

CS272 Lab Assignment #11: Searching.

0. Reach Chapter 11.1 in the textbook. It contains implementations of serial (linear) search and binary search that you will use in the assignment in part 2.
1. Do Programming Project 2 from Chapter 11 (p.612). Name your program **Game.java**. Use a **binary search** technique to write a game program that asks the user to think of an integer in a particular range and then tries to guess the number. The program may ask questions such as “Is your number bigger than 42?” Your result should have worst-case time of $O(\log n)$, where n is the size of the range of numbers. You program should do the following:
 - Prompt the user to enter the range of numbers (the smallest possible number and the largest possible number) and read the numbers entered by the user.
 - Print a message asking the user to think of a number in the range.
 - **Use a binary search** technique to guess the number by asking questions of the form: “Is your number bigger than ... ?”
2. Write a program called **Compare.java** that would compare serial search (linear search) and binary search by computing estimates of the worst case time required to search for an element in an array using these two methods. The worst case occurs when the target is not in the array. You estimate the time by calling `System.nanoTime` both before and after each of the searching methods. The difference between the two return values is the approximate number of nanoseconds required by the search method. It is only approximate because the sort method does not have exclusive use of the computer during the time that it is executing. Examples on timing Java programs you may see in [Timing your Java program](#). Specifically, your program should do the following:
 - i. Make `SIZE` an int constant with value 1,000,000. Create an array of size `SIZE`. Place numbers 1, 2, 3, ..., `SIZE` in the array.
 - ii. Search the array for element `SIZE+1` using 1) linear search and 2) binary search. **Note:** The element is not in the array so you will get the worst case running time.
 - iii. Measure how many nanoseconds each of the two searches takes and output the result.
 - iv. Repeat steps ii and iii 5 times.
 - v. Compute and output the average running time you get for the linear search and the average running time you get for the binary search (average of the 5 runs).

Sample run of your program may look like the following (the numbers will be different for each run):

```
Run 1: Linear search took 3788800 nanoseconds.
      Binary search took 5340 nanoseconds.
Run 2: Linear search took 4474943 nanoseconds.
      Binary search took 1945 nanoseconds.
Run 3: Linear search took 373005 nanoseconds.
      Binary search took 1734 nanoseconds.
Run 4: Linear search took 360309 nanoseconds.
      Binary search took 1673 nanoseconds.
Run 5: Linear search took 361849 nanoseconds.
      Binary search took 1605 nanoseconds.
Average time for linear search is 1871781 nanoseconds
Average time for binary search is 2459 nanoseconds
```

Note: In 2, you may use linear search and binary search code from the textbook .

What to submit:

- Submit your source code (Game.java and Compare.java) electronically on Canvas.