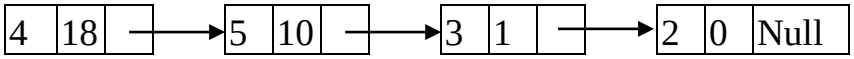
Assignment #5 (An application of linked lists)

Goal: Implement the addition and multiplication of two polynomials
Guide:

Each polynomial can be stored with a linked list, in which each node consists of three fields:

coefficient	exponent	next node address

For example, the polynomial $4x^{18}+5x^{10}+3x+2$ is stored as follows.



The results of addition and multiplication are also stored in linked lists. During your processing, some nodes may be inserted into the list, while some may be removed.

Note that you have to construct the class of linked list (as shown in the text book). Then, use your class to implement the polynomials. You can neither use the linked list in C/C++ STL to write your program, nor an array as a simulation.

You have to use the 「operator overloading」 to implement addition and multiplication (redefine + and *). Suppose your polynomial class is called Poly. You should accomplish the operations of polynomials directly through the operator as follows：

```
Poly A, B, C, D; //Polynomial declaration
C = A+B;
//Add polynomial A and polynomial B, then store into Polynomial C
D = A*B;
//Multipy polynomial A and polynomial B, then store into Polynomial
D
```

Input format：

```
P
X1   Y1
X2   Y2
.
.
Xp   Yp
Q
```

X1 Y1
X2 Y2
.
.
Xq Yq
0
0 **(P = 0 and Q = 0 , input stops here.)**

P means that there are P elements in the first polynomial (polynomial A) of the first test case. The following P (X,Y) pairs give the elements in polynomial A , where X1 and Y1 are the coefficient and exponent of the first element, respectively. Similarly, the number Q and its following Q pairs give the second polynomial (polynomial B). If there are several test cases, it will have another P after the previous case, which denotes the number of elements in the first polynomial for the next test case, and so on.

The input is terminated by P=0 and Q=0. There is no output for this case.

Output format: For each test case, you should print the results of addition and multiplication as follows:

Case1:
ADD
X1 Y1
X2 Y2
.
.
MULTIPLY
X1 Y1
X2 Y2
.
.

Case2:
ADD
X1 Y2
X2 Y2

.

.

Note：

(1) The input elements may not be sorted by their exponents. In addition, there may be more than one element with the same exponent. The coefficient and exponent of an input element may both be zero.

(2) You have to use the command “free” or “delete” to remove any element of a zero-coefficient.

(3) In your list, you have to merge those elements with the same exponent. (You are required to remove some nodes)

(4) If the result is zero, please output “0 0”.

(5) The output polynomial (both addition and multiplication) must be sorted by exponent in descending order. Also, they should be with distinct exponents.

Basic testing data:

case 1: 1st polynomial: 0

2nd polynomial: $x^2 + x + 1$

(Note that their multiplication yields 0)

case 2: 1st polynomial: $3x^5 + x + x$

2nd polynomial: $-2x + x^2$

(You should first merge the two x in the 1st polynomial. Also, note that in the addition, x should be removed because its coefficient is zero)

case 3: 1st polynomial: $5x - 7$

2nd polynomial: $-5x + 7$

(Note that their addition yields 0)

B 1 :

Case 1

```
0
3
1 2
1 1
1 0
```

P =0
A = 0
Q=3
B = $x^2 + x + 1$

Case 2

```
3
3 5
1 1
1 1
2
-2 1
1 2
```

P =3
A = $3x^5 + x + x$
= $3x^5 + 2x$

Q=2
B = $x^2 - 2x$

Case 3

```
2
5 1
-7 0
2
-5 1
7 0
0
0
```

P =2
A = 5x - 7

Q=2
B =-5x + 7

P =0
Q=0
End!!

Basic testing data output_1：

Case1:
ADD
1 2
1 1
1 0

ADD result: $x^2 + x + 1$

MULTIPLY
0 0

MULTIPLY result: 0

Case2:
ADD
3 5
1 2

ADD result: $3x^5 + x^2$

MULTIPLY
3 7
-6 6
2 3
-4 2

MULTIPLY result: $3x^7 - 6x^6 + 2x^3 - 4x^2$

Case3:
ADD
0 0

ADD result: 0

MULTIPLY
-25 2
70 1
-49 0

MULTIPLY result: $-25x^2 - 70x - 49$

Basic testing data input_2：

Case 1

```
0
3
1 2
1 1
1 0
```

P =0
P = 0
Q=3
$Q = x^2 + x + 1$

Case 2

```
5
1 5
-2 1
2 1
2 5
2 1
2
-2 1
1 2
```

P =5
$P = x^5 - 2x + 2x + 2x^5 + 2x$
$= 3x^5 + 2x$

Q=2
$Q = x^2 - 2x$

Case 3

```
8
1 1
-1 1
1 1
1 1
1 1
1 1
1 1
-7 0
8
1 0
1 0
1 0
-5 1
1 0
1 0
1 0
1 0
0
0
```

P =8
$P = x - x + x + x + x + x + x - 7$
$= 5x - 7$

Q=8
$Q = 1 + 1 + 1 - 5x + 1 + 1 + 1 + 1$
$= -5x + 7$

P =0
Q=0
End!!

Basic testing data output_2：

Case1:

ADD

1 2

1 1

1 0

ADD result: $x^2 + x + 1$

MULTIPLY

0 0

MULTIPLY result: 0

Case2:

ADD

3 5

1 2

ADD result: $3x^5 + x^2$

MULTIPLY

3 7

-6 6

2 3

-4 2

MULTIPLY result: $3x^7 - 6x^6 + 2x^3 - 4x^2$

Case3:

ADD

0 0

ADD result: 0

MULTIPLY

-25 2

70 1

-49 0

MULTIPLY result: $-25x^2 - 70x - 49$