**Exercise – Ballistic Motion:**

**Download the notebook: Ballistic.ipynb**

We are now using the numerical framework used in the book. The objective here is to understand how to run the code (not all code details)

1] Where do we set simulation time and timestep?

2] Where do we set the initial speed and angle of the projectile

3] Where do we specify the initial conditions?

4] Check how the F function is implemented and if it fits with the lecture notes.

5] What does the function exact\_solution do ?

6] What does the function PrintSoln do and what is shown in the different Y columns?

7] What does the function findRange do ?

8) What kind of plots are shown?

9] Let m = 2 kg, Cd = 0.01 kg/m, w = 0, Vo=80 m/s, angle = 60 degrees.

Simulate and compare with the exact solution with no drag. What are the main differences in results?

10] Simulate again with Cd = 0.How does the results look like now ? What can this tell us ?

11) Compare zero wind with headwind (w = - 20 m/s) and tailwind (+ 20 m/s). What are the differences with respect to range and time of flight ?

12) Compare the plot height vs x (title height vs range )for w = + 20 m/s and w = - 20 m/s). Explain what happens.

**Download the notebook RandomBallisticData.ipynb**

13] Study how introduce a loop to run the simulator several times in one go.

[14] Study how we randomize initial Vo and angle for each simulation to produce a new different simulation

[15] Study how we open a file to write input data and output results for each simulation + close the file in the end.

[16] Study where we specify the wind now (not in F function) and how this has altered the variables sent into the functions.

[17] Check how the file ballistiskedata.txt looks after running the simulator

[18] Try to randomize the wind and also include this input parameter in the final results file (ballisitiskedata.txt)

[19] Can we use such data to train a machine learning model (ANN)?. What will be the input nodes and output nodes in such a model? (question you can reflect upon after taking the machine learning part)