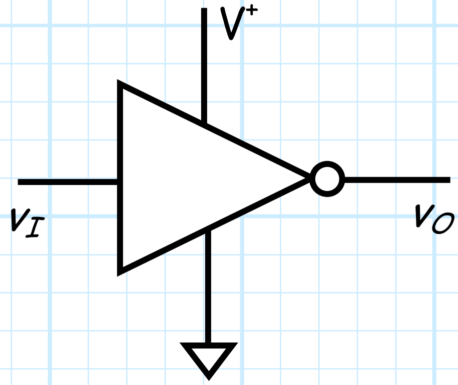
The Ideal Inverter

Q: *How would the "**perfect**" inverter behave?*



A: Clearly, if $v_I = 0$, then $v_O = V^+$, and if $v_I = V^+$, then $v_O = 0$.

v_I	v_O
0	V^+
V^+	0

But what happens if v_I is **not** equal to precisely 0.0 or V^+ ??

In other words, what is the **ideal transfer function** $v_O = f(v_I)$ of a digital inverter?

For example, say $V^+ = 5V$. How should the inverter respond to $v_I = 1V$, or $v_I = 2V$, or $v_I = 4V$??

Since $v_I = 1V$ and $v_I = 2V$ are closer to 0.0 V (low level) than they are to 5.0 V (high level), the inverter **should** interpret them as **low** inputs and the output should then be placed precisely at the high state $v_O = 5V$.

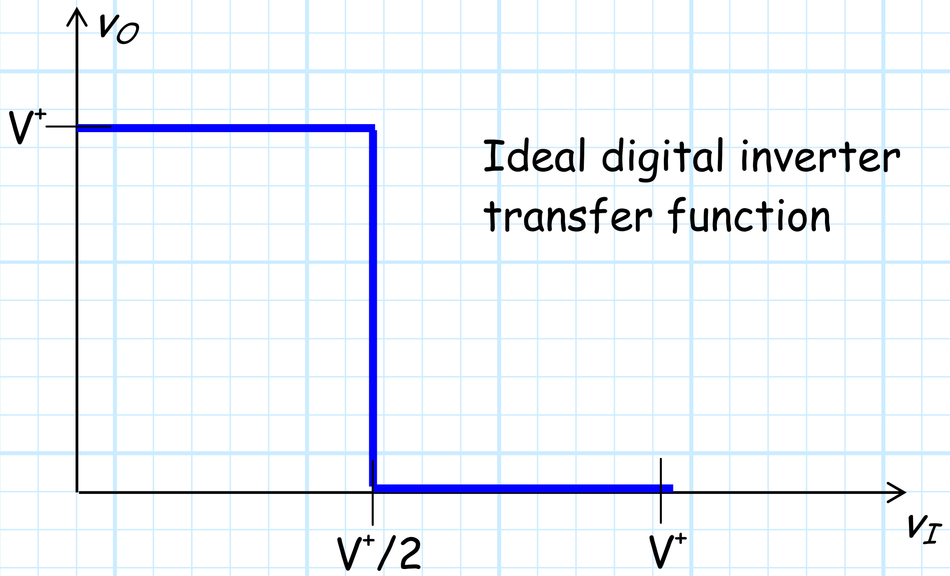
Similarly, for $v_I = 4V$, the inverter **should** interpret it as **high** input and thus the output should be placed precisely at the low state $v_O = 0V$.

Therefore, we can say that an **ideal** digital inverter will interpret **input** values **less** than $V^+/2$ (i.e., < 2.5 V) as **low** inputs, and thus produce an **ideal output** of V^+ (i.e., 5.0 V).

Likewise, any **input** values **greater** than $V^+/2$ (i.e., >2.5 V) will be interpreted as a **high** input, and thus an **ideal low** value of 0.0 V will be placed at the output.

Thus, the **ideal transfer function** for a digital inverter is:

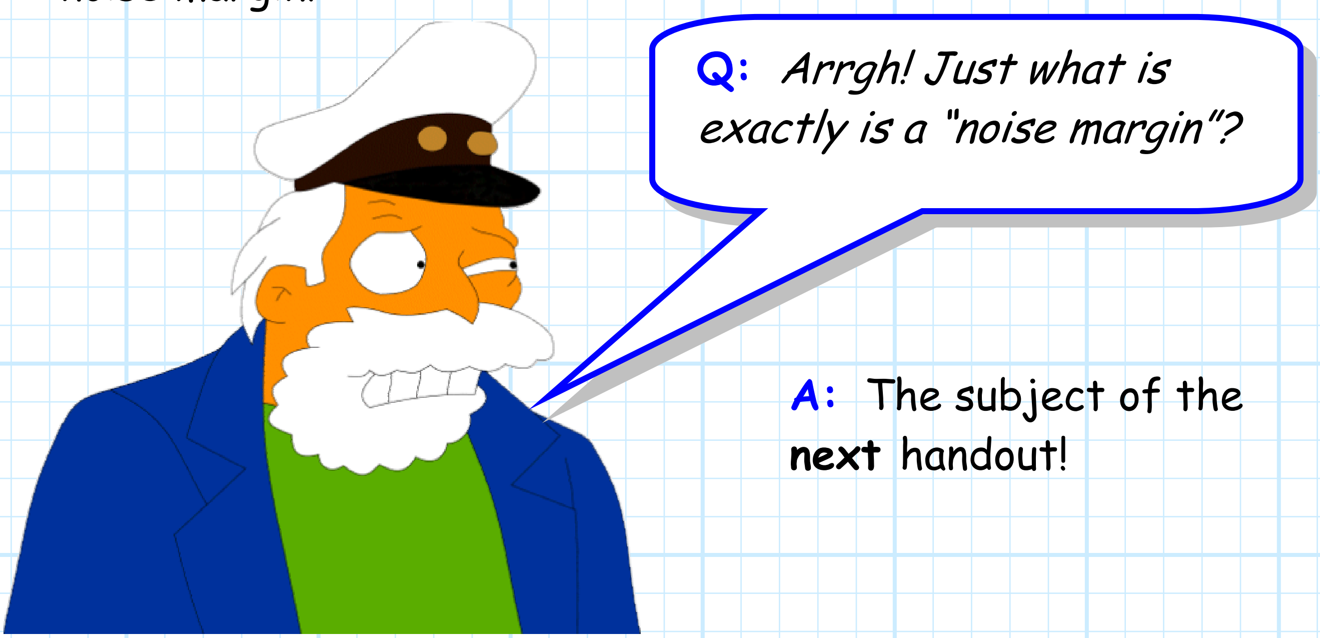
$$v_O = \begin{cases} V^+ & \text{if} \quad v_I < V^+/2 \\ \\ 0 & \text{if} \quad v_I > V^+/2 \end{cases}$$



By the way, the ideal inverter has **noise margins** (NM) of:

$$NM = \frac{V^+}{2}$$

This is the **largest possible** noise margin, therefore the **ideal** noise margin!



A: The subject of the **next** handout!