Assignment - Algorithm Analysis

**Due** Apr 14 by 11:59pm - **Points** 100 - **Submitting** a file upload - **File Types** zip

**Assignment #1 - Algorithm Analysis**

Suppose you need to generate a random permutation of the first N integers.

For example, {4, 3, 1, 5, 2} and {3, 1, 4, 2, 5} are legal permutations, but {5, 4, 1, 2, 1} is not, because one number (1) is duplicated and another (3) is missing. This routine is often used in simulation of algorithms. We assume the existence of a random number generator, r, with method randint(i, j), that generates integers between i and j with equal probability. Here are three algorithms:

Algorithm #1

Fill the array a from a[0] to a[n-1] as follows: To fill a[i], generate random numbers until you get one that is not already in a[0], a[1], … a[i-1].

Algorithm #2

Same as algorithm (1), but keep an extra array called the *used* When a random number, ran, is first put in the array a, set used[ran] = true. This means that when filling a[i] with a random number, you can test in one step to see whether the random number has been used, instead of the (possibly) i steps in the first algorithm.

Algorithm #3

Fill the array such that a[i] = i +1. Then:

for(int i = 1; i < n; i++)  
{  
    swapElements(a[i], a[randint(0, i)]);  
}

* Write each algorithm and test them thoroughly.
* Give as accurate (Big-Oh) an analysis as you can of the expected running time of each algorithm.
* Write (separate) programs to execute each algorithm 10 times, and record the average number of operations made each execution. Only consider operations where you access or assign an index in an array.
* *Note: you will need to keep a running counter of the number of operations you are performing during the execution of the algorithm.*
* Run program (1) for N = 250, 500, 1,000, 2,000; program (2) for N = 25,000, 50,000, 100,000, 200,000, 400,000, 800,000; and program (3) for N = 100,000, 200,000, 400,000, 800,000, 1,600,000, 3,200,000, 6,400,000.
* Compare your analysis from (b) with the actual running times. (Plot them in an excel document and compare the results)