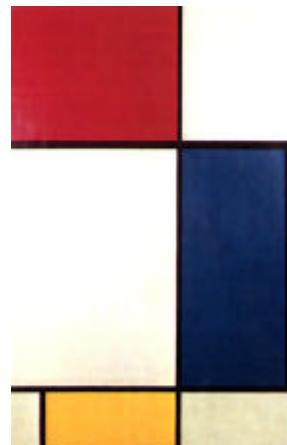


MOS Capacitances

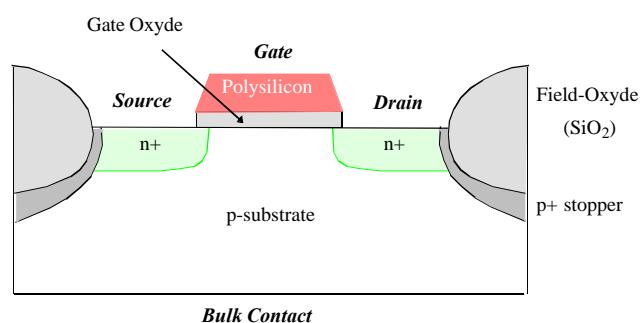


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The MOS Transistor



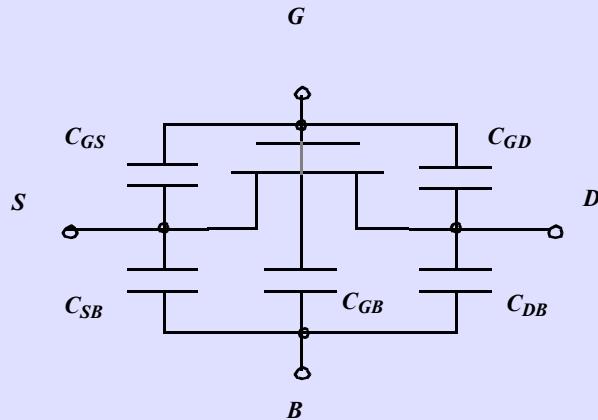
CROSS-SECTION of NMOS Transistor

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Dynamic Behavior of MOS Transistor

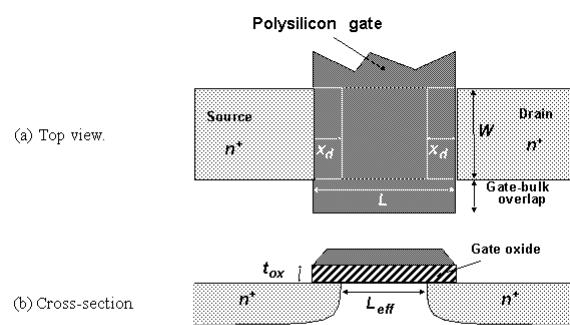


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The Gate Capacitance



$$C_{gate} = \frac{\epsilon_{ox}}{t_{ox}} WL$$

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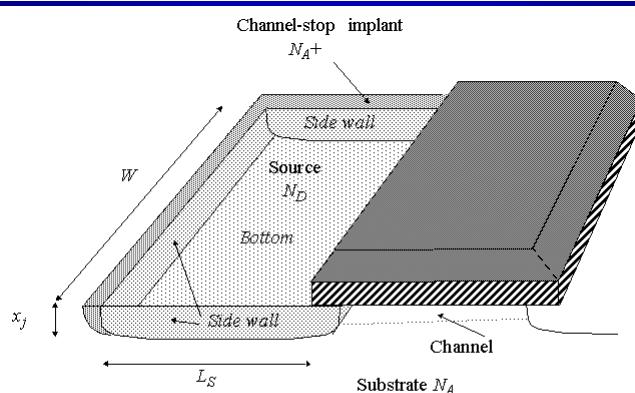
Average Gate Capacitance

Different distributions of gate capacitance for varying
operating conditions

Operation Region	C_{gb}	C_{gs}	C_{gd}
Cutoff	$C_{ox}WL_{eff}$	0	0
Triode	0	$C_{ox}WL_{eff}/2$	$C_{ox}WL_{eff}/2$
Saturation	0	$(2/3)C_{ox}WL_{eff}$	0

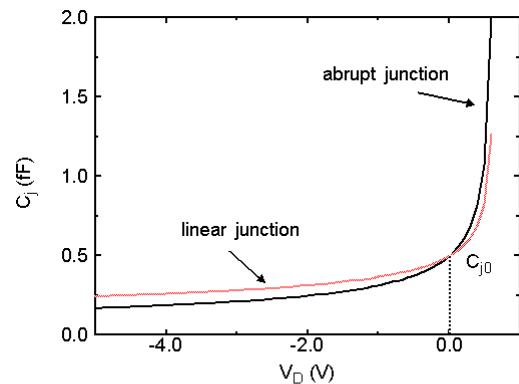
For manual analysis: $C_G = C_{GS} + C_{GD} + C_{GB} = C_{ox}WL$

Diffusion Capacitance



$$C_{diff} = C_{bottom} + C_{sw} = C_j \times AREA + C_{jsw} \times PERIMETER \\ = C_j L_S W + C_{jsw} (2L_S + W)$$

Junction Capacitance



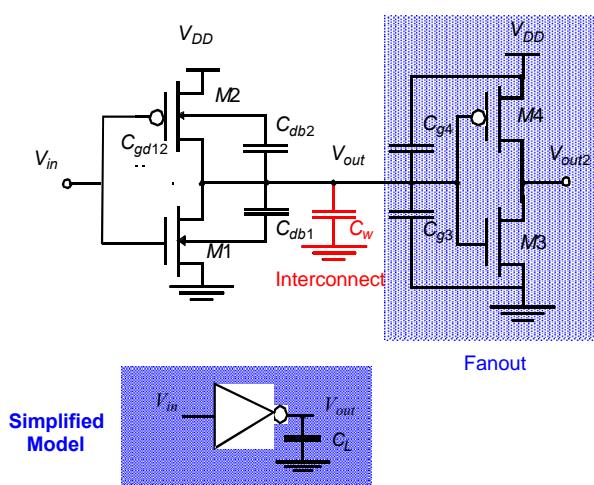
$$C_j = \frac{C_{j0}}{(1 - V_D/\phi_0)^m}$$

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Computing the Capacitances

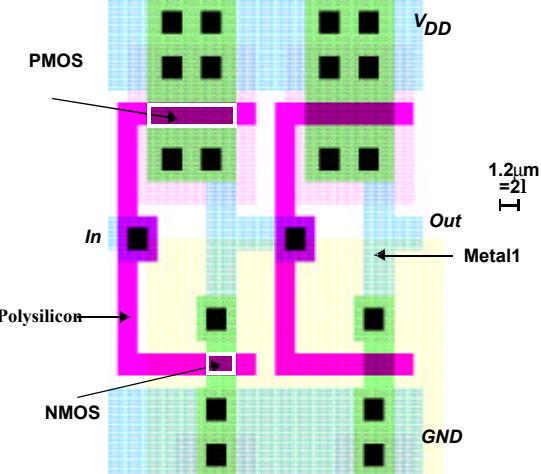


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CMOS Inverters

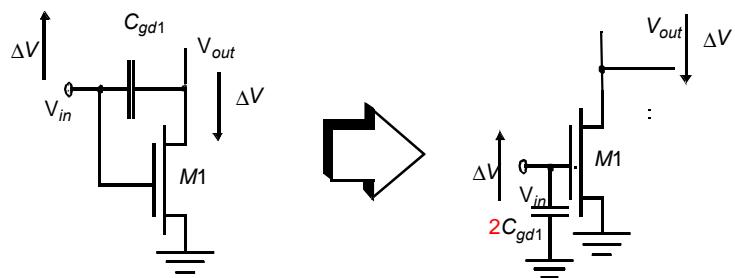


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The Miller Effect



"A capacitor experiencing identical but opposite voltage swings at both its terminals can be replaced by a capacitor to ground, whose value is two times the original value."

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