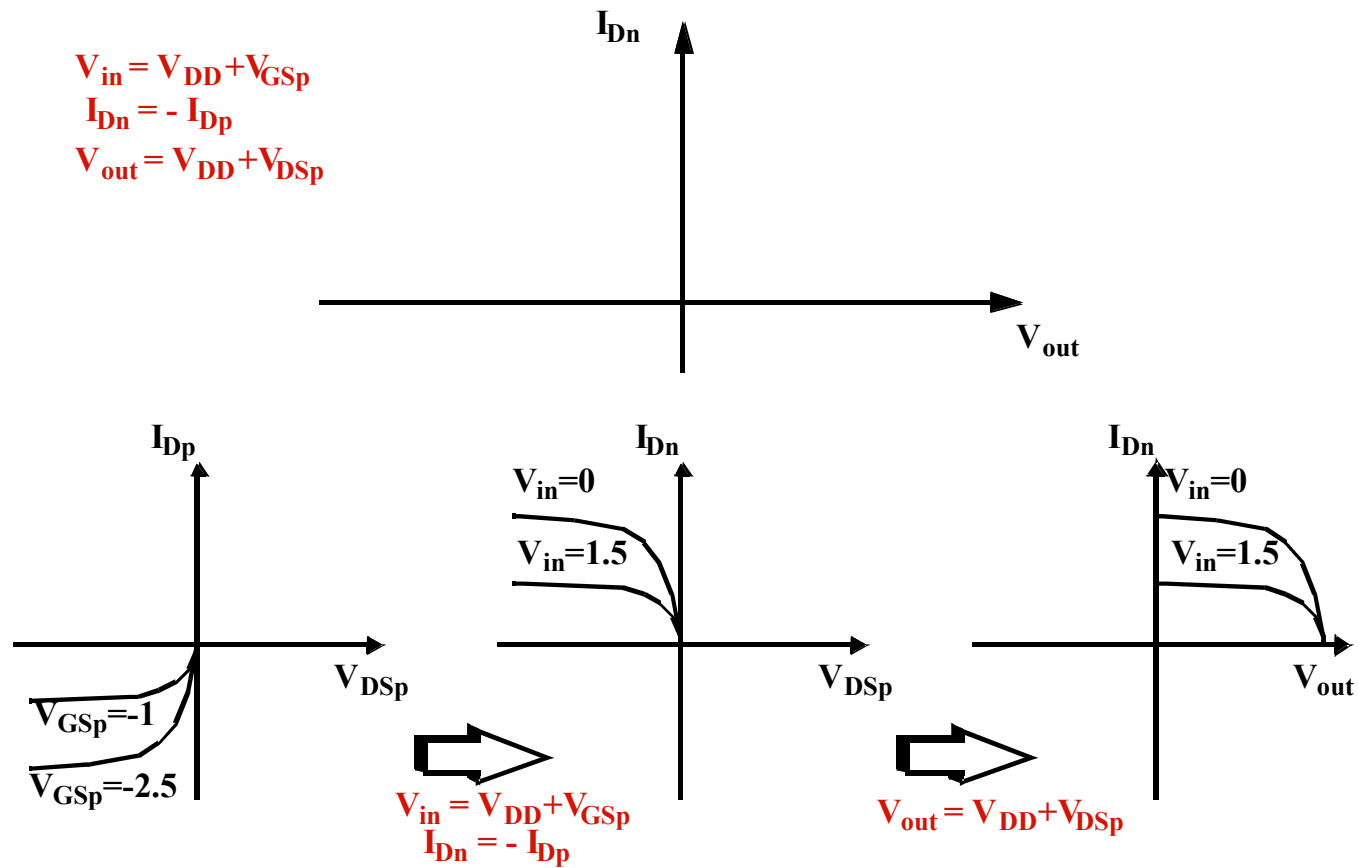
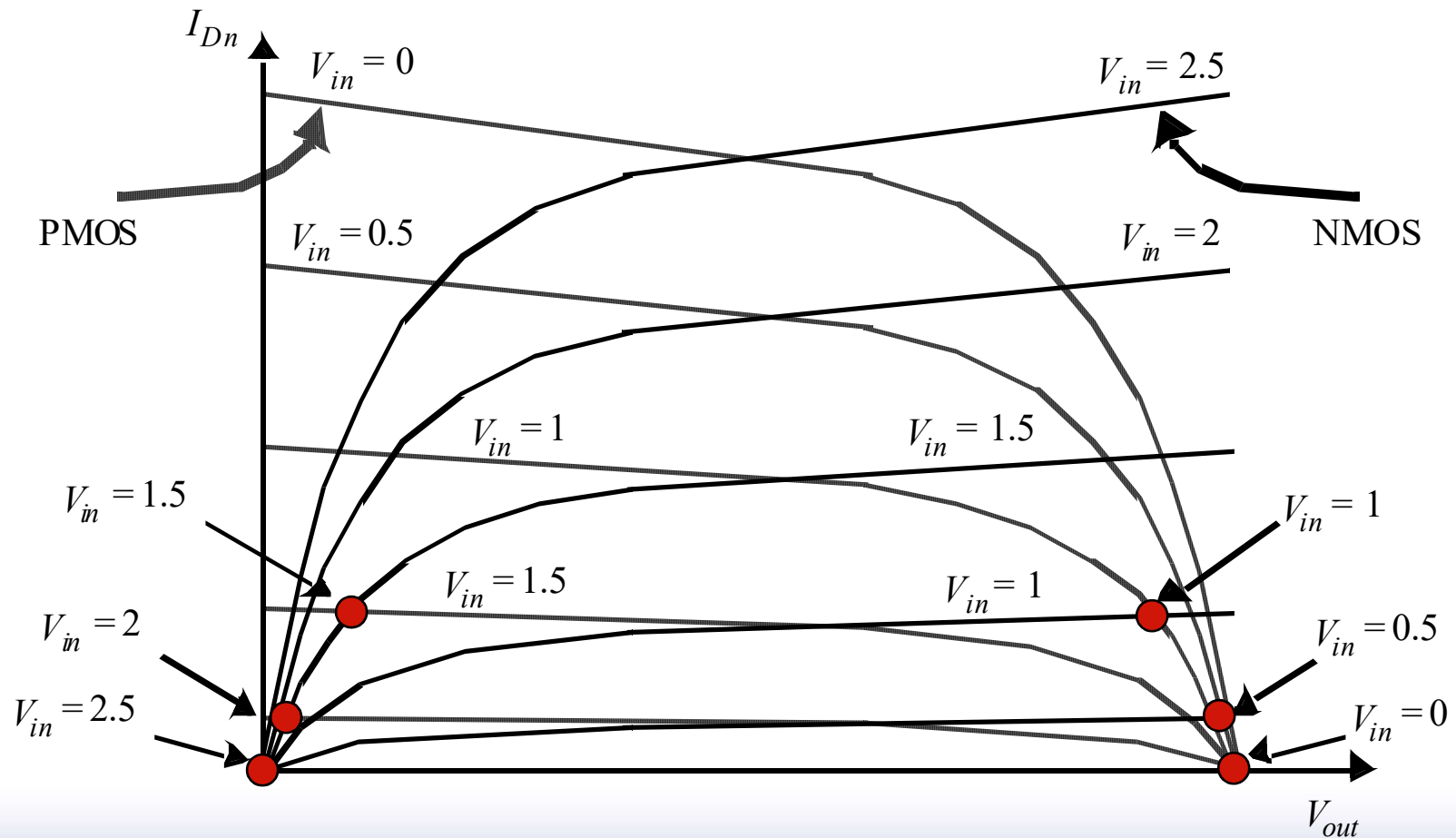


Voltage Transfer Characteristic

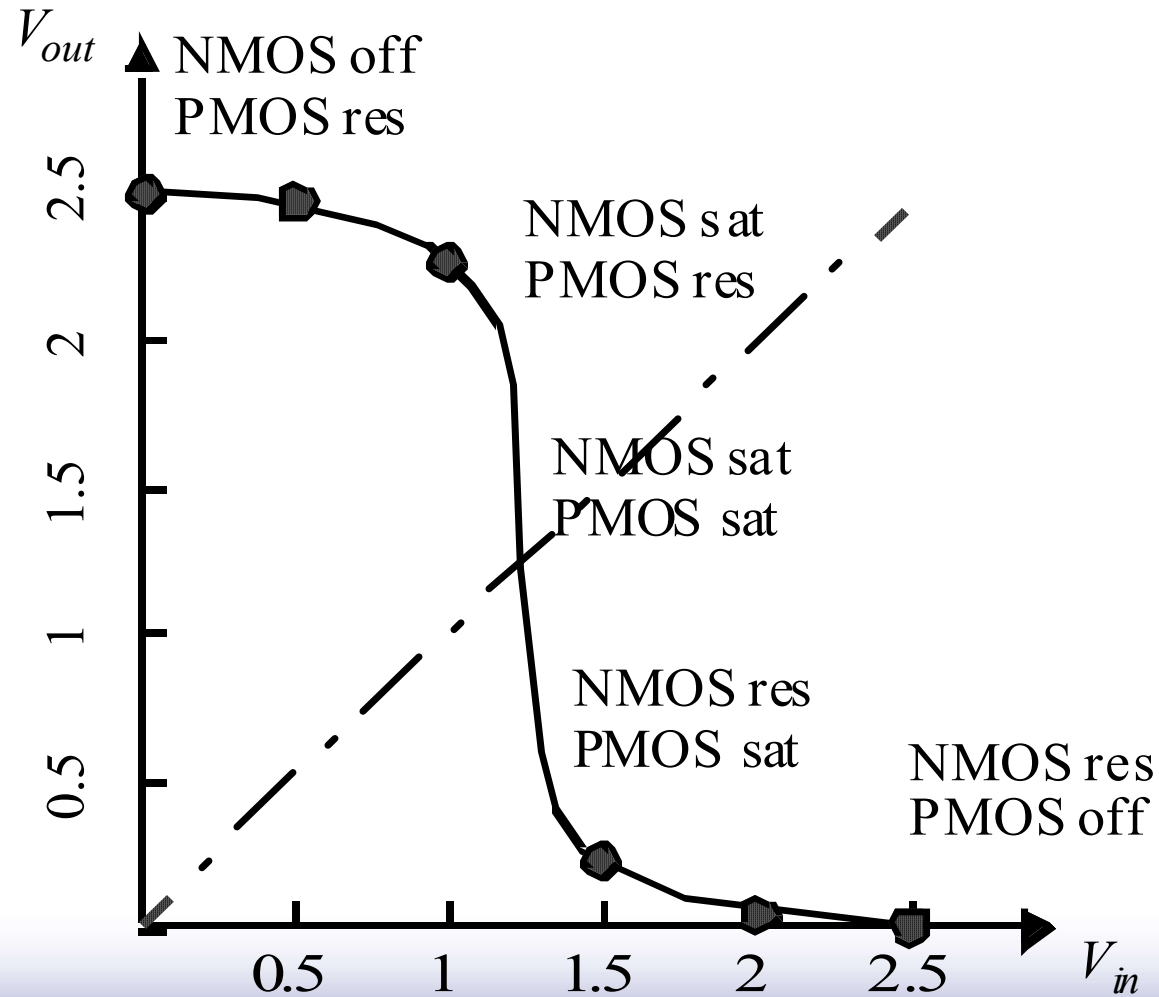
PMOS Load Lines



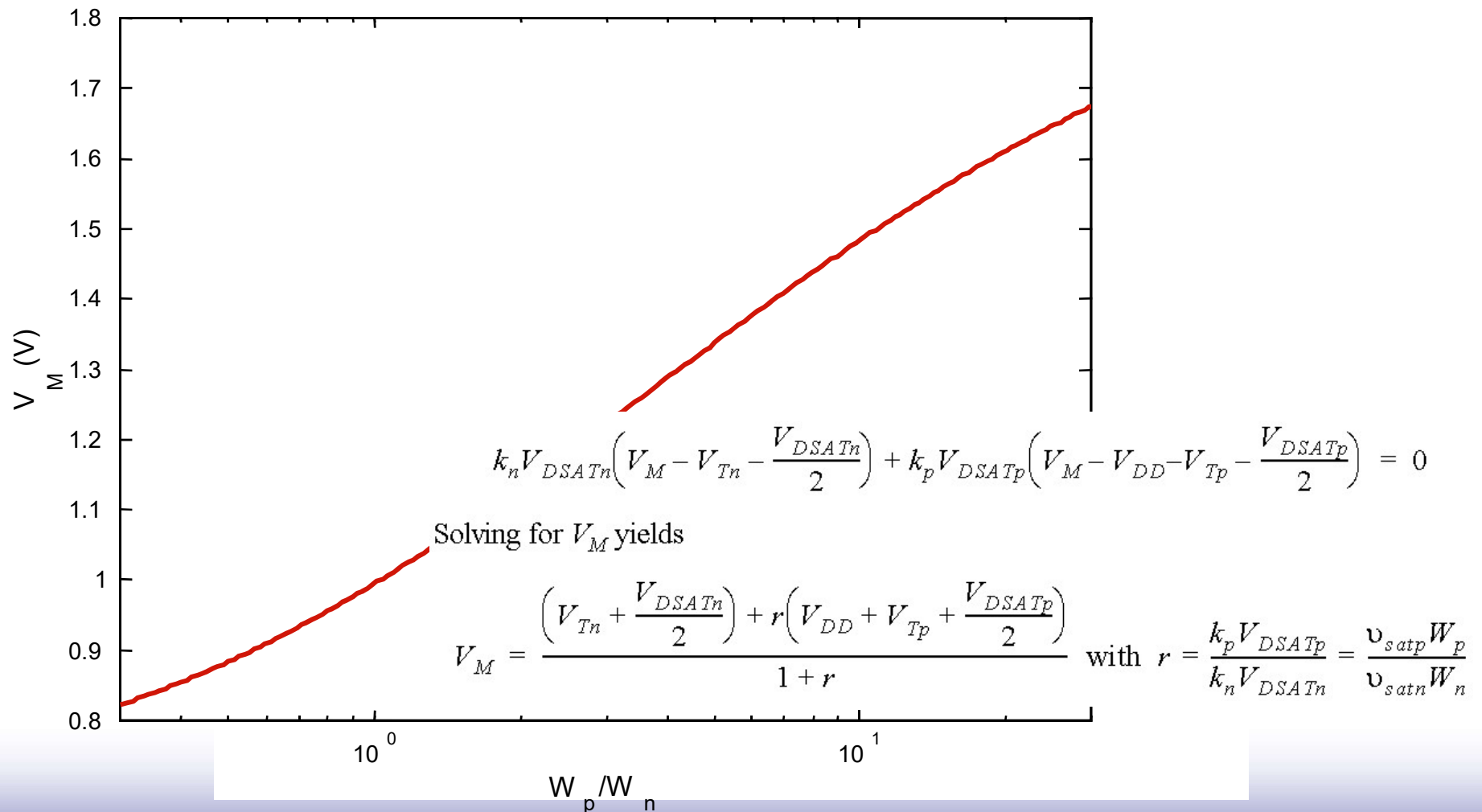
CMOS Inverter Load Characteristics



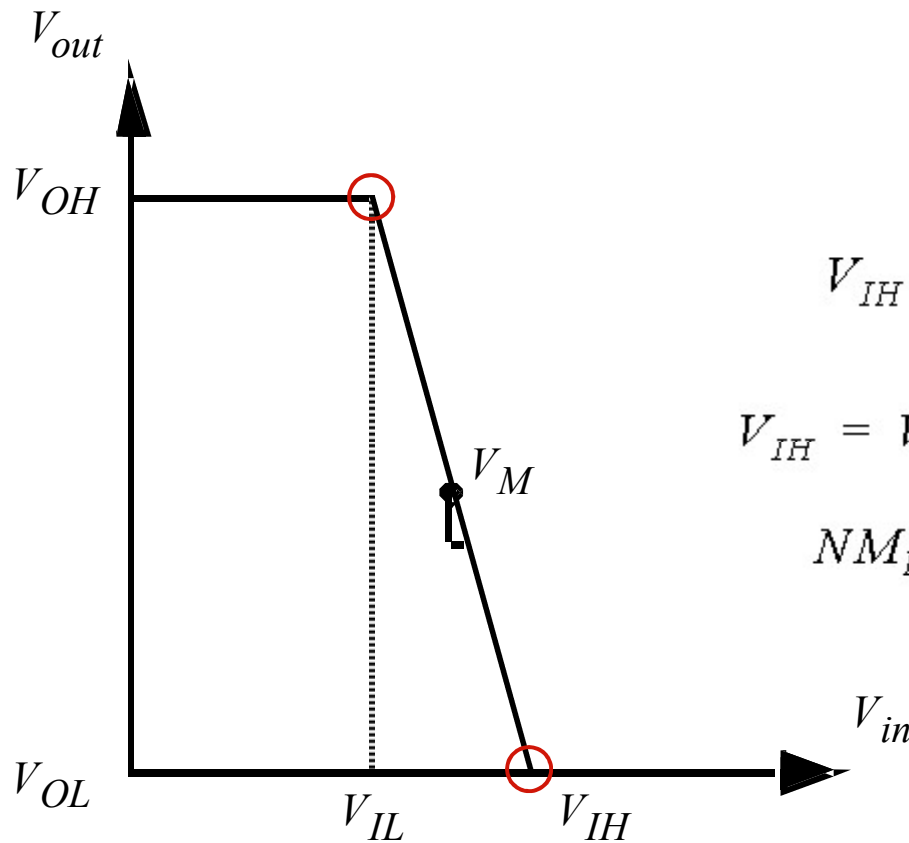
CMOS Inverter VTC



Switching Threshold as a function of Transistor Ratio



Determining V_{IH} and V_{IL}



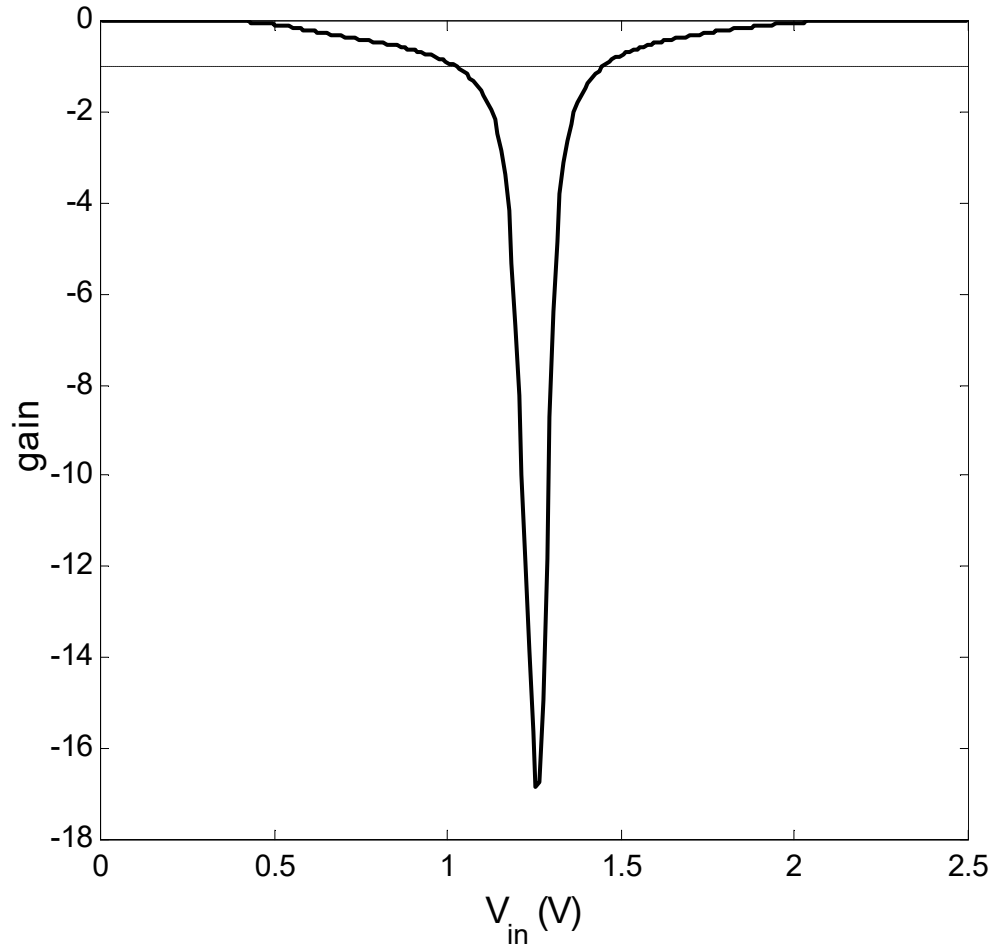
$$V_{IH} - V_{IL} = -\frac{(V_{OH} - V_{OL})}{g} = \frac{-V_{DD}}{g}$$

$$V_{IH} = V_M - \frac{V_M}{g} \quad V_{IL} = V_M + \frac{V_{DD} - V_M}{g}$$

$$NM_H = V_{DD} - V_{IH} \quad NM_L = V_{IL}$$

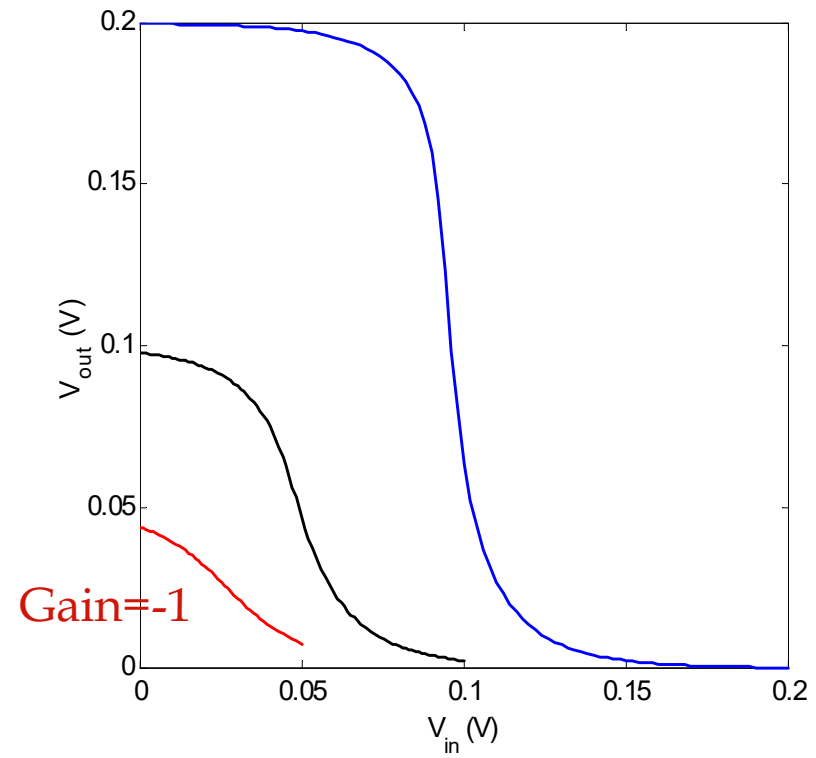
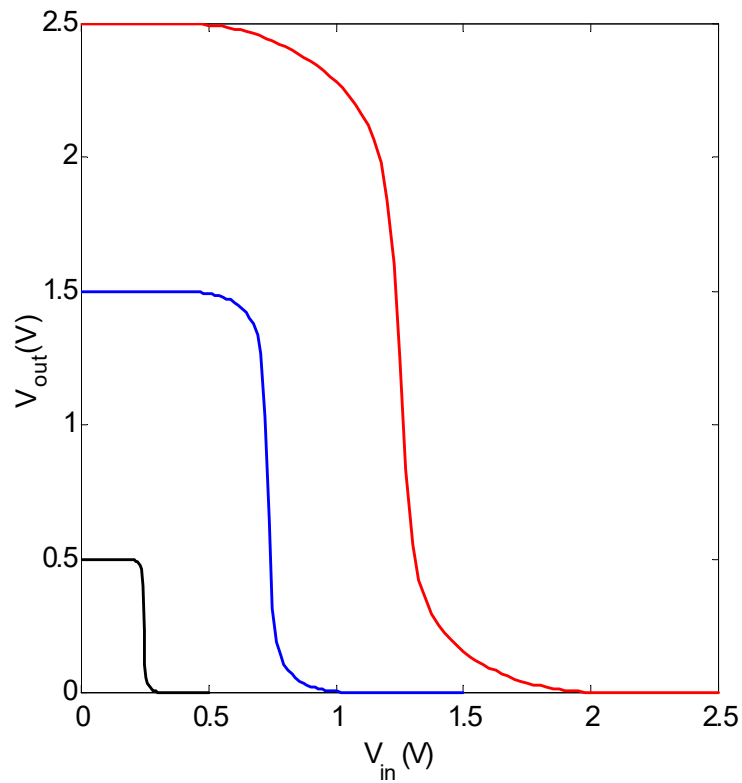
A simplified approach

Inverter Gain

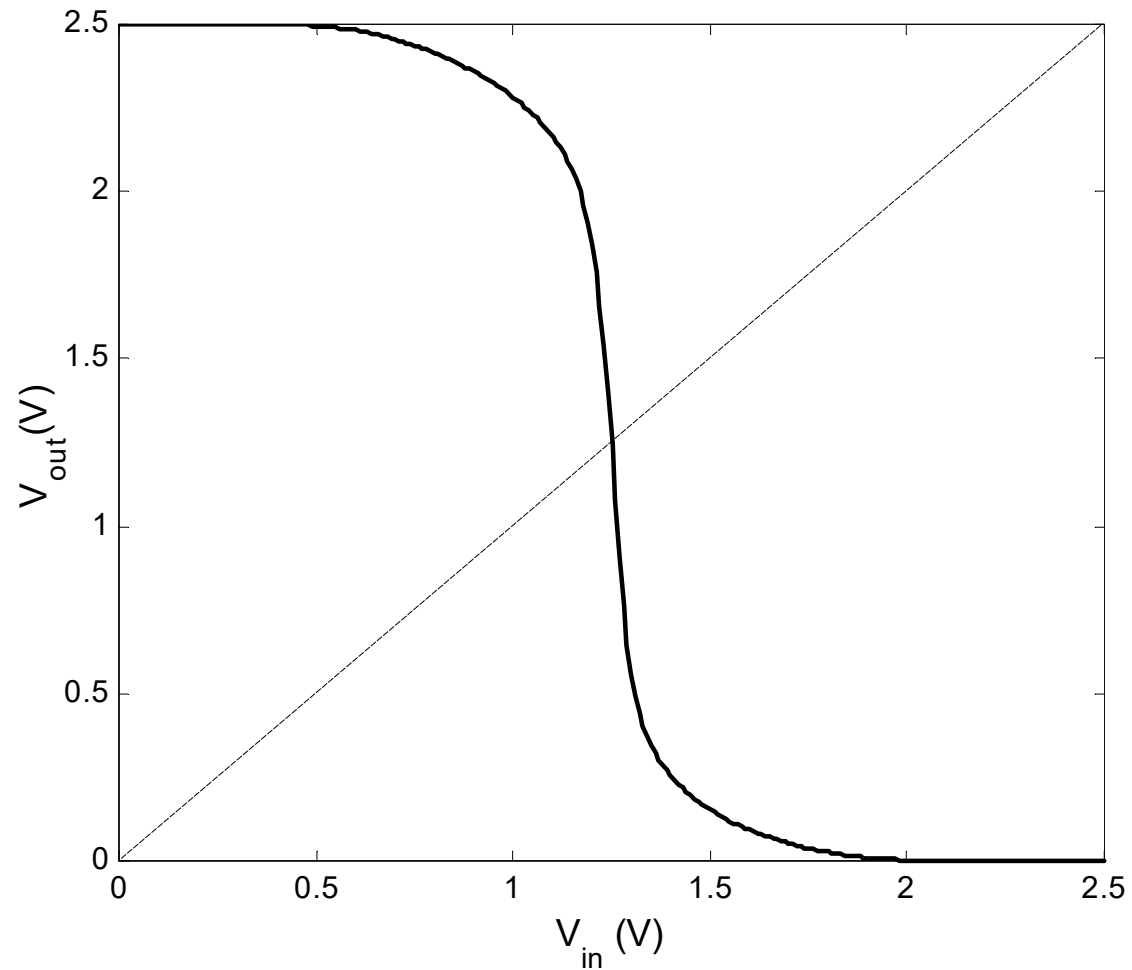


$$g = -\frac{1}{I_D(V_M)} \frac{k_n V_{DSATn} + k_p V_{DSATp}}{\lambda_n - \lambda_p}$$
$$\approx \frac{1+r}{(V_M - V_{Tn} - V_{DSATn}/2)(\lambda_n - \lambda_p)}$$

Gain as a function of VDD



Simulated VTC



Impact of Process Variations

