$$y'(t) \quad = \quad f(t) \qquad \text{(but not a function of y)}$$

$$y'(t) \quad = \quad -(9.8\frac{m}{s^2})\,t$$

$$y_{i+1} \quad = \quad y_i \;+\; y'_i\,dt$$

$$y_{i+1} \quad = \quad y_i \;+\; \frac{1}{2}(y'_i + y'_{i+1})\,dt$$

$$y_{i+1} \quad = \quad y_i \;+\; \frac{(y'_i \;+\; 4y'_{i+1/2} \;+\; y'_{i+1})}{6}\,dt$$

$$y'(t) \quad = \quad f(y, t, a, b, ...)$$

$$\begin{aligned}
\frac{dv_y}{dt} &= -\frac{GM}{y^2}\left(\frac{y}{|y|}\right) \\
\frac{dy}{dt} &= v_y
\end{aligned}$$

$$\begin{aligned}
t &= 0 \\
y &= 10 \text{ m} \\
v_y &= 0 \text{ m/s}
\end{aligned}$$

$$\begin{aligned}
\text{predict} \;\; \tilde{y}'_{i+1} &= y'_i \;+\; y''_i\,dt \\
&= 0 \;-\; 0.667 \text{ m/s}^2 (1 \text{ s}) \\
&= -0.667 \text{ m/s}^2
\end{aligned}$$

$$\begin{aligned}
\text{predict} \;\; \tilde{y}_{i+1} &= y_i \;+\; y'_i\,dt \\
&= 10 \text{ m} \;+\; 0 \text{ m/s}(1 \text{ s}) \\
&= 10 \text{ m}
\end{aligned}$$

$$\begin{aligned}
\text{predict} \;\; \tilde{y}''_{i+1} &= -\frac{GM}{(\tilde{y}_{i+1})^2} \\
&= -0.667 \text{ m/s}^2
\end{aligned}$$

$$
\begin{aligned}
y'_{i+1} &= y'_i + \frac{1}{2}(y''_i + \tilde{y}''_{i+1})\,dt \\
&= 0 - 0.667 \text{ m/s}^2(1 \text{ s}) \\
&= -0.667 \text{ m/s}^2
\end{aligned}
$$

$$
\begin{aligned}
y_{i+1} &= y_i + \frac{1}{2}(y'_i + \tilde{y}'_{i+1})\,dt \\
&= 10 \text{ m} + \frac{1}{2}(0 \text{ m/s} - 0.667 \text{ m/s})(1 \text{ s}) \\
&= 9.66 \text{ m}
\end{aligned}
$$