

BIL105E - INTRODUCTION TO SCIENTIFIC AND ENGINEERING COMPUTING

FINAL EXAM

(There are 2 Questions. 2-Hour Exam)

Q.1) (50) A polynomial may be represented as a linked list where each node contains the coefficient and exponent of a term. For example, the polynomial $4x^3 + 3x^2 - 5$, would be represented as shown below. Zero coefficient terms are not stored in the linked list. Complete the following application so that the output should look the same as

$4x^5+3x^4+2x+4$

$4x^5+5x^3+2x+3$

$8x^5+3x^4+5x^3+4x+7$

The application is run at the command line as `$run poly1.txt poly2.txt`

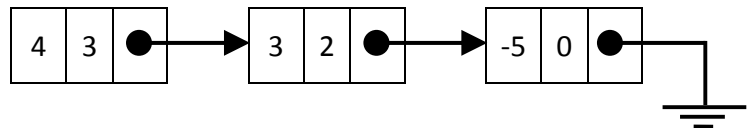
The content of the files (poly1.txt and poly2.txt) are given as

4	5
3	4
2	1
4	0

"poly1.txt"

4	5
5	3
2	1
3	0

"poly2.txt"



```
// insert necessary headers and namespaces
```

```
struct SPolynomial {
```

```
    double coefficient;
```

```
    unsigned int exponent;
```

```
};
```

```
typedef struct SPolynomial Polynomial;
```

```
struct SNode {
```

```
    Polynomial term;
```

```
    struct SNode *next;
```

```
};
```

```
typedef struct SNode Node;
```

```
typedef struct SNode* PNode;
```

```
// assume that insert() function is given
```

```
// so, you do not need to write an insert function
```

```
// insert function inserts a node into a sorted linked list.
```

```
// call insert() function in implementing loadPolynomialFromFile() and addPolynomials()
```

```
void insert(PNode &head,double coeff,int exp);
```

```

int main(int argc, char *argv[]){
    PNode poly1=0L, poly2=0L;
    if (loadPolynomialFromFile(argv[1], poly1)){
        cout << "Cannot read the file" << endl ; exit(0);
    }
    printPolynomial(poly1);
    if (loadPolynomialFromFile(argv[2], poly2)){
        cout << "Cannot read the file" << endl ; exit(0);
    }
    printPolynomial(poly2);
    PNode poly= addPolynomials(poly1, poly2);
    printPolynomial(poly);
    return 0;
}

```

Q.2) (50) Assume that **A** is an upper triangular matrix of size **N** by **N**, **X** and **B** are arrays of size **N**. Then, **AX = B** can be written as a system of linear equations:

$$\begin{aligned}
 a_{11}X_1 &= b_1 \\
 a_{21}X_1 + a_{22}X_2 &= b_2 \\
 &\dots\dots\dots \\
 a_{n1}X_1 + a_{n2}X_2 + \dots + a_{nn}X_n &= b_n
 \end{aligned}$$

$$X_i = \frac{b_i - \sum_{k=1}^{i-1} a_{ik} x_k}{a_{ii}}$$

which can be easily solved by the following substitution formula:

Write a program which reads the equation from a file, solves the equation and displays the solution **X** on screen. All data should be read from a file similar to following example. Complete the following application so that the output should look the same as given below.

size N ←	4			
	5	0	0	0
matrix A ← {	2	4	0	0
	-6	1	9	0
	8	9	7	-3
array B ←	15	-12	4	27

```

struct SEquation {
    unsigned int N;
    double **A;
    double *B;
    double *x;
};
typedef struct SEquation Equation;
int main(int argc, char *argv[]){
    Equation eqn;
    loadEquationFromFile(argv[1], eqn);
    printEquation(eqn);
    solveEquation(eqn);
    printSolution(eqn);
    return 0;
}

```

Program Output

```

5*x(1) = 15
2*x(1)+ 4*x(2) = -12
-6*x(1)+ 1*x(2)+ 9*x(3) = 4
8*x(1)+ 9*x(2)+ 7*x(3)+ -3*x(4) = 27

x(1)=3
x(2)=-4.5
x(3)=2.94444
x(4)=-7.62963

```