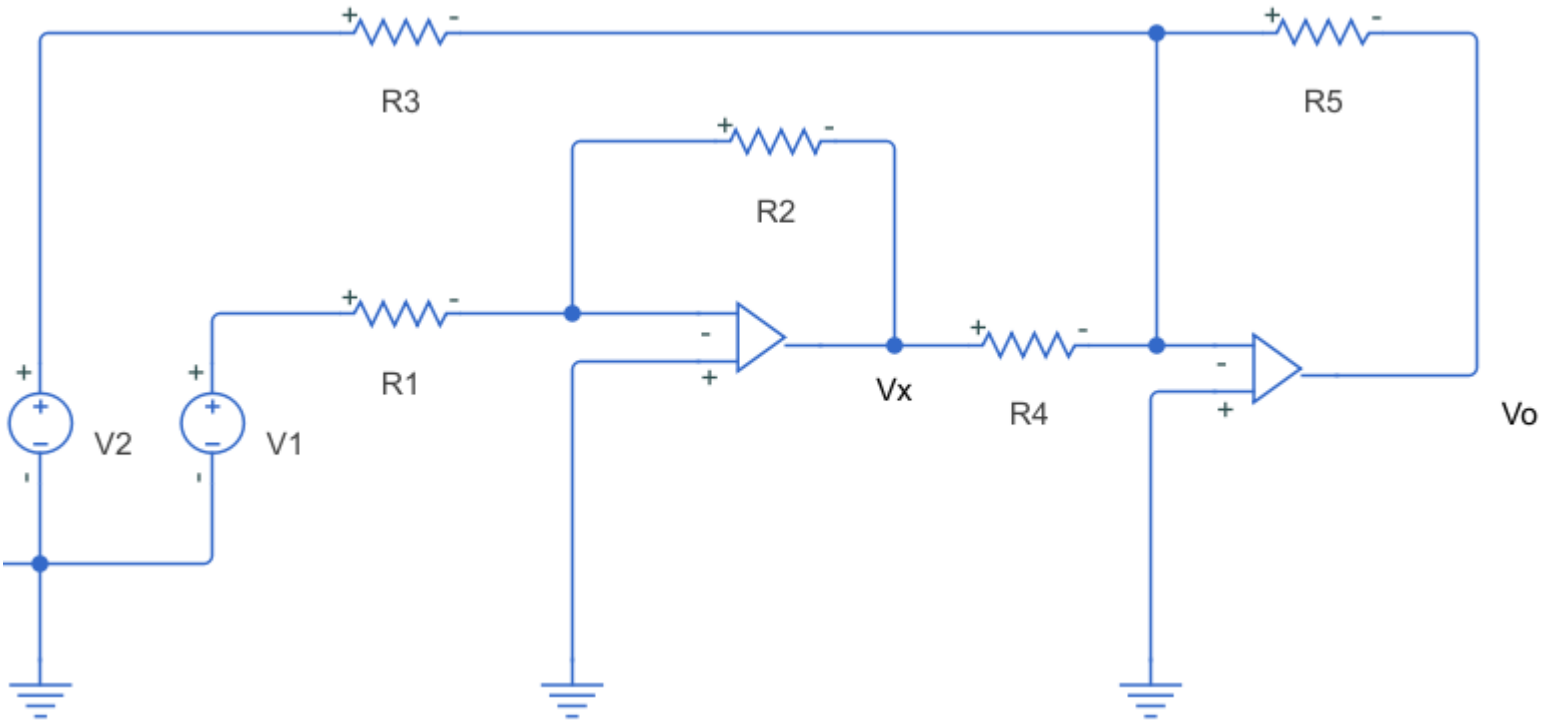
Two OpAmp differential derivation



For the first inverter opamp circuit we have

$$\frac{V_1}{R_1} + \frac{V_x}{R_2} = 0$$

therefore

$$V_x = -\frac{R_2}{R_1} \times V_1$$

Applying superposition to the outer circuit (by eliminating the inverter circuit), considering first $V_1 = 0$

$$\frac{V_2}{R_3} + \frac{V_o}{R_5} = 0$$

therefore

$$V_o = -\frac{R_5}{R_3} \times V_2$$

considering next $V_2 = 0$

$$\frac{V_x}{R_4} + \frac{V_o}{R_5} = 0$$

therefore

$$V_o = -\frac{R_5}{R_4} \times V_x$$

hence,

$$-\frac{R_5}{R_3} \times V_2 - \frac{R_5}{R_4} \times V_x = V_o$$

since

$$V_x = -\frac{R_2}{R_1} \times V_1$$

therefore

$$-\frac{R_5}{R_3} \times V_2 - \frac{R_5}{R_4} \times (-\frac{R_2}{R_1}) \times V_1 = V_o$$

by assuming that $R_2 = R_1$ and $R_4 = R_3$

$$V_o = \frac{R_5}{R_3} \times (V_1 - V_2)$$