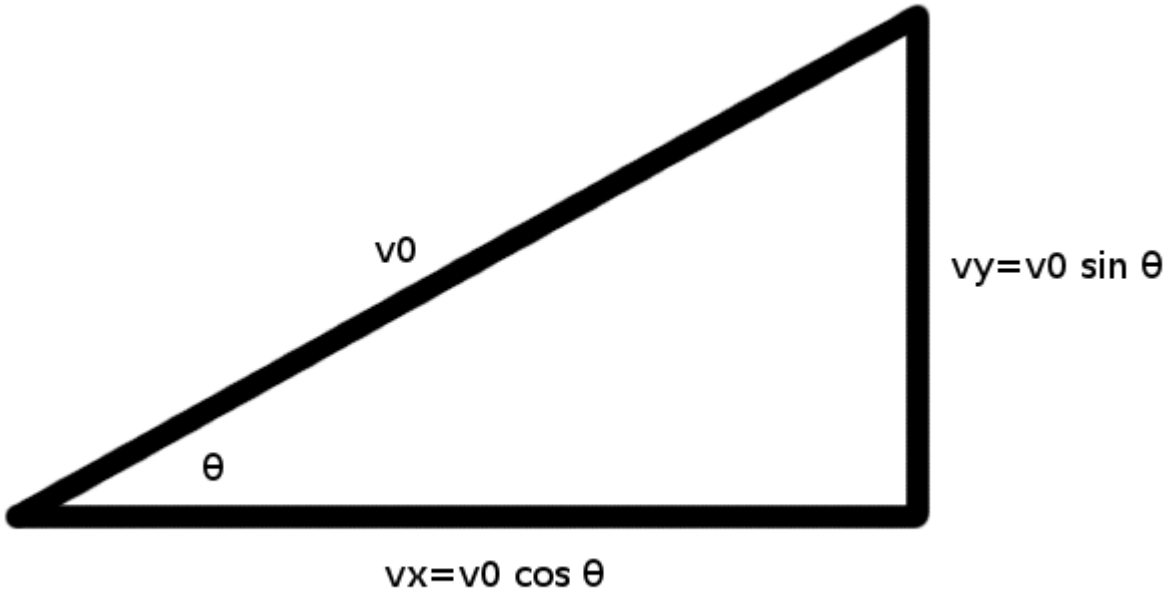
Wind

October 2011

Translate into horizontal and vertical velocities...



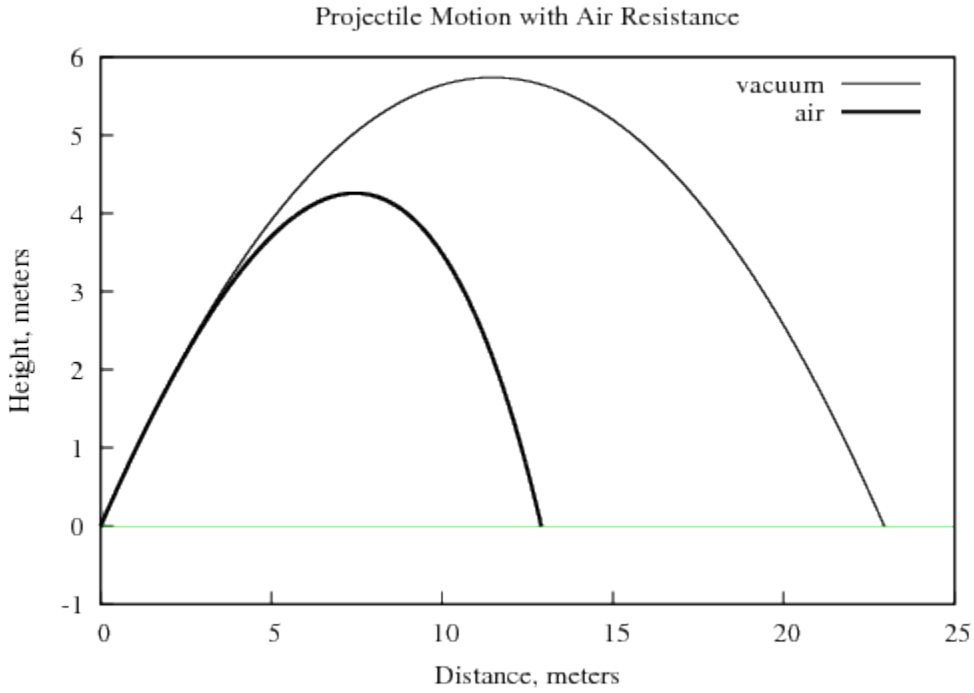
Initial Conditions

```
from math import cos,sin,pi
#
v0    = 15.00              # meters per second
theta = 45.0*(pi/180.0)
#
vx    = v0*cos(theta)      # m/s
vy    = v0*sin(theta)
#
g     = -9.81              # m/s per second
```

Air Resistance Terms

```
while y>=0.0:
    #
    x  += (vx*dt)    # dt is the "timestep"
    y  += (vy*dt)
    vx += (ax*dt)
    vy += (ay*dt)
    #                # TWO BIG IDEAS
    ax  = ( -c1*vx) # 1 oppose direction of motion
    ay  = (g-c1*vy) # 2 scale with increased speed
```

Comparison for $c_1 = 0.5$



- Both range and peak height are diminished.

Code to Data to Plot

```
python parabola.py > parabola.txt
gnuplot parabola.gnu
display parabola.png
```

Advantage

- Quickly determine data from model.
- Quickly generate plots from data.
- Quickly compare the effects of c_1, v_w, v_0, and θ.

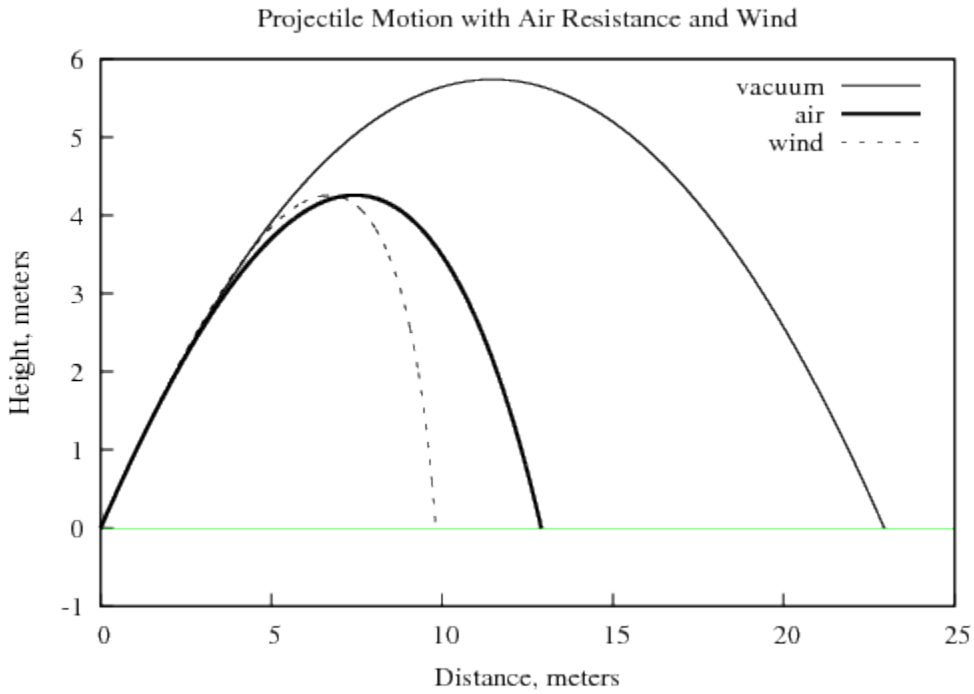
Gnuplot Script

```
set terminal png
set output "parabola.png"
set title "Deconstructed Parabola"
set xlabel "Distance, meters"
set ylabel "Height, meters"
set xtics nomirror
set ytics nomirror
set xrange[:25]
plot "parabola.txt" using 2:3 w l notitle, 0 w l
```

Horizontal Wind Only

```
#
vw = -4.4704  # headwind of 10 mph
#
while y>=0.0:
   #
   ...
   #
   ax  = ( -c1*(vx-vw))
   ay  = (g-c1*(vy   ))
```

Comparison

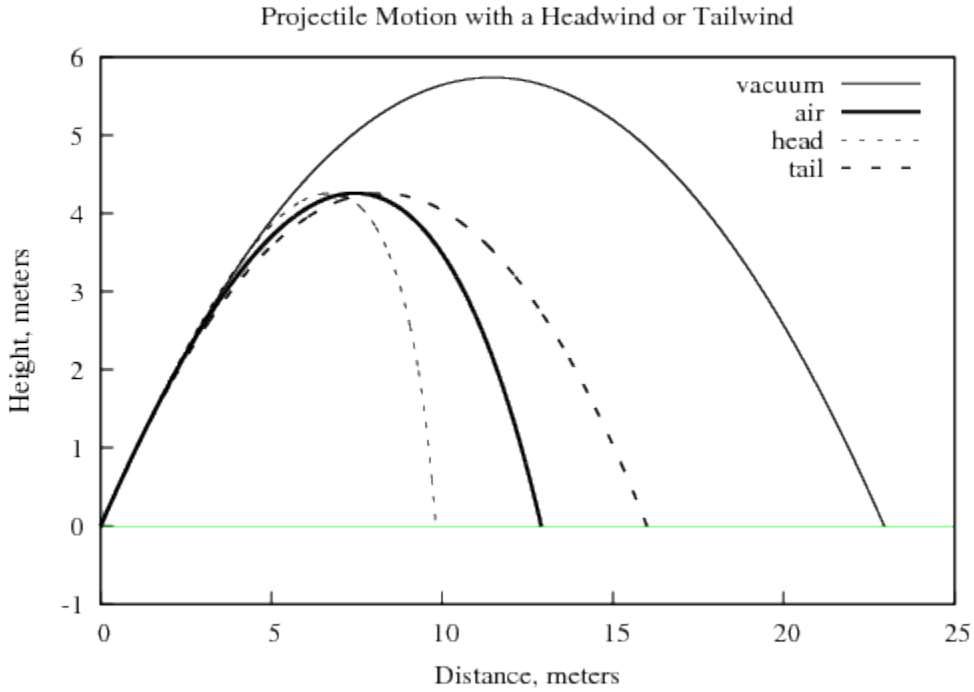


- Note how t_{max} is greater for the $c_1 = 0$ case.

Horizontal Wind Only, Part Two

```
#
vw =  4.4704  # tailwind of 10 mph
#
while y>=0.0:
    #
    ...
    #
    ax  = ( -c1*(vx-vw))
    ay  = (g-c1*(vy   ))
```

Comparison, Part Two



- Note how t_{max} is the same for all $c_1 \neq 0$ cases.

Lab Assignment: Air Resistance with Wind

- Set $c_1 = 0.5$, $v_0 = 15.0$ m/s, $\theta = 60°$ and compare wind to the no air resistance parabola.
- Use $v_w = -10.0$, 0.0, 10.0, 20.0 and 30.0 m/s. Sketch a plot.
- Sketch a plot to compare the range x_T for various values of v_w.
  - Increment v_w by 1.0 m/s between samples.
- Also...
  - How do different c_1 values compare?
  - How do different θ values compare?

Next Topic → Free Fall