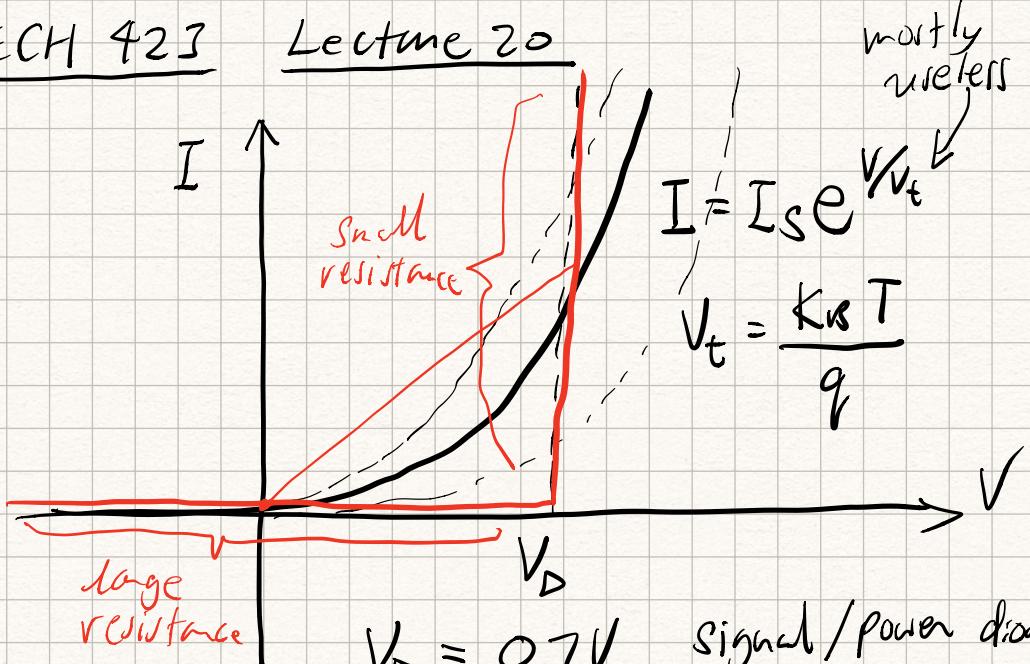
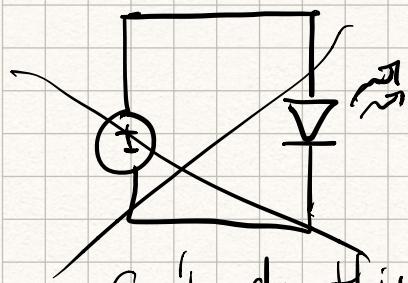
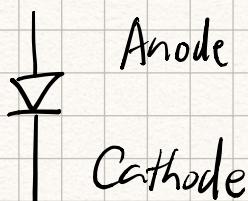


Diodes

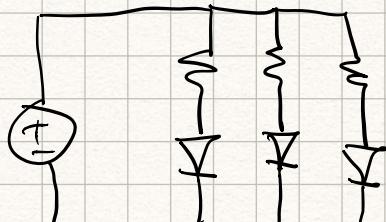
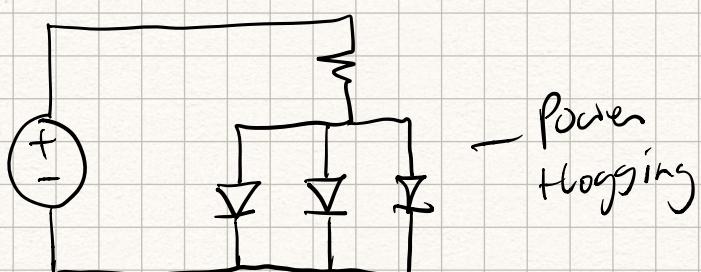
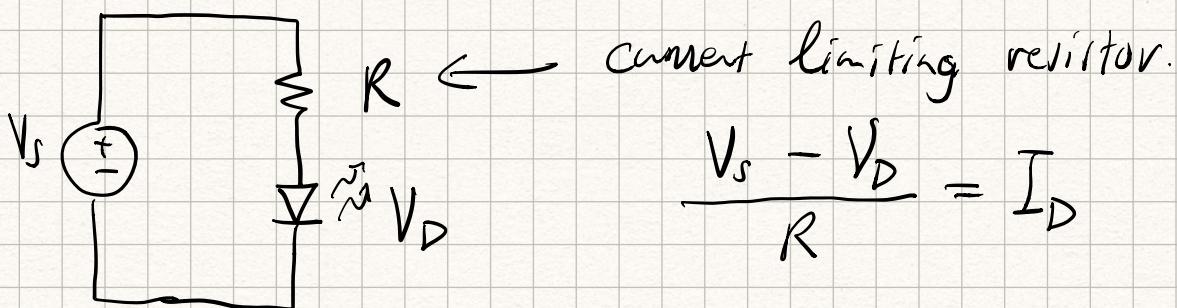
$V_D = 0.7V$  signal/power diode

$\sim 2V$  for Red, Yellow, Green LED

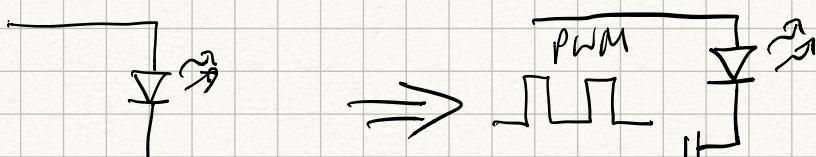
$\sim 4V$  for Blue & white LED

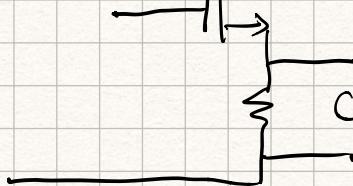
$$I = I_s e^{V/V_t}$$

↑ Not constant, Temp. dependent.  
— Positive feedback



more efficient LED drive:

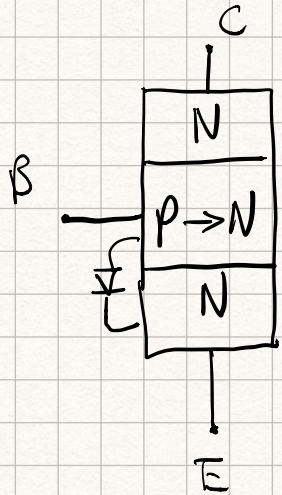




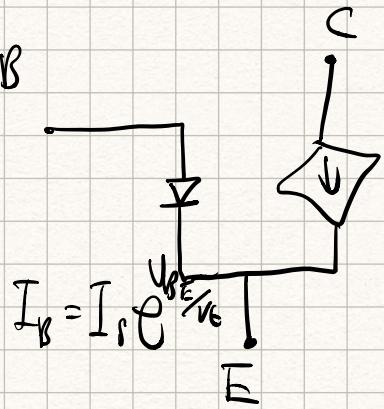
Current sense resistor

## BJT

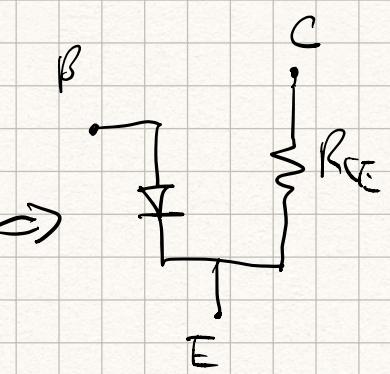
\* A transistor is not a pump. (The power supply is the pump)  
A transistor is a valve.



$\Rightarrow$



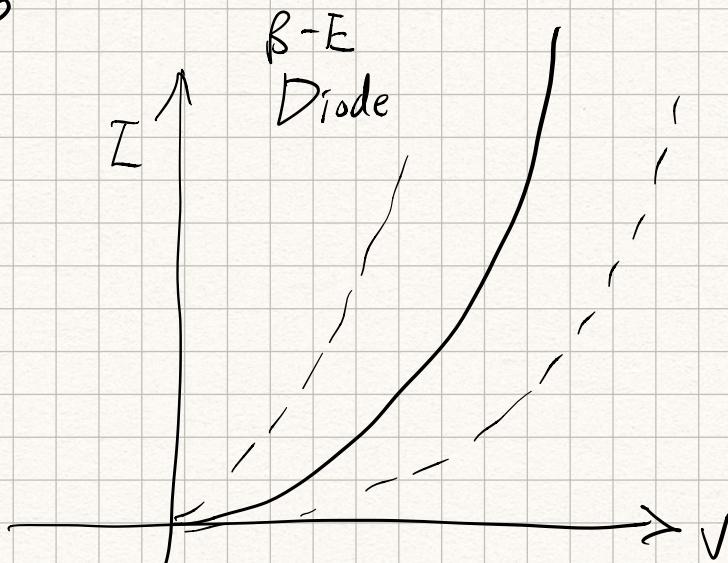
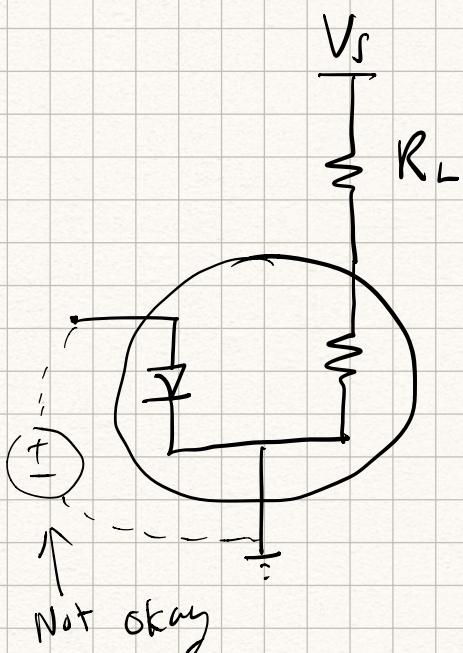
$$I_C = \beta I_B$$



$R_{CE}$  depend  
on  $V_{BE}$  &  $V_{CE}$

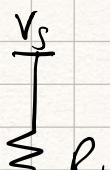
Two main ways to use a BJT

① Load on top



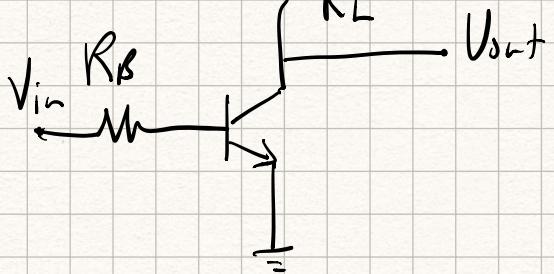
How to control diode current?

- Use a current limiting resistor.



What's value of  $R_B$ ?

- It's about milli ohms



- Typically  $1k - 100k$

If  $V_{in} < 0.7V$

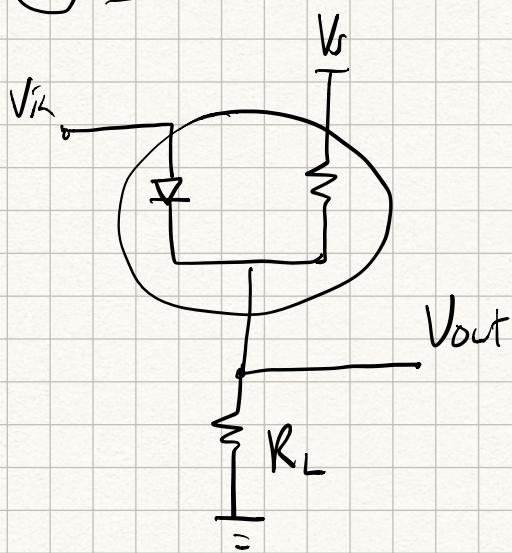
$$I_{R_L} \approx 0 \quad V_{out} = V_s$$

If  $V_{in} > 0.7V$  — Transistor ON

$$I_{R_L} \approx \frac{V_s}{R_L}$$

$$I_{R_L} = \frac{V_s - 0.7V}{R_L} \quad V_{out} \approx 0.3V$$

## ② Load on the bottom



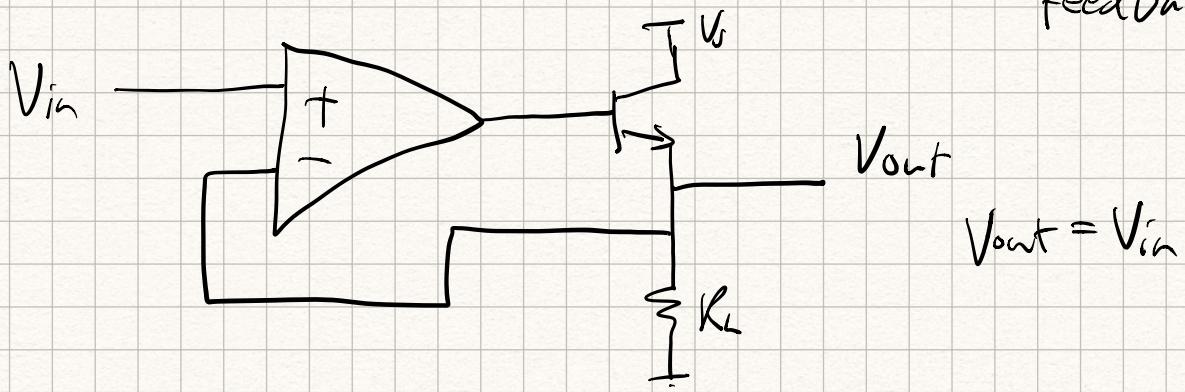
If  $V_{in} < 0.7V$  — Transistor is off  
 $V_{out} = 0$

If  $V_{in} > 0.7V$  — Transistor is on

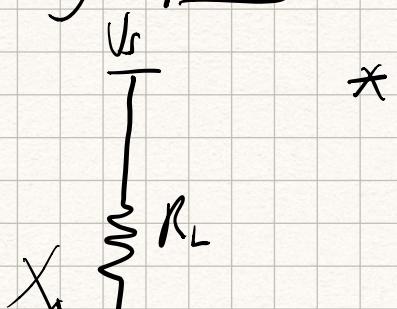
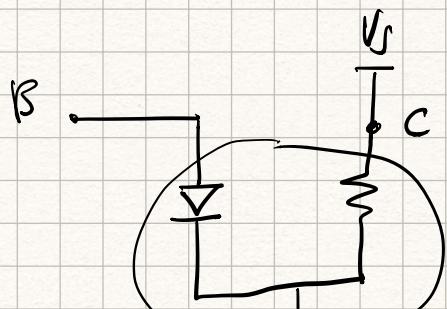
$$\boxed{V_{out} = V_{in} - 0.7V}$$

$$I_L = \frac{V_{out}}{R_L}$$

To remove  $0.7V$  — use negative feedback

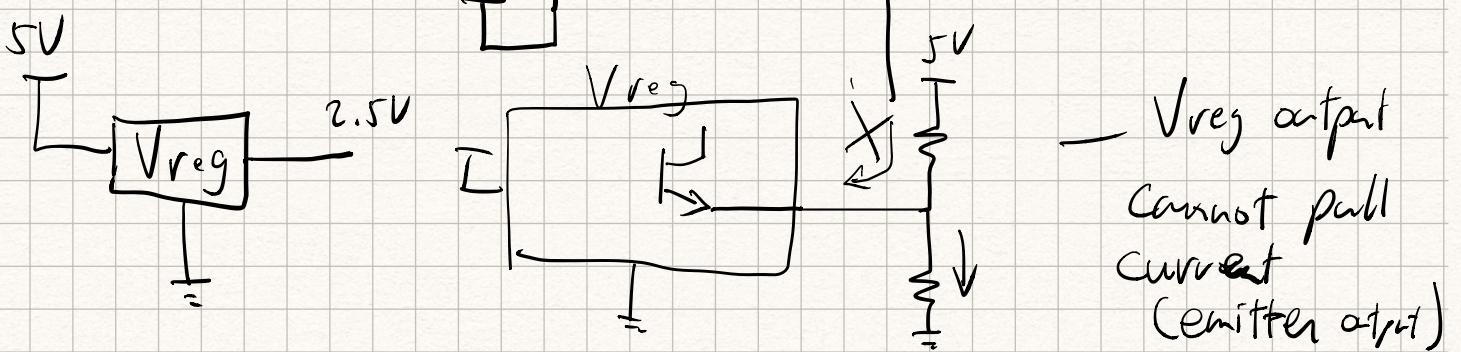
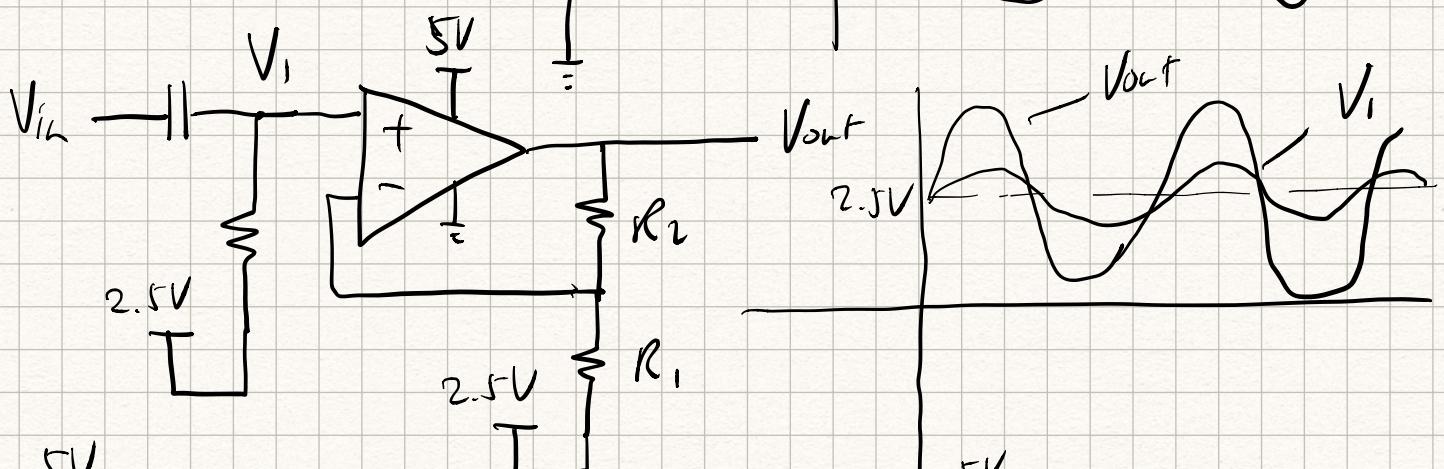
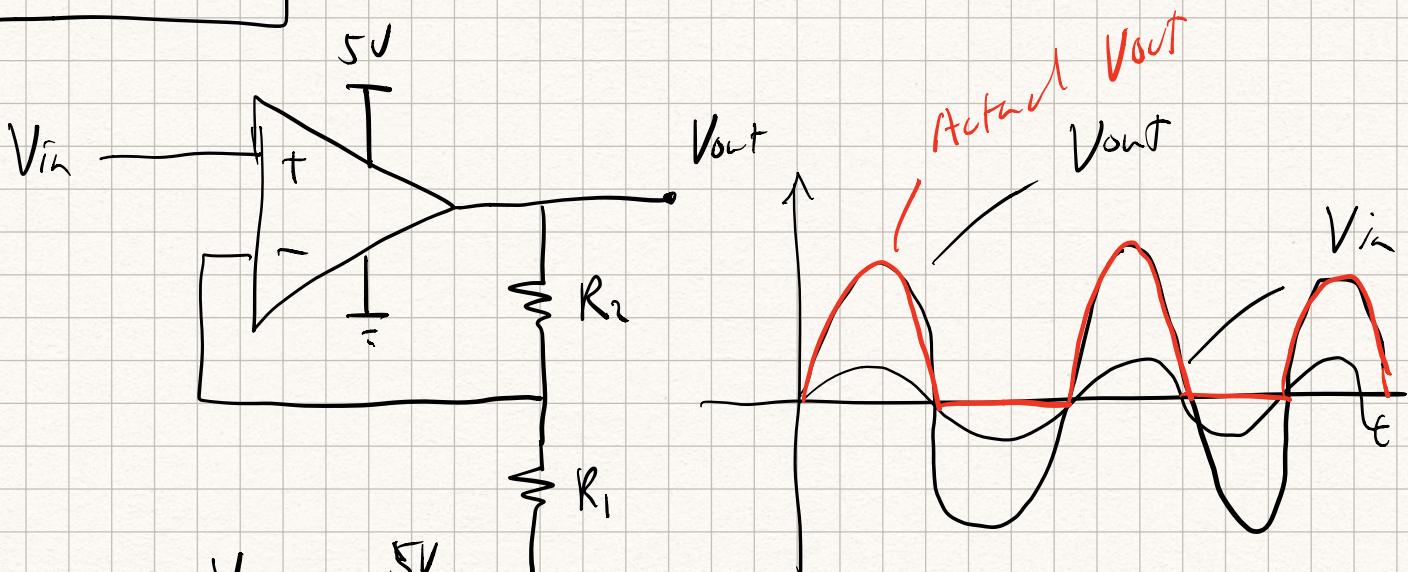
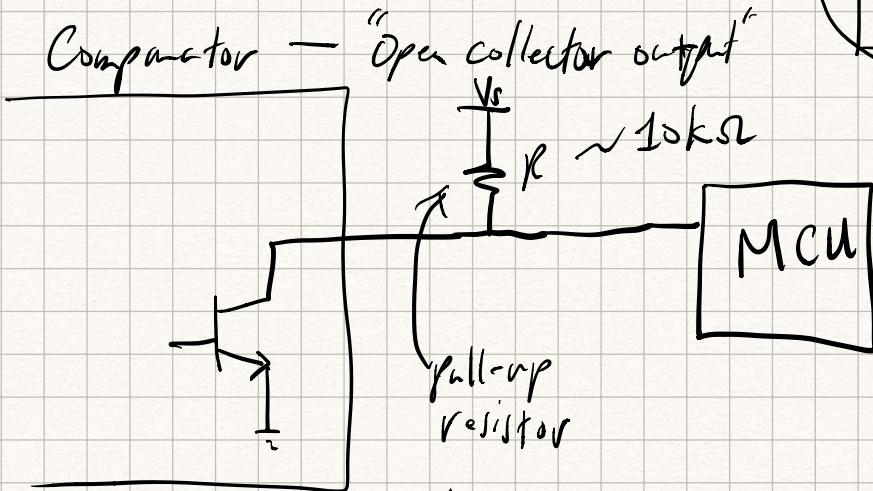
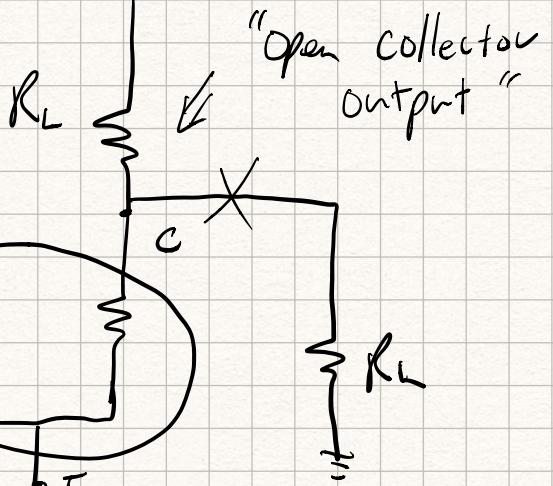
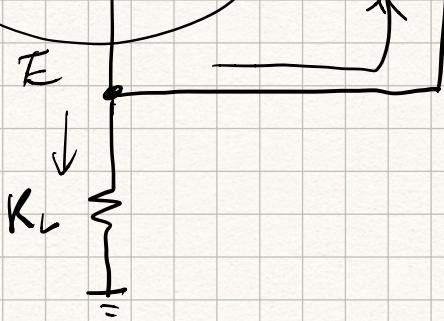


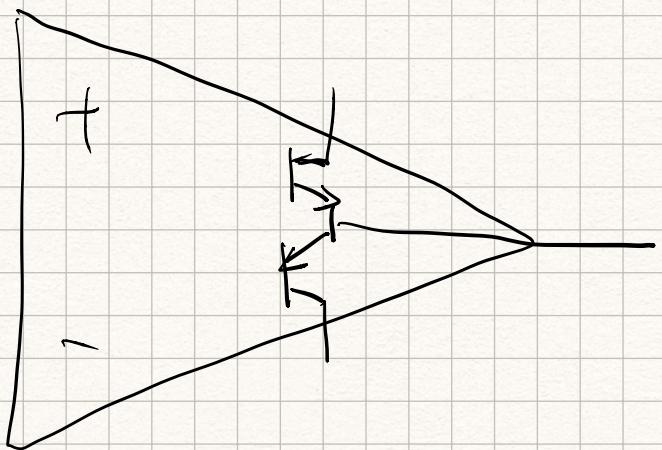
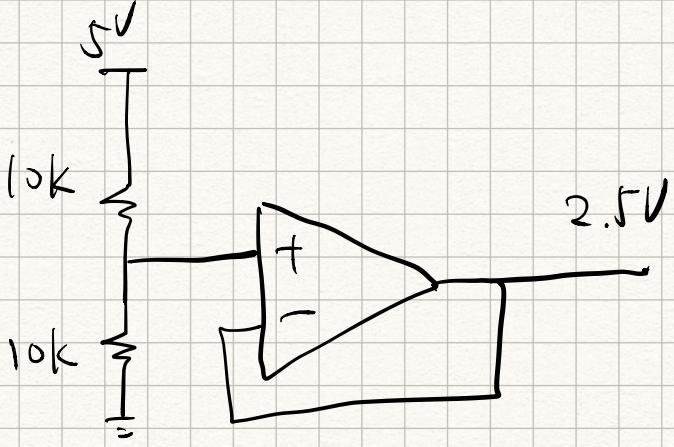
\* Emitters can only push current.



\* Collectors can only pull current

$$\frac{V_s}{V_{out}}$$





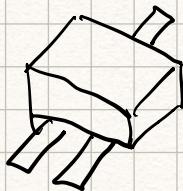
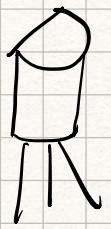
Some part numbers:

Small NPN BJT : 2N3904

Small PNP BJT : 2N3906

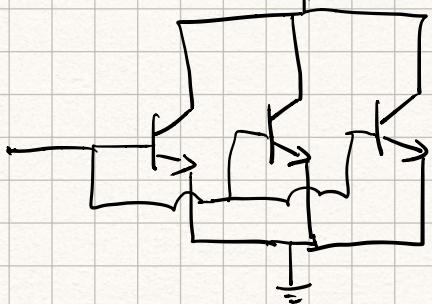
Power NPN : TIP31

Power PNP : TIP32



$V_S$

$R_L$



Power Hogging.

