Homework 2
02-201 / 02-601: Programming for Scientists
Random Walks
Due: Wednesday, Sept. 17, 2014 at 11:59pm

You may discuss this homework with your classmates, but all code you write should be your own. You should not share code or look at others' code.

Overview. In this homework you will write a complete program that simulates a random walk in a $width \times height$ field. Your program should be runnable with the following command:

    go run randwalk.go WIDTH HEIGHT STEPSIZE NUMBER-OF-STEPS SEED

For example:

    go run randwalk.go 10 100.1 0.2 1000 39481

should simulate a random walk of 1000 steps in a field of width 10 and height 100, where each step is of distance 0.2. The final command line parameter is the seed for the random number generator. The first thing your program should do is call:

    rand.Seed(n)

where n is the integer represented by this last parameter (39481) above. You will need to use the `math/rand` package.

Input. The only input your program should take are the 5 command line arguments above. If any of the arguments are invalid (for example a width that is ≤ 0 or something that is not an integer when it should be, etc.) you should print out an error message like the following and stop your program:

    Error: informative error message here

Your error message must start with "Error:" and then should explain the problem.

Output. Simulate the random walk for the given number of steps (see below). At each step, including the starting point, output the position of your random walker in the format:

    x y

where x and y are real numbers.

Finally, at the end, print out the final distance between where the walker ended up and where the walker started in the format:

    Distance = 37.3245

Recall that the distance between (x_0, y_0) and (x_1, y_1) can be computed using:

$$\sqrt{(x_0 - x_1)^2 + (y_0 - y_1)^2}.$$

Use the `math` package as needed.

Submitting. Submit your file `randwalk.go` to Autolab.

The rules of the random walk. Note that this random walk is similar to the one we discussed in class, but with one major difference: instead of walking on a "chessboard" your random walker is walking in the 2D plane.

Suppose your program is run with:

```
go run randwalk.go w h d n s
```

Then the walker should start at position $(w/2, h/2)$. It should make n steps, each of length d. Recall from geometry the relationship between two points and a distance d between them:

$$x' = x + d \cos \theta$$
$$y' = y + d \sin \theta$$

d
$d \sin \theta$
θ
(x,y)
$d \cos \theta$
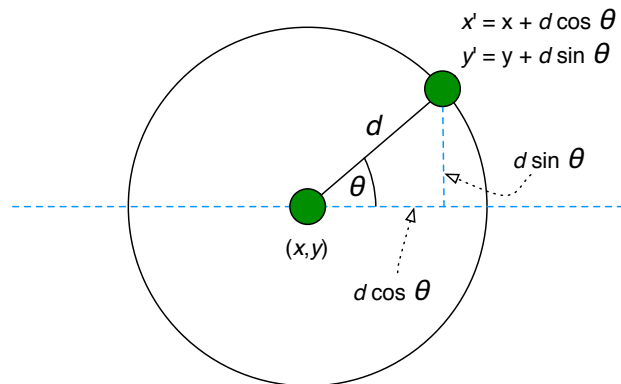
The above equations give the update rule for how the position should change at every step. At each step, you should choose a random θ between 0 and 2π, and move in that direction.

Finally, a step is not allowed to take the walker outside of the field, so at any step, you cannot choose a θ that would take you outside of the field.

Learning outcomes. After this assignment, you should:

- be familiar with using command line arguments.
- be familiar with using packages, particularly the `math/rand` package.
- have gained practice writing **for** and **if** statements.
- have understood how to write a complete Go program.