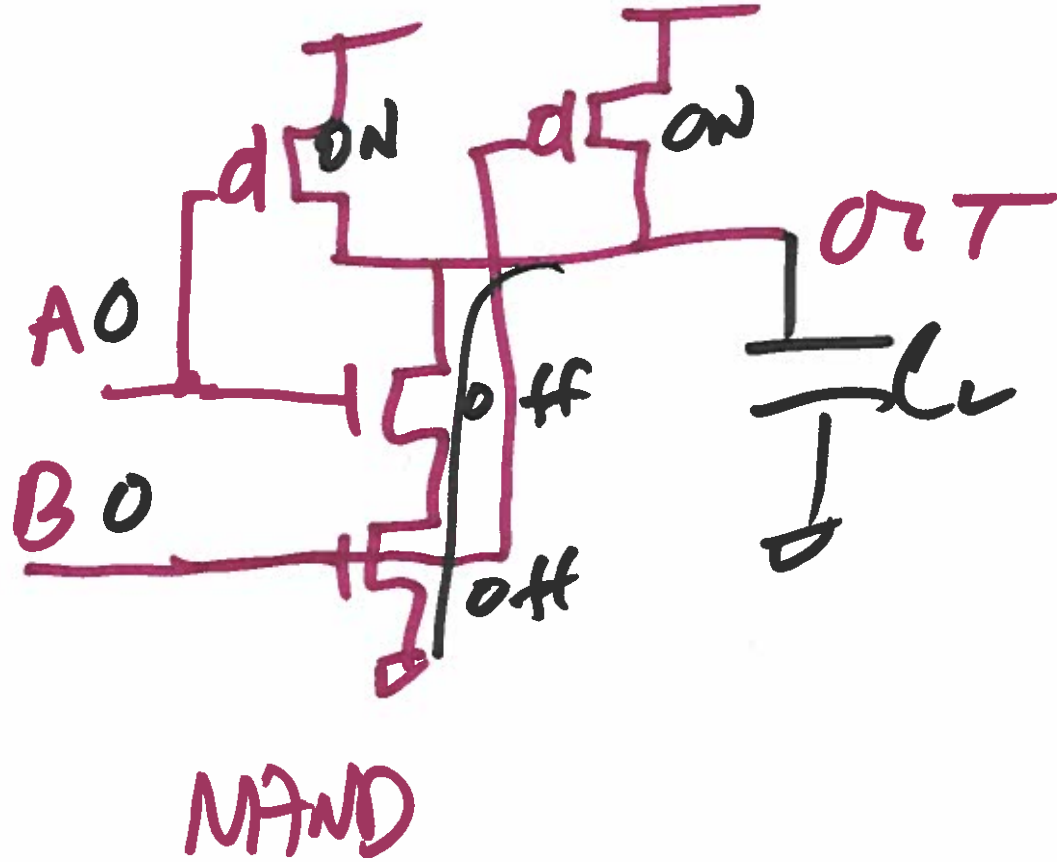


$$NM_H = V_{OH} - V_{IH}$$

$$NM_L = V_{IL} - V_{OL}$$



Static Logic



$$t_{pLH} = R_p \cdot 0.7 \cdot C_L$$

$$t_{pHL} = 0.7 \cdot 2R_n \cdot C_L$$

NOR GATE

