## **Course: Algorithm CS 435**

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## **Assignment: W1D1**

Question 1 – Comparing Algorithm

Problem statement: Find the largest distance between any two even integers in an integer array.

* Algorithm 1: Create a new array consisting of even numbers only. Then use nested loops to solve the problem using the newly created array of even numbers only.
* Algorithm 2: Use a nested loop to solve the problem without creating an extra array.
* Algorithm 3: Use one loop. Find max and min of even integers. Compute max – \_min.
* Algorithm 4: Use Streams to find the max and min. Compute max – \_min.

Below is the time running report for the above four algorithms with different size of integer arrays: 1000, 2000, 3000, 4000. Note that values in array is randomly generated. Duration is in millisecond.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Array Size** | **Algorithm 1** | **Algorithm 2** | **Algorithm 3** | **Algorithm 4** |
| 1000 | 10 | 14 | 0 | 48 |
| 2000 | 18 | 20 | 0 | 0 |
| 3000 | 12 | 17 | 0 | 1 |
| 4000 | 16 | 29 | 1 | 0 |

A close up of a map

Description automatically generated

As we can see, the Algorithms 3, 4 is very efficient although the size of the array is increasing, the time for computation is not increasing except in algorithm 4 with smallest size of array has high time of computation. While the two first Algorithm is not as good as the two last which is using one loop and stream. Algorithm 2 with loop inside a loop has worst performance. In term of space (the memory), algorithm 1 use one additional array for even number that means it costs more memory as compared to the last 3 algorithms. For more detail, please look at Question1.java

Question 2- Proof by Induction

Let F(n) denote the nth Fibonacci number. Prove F(n) > (4/3)n for n > 4.

Hints:

(1) Use the strong induction

(2) Use the fact F(n) = F(n-1) + F(n-2)

(3) Since you are using two values, you must prove the two base cases: n = 5 and n = 6.

Let F(n) denote the nth Fibonacci number. Prove for n > 4

**Base cases**:

Clearly, the result holds.

**Induction Hypothesis:** Assume the result is true for all values of n in the interval . That is, m is the largest value for which the result is true

**Induction step:** We need to prove the following is true

**(2)** is clearly true.So the problem is proved