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## Homework 10 Solutions

### 10.1 Logic Functions

a) The logic function for Vout1 is
$(\overline{\mathrm{A} 1+\mathrm{B} 1})$
b) The logic function for Vout2 is

Vout2 $=((\mathrm{B} 2 * \mathrm{C} 2)+\mathrm{A} 2)$
c) What is the propagation delays of this circuit in terms of inverter delays?

$$
\tau_{\text {PD_CASCADE }}=\tau_{\text {PD_1 }}+\tau_{\text {PD_2 }}
$$

Tpd_1 = 2Tinv and Tpd $\_2=2$ Tinv
Therefore, Tpd_cascade $=4$ Tinv
10.2 Average Resistances Use the circuit to the right.
a) Evaluate the equivalent resistance of the pull down network for $\mathrm{Vdd}=5 \mathrm{~V}$, $\mathrm{Vth}=1 \mathrm{~V}$, Vin $=2 \mathrm{~V}$ and Vout_sat=1V
Use:
$I_{\text {OUT-SAT-n }}=k_{n}^{\prime}\left(\frac{W}{L}\right)_{n}\left(V_{I N}-V_{T n}\right) V_{O U T-S A T-n}$
We find for $\mathrm{Vdd}=5 \mathrm{~V}$, Iout_sat $=200 \mu \mathrm{~A}$
Reqn $=3 / 4 \mathrm{Vdd} / \mathrm{Idsat}=3 / 4(5 \mathrm{~V}) /(200 \mu \mathrm{~A})=25 \mathrm{~K} \Omega$
b) Evaluate the equivalent resistance for Vdd $=3 \mathrm{~V}, \mathrm{~V}$ th $=0.43 \mathrm{~V}$, Vin $=2 \mathrm{~V}$ and Vout_sat=0.63V

We find for Vdd $=3 \mathrm{~V}$, Iout $\_$sat $=197.82 \mu \mathrm{~A}$


Reqn $=3 / 4 \mathrm{Vdd} /$ Idsat $=3 / 4(3 \mathrm{~V}) /(197.82 \mu \mathrm{~A})=15 \mathrm{~K} \Omega$

