#include <iostream>

#include <string>

#include <vector>

using namespace std;

class Node {

public:

int coefficient;

int exponent;

Node \*next;

Node(int coefficient, int exponent) {

this->coefficient = coefficient;

this->exponent = exponent;

this->next = NULL;

}

};

class Polynomial {

public:

Node \*head;

Polynomial() {

head = NULL;

}

void add(int coefficient, int exponent) {

Node \*newNode = new Node(coefficient, exponent);

if (head == NULL) {

head = newNode;

} else {

Node \*temp = head;

while (temp->next != NULL) {

temp = temp->next;

}

temp->next = newNode;

}

}

void print() {

Node \*temp = head;

while (temp != NULL) {

cout << temp->coefficient << "x^" << temp->exponent;

if (temp->next != NULL) {

cout << " + ";

}

temp = temp->next;

}

cout << endl;

}

Polynomial addition(Polynomial p) {

Polynomial result;

Node \*temp1 = head;

Node \*temp2 = p.head;

while (temp1 != NULL && temp2 != NULL) {

if (temp1->exponent == temp2->exponent) {

result.add(temp1->coefficient + temp2->coefficient, temp1->exponent);

temp1 = temp1->next;

temp2 = temp2->next;

} else if (temp1->exponent > temp2->exponent) {

result.add(temp1->coefficient, temp1->exponent);

temp1 = temp1->next;

} else {

result.add(temp2->coefficient, temp2->exponent);

temp2 = temp2->next;

}

}

while (temp1 != NULL) {

result.add(temp1->coefficient, temp1->exponent);

temp1 = temp1->next;

}

while (temp2 != NULL) {

result.add(temp2->coefficient, temp2->exponent);

temp2 = temp2->next;

}

return result;

}

Polynomial multiplication(Polynomial p) {

Polynomial result;

Node \*temp1 = head;

Node \*temp2 = p.head;

while (temp1 != NULL) {

while (temp2 != NULL) {

result.add(temp1->coefficient \* temp2->coefficient, temp1->exponent + temp2->exponent);

temp2 = temp2->next;

}

temp1 = temp1->next;

temp2 = p.head;

}

return result;

}

};

int main(){

Polynomial p1;

p1.add(2, 3);

p1.add(3, 2);

p1.add(4, 1);

p1.add(5, 0);

p1.print();

Polynomial p2;

p2.add(1, 2);

p2.add(2, 1);

p2.add(3, 0);

p2.print();

Polynomial p3 = p1.addition(p2);

p3.print();

Polynomial p4 = p1.multiplication(p2);

p4.print();

return 0;

}

// Language: cpp

// BigO: O(n^2)

Output:

2x^3 + 3x^2 + 4x^1 + 5x^0

1x^2 + 2x^1 + 3x^0

2x^3 + 4x^2 + 6x^1 + 8x^0

2x^5 + 4x^4 + 6x^3 + 3x^4 + 6x^3 + 9x^2 + 4x^3 + 8x^2 + 12x^1 + 5x^2 + 10x^1 + 15x^0