1. Pre-Lab

1.1.

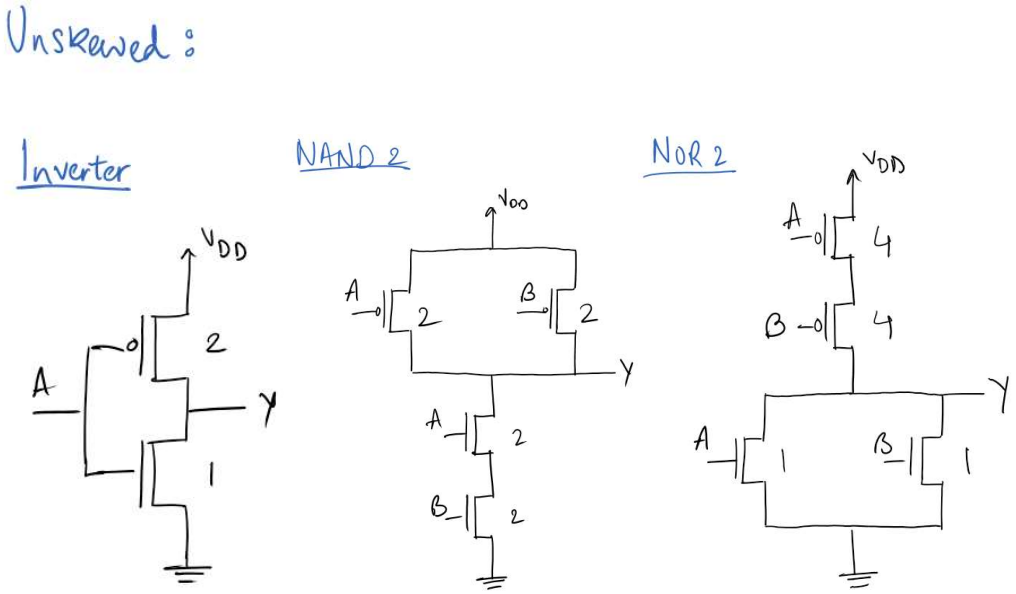


Figure 1: Unskewed Inverter, NOR2 and NAND2 gates.

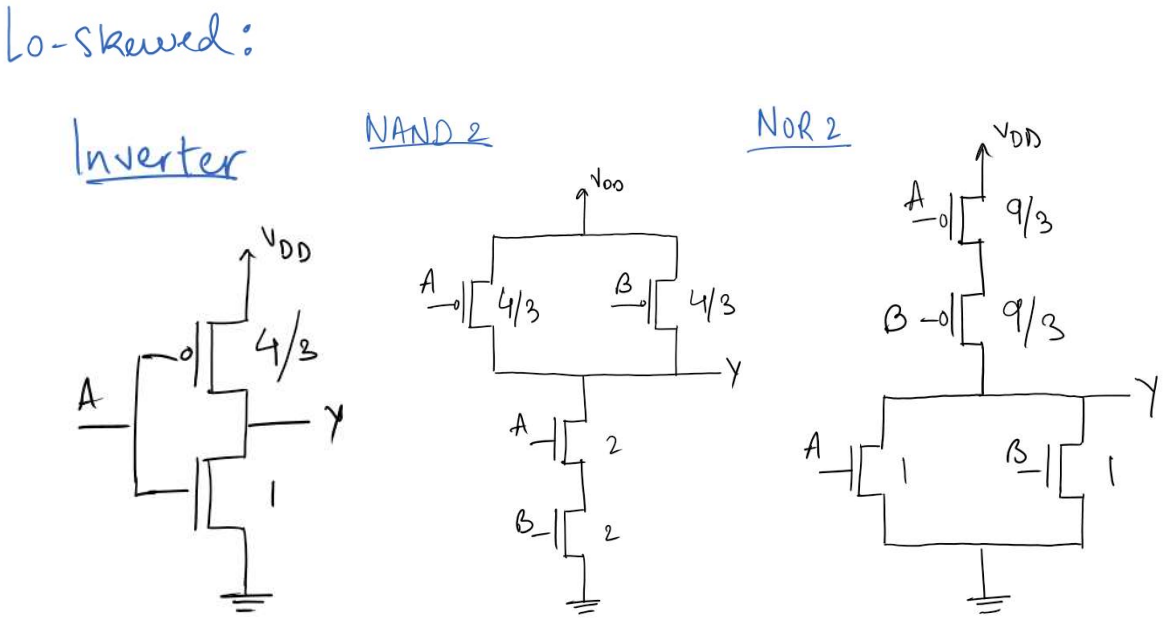


Figure 2: Low-skewed Inverter, NOR2 and NAND2 gates.

Hi-skewed:

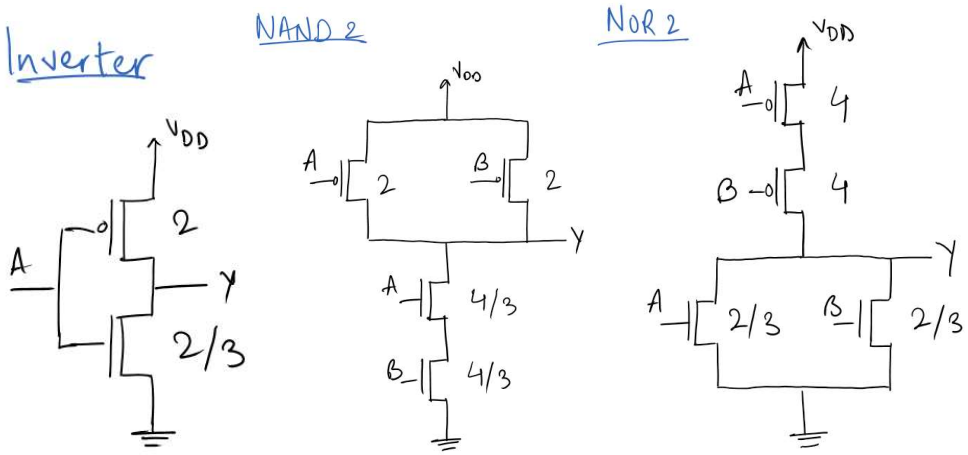
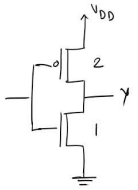


Figure 3: High-skewed Inverter, NOR2 and NAND2 gates.

1.2

NAND2:

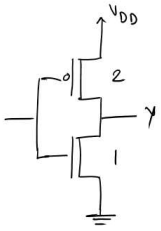
Unskewed - up



$g_u = \frac{C_{in}}{C_{inv}} = \frac{2+2}{2+1} = \frac{4}{3}$

$P_u = \frac{C_{out}}{C_{oinv}} = \frac{2+2+2}{2+} = 2$

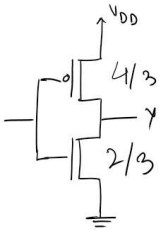
Unskewed - down



$g_d = \frac{C_{in}}{C_{inv}} = \frac{2+2}{2+1} = \frac{4}{3}$

$P_u = \frac{C_{out}}{C_{oinv}} = \frac{2+2+2}{2+} = 2$

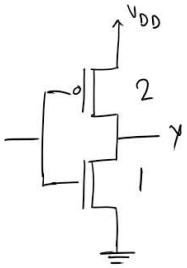
Lo - skewed - up



$\frac{2R}{\frac{2R}{4/3}} = 4/3$

$g_u = \frac{2 + 4/3}{4/3 + 2/3} = 1.67$

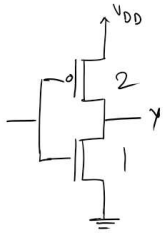
Lo - skewed - down



$\frac{R}{\frac{R}{2} \times 2} = 1$

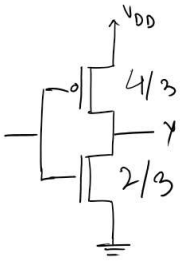
$g_d = \frac{2 + 4/3}{3} = 1.11$

Hi - skewed - up



$g_u = \frac{2 + 4/3}{3} = 1.11$

Hi - skewed - down



$\frac{R}{\frac{R}{4/3} \times 2} = 2/3$

$g_d = \frac{2 + 4/3}{4/3 + 2/3} = 1.67$

$g_{avg}\ (\text{unskewed}) = \frac{4}{3} = 1.33$

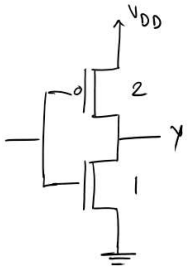
$g_{avg}\ (\text{lo-skewed}) = \frac{g_u + g_d}{2} = 1.388$

$g_{avg}\ (\text{hi-skewed}) = g_{avg} = 1.388$

Figure 4: Rising, falling, and average logic effort for the unskewed, high-skewed and low-skewed NAND2 gate.

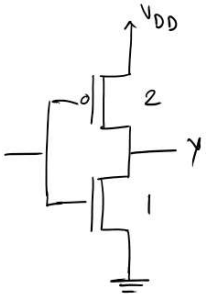
NOR2:

Unskewed - up



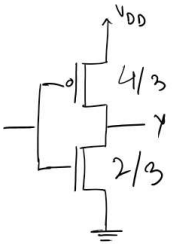
$g_u = \frac{C_{in}}{C_{inv}} = \frac{5}{3}$

Unskewed - down



$g_d = \frac{C_{in}}{C_{inv}} = \frac{5}{3}$

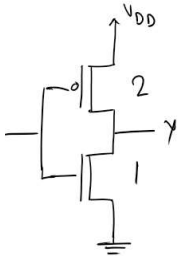
Lo - skewed - up



$\frac{2R}{\frac{2R}{8/3} \times 2} = 4/3$

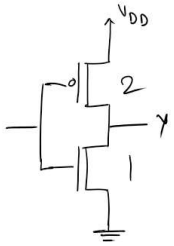
$g_u = \frac{8/3 + 1}{4/3 + 2/3} = 1.833$

Lo - skewed - down



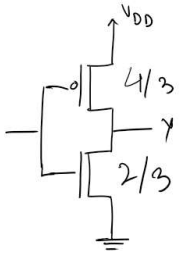
$g_d = \frac{8/3 + 1}{3} = 1.22$

Hi - skewed - up



$g_u = \frac{2/3 + 4}{3} = 1.556$

Hi - skewed - down



$\frac{R}{\frac{R}{2/3}} = 2/3$

$g_d = \frac{2 + 4/3}{4/3 + 2/3} = 2.33$

$g_{avg}\ (\text{unskewed}) = \frac{5}{3} = 1.667$

$g_{avg}\ (\text{lo-skewed}) = \frac{g_u + g_d}{2} = 1.5275$

$g_{avg}\ (\text{hi-skewed}) = g_{avg} = 1.94465$

Figure 5: Rising, falling, and average logic effort for the unskewed, high-skewed and low-skewed NOR2 gate.