cs002 Homework 5
A Dash of Python

Assigned: November 16, 2016   **Due: December 9, 2016**

Introduction

Now that you've learned the basics of Python programming, you are going to write a program to simulate the scenario described below!

Assignment Goals

- Communicate technical details in natural language
- Design and prototype a complex system
- Write and test a Python program.

Required Tasks

Dash has been trapped on a perfectly rectangular island by Syndrome, who has dizzied him with his evil devices to the extent that Dash is entirely incapable of controlling his direction of movement. We'll think of the island as a rectangle on the *xy*-coordinate plane, where each unit is a mile.

Dash needs to make it to the perimeter / "coastline" of the island from his current position (0, 0) in the interior of the island in order to be rescued. So Dash decides to do what he does best: run very, very fast (at 1 mile per second) in a random initial direction.

Unfortunately, Dash is so dizzy that with every passing second, he chooses a new random direction (north, south, east, or west), sometimes continuing the same way, sometimes turning to the side, or sometimes reversing course entirely. But he knows that even without any sense or ability of direction, he will eventually make it to one of the island's four coasts.

Given inputs of where the coasts of the island are (as lines on the coordinate plane[1]), your task is to calculate how many seconds – on average – it will take him to reach one of them.

Your program's input and output should look like this:

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[1] Don't worry about any cases in which the coastlines' positions wouldn't make sense in the real world.

```
Northern edge of the island: <positive input>
Southern edge of the island: <negative input>
Eastern edge of the island: <positive input>
Western edge of the island: <negative input>
<output>
```

To confirm that your program is correct, take this island as an example:
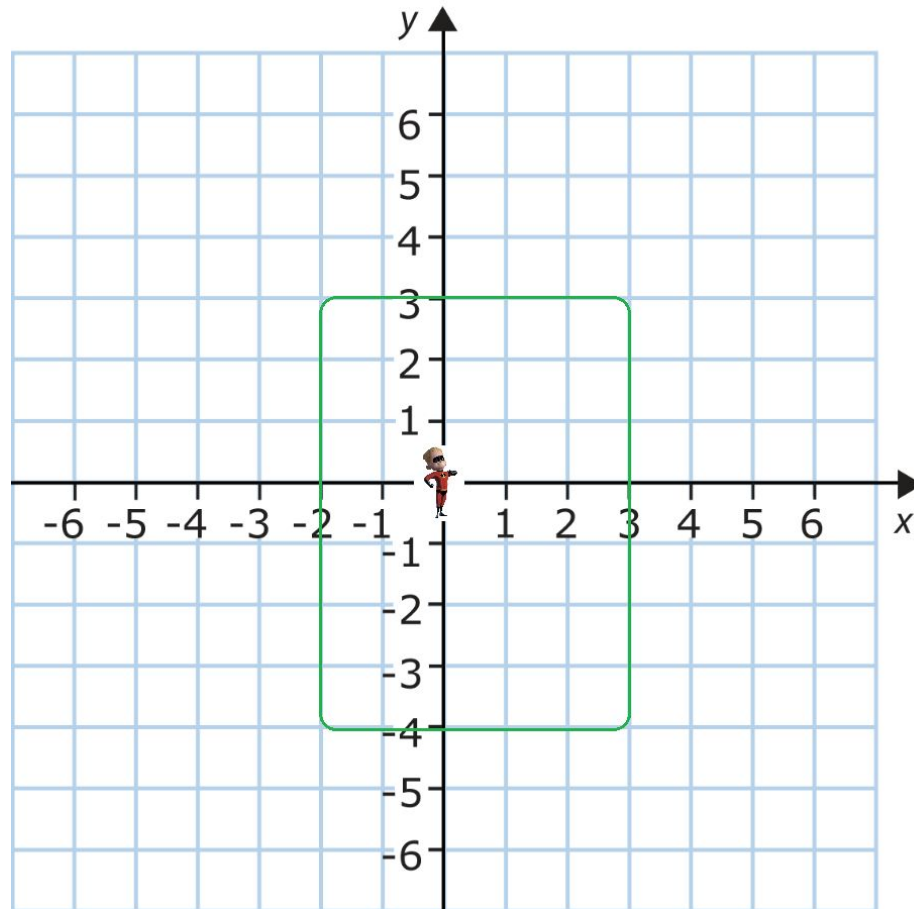
With the following input, you should get an answer between 8.8 and 9.2 almost every time you run your program (the variance is on account of the slightly random element of this question):

```
Northern edge of the island: 3
Southern edge of the island: -4
Eastern edge of the island: 3
Western edge of the island: -2
8.9604
```

Hints (*you need to read these*)

1. Preface your program with import random so you can make use of Python's random library, specifically the `random.randint(a, b)` function that will allow you to generate random directions for Dash to move in.
2. Be careful of off-by-one errors (*e.g.* decide carefully between < and <= when using one or the other), noting that if the eastern edge of the island is, say, 3 and Dash is at (3, 0), he has indeed successfully reached the coastline.
3. **Program a single iteration of Dash's journey, adding how many seconds that takes to a cumulative time counter. Use a loop to execute that same process 10,000 times, and then divide the cumulative total by 10,000. That average is a good estimator for the true average time.**

Summary of Required Tasks

1. Write a paragraph (in a .txt file) that explains your understanding of the problem and your logical method for implementing the solution.
2. Write a solution in pseudocode (in the same .txt file). You may want to check the lecture slides to refresh your memory about writing pseudocode.
3. Once you have designed your program in natural language and in pseudocode, write it in Python. You may want to use some of the functions and structures discussed in class/lab, though you may also use other functions and structures available in the language.
4. Read through your code and make sure anything not immediately understandable to someone else reading your code is explained in a comment.
5. Run your program on an island with a northern edge of 4, a southern edge of -4, an eastern edge of 4, and a western edge of -4, and make note of the output

Note (*you don't need to read this, but might feel good about yourself if you do*)

If you find this assignment somewhat challenging, that would be because it's an actual application of computer science. The scenario of Dash running around an island may be highly contrived, but there are clear analogues to real life situations like stock trading.[2] Theoretical techniques exist and are used for calculations relating to 2-D random walks,[3] but it's useful to confirm them by modeling the simulation iteratively. If this is a subject of interest, you might be interested in such courses as APMA0100 and APMA1690.

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[2] https://en.wikipedia.org/wiki/Random_walk_hypothesis
[3] https://en.wikipedia.org/wiki/Random_walk#Higher_dimensions

Submission:

For this assignment, your submission should include:
- Python (.py) file containing your code that we can run
- Text file containing:
  - Natural language description of the task
  - Pseudocode
  - Answer for the island with northern edge 4, southern edge -4, eastern edge 4, and western edge -4.

All homeworks will be submitted on Canvas. Make sure to save it as a zip file, saved as firstname_lastname_05python.zip. Within your zip file, be sure to name each document in a way that clearly indicates what it is. If you need an extension for this assignment due to sickness, injury, or *etc.* please contact BOTH Don and the cs002 TAs via email. Please contact the cs002 TAs if you have any further questions.

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