

## Serie de Taylor

$$f(x_{i+1}) = f(x_i) + hf'(x_i) + \frac{h^2}{2!}f''(x_i) + \dots + \frac{h^n}{n!}f^{(n)}(x_i)$$

## Euler

$$\begin{aligned}y_{i+1} &= y_i + \phi h \\ \phi &= f(x_i, y_i) \\ h &= x_{i+1} - x_i\end{aligned}$$

## Euler Modificado

Ecuación predictiva

$$y_{i+1}^0 = y_i + f(x_i, y_i)h$$

Ecuación correctiva

$$y_{i+1} = y_i + \frac{f(x_i, y_i) + f(x_{i+1}, y_{i+1}^0)}{2}h$$

## Runge-Kutta 2do Orden

$$\begin{aligned}y_{i+1} &= y_i + \frac{h}{2}(k_0 + k_1) \\ k_0 &= f(x_i, y_i) \\ k_1 &= f(x_i + h, y_i + hk_0)\end{aligned}$$

## Runge-Kutta 3er Orden

$$\begin{aligned}y_{i+1} &= y_i + \frac{h}{6}(k_1 + 4k_2 + k_3) \\ k_1 &= f(x_i, y_i) \\ k_2 &= f(x_i + \frac{h}{2}, y_i + \frac{h}{2}k_1) \\ k_3 &= f(x_i + h, y_i - hk_1 + 2hk_2)\end{aligned}$$

## Runge-Kutta 2do Orden (Sistema de ecuaciones)

$$\begin{aligned}y_{(i+1,j)} &= y_{(i,j)} + \left(\frac{1}{3}k_{(1,j)} + \frac{2}{3}k_{(2,j)}\right)h \\ k_{(1,j)} &= f_j(x_i, y_{(i,1)}, y_{(i,2)}, \dots, y_{(i,n)}) \\ k_{(2,j)} &= f_j(x_i + \frac{3}{4}h, y_{(i,1)} + \frac{3}{4}hk_{(1,1)}, y_{(i,2)} + \\ &\quad + \frac{3}{4}hk_{(1,2)}, \dots, y_{(i,n)} + \frac{3}{4}hk_{(1,n)})\end{aligned}$$

## Diferencias finitas

$$\begin{aligned}\frac{d^2y}{dx^2} &= \frac{y_{i+1} - 2y_i + y_{i-1}}{h^2} \\ \frac{dy}{dx} &= \frac{y_{i+1} - y_i}{2h}\end{aligned}$$

## Sustitución (Ecuaciones orden superior)

$$\begin{aligned}\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} - y\frac{dy}{dx} &= 0 \\ y(0) = 0, \quad y'(0) = 1, \quad y''(0) = -1. \\ z_1 = y; \quad f_1 = \frac{dz_1}{dx} = z_2 \\ \frac{d}{dx} \left[ \frac{d}{dx} \left( \frac{dz_1}{dx} \right) \right] - 3\frac{d}{dx} \left( \frac{dz_1}{dx} \right) - z_1\frac{dz_1}{dx} &= 0 \\ \frac{d}{dx} \left( \frac{dz_2}{dx} \right) - 3\frac{dz_2}{dx} - z_1z_2 = 0; \quad f_2 = \frac{dz_2}{dx} = z_3 \\ \frac{dz_3}{dx} - 3z_3 - z_1z_2 = 0; \quad f_3 = \frac{dz_3}{dx} = 3z_3 + z_1z_2\end{aligned}$$

Condiciones iniciales

$$z_1(0) = 0, \quad z_2(0) = 1 \quad z_3(0) = -1$$