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Homework 2

1. Indicator Variable Exercises

   5.4-1: How many people must there be in a room before the probability that someone has the same birthday as you do is at least 1/2?

   Beign n the number of days in a year and k the number of people in the room, the probability of a person not having the same birthday as I do is:

$$\frac{n-1}{n}$$

   And the probability of k persons **not** having the same birthday is as I do is:

$$(\frac{n-1}{n})^k$$

   Then we can show that:

$$1-(\frac{n-1}{n})^k \geq \frac{1}{2}$$

$$(\frac{n-1}{n})^k \leq \frac{1}{2}$$

$$klog(n-1)log(n) \leq \frac{1}{2}$$

$$k = \frac{log(0.5)}{log(\frac{364}{365})} \approx 263$$

   5.4-6: How many people must there be for the probability that at least 2 people have a birthday on *July 4* is $> 1/2$?

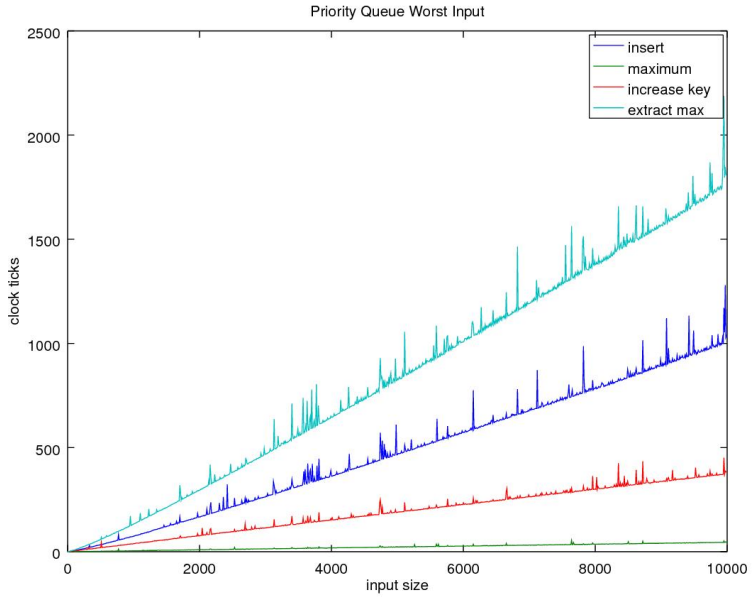
$$\binom{k}{1}(\frac{1}{365})(\frac{354}{365})^{k-1} - \binom{k}{0}(\frac{364}{365})^k$$

$$\therefore k \geq 613$$

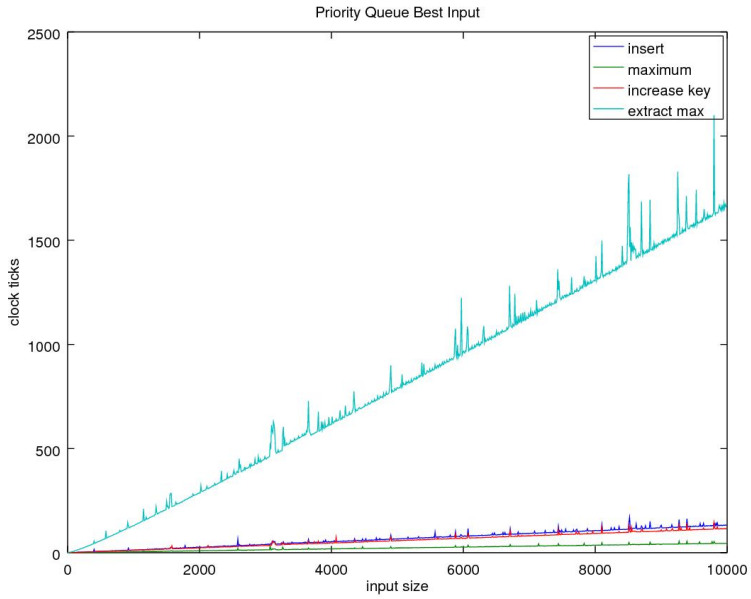
2. Priority Queue

   Implement the Max Priority Queue using a Max-Heap with all the operations described using the programming language C++. Then using the clock ticks, prove that the complexities described in the Cormen's book are correct by using adequate scales and plots.

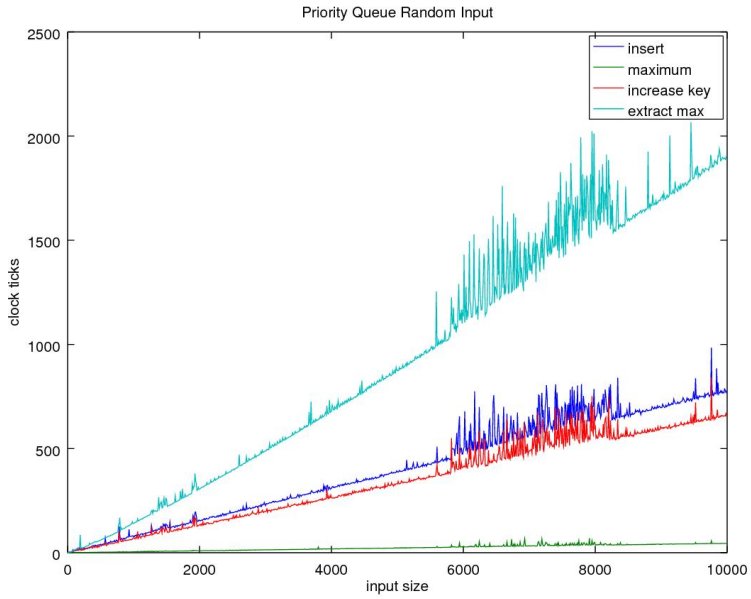
   Find the code in the priorityQueue directory.



   Worst



Best



Random

3. Linear Sorting
    - Bucket Sort:

– ***Find the code in linearSorting/src/BucketSort.cpp***

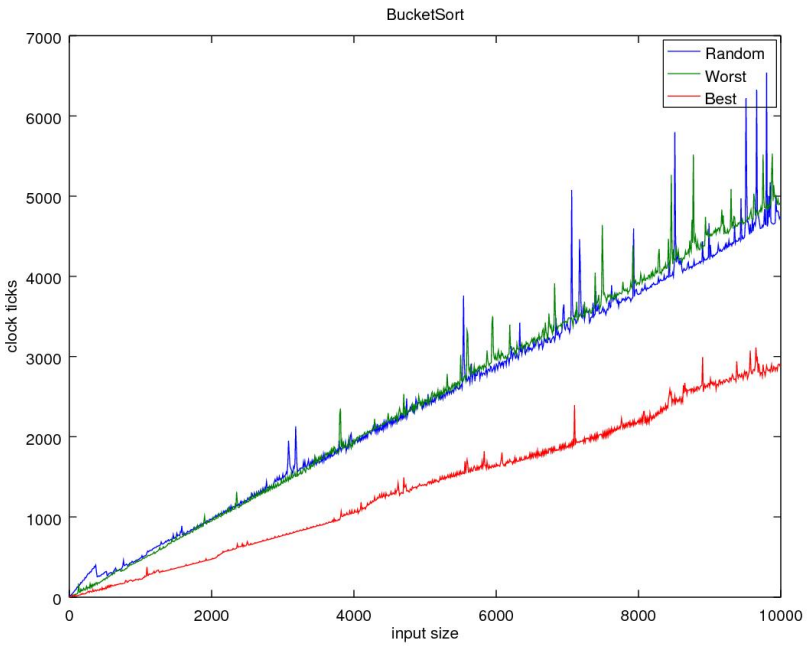


Figure 1: Bucket sort

- Radix Sort:
  – ***Find the code in linearSorting/src/RadixSort.cpp***

4. Hash Tables

   Implement the Hash table using link list as collision policy, then test the complexity $O(1+\alpha)$ for successful or unsuccessful search of the table using a correct range. For the hash table test the following hash functions:

   i. Universal Hashing using the Random Matrix (using the bit counting idea).
   ii. The Division Method.
   iii. The Multiplication Method using the computer implementation.

   Find the code in the directory hashTable

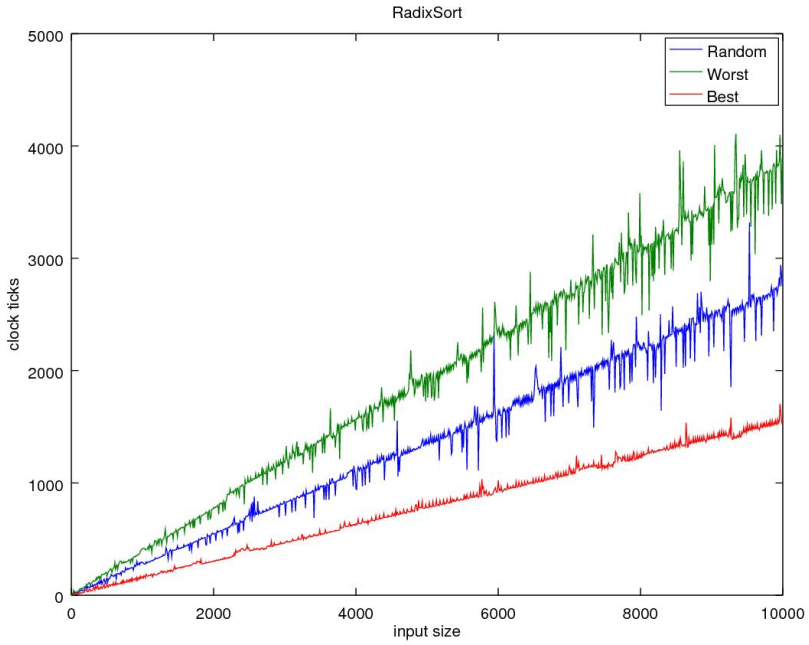


Figure 2: Radix sort