Algorithms I (CS21003) Autumn 2010

Assignment 1

1. (July 20, 2009)

- (a) Dynamically allocate a matrix A of size n × n, where n = 2^k, k ≥ 1. Randomly generate each element x of A such that x is an integer in the closed interval [a, b].
 Store the matrix in a file "roll_number_al0.txt" (Ex: 09CS1001_al0.txt) such that each line of the file contains a row of A. The elements in each column should be right-aligned. [User input: k, a, b.]
- (b) The matrix $A = \begin{bmatrix} A_1 & A_2 \\ A_3 & A_4 \end{bmatrix}$, where each of A_1 , A_2 , A_3 , and A_4 has size $\frac{n}{2} \times \frac{n}{2}(n = 2^k)$, is said to have the *Property P* if its satisfies the following:
 - i. A₁ ≤ A₂ ≤ A₃ ≤ A₄, which means no element of A₁ exceeds any element of A₂; no element of A₂ exceeds any element of A₃; no element of A₃ exceeds any element of A₄.
 - ii. Each of A_1 , A_2 , A_3 , and A_4 satisfies Property P.

An example: (k = 2, a = 2, b = 9)

7	3	6	9		2	2	3	4
2	9	7	3		3	3	5	6
6	4	2	3	$ \rightarrow$	6	6	7	8
7	8	6	5		7	7	9	9

Rearrange the elements of the randomly generated matrix A in Part (a) so as to get an output matrix satisfying Property P.

Store the output matrix in a file "roll_number_all.txt" such that each line of the file contains a row of it. The elements in each column should be right-aligned.

- (c) Report the number of comparisons (element to element) for k = 1, 2, ..., 10, 20, 30, ..., 100, 200, 300, ..., 1000.
- (d) Prepare a matrix A' from the above matrix A such that the row-major ordering of the elements in A' produce a non-decreasing sequence. This matrix should be reported for k ≤ 20 only.
 Store A' in "roll_number_al2.txt".