3300 Problems, Section 5: Simulations, Numerical Integration, Newton's Method, Filestreams and More Lists

1. Suppose that I pick three random integers between 1 and 100. What is the probability that the two smallest of the three have a sum that is greater than the largest of the three? Write a program that estimates the answer to this problem, using a simulation running 50,000 trials. (Don't try to provide a numerical answer to the question!)

2. Suppose that I add up 25 random integers between 1 and 100. What is the probability that the sum of these numbers is greater than 1000? Write a program that estimates the answer to this problem, using a simulation running 50,000 trials – each trial involves picking 25 random integers and adding them. (Don't try to provide a numerical answer to the question!)

3. Estimate $\int_4^8 \sqrt{1 + x^4} dx$ using Simpson's rule, with $N = 4$. Do not simplify your answer.

4. Estimate $\int_0^{30} x^2 dx$ using the trapezoidal rule, with $N = 3$.

5. Estimate a solution of $x^3 - 2x + 3 = 0$ using two iterations of Newton's method (i.e., two "updates"), starting from $x_0 = 1$. You do not need to simplify your answer. (YOUR ANSWER SHOULD CONSIST OF CALCULATIONS, NOT CODE.)

6. Estimate a solution of $x^2 = 6$ using two iterations of Newton's method (i.e., two "updates"), starting from $x_0 = 1$. You do not need to simplify your answer. (YOUR ANSWER SHOULD CONSIST OF CALCULATIONS, NOT CODE.)

7. Write code to open a file named `data.txt`, which contains 3 numbers, and print the sum of those numbers to the console.

8. Write code that opens a file named `words.txt` containing an essay, and the prints out the SECOND word in the file to the console.

9. Write the code necessary to read a number in from a file `number.txt`, and then write that number to a file named `three.txt`, with EXACTLY 3 digits shown *after* the decimal place.

10. Write a program that opens a file named `hello.txt`, which contains a number of words. The program should **randomly** choose one of the words to print out to the console – each word should have an (approximately) equal chance of printing out.

11. Write a program that opens a text file named `lines.txt`, and for each line, either prints out the third character on that line, or prints `Short!!!!` if that line has fewer than 3 characters.

12. Write a program that opens a text file named `report.txt`, and prints out the longest line contained in that file.

13. Write a program that opens a file named `first.txt`, which contains a bunch of words. The program should print out the word that occurs most frequently in `first.txt`. (Assume all the words are lowercase, and ignore the possibility of ties.)

    For example, if `first.txt` contains the sentence

    `here a quack there a quack everywhere a quack quack`

    the program should print `quack`. Do NOT use `.count()`!

14. Write a program which opens a file named `news.txt` and print out its content to the console, except with every appearance of the words "`Hillary`" or "`Donald`" replaced with "`***`". So, for example, if `news.txt` contained the sentence

    `Hillary and Donald ate lunch together in the park`

    then the sentence that prints out to the console should be

    `*** and *** ate lunch together in the park`

    (You don't need to worry about capitalization, punctuation, or printing newlines properly – but do assume that there is a space between each word!)

15. Write a program that open a file named `short.txt`. The program should the print `Short` to the console if all of the words have less than 6 letters; otherwise, `Not short` should be printed to the console. For example: if `short.txt` contains

    `dog cat hippopotamus bird`

then when I run this program, `Not short` should be displayed, whereas if `short.txt` contains

`ay bee see dee`

then when I run this program, `Short` should be displayed.

16. Using loops, declare and set a two-dimensional list `table` to have values `table[i][j]` given by the following table:

```
1   2   3   4
2   3   4   5
3   4   5   6
```

17. Suppose that `table` is a 2 × 4 list of integers given by

```
table = [[1,5,2,10], [3,15,4,20]]
```

What will the following code print out?

```
for i in range(4):
  for j in range(2):
    print(table[j][i], end = " ")
  print("")
```

18. A 2 × 4 list of integers named `myTable` has been defined. Write the code necessary to add 1 to all the even values in `myTable` (and do nothing to the odd values).

19. A 2 × 4 list of integers named `myTable` has been defined. Write the code necessary to change `myTable` so that all non-negative entries are kept the same, while all negative entries are replaced with `0`.

20. What will the following code print out?

```
a = ["p", "q", "r", "s"]
b = a
c = a + ["t"]
a.append("u")
print(len(a), len(b), len(c))
```

21. What will the following code print out?

```
my_list = [1, 2, 3, 4]
your_list = my_list
my_list[0] = 5
my_list = [6, 7, 8]
print(my_list, your_list)
```

And what would happen if the third and fourth lines of the above (`my_list[0] = 5` and `my_list = [6, 7, 8]`) were reversed?

22. What will the following code print out?

```
x1 = [9, 1, 3]
x2 = x1
del x2[2]
print(x1, x2)
x1 = [6, 0]
x2.append(5)
print(x1, x2)
```