Euler method for solving a differential Eq.
Example:

$$\frac{d^2\theta}{dt^2} = -\sin(\theta) \tag{1}$$

Define $\qquad v(t) = d\theta/dt$
$dv/dt = -\sin(\theta)$

Taylor series $\; f_{n+1} = f_n + hf'_n + h^2 f''_n/2 + \mathcal{O}(h^3)$
$d\theta/dt = [\theta(t+h) - \theta(t)]/h + \mathcal{O}(h) = v(n)$

$$dv/dt = [v(n+1) - v(n)]/h + \mathcal{O}(h) = -\sin(\theta)$$

$$\theta_{n+1} = \theta_n + h\theta'_n + \mathcal{O}(h^2)$$

$v_{n+1} = v_n - h\sin(\theta_n) + \mathcal{O}(h^2)$

Iterate: $\qquad \theta_1 = 50 \times \frac{\pi}{180}; \quad v_1 = 0 \quad$ start from rest at a large angle
$\theta_2 = \theta_1 + hv_1 + \mathcal{O}(h^2) = \theta_1 + \mathcal{O}(h^2)$
$v_2 = v_1 + h[-\sin(\theta_1)] + \mathcal{O}(h^2)$

$$\theta_3 = \theta_3 + hv_3 + \mathcal{O}(h^2)$$

$v_3 = v_2 + h[-\sin(\theta_2)] + \mathcal{O}(h^2)$
etc

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$v_{n+1} = v_n + h[-\sin(\theta_n)] + \mathcal{O}(h^2)$

$\theta_{n+1} = \theta_n + hv_n + \mathcal{O}(h^2)$,replace
$v_n \to (v_{n+1} + v_n)/2 = (v_n + h[-\sin(\theta_n)] + v_n)/2 + \mathcal{O}(h^2) = v_n + h[-\sin(\theta_2)/2 + \mathcal{O}(h^2)$

Get: $\qquad v_{n+1} = v_n + h[-\sin(\theta_n)] + \mathcal{O}(h^2)$
$\theta_{n+1} = \theta_n + hv_n + h^2(-\sin(\theta_n) + \mathcal{O}(h^3)$; gain one additional order of magnitude accuracy