

# Polynomial Calculator



EEDS HW2





<http://acm.cs.nthu.edu.tw/problem/10783/>

# Requirements

- Human-readable polynomial expression
  - e.g.,  $x^7 + 2x^3 - x + 10$
- Four fundamental operations
  - i.e., +, -, \*, and /
- Successive operations in an expression
  - e.g.,  $A * B / C - D + E$ , where A, B, C, D, and E are all polynomials

# Input

$-3x^{22} - 9x^{19} + x^{17} - 6x^{15} + 3x^{14} - 18x^{12} + 6x^6 + 18x^3$  ↓  
 $-4x^{20} + 7x^{19} - 18x^{17} + 21x^{16} - x^{15} - 18x^{14} + 5x^{12} + 32x^9 + 24x^6$  ↓  
+ ↓  
 $3x^{17} - 7x^{13} + 8x^9 + 6x^7 + 2x^5 + 6x$  ↓  
\* ↓  
 $x^5 + 3x^2$  ↓  
/ ↓

→ (( + ) \* ) / 

- Each input line contains either a polynomial or an operation
  - Each polynomial is followed by **exact one operation** (except for the first polynomial)
- Formula is evaluated **from left to right, one after one**
  - No need to take care of the priority of the operations
- The dividend is always a multiple of the divisor in the test cases

# Output

```
-3*x^22 -9*x^19 +x^17 -6*x^15 +3*x^14 -18*x^12 +6*x^6 +18*x^3 ↵  
-4*x^20 +7*x^19 -18*x^17 +21*x^16 -x^15 -18*x^14 +5*x^12 +32*x^9 +24*x^6 ↵  
+ ↵  
3*x^17 -7*x^13 +8*x^9 +6*x^7 +2*x^5 +6*x ↵  
* ↵  
x^5 +3*x^2 ↵  
/ ↵  
= -9*x^34 -12*x^32 +21*x^31 +21*x^30 -15*x^29 +28*x^28 -70*x^27 -24*x^26  
+35*x^25 -26*x^24 +105*x^23 -30*x^22 +26*x^21 -64*x^20 -72*x^19 -108*x^17  
+40*x^16 +28*x^15 +6*x^14 +34*x^13 +16*x^12 +6*x^11 +48*x^10 +16*x^9  
+84*x^8 +12*x^6 +48*x^5 +36*x^2 ↵
```

- Input formula is repeated first
- The result is printed in the last **one line** with an equality mark

# Hint: Multiplication and Division

$$\begin{array}{r} 9x^2 - 12x + 16 \\ \times \quad 3x + 4 \\ \hline 27x^3 - 36x^2 + 48x \\ \hline 27x^3 \qquad \qquad \qquad + 64 \end{array}$$

$$\begin{array}{r} 3x + 4 \\ \hline 9x^2 - 12x + 16 \overline{) 27x^3 \qquad \qquad \qquad + 64} \\ \underline{27x^3 - 36x^2 + 48x} \phantom{+ 64} \\ 36x^2 + 48x + 64 \\ \underline{36x^2 + 48x + 64} \\ 0 \end{array}$$

# Hint: Printing out Polynomials

- Keep Polynomials Short

- $x^5 - 3x^2 + x + 7$

- $+x^5 - 3x^2 + x + 7$

- $+1x^5 - 3x^2 + x + 7$

- $x^5 + -3x^2 + x + 7$

- $x^5 + 0x^4 - 3x^2 + x + 7$

- $x^5 - 3x^2 + 1x + 7$

- $x^5 - 3x^2 + x^1 + 7$

- $x^5 - 3x^2 + x + 7x^0$

} Wrong polynomials

- Same conventions we typically use

# Hint: Printing out Polynomials

- Strategy
  - Analyze possible conditions using paper and pencil
  - Design the code accordingly

Example		Exponent					
		Leading Term			Other terms		
		b>1	1	0	b>1	1	0
Coefficient	1	$x^b$	$x$	<b>1</b>	...	...	...
	-1	$-x^b$	$-x$	<b>-1</b>	...	...	...
	others	...	...	...	...	...	...

*This is just an illustrative example, please verify the correctness*

# Hint: Reading Polynomials

- Goal

string object

$x^5 - 3x^2 + x + 7$



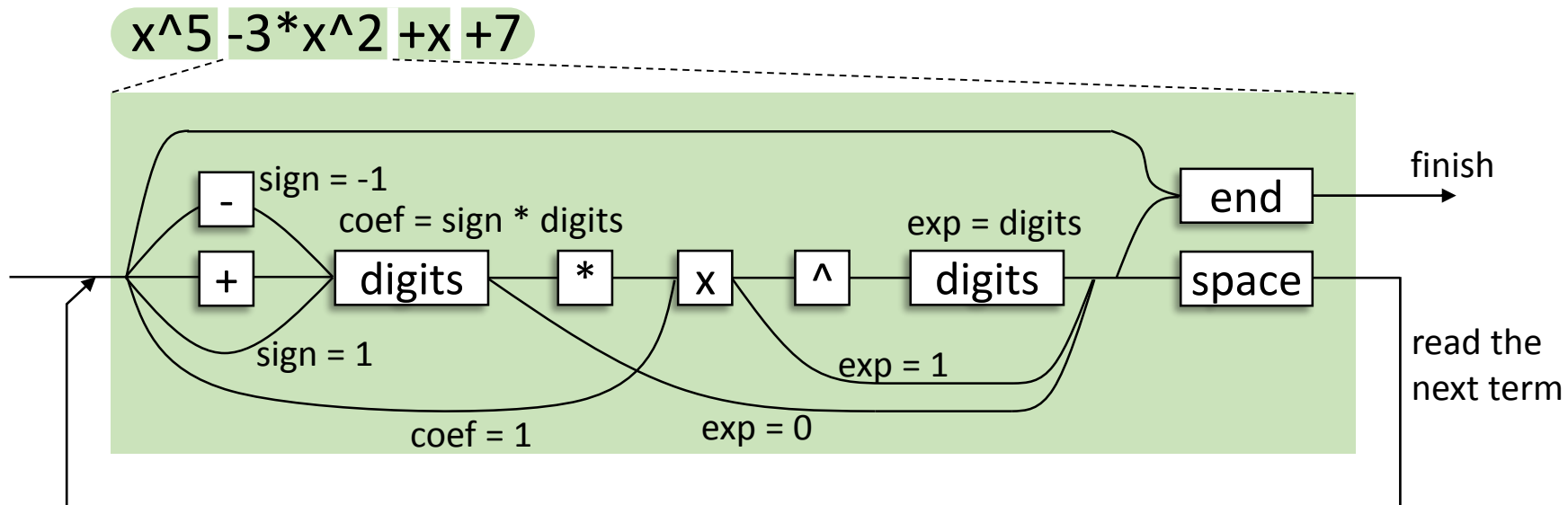
Polynomial object

coef	exp
1	5
-3	2
1	1
7	0



# Hint: Reading Polynomials

- Strategy
  - Analyze the **grammar** of polynomials
  - Keep **peeking** one character further in a string to guide parsing the string



*This is just an illustrative example, please verify the correctness*

# Hint: Some Code Snippets

```
#include <vector>
class Term;
vector <Term> terms;
terms.push_back(t);
a = terms.size();
```

```
bool isdigit(char c)
{
    if(c>='0' && c<='9')
        return true;
    ...
}
```

```
#include <string>
#include <sstream>
string s;
stringstream ss( s.c_str() + i );
ss >> coef;
```

```
#include <string>
int main()
{
    if(freopen("t2.txt", "r", stdin) == NULL){
        cout << "freopen error";
        return 1;
    }
    string s;
    getline(cin, s);
    Polynomial a(s);
    a.Print();
    ....
}
```

```
string s;
getline(cin, s);
switch(s[0]){
    case '+':
        a = a.Add(b);
        ....
        break;
    case '-':
        ....
}
```

### Polynomials & Scientific Calculator

Expression to operate:

Vars.& Fns. f(x)=..., x=..., \_x1=...:

9x<sup>2</sup> -12x + 16  
\*  
3x + 4

(adjust the formula a bit)

Calculate (F8 key)

Result:

Question:

9x<sup>2</sup> -12x + 16  
\*  
3x + 4  
= ?

Answer:

27\*x<sup>3</sup> +64

build your test case

9\*x<sup>2</sup> -12\*x + 16  
3\*x + 4  
\*

compare the results  
using tools

9\*x<sup>2</sup> -12\*x + 16  
3\*x + 4  
\*  
= 27\*x<sup>3</sup> +64

<https://www.diffchecker.com/>

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1 removal. 1 addition.

```
1. -9*x^34 -12*x^32 +21*x^31 +21*x^30 -15*x^29 +28*x^28 -70*x^27
7 -24*x^26 +35*x^25 -26*x^24 +105*x^23 -30*x^22 +26*x^21 -64
*x^20 -72*x^19 -108*x^17 +40*x^16 +28*x^15 +6*x^14 +34*x^13
+16*x^12 +6*x^11 +48*x^10 +16*x^9 +84*x^8 +12*x^6 +48*x^5 +36
*x^2
```

```
1. -9*x^34 -12*x^32 +21*x^31 +21*x^30 -15*x^29 +28*x^28 -70*x^27
7 -24*x^26 +35*x^25 -26*x^24 +105*x^23 -30*x^22 +26*x^21 -64
*x^20 -72*x^19 -108*x^17 +40*x^16 +28*x^15 +6*x^4 +34*x^13 +
16*x^12 +6*x^11 +48*x^10 +16*x^9 +84*x^8 +12*x^6 +48*x^5 +36
*x^2
```

```
1 -9*x^34 -12*x^32 +21*x^31 +21*x^30 -15*x^29 ORIGINAL TEXT
+28*x^28 -70*x^27 -24*x^26 +35*x^25 -26*x^24
+105*x^23 -30*x^22 +26*x^21 -64*x^20 -72*x^19
-108*x^17 +40*x^16 +28*x^15 +6*x^14 +34*x^13
+16*x^12 +6*x^11 +48*x^10 +16*x^9 +84*x^8 +12*x^6
+48*x^5 +36*x^2
2
```

```
1 -9*x^34 -12*x^32 +21*x^31 +21*x^30 -15*x^29 CHANGED TEXT
+28*x^28 -70*x^27 -24*x^26 +35*x^25 -26*x^24
+105*x^23 -30*x^22 +26*x^21 -64*x^20 -72*x^19
-108*x^17 +40*x^16 +28*x^15 +6*x^4 +34*x^13
+16*x^12 +6*x^11 +48*x^10 +16*x^9 +84*x^8 +12*x^6
+48*x^5 +36*x^2
2
```

Don't store diff

[Find Difference!](#)



<http://sourceforge.net/projects/winmerge/>

- Winmerge (open source and free) software

