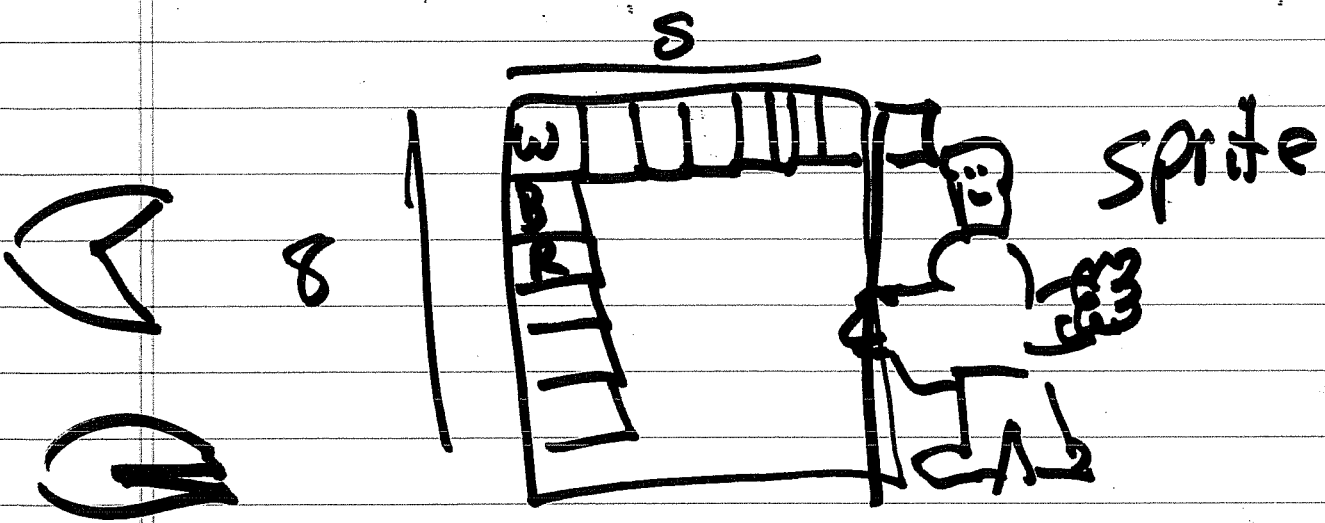


1024 x 768

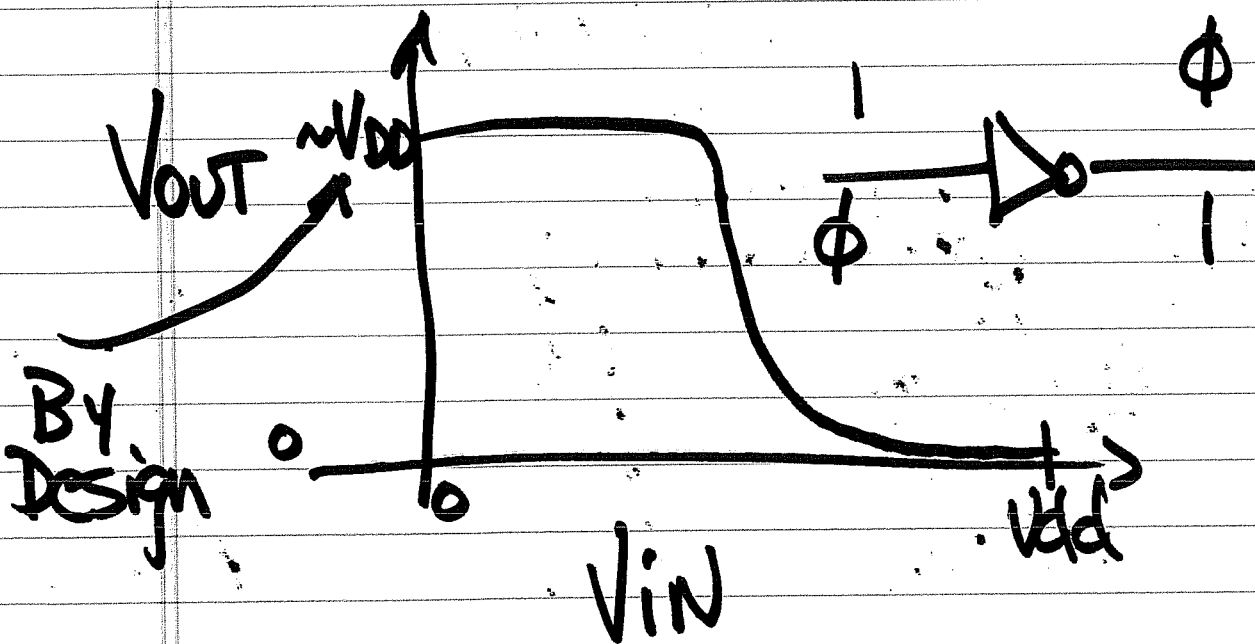


Digital Logic Timing

What is digital?

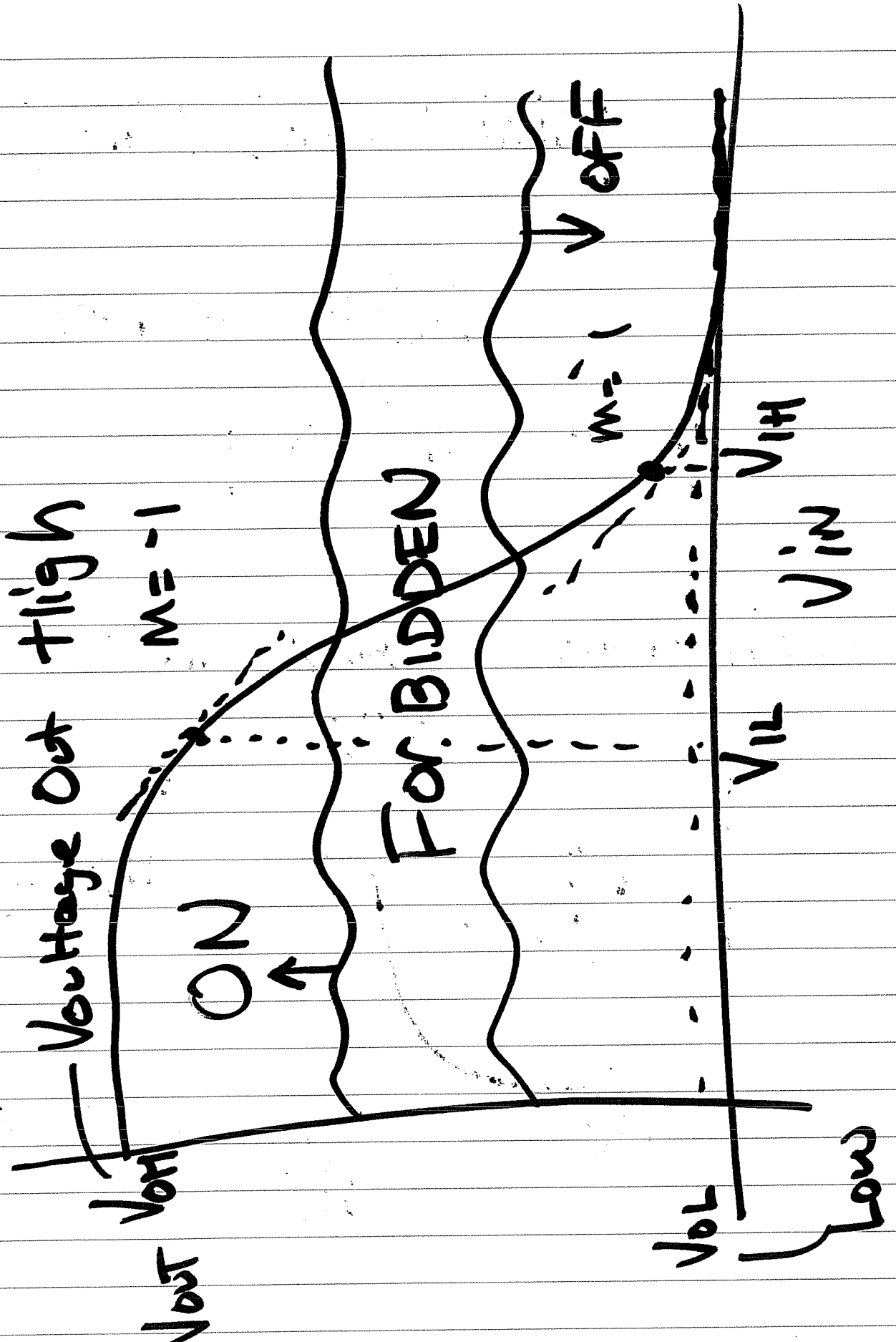


Voltage Transfer Characteristic VTC



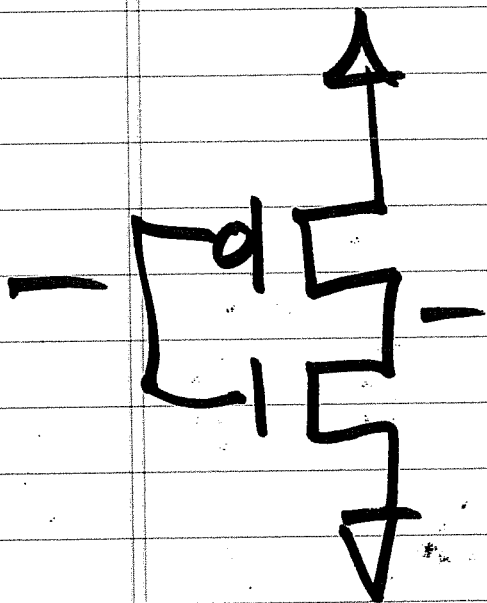
By Design

VTC



7404

→ 74LS04



CMOS inverter

2 transistors

1 NMOS / 1 PMOS

Noise Margin

$$NM_L = V_{IL} - V_{OL}$$

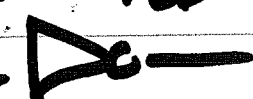
$$NM_H = V_{OH} - V_{IH}$$

$V_{DD} = 5V$



Driver

Noise Margin



Receiver

$V_{DD} = 3.3V$

Part	V _{DD}	V _{IL}	V _{IH}	V _{OL}	V _{OH}
TTL	5V	0.8	2.0	0.4	2.4
CMOS	5V	1.35	3.15	0.33	3.84
VTTL	3.3	0.8	2.0	0.4	2.4
VCMOS	3.3	0.9	1.8	0.36	2.7