ECE 368 Assignment 1

Q1

a) If a is a lower triangular matrix

$$a = \begin{bmatrix} a_{11} & 0 & \cdots & 0 \\ a_{21} & a_{22} & & 0 \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & & a_{nn} \end{bmatrix}$$

There are 1 nonzero elements in row 1,
2 " " " " 2,
3 " " " " 3,
⋮
n " " " " n, maximum.

thus the maximum number of nonzero elements in a $n\times n$, lower triangular matrix is

$$\sum_{k=1}^{n} k = 1+2+3+\cdots+(n-2)+(n-1)+n$$

All these terms sum to $(n+1)$. there are $\frac{1}{2}n$ of these terms.

$$= \frac{1}{2}n(n+1)$$

These elements can be stored sequentially in memory in an array of $\frac{1}{2}n(n+1)$ elements. Let l be an array of $\frac{1}{2}n(n+1)$ elements containing the lower diagonal elements of a. So l is arranged as follows:

$$l = [a_{11}\ a_{21}\ a_{22}\ \cdots\ a_{n1}\ a_{n2}\ \cdots\ a_{nn}]$$

Then to access $a[i][j]$ in l:

$$a[i][j] \equiv l\left[\tfrac{1}{2}i(i-1)+j\right] \quad i \geq j$$
$$a[i][j] \equiv 0 \quad i < j$$

Similarly for an upper diagonal matrix there are a maximum of $\frac{1}{2}n(n+1)$ nonzero elements and they can be stored in an array u of $\frac{1}{2}n(n+1)$ elements so that $u = [a_{11}\ a_{12}\ \cdots\ a_{1n}\ a_{22}\ \cdots\ a_{2n}\ \cdots\ a_{nn}]$

$a[i][j] \equiv u[\frac{1}{2}n(n+1) - \frac{1}{2}(n-i)(n-i+1) - (n-j)]$ $i \le j$
$a[i][j] \equiv 0$ $i > j$.

for an nxn upper triangular matrix a, in which
a[i][j]==0 if i>j.

Q2. a) (A+B) * (C $ D - E + F) - G   (infix)
AB + CDE - $F +*G -   (postfix)
-* +AB + $C - DEFG   (prefix)

b) A+ (((B-C) * (D-E) +F)/G) $ (H-J)   (infix)
ABC - DE - * F + G / HJ - $ +   (postfix)
+ A $ / + * - BC - DEFG - HJ   (prefix)

In case, if this symbol is taken as $, the answer does not change.

Q3 a) ++A - * $ BCD / + EF * GHI   (prefix)
(A + (((B $ C) * D) - ((E + F) / (G * H)))) + I   (infix)

b) + - $ ABC * D * * EFG   (prefix)
((A $ B) - C) + (D * ((E * F) * G))   (infix)

Q4 a) AB - C + DEF - + $ (postfix)
((A - B) + C) $ (D + (E - F))   (infix)

b) ABCDE - + $ * EF * -   (postfix)
((A * (B $ (C + (D - E)))) - (E * F))   (infix)

Q5 a) AB+C−BA+C$−

symb	opnd 1	opnd 2	value	opandstk
1				1
2				1, 2
+	1	2	3	3
3				3, 3
−	3	3	0	0
2				0, 2
1				0, 2, 1
+	2	1	3	0, 3
3				0, 3, 3
$	3	3	27	0, 27
−	0	27	−27	−27

b) ABC+* CBA−+*

symb	opnd 1	opnd 2	value	opndstk
1				1
2				1, 2
3				1, 2, 3
+	2	3	5	1, 5
*	1	5	5	5
3				5, 3
2				5, 3, 2
1				5, 3, 2, 1
−	2	1	1	5, 3, 1
+	3	1	4	5, 4
*	5	4	20	20

check : 1 2 3+*321−+*

(1*(2+3))(3+(2−1))*

(1*(2+3))*(3+(2−1))

5*4=20.

Q6. (5*((9*8)+(7*(4+6)))) (infix)

598*746+*+* (postfix)