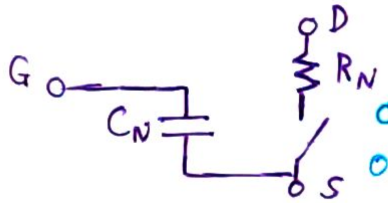
EECS 16B ## 1.28 LECTURE 3

this is a capacitor!

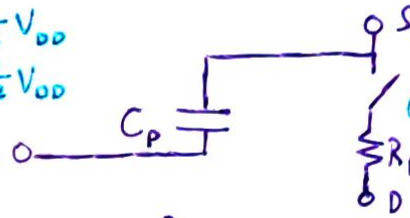
We'll model transitions between ON & OFF as occurring at $V_{GS} = \frac{1}{2} V_{DD}$.

Thus, we can simplify NMOS:



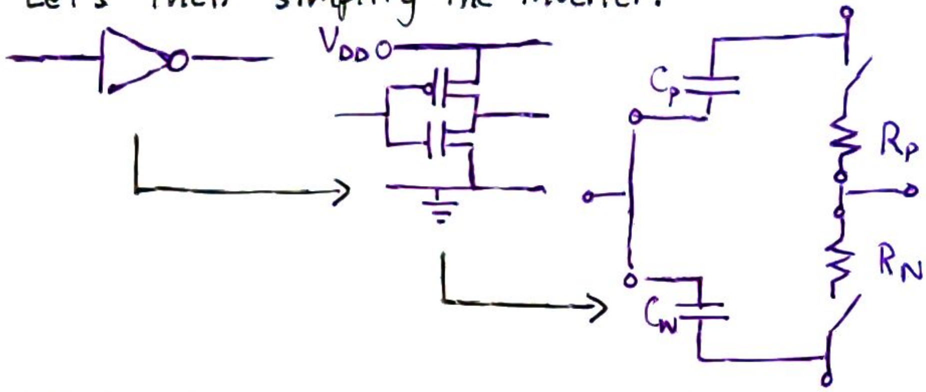
ON: $V_{GS} > \frac{1}{2} V_{DD}$
OFF: $V_{GS} < \frac{1}{2} V_{DD}$

Analogously for the PMOS:

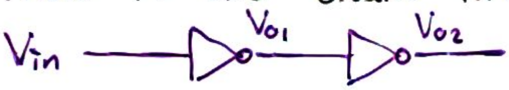


ON: $V_{gs} < -\frac{1}{2} V_{DD}$
OFF: $V_{gs} > -\frac{1}{2} V_{DD}$

Let's then simplify the inverter:



What if we chain inverters?



Before t_1, V_{o1} is high, V_{in} & V_{o2} are low

After t_1, $\quad V_{o1}/R_N + C_N \frac{d}{dt} V_{o1} + C_p \frac{d}{dt}(V_{o1} - \cancel{V_{DD}}) = 0$

$$\frac{d}{dt} V_{o1} + \frac{1}{\underbrace{R_N(C_N + C_p)}_{\text{time constant: } \Omega \cdot F = \text{seconds} \quad \tau}} V_{o1} = 0 \qquad V_{o1}(t_1) = V_{DD}$$

$\frac{d}{dt} V_{o1} = -\frac{1}{\tau} \cdot V_{o1} \qquad -\frac{1}{\tau} = \lambda \quad$ eigenvalues??

$\frac{d}{dt} V_{o1} = \lambda V_{o1} \qquad V_{o1}(t_1) = V_{DD}$

$V_{o1} = A e^{\lambda t} \longrightarrow A e^{\lambda t}\big|_{t_1} = A e^{\lambda t_1} = V_{DD} \qquad A = V_{DD} e^{-\lambda t_1}$

$V_{o1} = V_{DD} e^{-\lambda t_1} \cdot e^{\lambda t}$

Just solved a differential equation!