LAB 3  Projectiles

For the Y Coordinate

\[ y(t_1) = y(t + \Delta t) = y(t) + \Delta y(t) \]
\[ \Delta y(t) = V_y \times \Delta t \]

\[ V_y(t + \Delta t) = V_y(t) + \Delta V_y(t) \]
\[ \Delta V_y(t) = A_y \times \Delta t = -g \times \Delta t \]
\[ V_y(t + \Delta t) = V_y(t) - g \times \Delta t \]
\[ \Delta y(t) = (V_y(t) - g \times \Delta t) \times \Delta t \]
\[ y(t_1) = y(t + \Delta t) = y(t) + V_y(t) \times \Delta t - g \times (\Delta t)^2 \]

\[ V_y(t + \Delta t) = V_y(t) - g \times \Delta t \]

**Example:****

\[ t_0 = 0 \Rightarrow y(t_0) = h, \ V_{x0}, \ V_{y0} \]

\[ t_1 = t_0 + \Delta t \quad \Delta t = 1 \text{ sec} \quad g = 9.8 \text{ m/s} \]

\[ y(t_1) = y(t_0 + \Delta t) = y(t_0) + V_y(t_0) \times \Delta t - 9.8 \times (\Delta t)^2 \]

\[ t_2 = t_1 + \Delta t = t_0 + 2 \times \Delta t \quad \Delta t = 1 \text{ sec} \]

\[ t_i = t_0 + \Delta t \]

\[ y(t_2) = y(t_1 + \Delta t) = y(t_1) + V_y(t_1) \times \Delta t - 9.8 \times (\Delta t)^2 \]

\[ V_y(t_1) = V_y(t_0) - g \times \Delta t = V_y(t_0) - 9.8 \times \Delta t \]

**For the X Coordinate**

\[ x(t + \Delta t) = x(t) + \Delta x(t) \]

\[ \Delta x(t) = V_x \times \Delta t \]

\[ V_x(t + \Delta t) = V_x(t) + A_x \times \Delta t = 0 \times \Delta t = 0 \]

\[ V_x(t + \Delta t) = V_x(t) \Rightarrow \text{constant} \ V_{x0} \]

\[ \Delta x(t) = V_{x0} \times \Delta t \]
Examplification:

- $t_0=0 \Rightarrow x(t_0)=0, V_{x_0}, V_{y_0}$
- $t_1 = t_0 + \Delta t, \quad \Delta t = 1$ sec, \quad g=9.8 m/s
- $x(t_1) = x(t_0 + \Delta t) = x(t_0) + V_{x_0} \times \Delta t$

- $t_2 = t_1 + \Delta t = t_0 + 2 \times \Delta t, \quad \Delta t = 1$ sec
- $t_1 = t_0 + \Delta t$

- $x(t_2) = x(t_1 + \Delta t) = x(t_1) + V_{x_0} \times \Delta t$

Program:
Input: h, $V_{x_0}$ (m/s), $V_{y_0}$ (m/s), $\Delta t$ (sec)

Output:
- At $t = 1$ sec \quad $x=0.3$ \quad $y=2.1$
- At $t = 2$ sec \quad $x=0.5$ \quad $y=1.8$
- ...
- at $t= ... \quad x= ... \quad y=0$

Program stops when $y=0$ (the ball is on the ground)