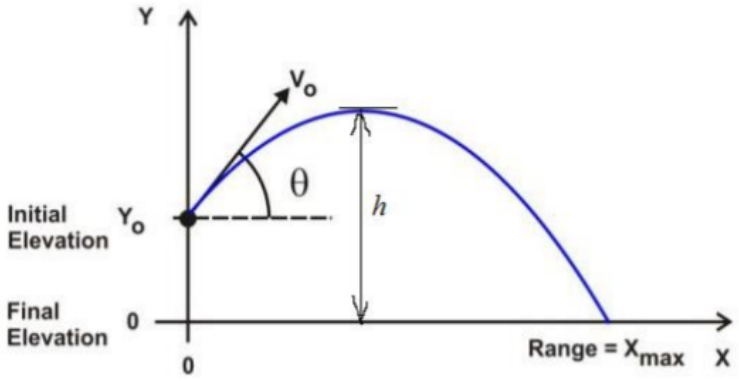
Homework 2

Projectile Motion

Write a program which prompts the user to supply the initial speed (in m/s) and initial height above landing point (in meters) of a launched projectile. Your program will find the launch angle θ (in degrees) which maximizes the *range* (the horizontal distance traveled) of the projectile.



Assuming the projectile's trajectory is only affected by gravity then we know the time of flight Δt (the time taken for the ball to land):

$$\Delta t = \frac{v_i \sin\theta + \sqrt{v_i^2 \sin^2\theta + 2gy_i}}{g} \tag{1}$$

Where v_i is the initial speed, y_i is the initial height, and $g = 9.81$ m·s^{-2} is the acceleration due to gravity at the surface of the Earth.

The horizontal distance traveled is then:

$$x_{\max} = v_i \cos\theta \Delta t \tag{2}$$

Given v_i and y_i, your program should calculate (to within 0.1°) which angle (between 0 and 90°) maximizes $x_{\max}$. *Hint: one way to do this is to calculate $x_{\max}$ for every value of θ between 0 and 90, in steps of 0.1, and then pick the angle that corresponds to the largest $x_{\max}$*

Requirements

Your program should utilize (at least) two functions (not including `main()`):

1. A function `time_of_flight(theta,vi,yi)` which uses the angle, initial velocity, and initial height to calculate and return Δt
2. A function `xrange(theta,vi,yi)` which first makes a call to `time_of_flight(theta,vi,yi)`, and then returns the quantity $v_i \cos\theta \Delta t$

Your program should follow the style and readability guidelines detailed here