COMP 301 Analysis of Algorithms
Instructor: Zafer Aydın
Lab Assignment 9

Introduction

In this lab you will compare two permutation algorithms and analyze whether the distribution of the permutations produced is uniform or not. Submit your answers to the questions below in a text file (e.g. Word document). Name your file in name_surname.docx format. Submit your solution document and Java codes as a compressed folder (.zip, .rar) in name_surname format to Canvas.

You can use the code templates in `permute.java` in this lab.

Problem Statement

Given an array of integers permute the numbers in this array. Analyze the output distribution of permutation algorithms.

Assignment

1. (a) Implement a Java method for the RANDOMIZE-IN-PLACE algorithm given below.

```
RANDOMIZE-IN-PLACE(A)
1  n = A.length
2  for i = 1 to n
3      swap A[i] with A[RANDOM(i, n)]
```

(b) Test your algorithm by choosing an array of size 10. Initialize your array by random numbers from 0 to 99. Make sure your program permutes the numbers. Include a sample of 5 output permutations produced by this method in your report.

2. (a) Implement a Java method for the PERMUTE-WITH-ALL algorithm given below.

```
PERMUTE-WITH-ALL(A)
1  n = A.length
2  for i = 1 to n
3      swap A[i] with A[RANDOM(1, n)]
```

(b) Test your algorithm by choosing an array of size 10. Initialize your array by random numbers from 0 to 99. Make sure your program permutes the numbers. Include a sample of 5 output permutations produced by this method in your report.

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3. Choose the input array size as 4. Initialize your array to include numbers 1,2,3,4 in this order.

(a) Repeatedly call RANDOMIZE-IN-PLACE 24000 times and include the number of times you receive each permutation to the table below. Write a code that performs these computations automatically.

(b) Repeatedly call PERMUTE-WITH-ALL 24000 times and include the number of times you receive each permutation to the table below. Write a code that performs these computations automatically.

Permutation index	Permutation	RANDOMIZE-IN-PLACE	PERMUTE-WITH-ALL
0	1234		
1	1243		
2	1324		
3	1342		
4	1423		
5	1432		
6	2134		
7	2143		
8	2314		
9	2341		
10	2413		
11	2431		
12	3124		
13	3142		

14	3214		
15	3241		
16	3412		
17	3421		
18	4123		
19	4132		
20	4213		
21	4231		
22	4312		
23	4321		

(c) Can you see approximately equal frequencies for RANDOMIZE-IN-PLACE (i.e. are they all around 1000)? Can you say that the distribution of permutations produced by RANDOMIZE-IN-PLACE is close to uniform?

(d) Do you see different frequencies for PERMUTE-WITH-ALL? Can you say that the distribution of permutations produced by PERMUTE-WITH-ALL is not close to uniform?

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