Data Structure Homework 1

Questions

Q1. There is a sparse matrix below. Please write or draw the data stores in a two-dimensional array clearly.

0 1 0 0 0
-5 0 0 1 3
0 0 0 0 9
0 0 11 0 0

A1.

Row	Column	Value
0	1	1
1	0	-5
1	3	1
1	4	3
2	4	9
3	2	11

Q2. Consider a sparse 6 x 6 matrix represented by a following array. Please calculate rowCount and rowStart arrays needed for matrix transposition. What will be the index of element with value 3 after the transposition?

index	row	column	value
0	0	1	81
1	0	3	10
2	2	1	3
3	3	2	104
4	4	4	52
5	5	3	67

A2

Index	0	1	2	3	4	5
rowSize	0	2	1	2	1	0
rowStart	0	0	2	3	5	

Q3. Suppose that the first element of array a is a[0][0] or a[0][0][0] and its address is 200. Assume that each int element requires 4 bytes and each float element requires 8 bytes. Please give the address of the indicated element in each of the following cases.

(a) int a[7][10]; row-major order; find element a[4][5].

(b) float a[7][10]; column-major order; find element a[4][5].

(c) int a[5][4][6]; column-major order; find element a[3][1][4].

(d) float a[5][4][6]; row-major order; find element a[3][1][4].

A3.

(a) a[4][5]=200+(4*10+5)*4=380

(b) a[4][5]=200+(4+5*7)*8=512

(c) a[3][1][4]=200+[(3)+(1)*5+(4)*(20)]*4=552

(d) a[3][1][4]=200+[(3*(4*6)+(1)*(6)+(4))*8 =856

Q4. The function $f(x) = 3n^2+10n \log n+1000n+4 \log n+9999$ belongs in which of the following complexity categories:

(a) θ(lg n)

(b) θ(n2log n)

(c) θ(n)

(d) θ(n lg n)

(e) θ(n2) → ANS

(f) None of these

Q5. Rank the following functions by asymptotic growth rate in non-decreasing order:

$(\frac{3}{2})^n,\ 2^{64}-1,\ n^3,\ 0.0001n^2,\ 10000n,\ \log n^2,\ 2^{\log n},\ n\log n,\ n2^n,\ 2^{1000},\ n,\ n^2\log n,$
$2^n,\ \log n,\ n^{100},\ 4^n,\ \log n^3,\ n^n,\ n^3\log n$

ANS.

$2^{64}-1, 2^{1000}, \log n, \log n^2, \log n^3, n, 2^{\log n}, 10000n, n\log n, 0.0001n^2, n^2\log n, n^3, n^3\log n, n^{100}, (3/2)^n, 2^n, n2^n, 4^n, n^n.$