Programming Lab – Ballistic Motion: Constant Acceleration in 2-Dimensions - PYTHON
PHYS 2511 – Prof. Matthew Newby – Spring 2018

Goal:	Create a python program that iteratively calculates and visualizes the motion of an object in a constant gravitational field.
Requirements:	The iterative calculation may only deviate from the analytic trajectory by 1%. Inputs and outputs should be on one sheet, with calculations on other sheet(s).
Inputs:	• Gravitational constant • Initial velocity magnitude • Initial velocity angle • Initial height • Time step
Outputs:	• Highest point • Distance to ground • Flight time • Optional: Plot of x-y motion (Covered next class)

Possible Issues: Accuracy

Background:

The position of an object in 1-dimension is given analytically by: $x(t) = x_0 + v_0 t + \frac{1}{2}at^2$
Where the "0" subscript represents initial values.

The Average Velocity and Average Acceleration are given by:

$$\bar{a} = \frac{\Delta\vec{v}}{\Delta t} \qquad (1) \qquad \bar{v} = \frac{\Delta\vec{x}}{\Delta t} \qquad (2)$$

Rearranging:

$$\Delta v = a\Delta t \qquad (3) \qquad \Delta x = v\Delta t \qquad (4)$$

Given initial values, and choosing a value for Δt, we can calculate *v*, Δt after 0, from that *x* at Δt.

We can keep going, using the output from the previous step (*i*), to get the velocity and position at a new step (*i+1*), like so:

$$v_{i+1} = v_i + a\Delta t \qquad (5) \qquad x_{i+1} = x_i + v\Delta t \qquad (6)$$

We can calculate as many steps as we need, depending on our ending condition.