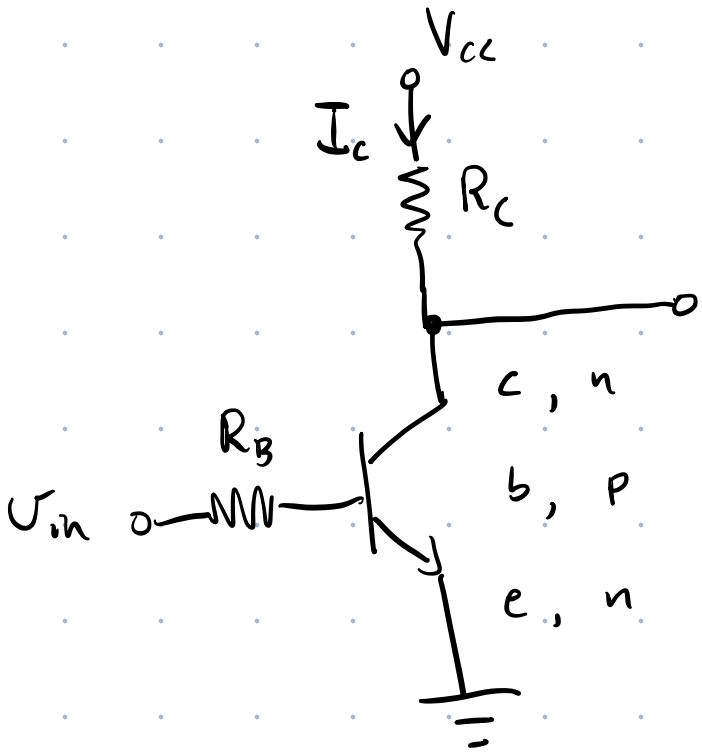
PHYS 231 Nov. 27, 2024

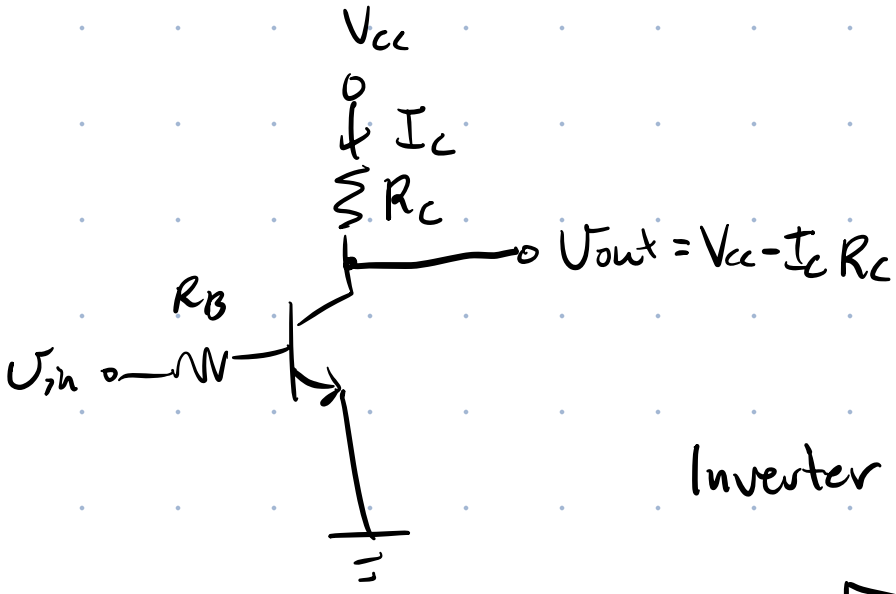
Last Time:

Transistor Switch



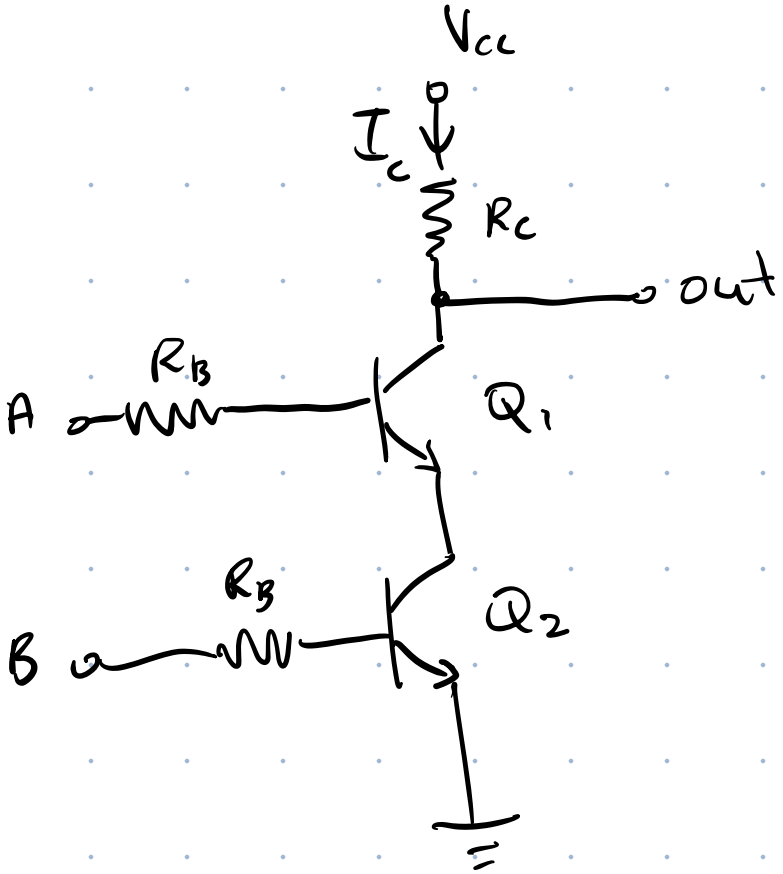
If V_{in} is LO, $I_c = 0$
If V_{in} is HI, $I_c \neq 0$

} transistor acts as an electronic switch. The voltage at the base controls the current through the transistor



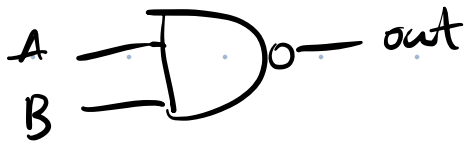
V_{in}	V_{out}
0	1
1	0

Inverter (NOT gate)

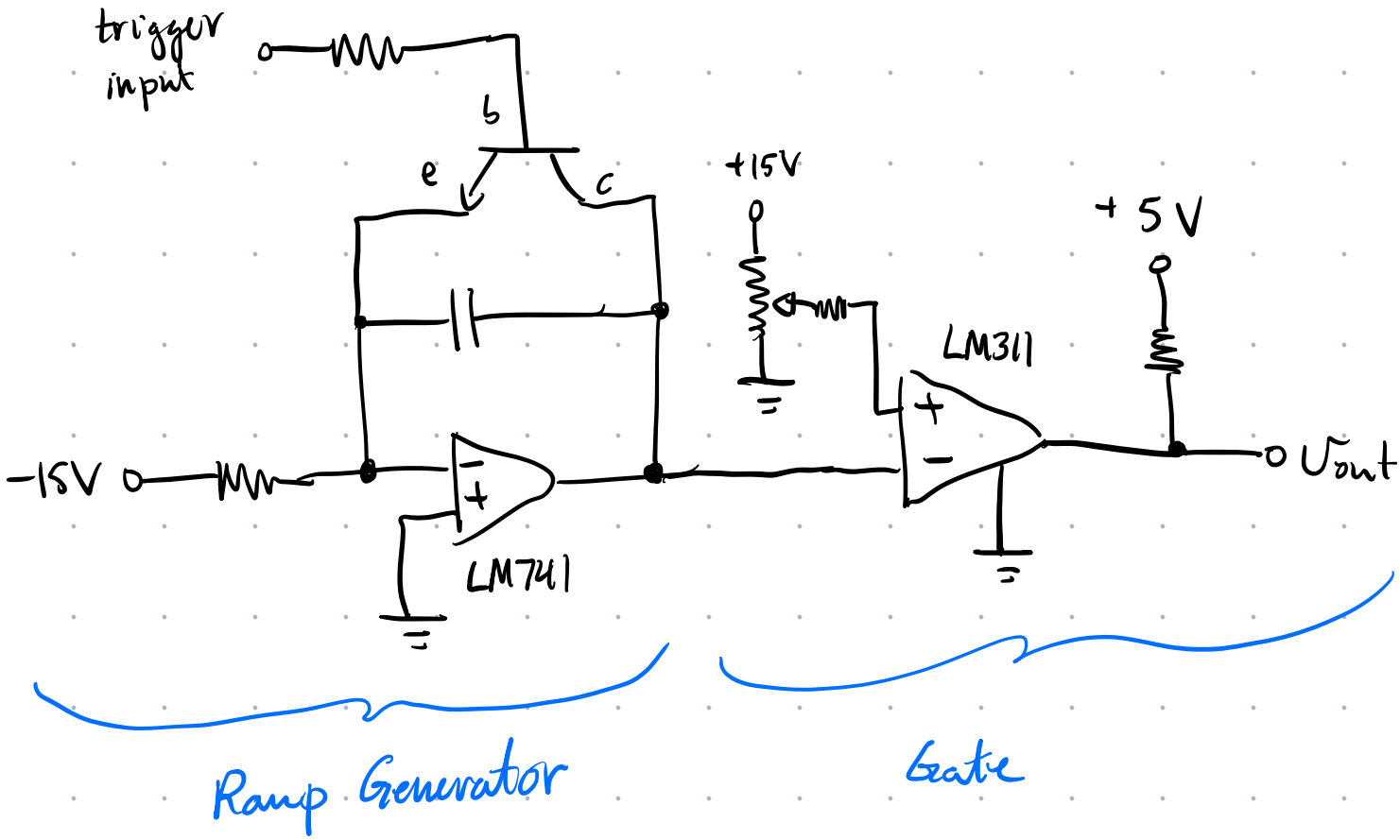


A	B	Q_1	Q_2	I_c	out
0	0	OFF	OFF	0	1
0	1	OFF	ON	0	1
1	0	ON	OFF	0	1
1	1	ON	ON	≠0	0

NAND gate

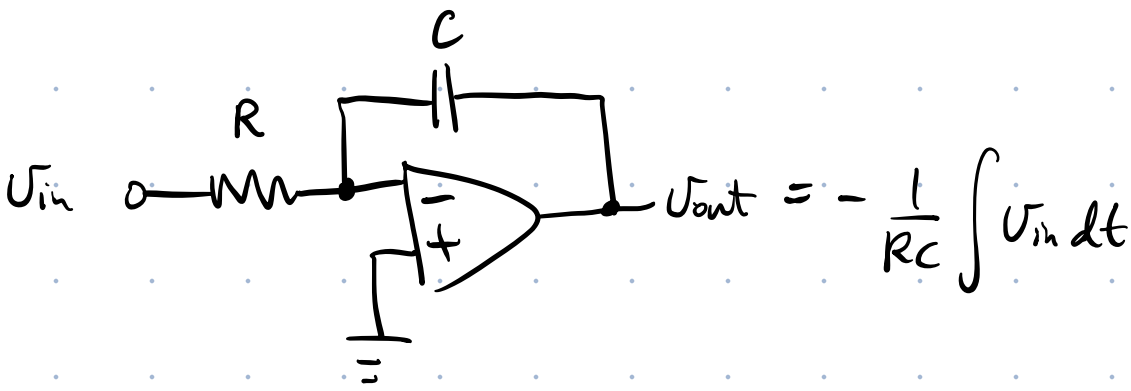


Today: Prepare for Day 2 of ADC project in which you will build & test the following circuit:



Ramp Generator:

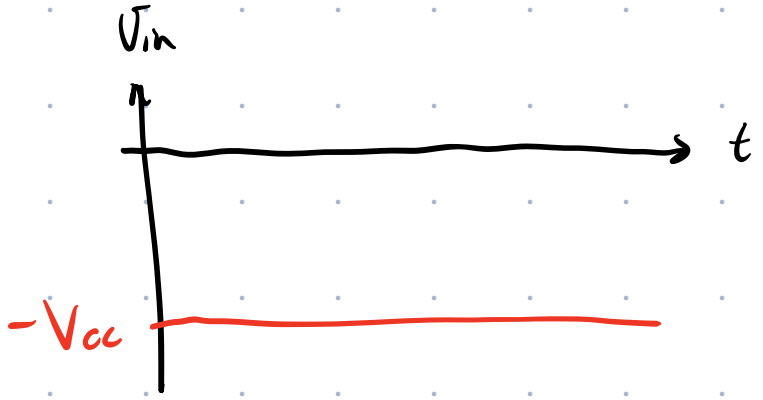
Recall the integrator

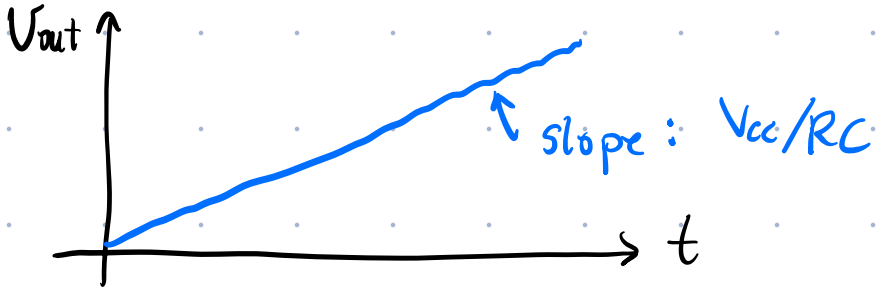


If we set $V_{in} = -V_{cc}$ $(-15V)$, then

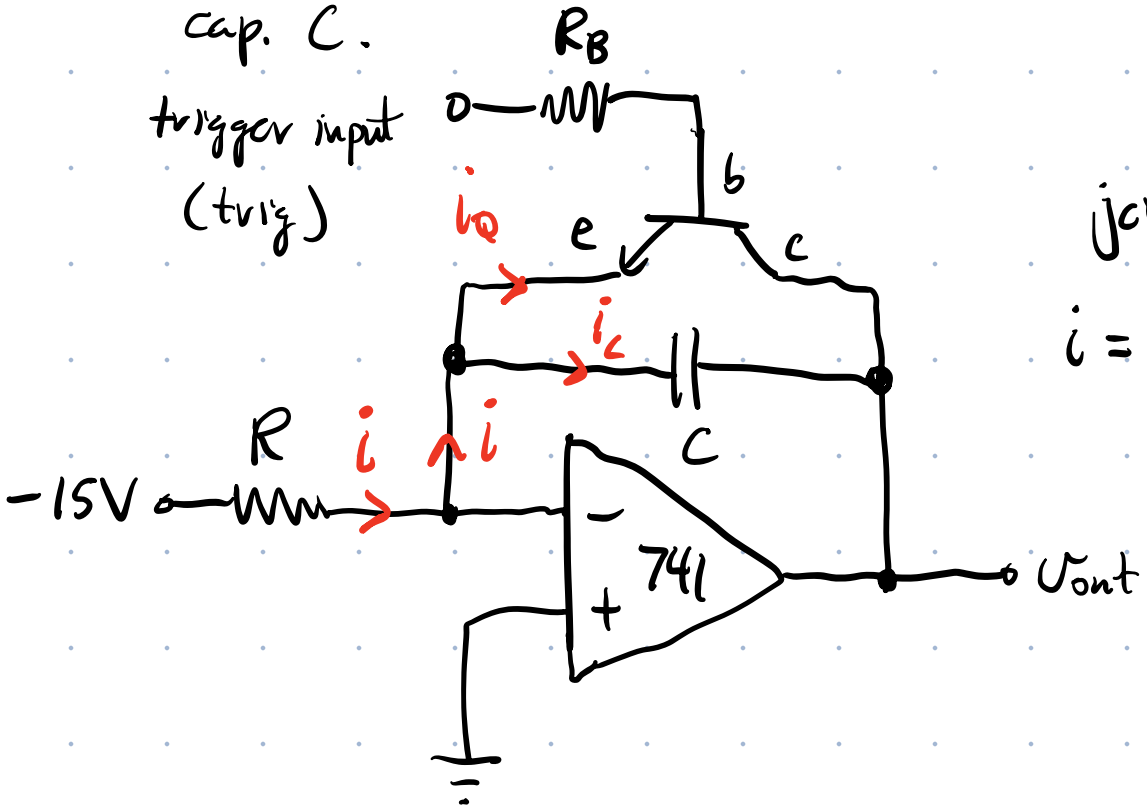
$$V_{out} = -\frac{1}{RC}\int \underbrace{(-V_{cc})}_{\text{const.}}\,dt = \frac{V_{cc}}{RC}\int dt$$

$$= \frac{V_{cc}}{RC}\,t$$





Add a transistor switch in parallel w/ feedback cap. C.



jcn rule:

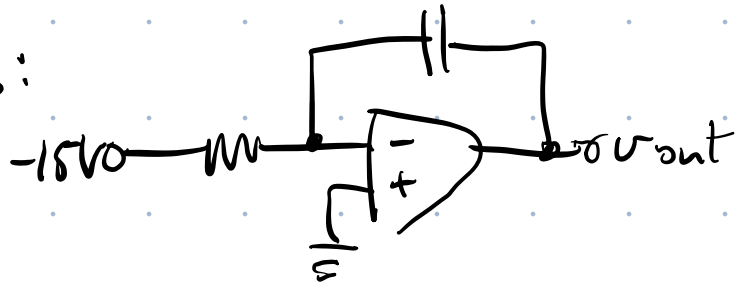
$i = i_c + i_Q$

Case ①: Trig is LO.

In this case, no current passes through trans. since B-E is <u>not</u> forward biased.

$\Rightarrow i_Q = 0$ (all current goes through cap.)

Equiv. circuit is:

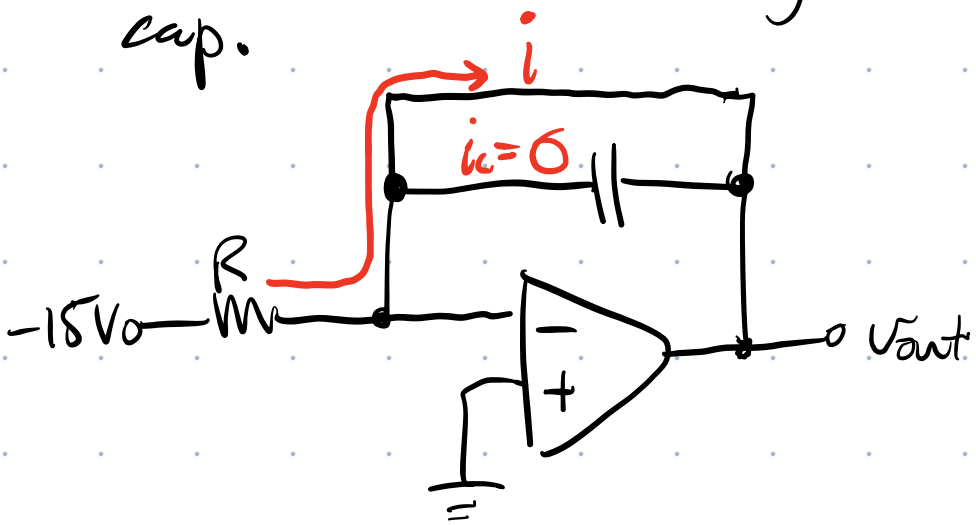


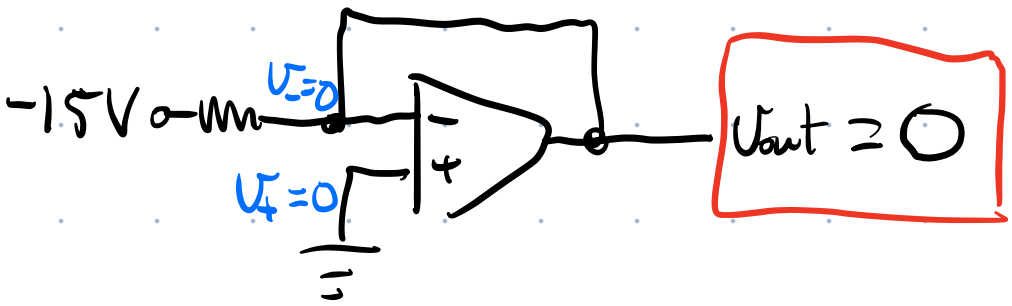
We are integrating. v_{out} is a ramp.

Case ②: Trig is Hi.

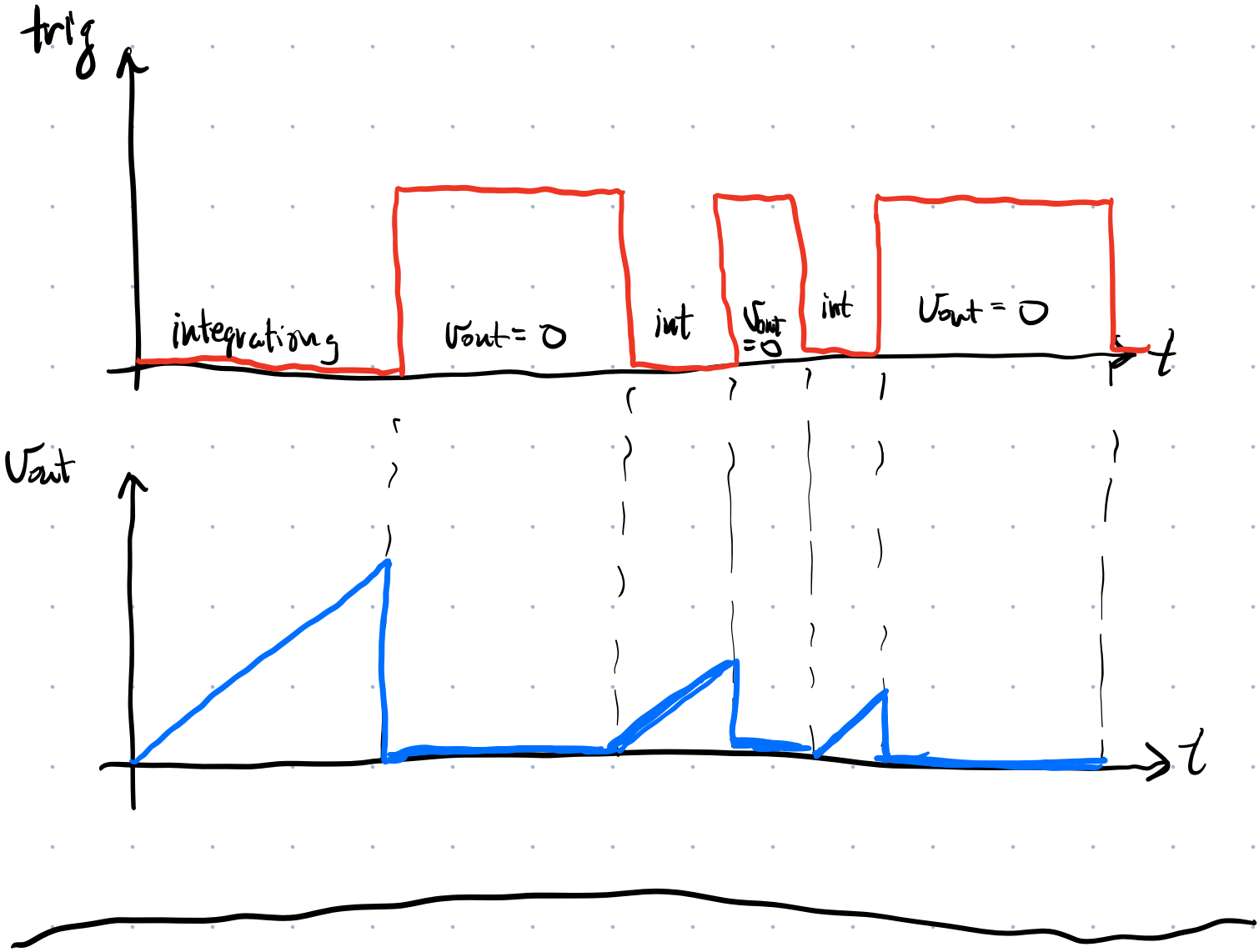
∴ transistor Q is conducting.

Transistor presents a very low impedance path for current. Effectively short circuit the cap.

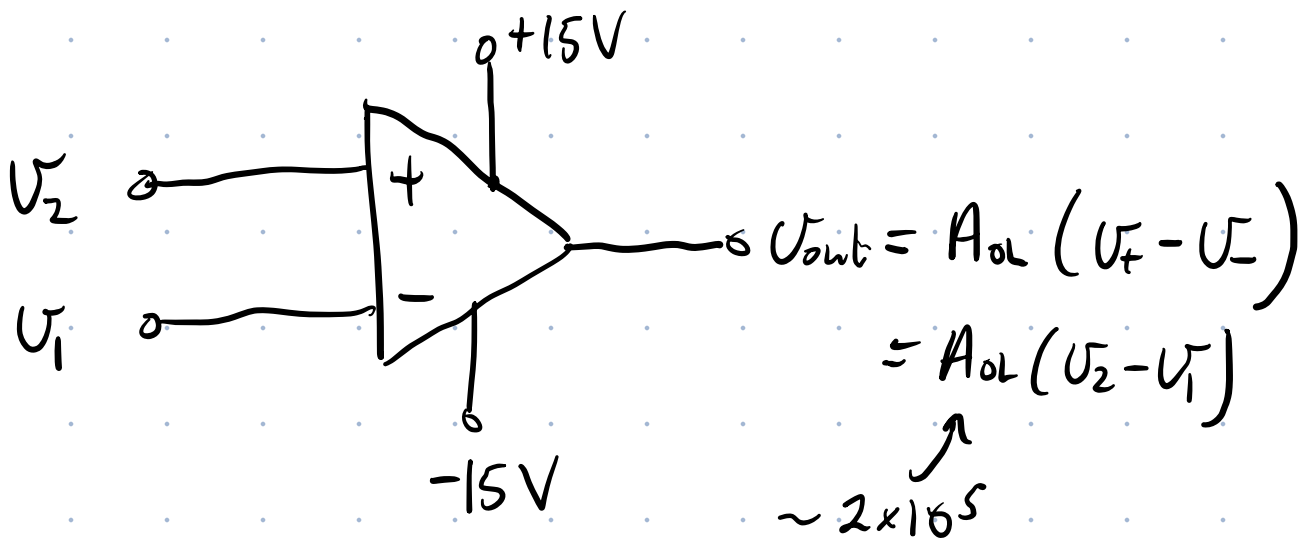


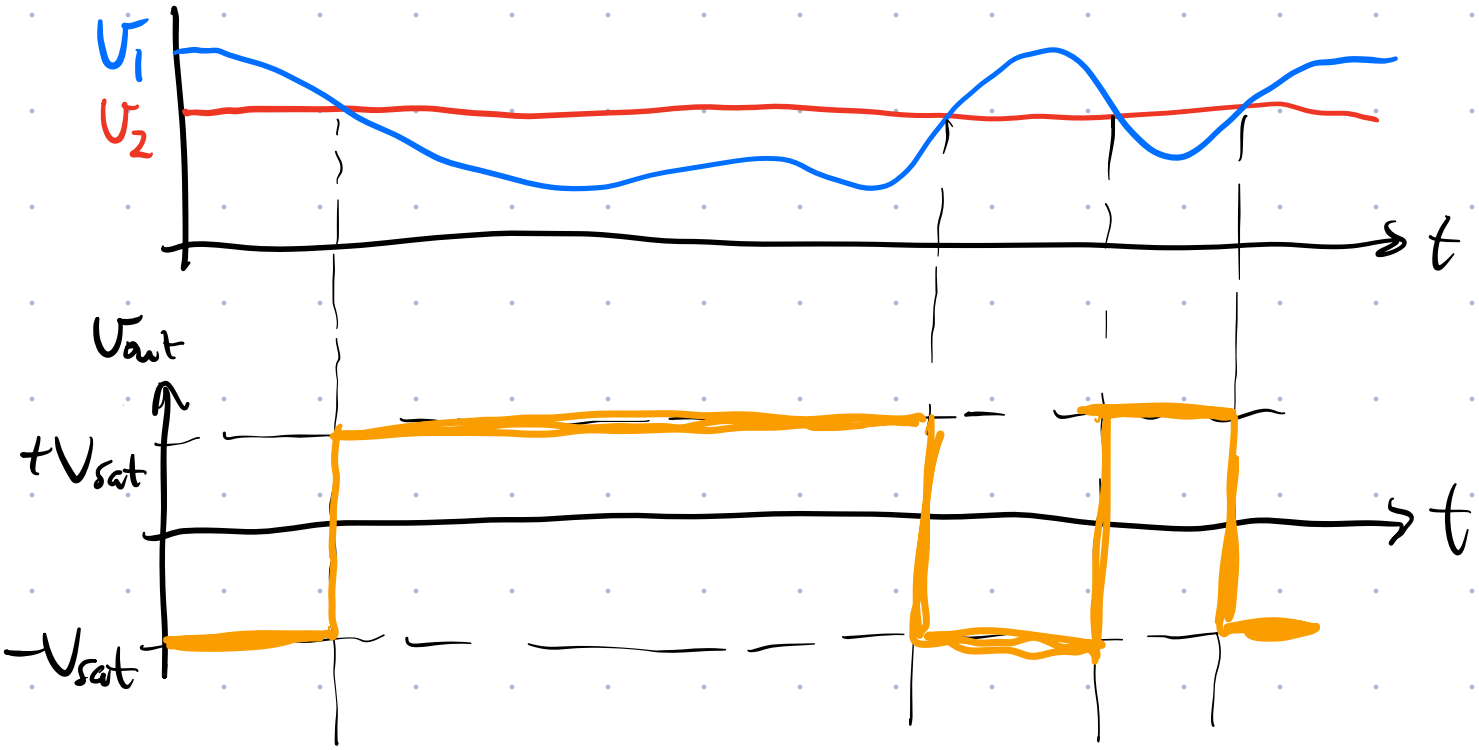


To test the circuit in the lab, we can provide the trig. input a square from TTL output of fcn gen.



Consider the following op amp circuit:



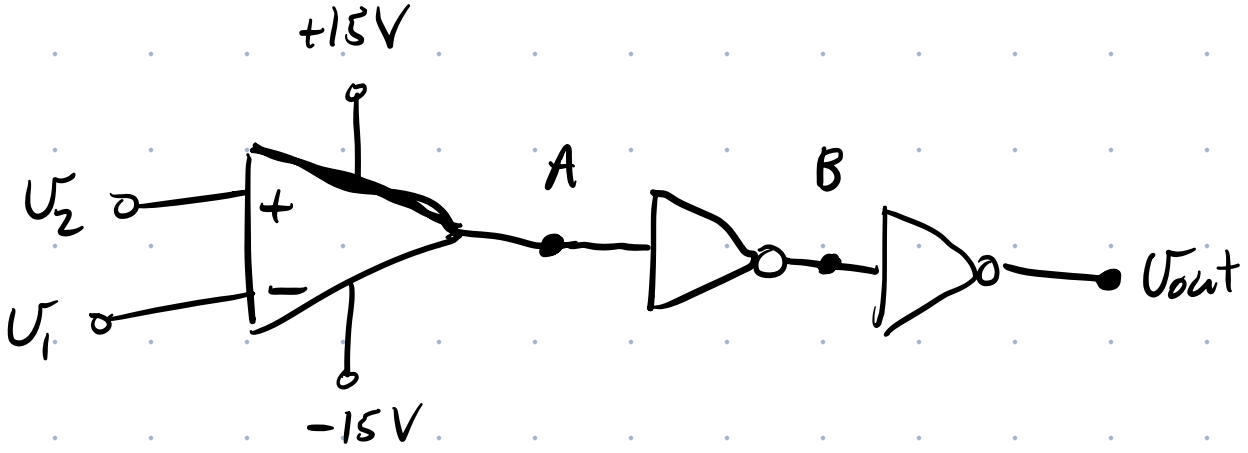


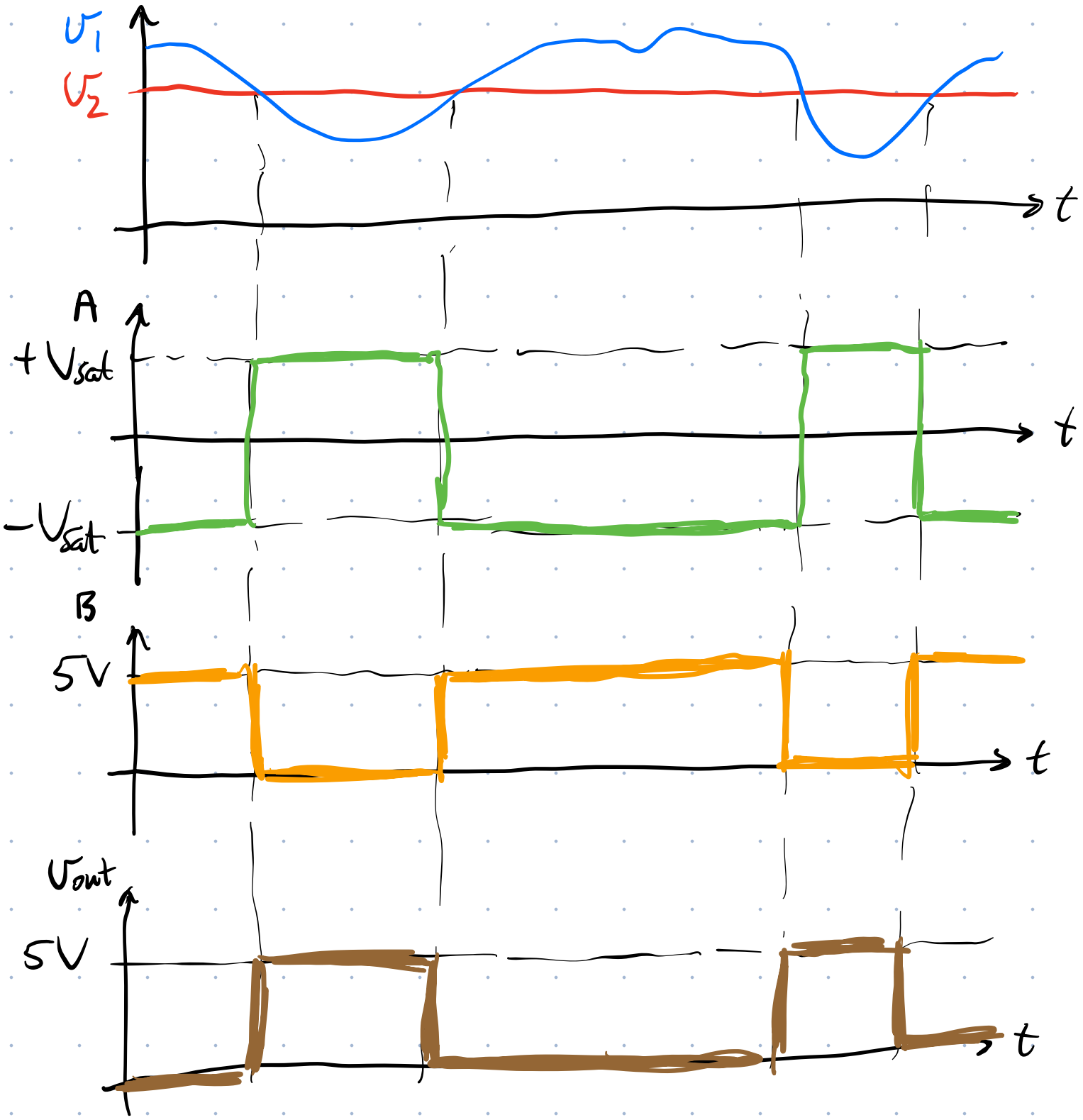
This is a type of comparator circuit.

If $V_2 > V_1$, $V_{out} = +V_{sat}$

if $V_2 < V_1$, $V_{out} = -V_{sat}$.

We would like the output to be LO (0V) or HI (5V) so that it is compatible w/ digital circuits.



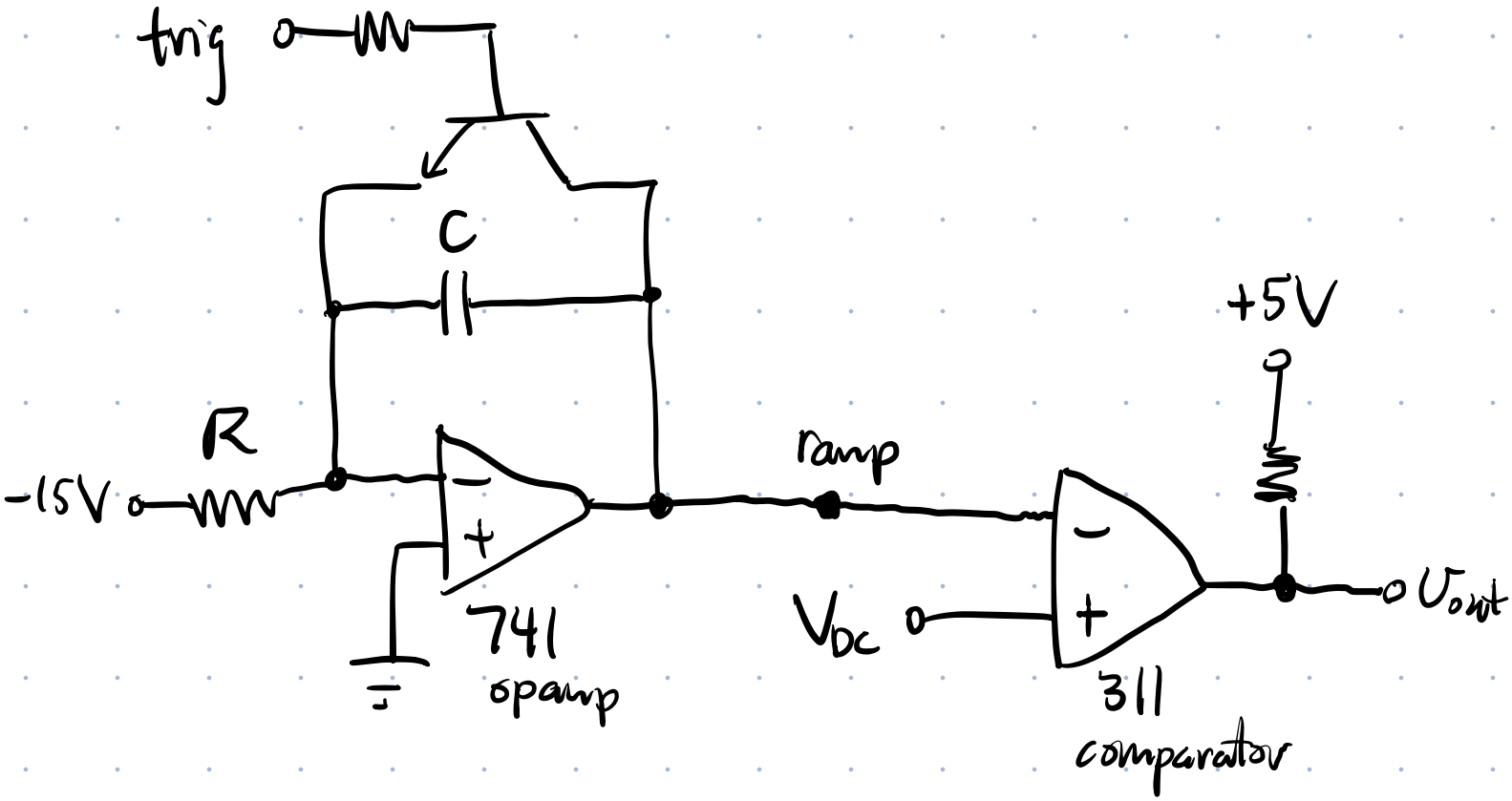


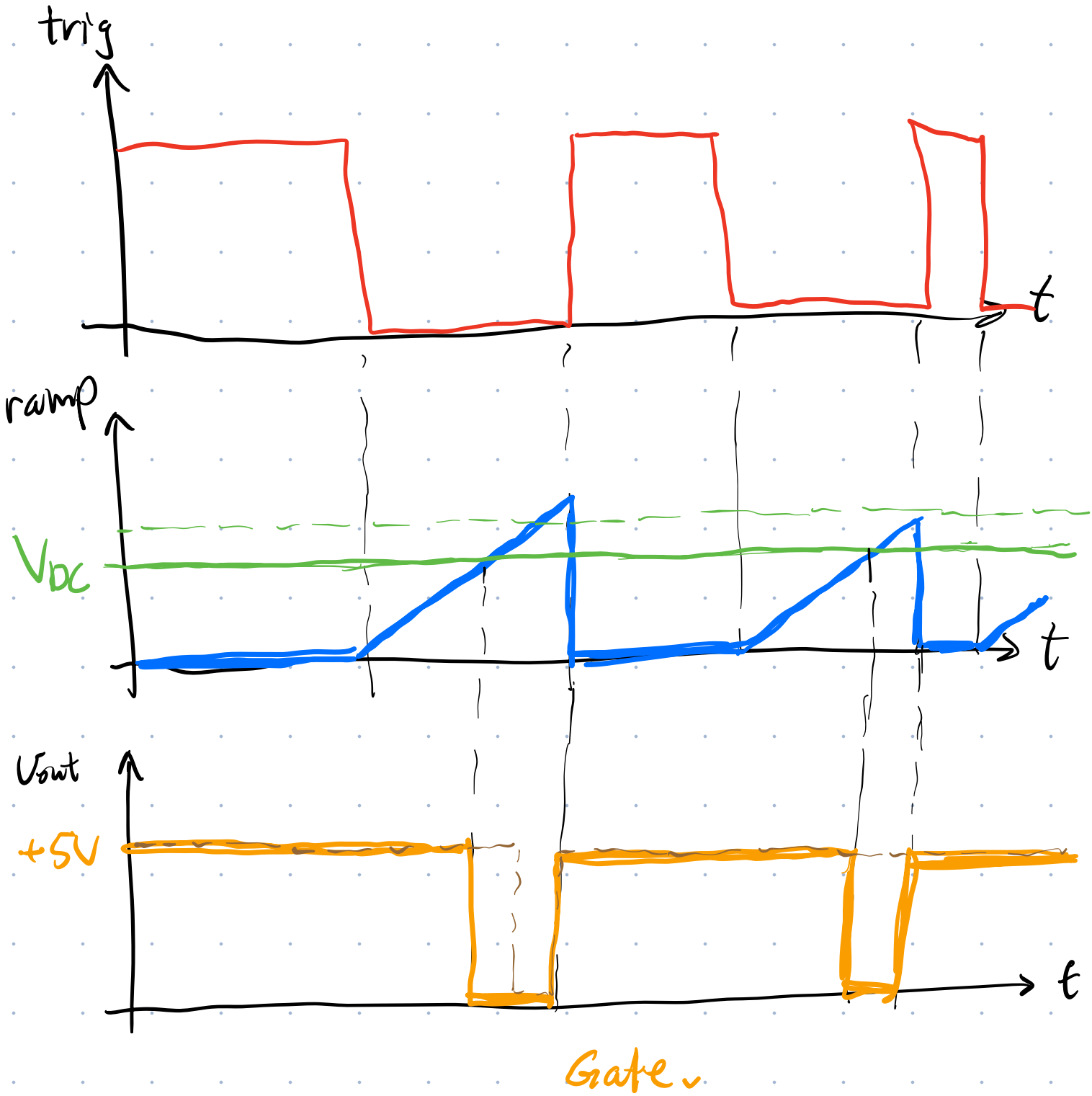
Now, if $V_2 > V_1 \rightarrow V_{out}$ is Hi ✓

if $V_2 < V_1 \rightarrow V_{out}$ is Lo

The LM311 comparator is essentially an opamp w/ two inverters (transistors) & comes as a chip.

Ramp Generator + Comparator




trig
t
ramp
VDC
t
Vout
+5V
t
Gate