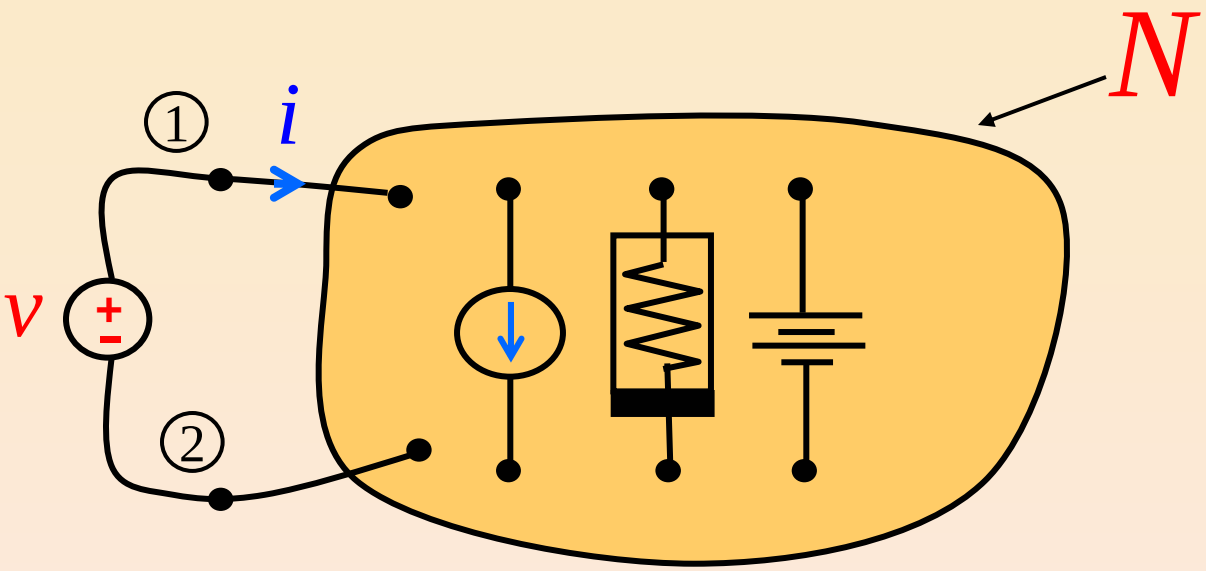
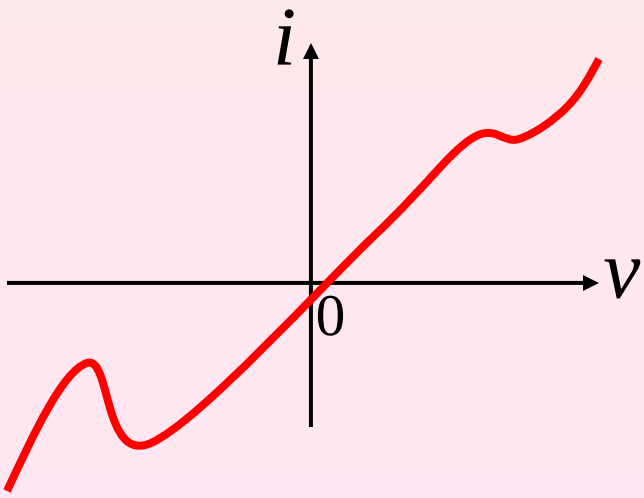
Driving-Point Characteristic



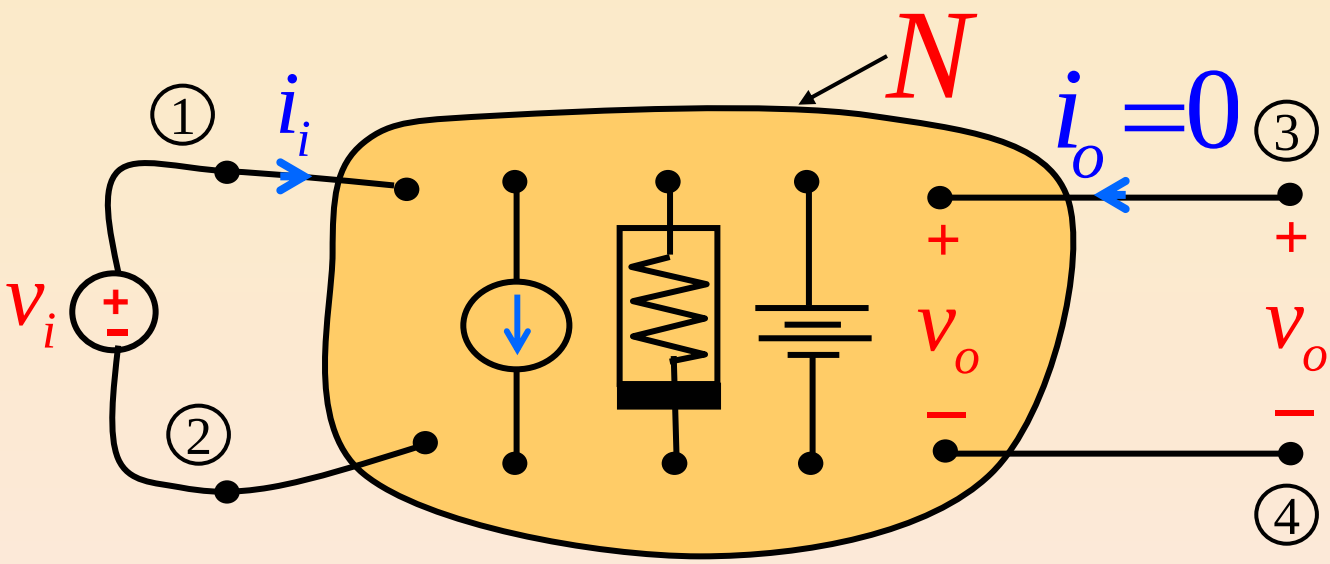
The 2 nodes { ① , ② } where the voltage source is connected are called **driving-point terminals**.

The *i*-vs.-*v* **driving-point characteristic** is the set of all (*i*,*v*) which simultaneously satisfy:

1. KCL
2. KVL
3. *v* – *i* characteristics of all elements inside ***N***



Transfer Characteristic

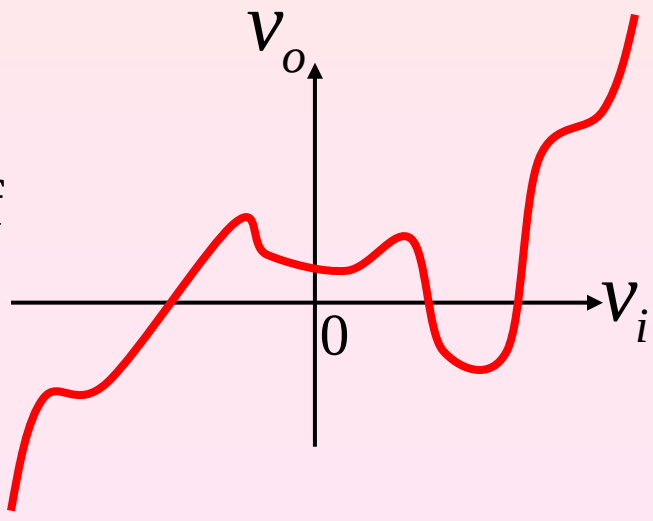


Nodes ① and ② are called driving-point terminals.

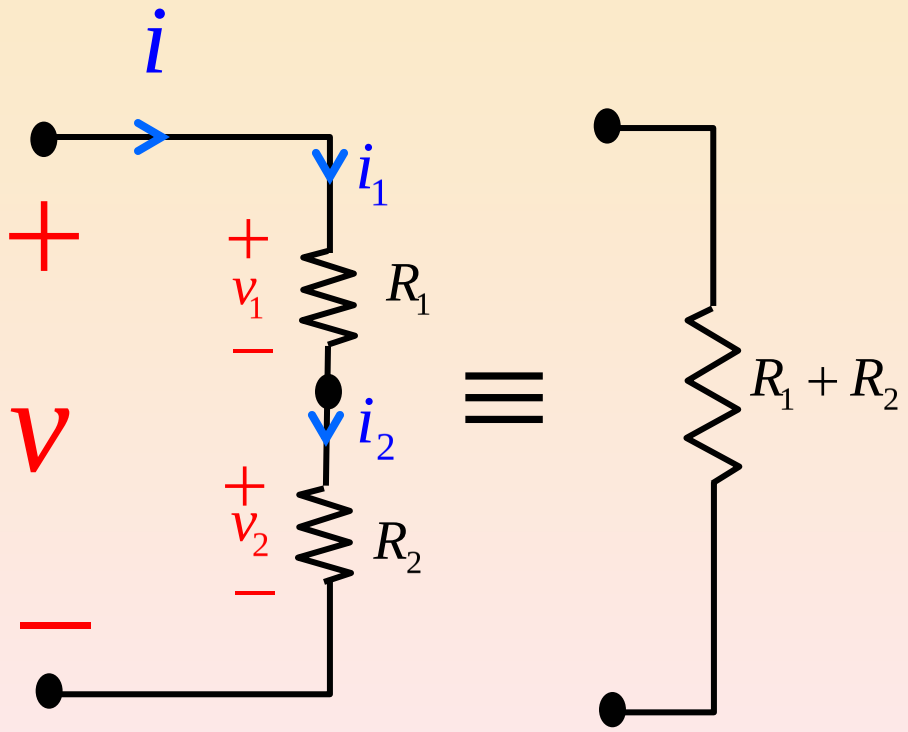
Remark:

The v_o-vs.-v_i **transfer characteristic** is the set of all (v_i, v_o) which simultaneously satisfy:

1. KCL
2. KVL
3. v - i characteristics of all elements inside ***N***
4. $i_o = 0$ (no-loading condition)



Equivalent Series Resistance



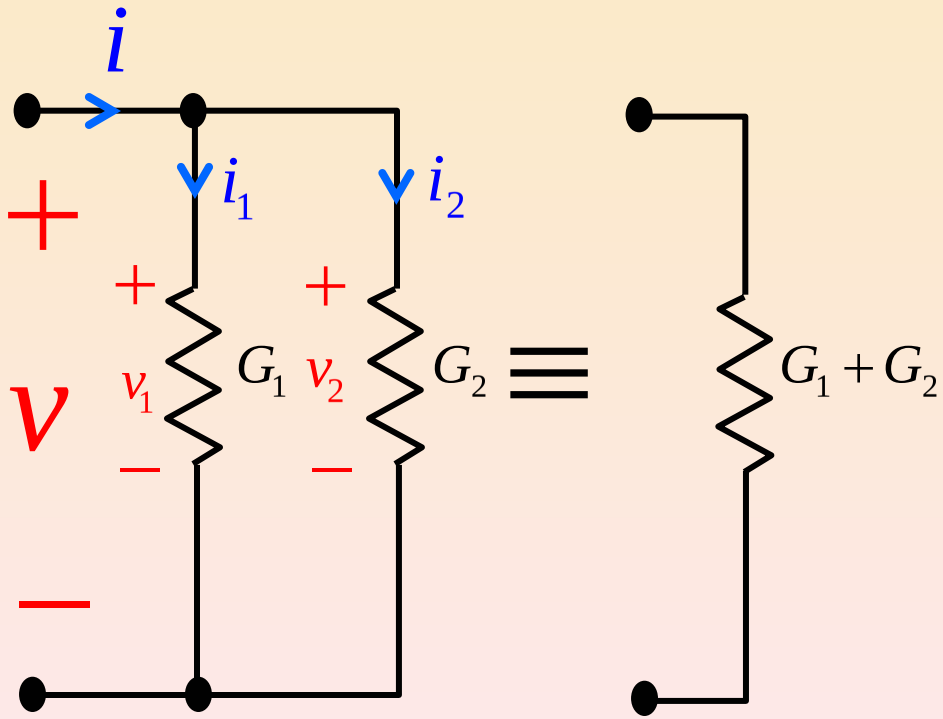
KCL: $i = i_1 = i_2$

KVL: $v = v_1 + v_2$

$= R_1 i_1 + R_2 i_2$

$= (R_1 + R_2) i$

Equivalent Parallel Conductance



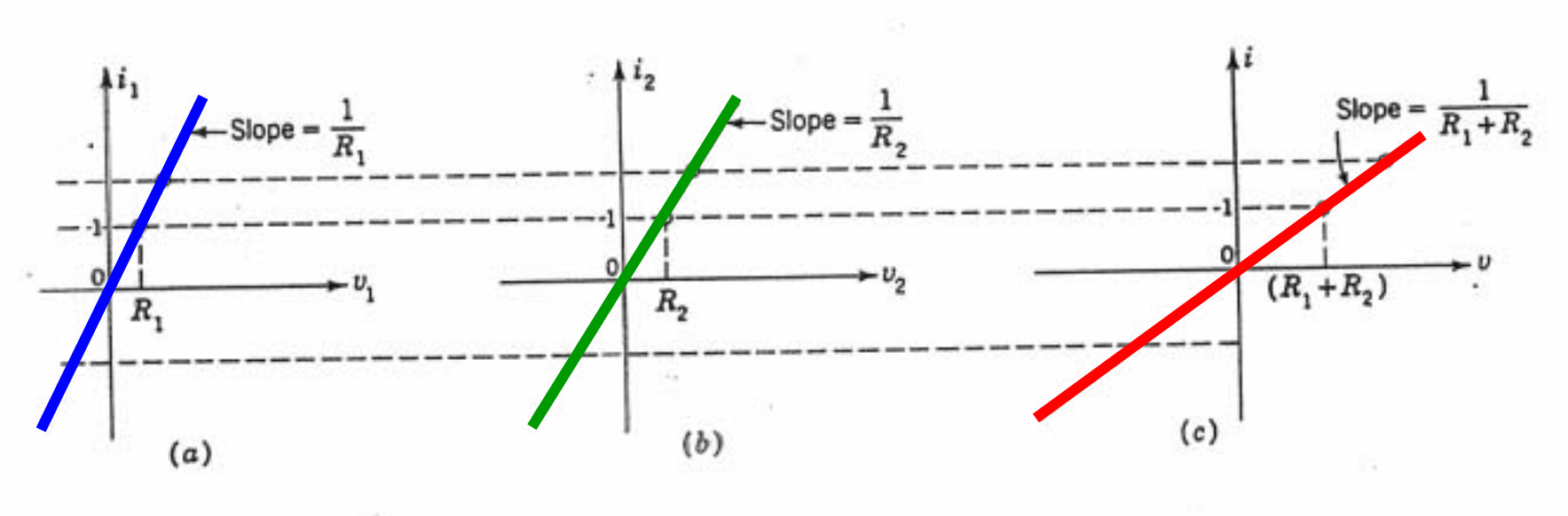
KVL: $v = v_1 = v_2$

KCL: $i = i_1 + i_2$

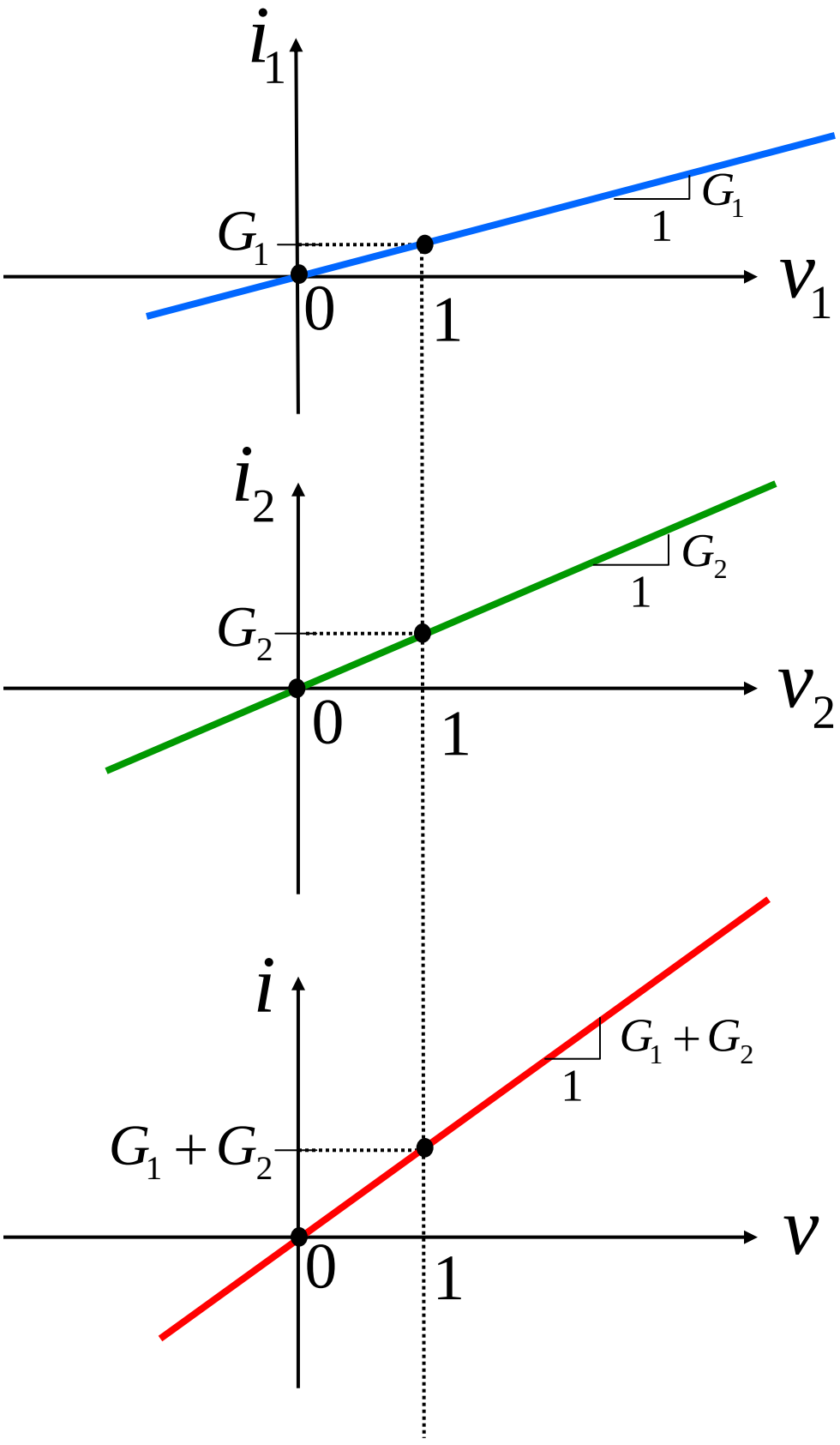
$= G_1 v_1 + G_2 v_2$

$= (G_1 + G_2) v$

Graphical Procedure for Series connection



Graphical Procedure for Parallel connection



Piecewise-Linear Resistors

Every 2-terminal Resistor modeled by a continuous piecewise-linear function of the form $i = \hat{i}(v)$ or $v = \hat{v}(i)$ can be described by

$$i = a_0 + a_1 v + b_1 |v - E_1| + b_2 |v - E_2| + \cdots + b_n |v - E_n|$$

or

$$v = a_0 + a_1 i + b_1 |i - I_1| + b_2 |i - I_2| + \cdots + b_n |i - I_n|$$

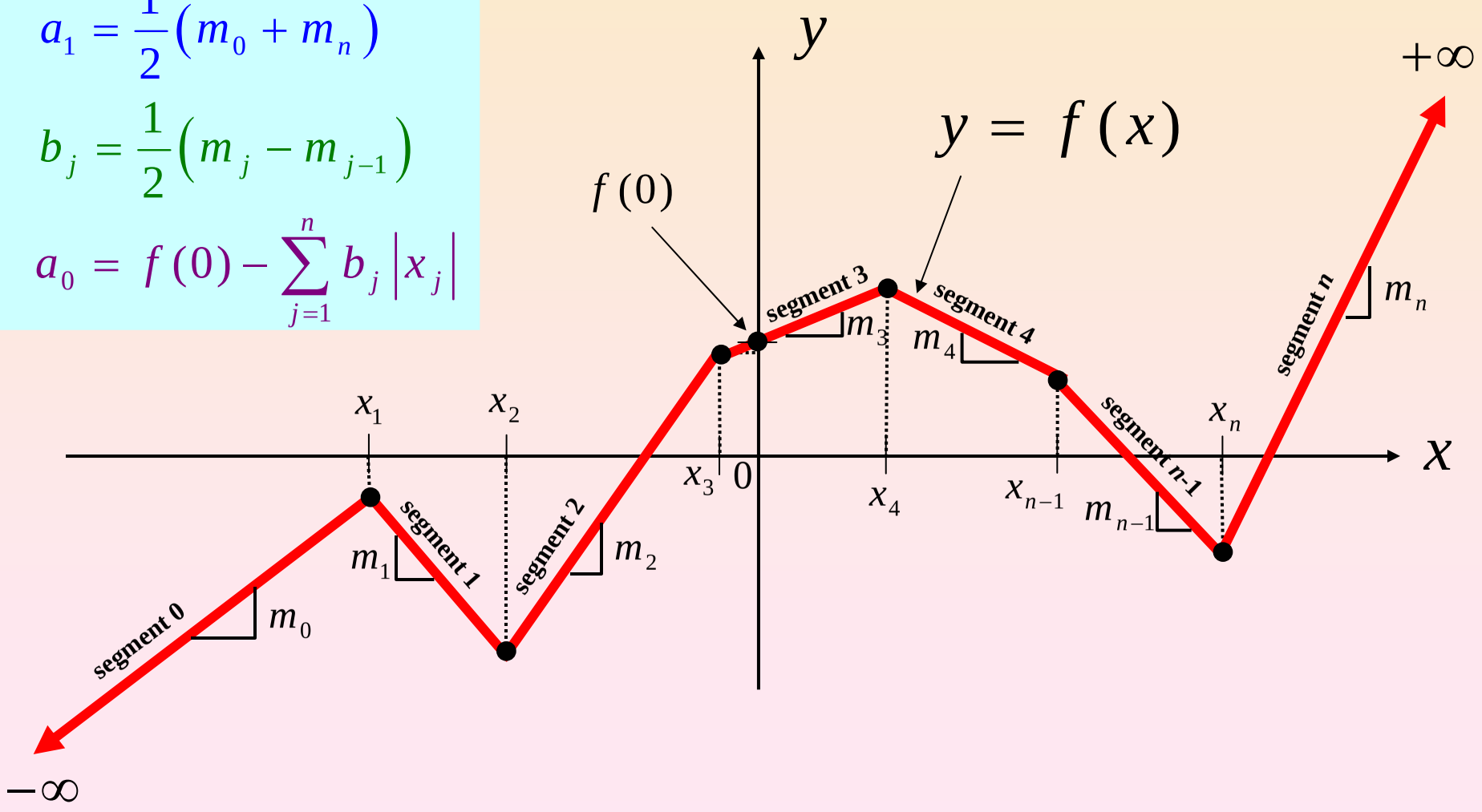
where (E_j, I_j), $j = 1, 2, \cdots, n$, is the (v,i) coordinate of the "n" Breakpoints and $\{a_0, a_1, b_j\}$ are coefficients determined by explicit formulas:

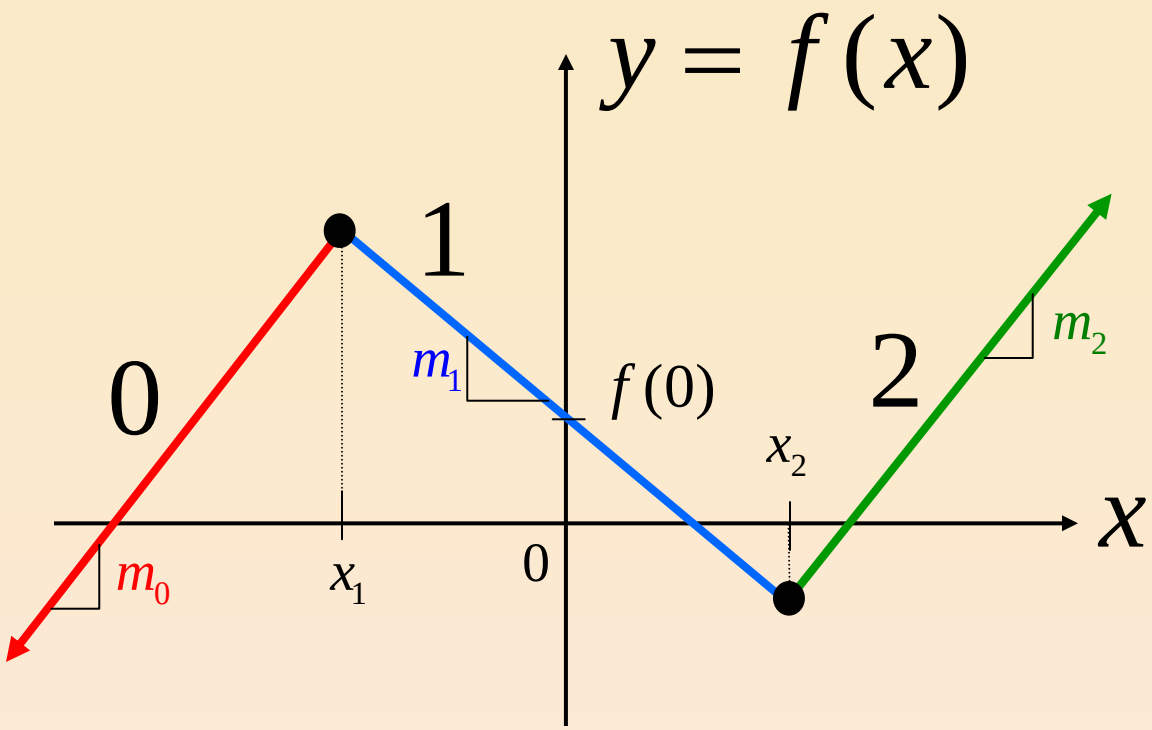
Half-Sum Half-Difference Formulas

$$a_1 = \frac{1}{2}\left(m_0 + m_n\right)$$

$$b_j = \frac{1}{2}\left(m_j - m_{j-1}\right)$$

$$a_0 = f(0) - \sum_{j=1}^{n} b_j \left|x_j\right|$$





Piecewise-Linear Equation:

$$f(x) = a_0 + a_1 x + b_1 |x - x_1| + b_2 |x - x_2|$$

$$a_1 = \frac{1}{2}(m_0 + m_2)$$

$$b_1 = \frac{1}{2}(m_1 - m_0)$$

$$b_2 = \frac{1}{2}(m_2 - m_1)$$

$$a_0 = f(0) - b_1 |x_1| - b_2 |x_2|$$

Examples of 3-Segment PWL Curves