Midterm Exam – The Problem with Birthdays

DUE: October 15 by 11:59:59 PM   **Assigned**: October 8

Background

Given a group of 'n' people, the odds that at least two people have the same birthday are much higher than you would think. https://en.wikipedia.org/wiki/Birthday_problem

An understanding of the mathematics is not required. This program requires running a simulation to show the math as being correct. THERE ARE NO LATE SUBMISSIONS ALLOWED FOR THIS EXAM.

Assignment Requirements

- The name of your source code file shall be exam01.cpp
- The program takes no input
- The output must be formatted like that found in the sample run
- Assumptions we are making:
    - There is an equal chance of birthday landing on any day of the year
    - We are not considering a leap year (only 365 days)
- The simulation will be run in the following manner:
    - For a group size of 2, assign a random birthday to each member
    - If the birthdays are identical, keep a count
    - Repeat 10,000 times
    - Print a statement with formatting identical to that of the Sample Run
    - Repeat the simulation for group sizes in the range [2, 50]
    - NOTE: For groups larger than 2, you only need to find a single match in order for it to count
- REMINDER: Discussion of the problem is always acceptable; sharing code is considered academic dishonesty

Sample Run

Notes on the sample run:
- Your percentages will not match exactly, but should be fairly close
- 2 key percentages to gauge with:
    - Group size 23 is the first > 50%
    - Group size 50 ~97%
    - Or, reference the chart here:
      https://en.wikipedia.org/wiki/Birthday_problem#Calculating_the_probability
- Note where some formatting is required to ensure all lines are aligned.

```
Group size:  2, matching birthdays found  0.24% of the time.
Group size:  3, matching birthdays found  0.91% of the time.
Group size:  4, matching birthdays found  1.64% of the time.
```

```
Group size:  5, matching birthdays found  2.79% of the time.
Group size:  6, matching birthdays found  4.27% of the time.
Group size:  7, matching birthdays found  6.03% of the time.
Group size:  8, matching birthdays found   7.3% of the time.
Group size:  9, matching birthdays found  8.91% of the time.
Group size: 10, matching birthdays found  11.9% of the time.
Group size: 11, matching birthdays found 14.57% of the time.
Group size: 12, matching birthdays found  17.9% of the time.
Group size: 13, matching birthdays found 19.19% of the time.
Group size: 14, matching birthdays found 22.11% of the time.
Group size: 15, matching birthdays found  25.3% of the time.
Group size: 16, matching birthdays found 29.15% of the time.
Group size: 17, matching birthdays found 31.42% of the time.
Group size: 18, matching birthdays found 35.06% of the time.
Group size: 19, matching birthdays found 38.04% of the time.
Group size: 20, matching birthdays found 41.31% of the time.
Group size: 21, matching birthdays found 44.38% of the time.
Group size: 22, matching birthdays found 47.91% of the time.
Group size: 23, matching birthdays found 50.89% of the time.
Group size: 24, matching birthdays found 54.95% of the time.
Group size: 25, matching birthdays found 56.68% of the time.
Group size: 26, matching birthdays found 59.88% of the time.
Group size: 27, matching birthdays found 63.55% of the time.
Group size: 28, matching birthdays found 65.84% of the time.
Group size: 29, matching birthdays found 67.79% of the time.
Group size: 30, matching birthdays found 71.19% of the time.
Group size: 31, matching birthdays found 72.86% of the time.
Group size: 32, matching birthdays found 76.56% of the time.
Group size: 33, matching birthdays found 77.35% of the time.
Group size: 34, matching birthdays found 79.48% of the time.
Group size: 35, matching birthdays found 81.91% of the time.
Group size: 36, matching birthdays found 83.36% of the time.
Group size: 37, matching birthdays found 84.28% of the time.
Group size: 38, matching birthdays found 86.64% of the time.
Group size: 39, matching birthdays found 87.84% of the time.
Group size: 40, matching birthdays found 89.32% of the time.
Group size: 41, matching birthdays found 90.34% of the time.
Group size: 42, matching birthdays found 91.71% of the time.
Group size: 43, matching birthdays found 92.87% of the time.
Group size: 44, matching birthdays found 92.94% of the time.
Group size: 45, matching birthdays found 94.29% of the time.
Group size: 46, matching birthdays found 94.97% of the time.
Group size: 47, matching birthdays found 95.54% of the time.
Group size: 48, matching birthdays found 96.27% of the time.
Group size: 49, matching birthdays found 96.65% of the time.
Group size: 50, matching birthdays found 97.11% of the time.
```

Hints

- You do not need to understand the mathematics behind this problem in order to run the simulation
- It may be simpler to consider the birthdays as ordinal numbers. E.g., Day 1 is January 1st, Day 32 is February 1st, etc.
- The order that the birthdays get assigned is a detail and not relevant to finding a match

Reminders

- Be sure to include a comment block at the top of every file with the required information
  - Refer to the General Homework Requirements handout on Blackboard
- Provide meaningful comments
  - If you think a comment is redundant, it probably is
  - If you think a comment is helpful, it probably is
  - Remember that you are writing comments for other programmers, not people who know nothing (obligatory Jon Snow) about coding
  - Comments are more helpful when they explain why, not what or how
- There will be no extensions

Preparing and Submitting

- Your code must be able to compile and run on the EECS lab machines
  - You are responsible for testing your code
  - "But it runs fine on my machine!" will **not** earn you any points
- Submit **ONLY** your source code file
- Homework submission will be handled exclusively through Blackboard