

# Homework Assignment #10

CS5004 – Object-Oriented Design  
Northeastern University – Silicon Valley  
Summer 2020

Due Sunday 8/2 at 11:00pm PT

**Grading:** Each programming problem is graded as follows

- A submission which does not compile gets 0.
- A submission which compiles but does something completely irrelevant gets 0.
- A submission which works (partially) correctly, gets (up to) %80 of the total credit.
- %20 is reserved for the coding style. Follow the coding style described in the book.

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**Problem 1 [40pts].** Write a program that approximates the probability that 2 or more people in the same room have the same birthday, for 2 to 50 people in a room. The program should use simulation to approximate the answer by performing a large number of trials. In more detail, for each value of  $n$  between 2 and 50, “run” 5000 trials. In each trial, randomly assign birthdays (i.e., a number from 1365) to everyone in the room. Use a `HashSet` to store the birthdays. As the birthdays are randomly generated, you can use the `contains` method to see if someone with the same birthday is already in the room. If so, increment a counter that tracks how many times at least two people have the same birthday and then move on to the next trial. After the trials are over, count the number of successes and divide the sum by the number of trials to get an estimated probability that two or more people share the same birthday for a given room size. Your output should look something like the following. It will not be exactly the same due to the random numbers:

```
For 2 people, the probability of two birthdays is about 0.002
For 3 people, the probability of two birthdays is about 0.0082
For 4 people, the probability of two birthdays is about 0.0163
...
For 49 people, the probability of two birthdays is about 0.9654
For 50 people, the probability of two birthdays is about 0.969
```

**Problem 2 [60pts].** Write a program that takes as input (1) text for an anonymous letter and (2) text for a magazine article and determines whether it is possible to write to anonymous letter using the characters from the magazine article. The anonymous letter could have been written using the article if for each character in the letter, the number of times it appears in the letter is no more than the number of times it appears in the article.

**Submission format:** Write `LetterDetective.java` containing a class of the same name. The `main()` method contains your algorithm. The program must take the two files as command-line arguments. For example

```
$ LetterDetective letter.txt magazine.txt
```

This is an interview-grade problem. Try to solve it yourself!

**Problem 3 [20pts].** Explain clearly and briefly how the methods `hashCode()` and `equals()` are used in hash-table-based containers such as `HashMap` and `HashSet`.