

LAB 8

Loopy exercises

Learning goals:

“while” and “for” loops.

More practice with plotting, if-else, string handling.

Dropping lead balls

Many have heard the story of Galileo proving Aristotle wrong about gravitational forces by dropping balls from the tower of Pisa. This story was probably made up, but there were two scientists, Stevin & de Groot, who dropped lead balls from the New Church tower in Delft (Netherlands) around 1586. Your assignment here is to simulate this experiment.

The overall goal is to make a plot of ball height versus time, $z(t)$. The ball is released from rest at an initial height of $z_0 = 9$ m. The equation of motion is:

$$z(t) = z_0 - \frac{1}{2}gt^2.$$

Your simulation begins at time $t_0 = 0$ and steps forward in small increments of time Δt . At each new time step, the latest position z is calculated and stored in an array (you should also build up an accompanying array for t). The simulation stops once the ball reaches the ground.

Your program will need a **while** condition and a loop (*the problem could be solved much more easily using vectorization, but this would not work if we needed to include air resistance!*) At each step within the loop, you should print out the current values of t and z using appropriate formatting. Your plot should be labeled appropriately, and the curve $z(t)$ should *not* extend underground.

Bonus: Calculate and plot a vector of velocity $v_z(t)$, making use of the definition that $v_z = dz/dt \approx \Delta z/\Delta t$. Overplot and compare the expectation $v_z = -gt$.