$V_{BE} = 0.71\,V$

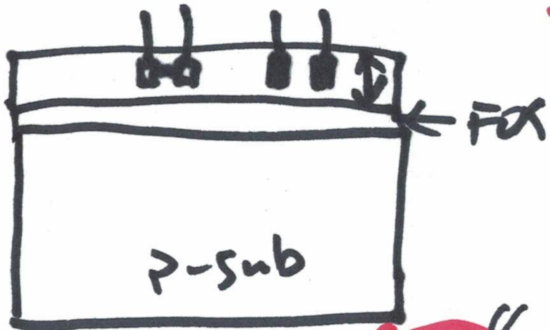
$I_C = 1\,mA$

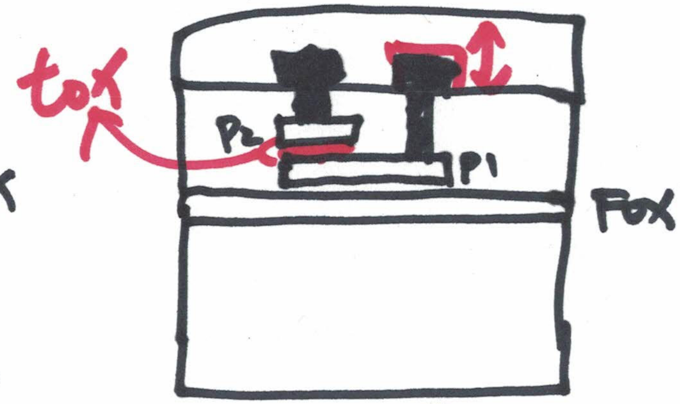
$V_{BE} = 0.69\,V$

I_C ?

$$I_C = I_S \cdot e^{V_{BE}/V_T}$$

$$\frac{I_{C1}}{I_{C2}} = \frac{I_S\, e^{V_{BE1}/V_T}}{I_S\, e^{V_{BE1}/V_T}}$$





$C = \varepsilon \cdot \frac{A}{d}$

not the capacitance

$C'_{ox} = \frac{\varepsilon_r \cdot \varepsilon_0}{t_{ox}} = \frac{\varepsilon_{ox}}{t_{ox}}$, $\varepsilon_0 = 8.85 \times 10^{-18}$ F/μm $= 8.85$ aF/μm

a: atto 10^{-18}

nano ← pico ← femto ← atto

nano 10^{-9}, pico 10^{-12}, femto 10^{-15}

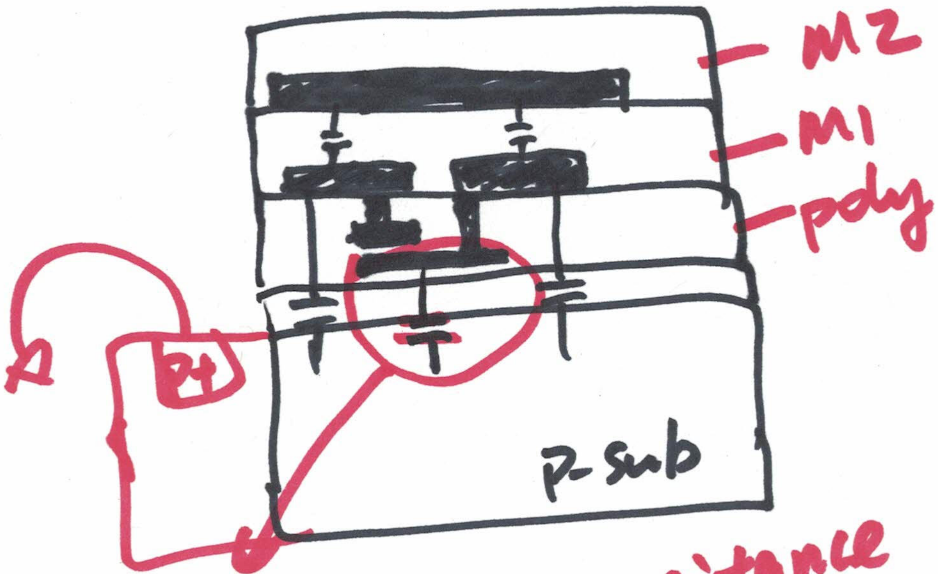
zepto: 10^{-21}

yocto: 10^{-24}

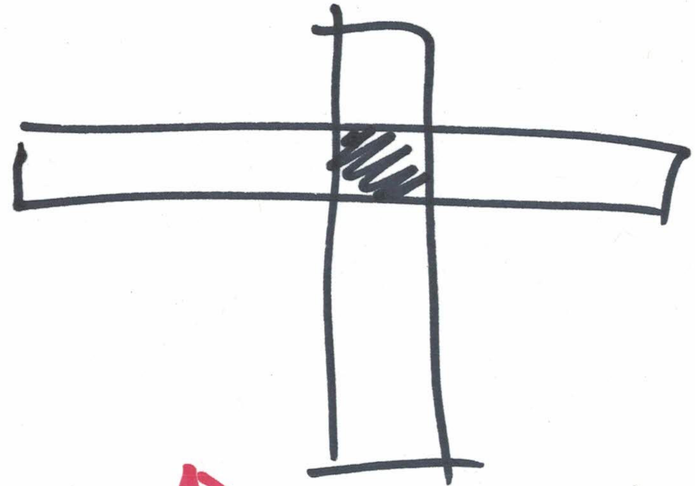
ε_0: permittivity of a vaccum

ε_r: permittivity of an insulator, SiO_2, $\varepsilon_r = 3.97$

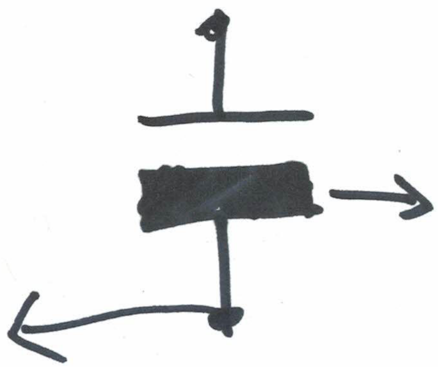
$C_{ox} = C'_{ox} \cdot A$



largest parasitics capacitance



$$C = \varepsilon \frac{A}{d}$$

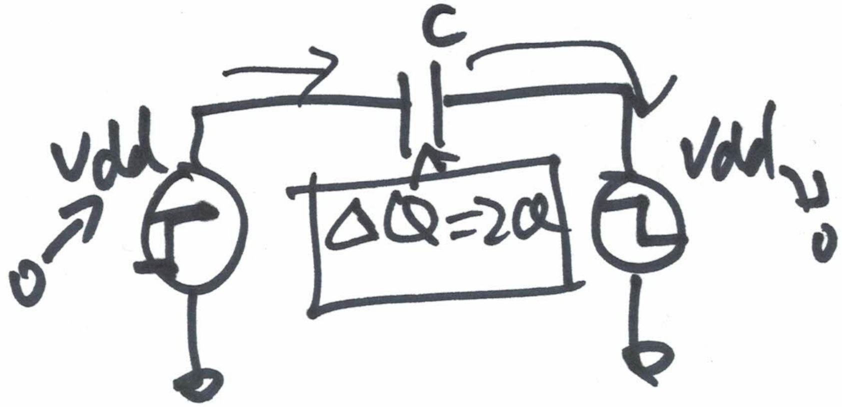


Models for Digital Design

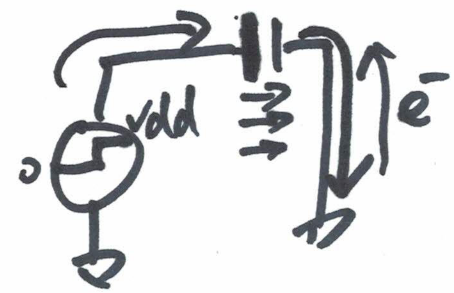
Miller Effect

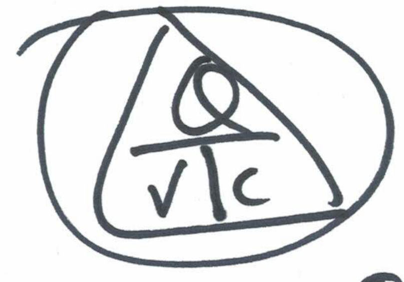
$\frac{V}{C}$ $\frac{C}{V}$

$Q = V \cdot C$



$Q = V \cdot C$





$\frac{Q}{V} = C$ $\frac{Q}{C} = V$

$V \cdot C = Q$