

# C212/A592 Lab 7

Intro to Software Systems

## Instructions:

- Review the requirements given below and Complete your work. Please compress all files (including main to test your work) into a zip file and submit it through Canvas.
- The grading scheme is provided on Canvas

## Cannonball

Design a class Cannonball to model a cannonball that is fired into the air. A ball has

- An x- and a y-position.
- An x- and a y-velocity.

Supply the following methods:

- A constructor with an x-position (the y-position is initially 0).
- A method move(double deltaSec) that moves the ball to the next position. First compute the distance traveled in deltaSec seconds, using the current velocities, then update the x- and y-positions; then update the y-velocity by taking into account the gravitational acceleration of  $-9.81 \text{ m/s}^2$ ; the x-velocity is unchanged.
- A method Point getLocation() that gets the current location of the cannonball, rounded to integer coordinates.
- A method ArrayList<Point> shoot(double alpha, double v, double deltaSec) whose arguments are the angle  $\alpha$  and initial velocity  $v$ . (Compute the x-velocity as  $v \cos \alpha$  and the y-velocity as  $v \sin \alpha$ ; then keep calling move with the given time interval until the y-position is 0; return an array list of locations after each call to move.)

Use this class in a program that prompts the user for the starting angle and the initial velocity. Then use shoot function and **draw the trajectory of the cannonball**.

## Complex Numbers

Create a class called Complex for performing arithmetic with complex numbers. Complex numbers have the form  $R + jI$  where,  $j = \sqrt{-1}$ . Complex numbers are also written as  $(R, I)$ .

Write a program to test your class. Use floating-point variables to represent the private data of the class. Provide a constructor that enables an object of this class to be initialized when it's declared. Provide a no-argument constructor with default values in case no initializers are provided. Declare all variables as private and provide their getters and setters. Also provide public methods that perform the following operations:

- a) Get the Conjugate of a Complex number
- b) Convert complex number (real and imaginary parts) to polar coordinates
- c) Add two Complex numbers

- d) Subtract two Complex numbers using the conjugate
- e) Multiply two Complex numbers
- f) Divide two complex numbers
- g) Print Complex numbers in both forms: (realPart, imaginaryPart) and (amplitude, angle) using toString.

Here are some common complex number arithmetic operations:

$$(a + bi) + (c + di) = (a + c) + (b + d)i$$

$$(a + bi) - (c + di) = (a - c) + (b - d)i$$

$$(a + bi) * (c + di) = (ac - bd) + (ad + bc)i$$

$$(a + bi) \div (c + di) = \frac{ac + bd}{c^2 + d^2} + \frac{bc - ad}{c^2 + d^2}i$$