$$f_{(x)} = a_0 + a_1(x-x_0) + a_2(x-x_0)(x-x_1)$$

$$f_{(x_0)} = a_0 \; ; \quad f_{(x_1)} = a_0 + a_1(x_1-x_0) \implies a_1 = \frac{f_{(x_1)}-f_{(x_0)}}{x_1-x_0}$$

Then
$$f_{(x_2)} = a_0 + a_1(x_2-x_0) + a_2(x_2-x_0)(x_2-x_1)$$

$$\implies a_2 = \frac{f_{(x_2)} - a_0 - a_1(x_2-x_0)}{(x_2-x_0)(x_2-x_1)}$$

$$= \frac{f_{(x_2)} - f_{(x_0)} - \left(f_{(x_1)}-f_{(x_0)}\right)\frac{x_2-x_0}{x_1-x_0}}{(x_2-x_0)(x_2-x_1)}$$

$$= \frac{f_{(x_2)} - f_{(x_1)} + f_{(x_1)} - f_{(x_0)} - \left(f_{(x_1)}-f_{(x_0)}\right)\frac{x_2-x_0}{x_1-x_0}}{(x_2-x_0)(x_2-x_1)}$$

$$= \frac{\dfrac{f_{(x_2)}-f_{(x_1)}}{x_2-x_1} + \left(\dfrac{f_{(x_1)}-f_{(x_0)}}{x_2-x_1}\right)\left(1-\dfrac{x_2-x_0}{x_1-x_0}\right)}{x_2-x_0}$$

$$= \frac{\dfrac{f_{(x_2)}-f_{(x_1)}}{x_2-x_1} + \left(\dfrac{f_{(x_1)}-f_{(x_0)}}{x_2-x_1}\right)\dfrac{x_1-x_2}{x_1-x_0}}{x_2-x_0}$$

$$= \frac{\dfrac{f_{(x_2)}-f_{(x_1)}}{x_2-x_1} - \dfrac{f_{(x_1)}-f_{(x_0)}}{x_1-x_0}}{x_2-x_0} \qquad \square$$