$$V \stackrel{\triangle}{=} V^{+} \approx V^{-}$$

V^-

V^+

$$\frac{V_1 - V}{R_1} + \frac{V_2 - V}{R_2} + \frac{V_{out} - V}{R_f} = 0,$$

$$\frac{V_3 - V}{R_3} + \frac{V_4 - V}{R_4} = 0$$

V

$$V = \frac{R_4}{R_3 + R_4} V_3 + \frac{R_3}{R_3 + R_4} V_4$$

$$V_{out} = -\frac{R_f}{R_1}V_1 - \frac{R_f}{R_2}V_2 + \left(\frac{R_f}{R_1} + \frac{R_f}{R_2} + 1\right)\left(\frac{R_4}{R_3 + R_4}V_3 + \frac{R_3}{R_3 + R_4}v_4\right)$$

$$V_{out} = \sum_{i} k_i V_i$$

$$R_2/R_1 = R_4/R_3$$

$$\frac{V^- - V}{R_1} + \frac{V_0 - V}{R_2} = 0, \qquad \frac{V^+ - V}{R_3} + \frac{V_0 - V}{R_4} = \frac{V}{R_L};$$

$$V_0 - V$$

$$V_0 - V = (V - V^-)\frac{R_2}{R_1} = (V - V^-)\frac{R_4}{R_3}$$

$$\frac{V^+ - V}{R_3} + \frac{V - V^-}{R_3} = \frac{V^+ - V^-}{R_3} = \frac{V}{R_L} = I_L$$

R_L

$$I_D = I_0 \left(e^{V_D/V_T} - 1 \right)$$

I_0

V_T

$$\frac{v_{out}}{R} = -I_0(e^{v_{in}/V_T} - 1) \approx -I_0 \ e^{v_{in}/V_T},$$

$$\frac{v_{in}}{R} = I_0(e^{-v_{out}/V_T} - 1) \approx I_0 \, e^{-v_{out}/V_T}$$

$$v_{out} \approx -RI_0 e^{v_{in}/V_T},$$

$$v_{out} \approx -V_T \ln(v_{in}/I_0 R)$$