$$f_{i+1} = f_i + \Delta x f_i' + \frac{\Delta x^2}{2} f_i'' + \frac{\Delta x^3}{6} f_i''' + \cdots$$

$$f_{i+2} = f_i + 2\Delta x f_i' + 2\Delta x^2 f_i'' + \frac{4}{3}\Delta x^3 f_i''' + \cdots$$

(1) $$\frac{f_{i+1} - f_i}{\Delta x} = f_i' + \frac{\Delta x}{2} f_i'' + \frac{\Delta x^2}{6} f_i''' + \cdots$$

(2) $$\frac{f_{i+2} - f_{i+1}}{\Delta x} = f_i' + \frac{3}{2}\Delta x f_i'' + \frac{7}{6}\Delta x^2 f_i''' + \cdots$$

$$a(1) + b(2) = f_i' + 0\,\Delta x f_i'' + \cdots$$

$$\Rightarrow a + b = 1 \quad \& \quad \frac{a}{2} + \frac{3b}{2} = 0$$

$$\Rightarrow -2b = 1 \quad \boxed{b = -1/2, \; a = 3/2}$$

$$\Rightarrow \frac{3}{2}\left(\frac{f_{i+1} - f_i}{\Delta x}\right) - \frac{1}{2}\left(\frac{f_{i+2} - f_{i+1}}{\Delta x}\right) = f_i'$$

$$\Rightarrow \boxed{\frac{4f_{i+1} - 3f_i - f_{i+2}}{2\Delta x} = f_i'}$$

is the formula of 2nd order