Reading: Chapter 5, Chapter 6.1-6.10.

Exercise 3.1. The number of Boolean functions of one variable ($A$) is four ($F_1$, $F_2$, $F_3$, and $F_4$), as it can be learned from the truth table given in Table 1. Then:

a. How many different Boolean functions are there of 2 variables, and of 3 variables?

b. How many different Boolean functions are there of $n$ variables?

<table>
<thead>
<tr>
<th>$A$</th>
<th>$F_1$</th>
<th>$F_2$</th>
<th>$F_3$</th>
<th>$F_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1: Truth table for the different Boolean Functions of one variable.

Exercise 3.2. Do Exercise 5.6, page 275 of the textbook, parts $a$, $b$, and $d$.


Figure 1: Input/Output transfer characteristic for inverter of Problem 3.2.
**Problem 3.2.** An inverter has the input/output transfer characteristic shown in Fig. 1. This inverter obeys the static discipline for suitable choices of the voltages $V_{OL}$, $V_{IL}$, $V_{IH}$, and $V_{OH}$, (see Fig. 5.8 on page 250 of the textbook), and those are such that $NM_H = NM_L$. Then:

a. Give values of $V_{OL}$, $V_{IL}$, $V_{IH}$, and $V_{OH}$ that actually achieve the static discipline with the maximum positive noise margin.

b. What is the noise margin you obtained?

**Problem 3.3** For this problem, consider the convention that a logical one corresponds to a high voltage level and a logical zero corresponds to a low voltage level. Thus, when the voltage $v_A$ associated with the Boolean variable $A$ is high (3V), $A = 1$. When $v_A$ is low ($\approx 0V$), $A = 0$. The same relation holds with $v_B$ and $B$, $v_C$ and $C$. Assume also the following:

- The high voltage level is much greater than the threshold voltage.
- The “on” resistance of the MOSFET is 100Ω.
- The “off” resistance of the MOSFET is 100MΩ.

Then, for each circuit in Fig. 2:

a. Generate a truth table which shows how the variable $C$ (associated with $v_C$) depends on the inputs $A$ (associated with $v_A$) and $B$ (associated with $v_B$).

b. For each particular entry of $C$ in the corresponding truth table of part a., find the value of the output voltage $v_C$.

![Figure 2: Circuits for Problem 3.3.](image_url)