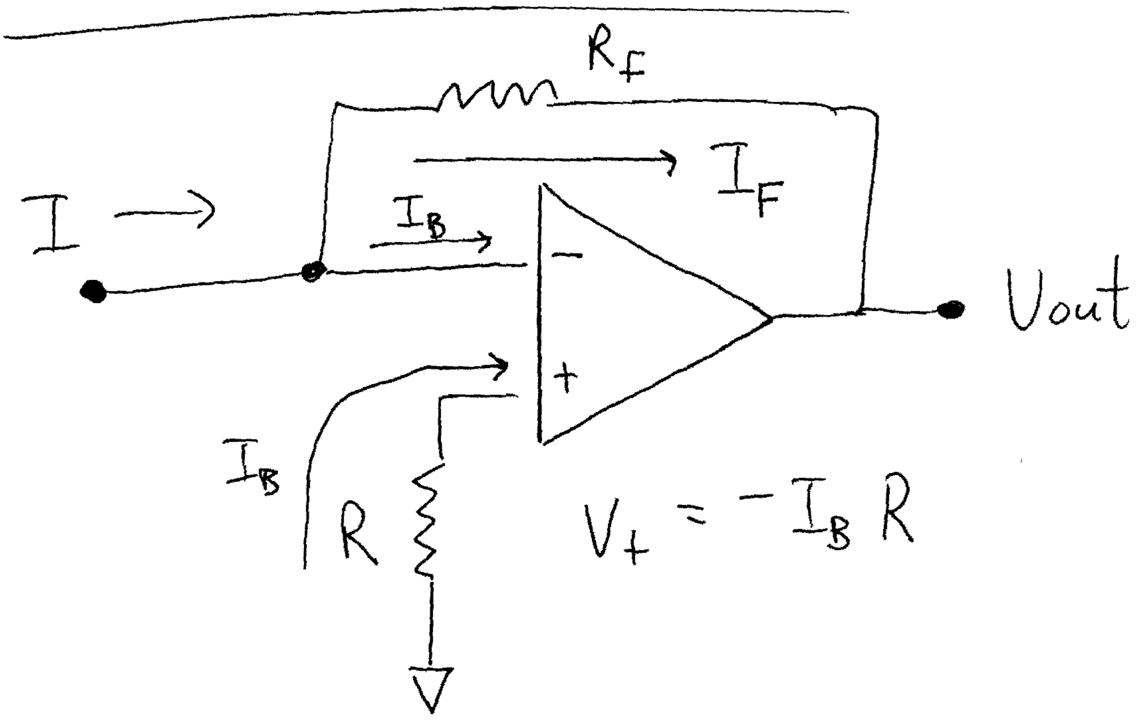
Transimpedance Op-Amp:



$$I = I_B + I_F \quad , \quad I_f = \frac{V_- - V_{out}}{R_f}$$

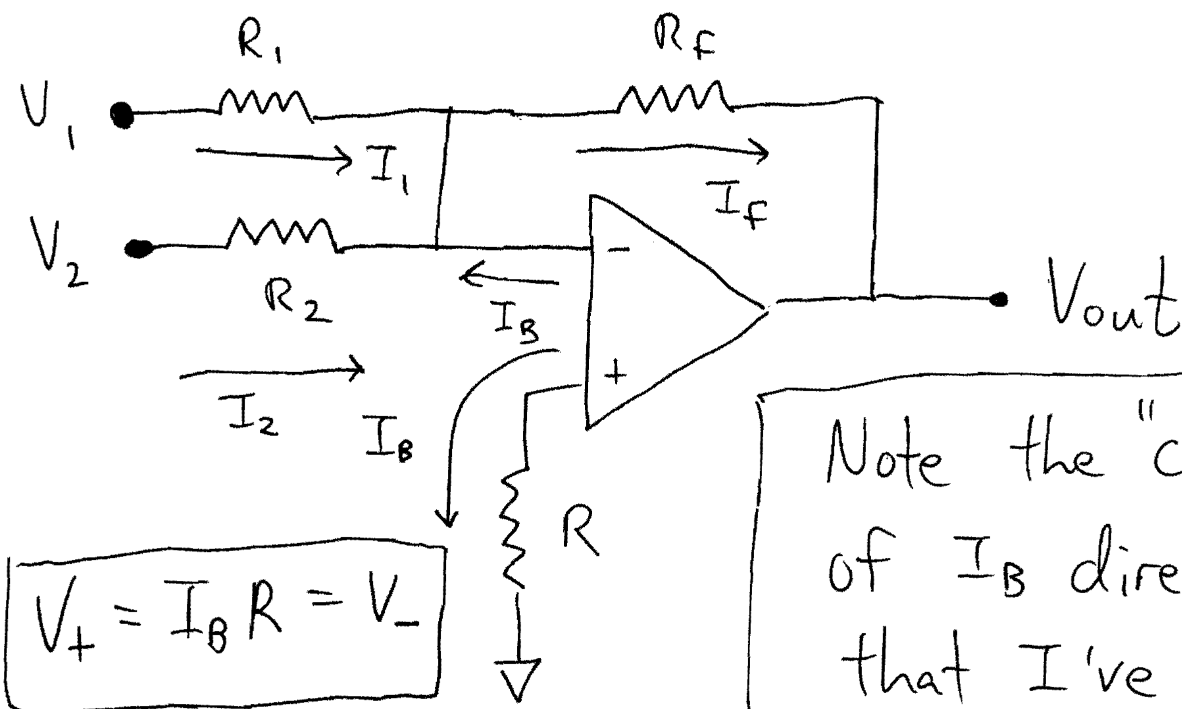
$$(I - I_B) R_F = \underbrace{V_-}_{= V_+} - V_{out}$$

$$(I - I_B) R_f = -I_B R - V_{out}$$

$$\boxed{V_{out} = -I R_f + I_B (R_f - R)}$$

①

Summing Amplifier:



$$V_+ = I_B R = V_-$$

Note the "choice" of I_B direction that I've made.

Conservation of Current:

$$I_1 + I_2 + I_B = I_F$$

$$I_1 = \frac{V_1 - V_-}{R_1} \; ; \quad I_2 = \frac{V_2 - V_-}{R_2} \; ; \quad I_F = \frac{V_- - V_{out}}{R_f}$$

So,

$$\frac{V_1 - I_B R}{R_1} + \frac{V_2 - I_B R}{R_2} + I_B = \frac{I_B R - V_{out}}{R_f} \qquad (1)$$

Simplify and Solve for V_{out}

$$V_{out} = \left(-\frac{R_f}{R_1}\right)V_1 - \frac{R_f}{R_2}V_2 + I_B\left(R - R_f + \frac{RR_f}{R_1} + \frac{RR_f}{R_2}\right)$$

Want this $= 0$

want: $R - R_f + \frac{RR_f}{R_1} + \frac{RR_f}{R_2} = 0$

or $R\left(1 + \frac{R_f}{R_1} + \frac{R_f}{R_2}\right) = 0$

or $$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_f}$$

This makes the last term zero.

(2)

$$V_{out} = -\frac{R_f}{R_1} V_1 - \frac{R_f}{R_2} V_2$$

if $$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_f}$$