**2.2 Sample 2: Polynomial Showdown**

1. **Description of the contest problem.**

Given the coefficients of a polynomial from degree 8 down to 0, you are to format the polynomial in a readable format with unnecessary characters removed. For instance, given the coefficients 0, 0, 0, 1, 22, -333, 0, 1, and -1, you should generate an output line which displays *x*^5 + 22*x*^4 - 333*x*^3 + *x* - 1.

The formatting rules which must be adhered to are as follows:

1. Terms must appear in decreasing order of degree.

2. Exponents should appear after a caret "^".

3. The constant term appears as only the constant.

4. Only terms with nonzero coefficients should appear, unless all terms have zero coefficients in which case the constant term should appear.

5. The only spaces should be a single space on either side of the binary + and - operators.

6. If the leading term is positive then no sign should precede it; a negative leading term should be preceded by a minus sign, as in -7*x*^2 + 30*x* + 66.

7. Negated terms should appear as a subtracted unnegated term (with the exception of a negative leading term which should appear as described above). That is, rather than *x*^2 + -3*x*, the output should be *x*^2 - 3*x*.

8. The constants 1 and -1 should appear only as the constant term. That is, rather than -1*x*^3 + 1*x*^2 + 3*x*^1 - 1, the output should appear as-*x*^3 + *x*^2 + 3*x* - 1.

**Input**

The input will contain one or more lines of coefficients delimited by one or more spaces. There are nine coefficients per line, each coefficient being an integer with a magnitude of less than 1000.

**Output**

The output should contain the formatted polynomials, one per line.

|  |  |
| --- | --- |
| **Sample Input** | **Sample Output** |
| 0 0 0 1 22 -333 0 1 -1  0 0 0 0 0 0 -55 5 0 | x^5 + 22x^4 - 333x^3 + x - 1  -55x^2 + 5x |

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1. **Analysis of the problem**

Coefficient *an-i-*1 whose exponent is *n-i*-1 is stored into array element *a*[*i*]. Array element *a*[*n*-1] is the constant term. Initially, based on exponents' order from high to low, coefficients are inputted into *a*[0..*n*-1].

Non-zero term *a*[*i*] (*a*[*i*]≠0, *i*=0..*n*-1) is analyzed from exponents' order from high to low. There are two cases: *a*[*i*] is the first term or is not the first term:

1. *a*[*i*] is the first term of the polynomial:

Coefficient: If *a*[*i*] == -1 and it is not a constant term ( *i* < *n*-1), then output '-' directly; otherwise, if *a*[*i*]]≠1 or *a*[*i*] is a constant term (*i==n*-1), then output coefficient *a*[*i*].

Power: If the exponent is 1 (*i==n*-2), then output 'x' directly; else if it is not a constant term (*i*< *n*-1), output "x^"(*n- i*-1).

Reserve the mark of the first term of the polynomial.

1. *a*[*i*] is not the first term of the polynomial:

Sign: Output (*a*[*i*] < 0 ? '-' : '+');

Coefficient: If *a*[*i*]1or-1, or *a*[*i*] is a constant term, output the absolute value of *a*[*i*];

Power: If the exponent is 1 (*i==n*-2), then output 'x' directly; else if it is not a constant term (*i*< *n*-1), output "x^"(*n- i*-1).

After dealing with the polynomial, if the mark of the first term of the polynomial is not changed, all coefficients are 0. Then output 0.

1. **The data structure and the algorithm to be used.**

data structure: array

algorithm: polynomial

1. **Explanation of the data structure to be used and the algorithm to be used.**

Representation and computation of polynomials is one of applications of linear lists accessed directly. A polynomial of one indeterminate is as follow.

*Pn*(*x*)=*a*0+*a*1*x*+*a*2*x*2+‥‥*anxn*=

There are two storage methods for polynomials of one indeterminate:

1. Numeric array *a* is used to store a polynomial of one indeterminate. All elements’ coefficients are stored in a array *a*[0..*n*] in exponents’ ascending order (*n* is the highest degree). The index for *a* shows the number of exponent for the current element. For example, if the *i*th element is empty, that is, in the polynomial the *i*th element’s coefficient *ai*=0, then the corresponding array element *a*[*i*]=0. Obviously, the length of array *a* lies on the highest degree of the polynomial.
2. Structure array *a* is used to store a polynomial of one indeterminate. Indexes for array *a* are serial numbers of elements. An array element is a structure containing its coefficient *a*[*i*].*coef* and exponent *a*[*i*].*exp*. Obviously the length of array *a* is the length of the polynomial.

Based on above data structures, computations of polynomials are introduced. For example,

+= \*=

Similarly, subtraction and division of two polynomials and other polynomials’ computations can also be implemented. If storage method ① is used, the storage of memory will be larger and algorithms will be simple. If storage method ② is used, the memory consumption will be reduced but the algorithms will be complex.