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Lab 2: Benchmarking

Data Structures and Algorithms

This lab is going to have you run benchmark on isPrime0, isPrime1, and isPrime2 mentioned in lectures.

For compute $\pi(100)$, we can use the following program:

CountPiN.java

```
public class CountPiN {
    static boolean isPrime0(int n) {
        if(n==1) return false;
        if(n<=3) return true;
        int m = n/2;
        for(int i=2; i<=m; i++) {
            if(n%i==0) return false;
        }
        return true;
    }
    public static void main(String[] args) {
        int count = 0;
        int N = 100;
        for(int n=1; n<N; n++) {
            if(isPrime0(n)) count++;
        }
        System.out.println("Pi("+N+")="+count);
    }
}
```

The output look like this:

```
>java CountPiN
Pi(100)=25
```

The method isPrime0(n) take any positive integer and return true if it is a prime, false otherwise. The method run through all integer from 2 to n/2 and check if n is divisible by any of them.

There are two more methods, isPrime1(n) and isPrime2(n). The method isPrime1(n) is similar to isPrime0(n) but only run from 2 to $\sqrt{n}$. The method isPrime2(n) improves upon

isPrime1(n) by take out anything divisible by 2 and 3 and not going to test divisibility of number that are multiple of 2 and 3.

Method isPrime1(n) and isPrime2(n)

```
static boolean isPrime1(int n) {
     if(n==1) return false;
     if(n<=3) return true;
     int m = (int)Math.sqrt(n);
     for(int i=2; i<=m; i++) {
          if(n%i==0) return false;
     }
     return true;
}
```

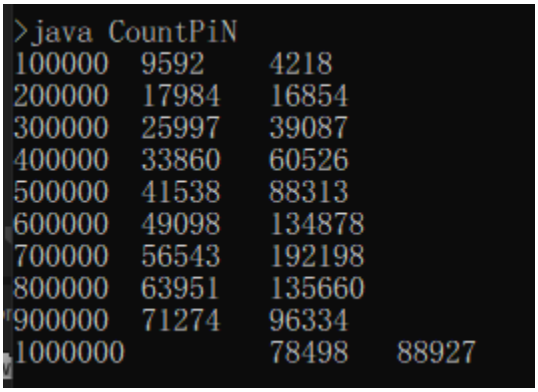
```
static boolean isPrime2(int n) {
     if(n==1) return false;
     if(n<=3) return true;

     if((n%2==0)||(n%3==0)) return false;
     int m = (int)Math.sqrt(n);
     for(int i=5; i<=m;i+=6) {
          if(n%i==0) return false;
          if(n%(i+2)==0) return false;
     }
     return true;
}
```

To measure efficiency of these methods, we must modify our main method like this

New main()

```
public static void main(String[] args) {
     for(int N=100000; N<=1000000; N+=100000) {
          long start = System.currentTimeMillis();
          int count = 0;
          for(int n=1; n<N; n++) {
               if(isPrime0(n)) count++;
          }
          long time = (System.currentTimeMillis()-
start);
          System.out.println(N+" \t"+count+" \t"+time);
     }
}
```

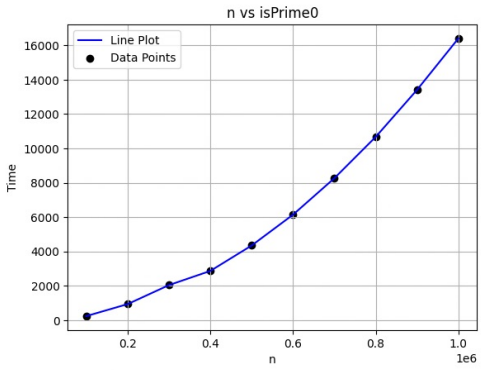
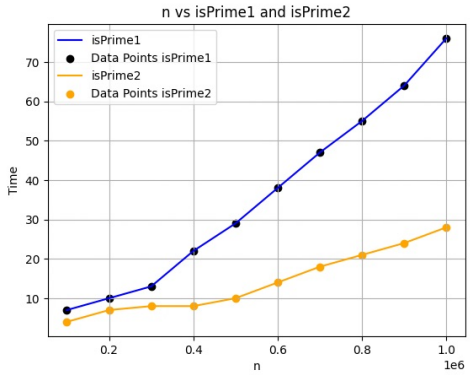
After the modification, the result of running with isPrime0(n) should be like this:



Your first task: run the program with isPrime0, isPrime1, and isPrime2 and record your result into the following table

Running-time table				
n	pi(n)	time (milliseconds)		
		isPrime0	isPrime1	isPrime2
100,000	9,592	242	7	4
200,000	17,984	940	16	7
300,000	25,997	2,046	13	8
400,000	33,860	2,870	22	8
500,000	41,538	4,350	29	10
600,000	49,098	6,142	38	14
700,000	56,543	8,264	47	18
800,000	63,951	10,668	55	21
900,000	71,274	13,406	64	24
1,000,000	78,498	16,393	76	28

Your second task: Plot two graphs, one is n vs. isPrime0's time and the other is n vs. isPrime1's time and isPrime2's time.

n vs. isPrime0	n vs. isPrime1 and isPrime2
	

Your final task: In your own words, describe trend of isPrime0, isPrime1, and isPrime2. Are your recorded times faster or slower than the recorded time shown in the lecture? Why?

สรุปได้ว่า ระยะเวลาในการทำงานของเรานั้น ทำได้เร็วกว่า ของใน lecture ไม่ว่าจะเป็น Prime 0, Prime 1 หรือ Prime 2 ก็ตาม เนื่องจากปัจจัยหลักๆ มาจากอุปกรณ์ในการ Run นั้นต่างกันจึงทำให้มีเวลาต่างกัน

Hand in your work in MS Team assignment by fill in the answer in this file. Change the name of this file to assignment1_xxxxxxx.pdf where xxxxxx is your student id.