

Instructions

The way I have chose to represent a polynomial such as $5x^2$ is by using the form:

`((5((2 x))))`

If the polynomial has an coefficient with more than one variable, such as $5xyz$ the variables must be in a consistent order throughout the polynomial calculation. $5xyz$ would be represented as:

`((5((1 x)(1 y)(1 z))))`

In my testing I have tried to include as many edge cases as possible. This involved testing with decimals, multi variable polynomials and polynomials of 0. I have used Common Lisp and used the SBCL compiler.

I have listed my examples, first with the standard mathematic representation, then my input the way I have chosen to implement it and finally the output.

Addition

$(x + y) + (x + y)$

`(p+ '((1((1 x)))(1((1 y)))) '((1((1 x)))(1((1 y)))))`
`((2 ((1 X))) (2 ((1 Y))))`

$(5) + (10)$

`(p+ '((5())) '((10)))`
15

$(x + y) + (a + b)$

`(p+ '((1((1 x)))(1((1 y)))) '((1((1 a)))(1((1 b)))))`
`((1 ((1 A))) (1 ((1 B))) (1 ((1 X))) (1 ((1 Y))))`

$(4x^2) + (5x^2)$

`(p+ '((4((2 x)))) '((5((2 x)))))`
`((9 ((2 X))))`

$(5x^2 + 3y^3) + (0)$

`(p+ '((5((2 x)))(3((3 y)))) '0))`
`((5 ((2 X))) (3 ((3 Y))))`

$(5x^3 + 3y^3 + 4z^2) + (6x^3 + 4y + 9z^2)$

`(p+ '((5((3 x)))(3((3 y)))(4((2 z)))) '((6((3 x)))(4((1 y)))(9((2 z)))))`
`((4 ((1 Y))) (13 ((2 Z))) (11 ((3 X))) (3 ((3 Y))))`

$$(5x + 3y + 4z) + (6a + 4b + 9c)$$

(p+ '((5((1 x))) (3((1 y))) (4((1 z)))) '((6((1 a))) (4((1 b))) (9((1 c)))))

((6 ((1 A))) (4 ((1 B))) (9 ((1 C))) (5 ((1 X))) (3 ((1 Y))) (4 ((1 Z))))

$$(10x^3 + 5) + (5x^3 + 5)$$

(p+ '((10((3 x))) (5())) '((5((3 x))) (5())))

((15 ((3 X))) (10 NIL))

$$(5x^3y^2z^2) + (-5x^3y^2z^2)$$

(p+ '((5((3 x)(2 y)(2 z)))) '((-5((3 x)(2 y)(2 z)))))

NIL

Subtraction

$$(3x) - (1x)$$

(p- '((3((1 x)))) '((1((1 x)))))

((2 ((1 X))))

$$(7) - (3)$$

(p- '((7())) '((3())))

((4 NIL))

$$(5x^2 + 3y^3) - (0)$$

(p- '((5((2 x))) (3((3 y)))) '())

((5 ((2 X))) (3 ((3 Y))))

$$(10x + 4y^4) - (10x + 4y^4)$$

(p- '((10((1 x))) (4((4 y)))) '((10((1 x))) (4((4 y)))))

NIL

$$(2y^2) - (-5y^2)$$

(p- '((2((2 y)))) '((-5((2 y)))))

((7 ((2 Y))))

$$(1.5x^{0.5}) - (3.2x^{0.5})$$

(p- '((1.5((0.5 x)))) '((3.2((0.5 x)))))

(-1.7 ((0.5 X)))

$$(0) - (5y^2)$$

$$(p - '((0))'((5((2 y))))))$$

$$((-5 ((2 Y))))$$

$$(5x + 3y + 4z) - (6a + 4b + 9c)$$

$$(p - '((5((1 x)))(3((1 y)))(4((1 z))))'((6((1 a)))(4((1 b)))(9((1 c)))))$$

$$((-6 ((1 A))) (-4 ((1 B))) (-9 ((1 C))) (5 ((1 X))) (3 ((1 Y))) (4 ((1 Z))))$$

$$(5x^3 + 3y^3 + 4z^2) - (6x^3 + 4y + 9z^2)$$

$$(p - '((5((3 x)))(3((3 y)))(4((2 z))))'((6((3 x)))(4((1 y)))(9((2 z)))))$$

$$((-4 ((1 Y))) (-5 ((2 Z))) (-1 ((3 X))) (3 ((3 Y))))$$

$$(10x^3 + 4y) - (0.5)$$

$$(p - '((10((3 x)))(4((1 y))))'((0.5))))$$

$$((4 ((1 Y))) (10 ((3 X))) (-0.5 NIL))$$

Multiplication

$$(5x^2 + 3y^3) * (0)$$

$$(p * '((5((2 x)))(3((3 y))))'())$$

$$NIL$$

$$(10x^3 + 4y) * (0.5)$$

$$(p * '((10((3 x)))(4((1 y))))'((0.5))))$$

$$((2.0 ((1 Y))) (5.0 ((3 X))))$$

$$(3x^2 + 7y^5) * (a^3 + 5b^2 + 2x^2)$$

$$(p * '((3((2 x)))(7((5 y))))'((1((3 a)))(5((2 b)))(2((2 x)))))$$

$$((15 ((2 B)) (2 X))) (56 ((2 X) (5 Y))) (3 ((3 A) (2 X))) (6 ((4 X))))$$

$$((2x + 3y^2) * (3x^2 + 2y^2)) + (6x^3)$$

$$(p + (p * '((2((1 x)))(3((2 y))))'((3((2 x)))(2((2 y)))))'((6((3 x)))))$$

$$((4 ((1 X) (2 Y))) (9 ((2 X) (2 Y))) (12 ((3 X))) (6 ((4 Y))))$$

$$(5x^3y^2z^2) * (3x^3y^2z^2 + 1)$$

$$(p * '((5((3 x)(2 y)(2 z))))'((3((3 x)(2 y)(2 z)))(1))))$$

$$((5 ((3 X) (2 Y) (2 Z))) (-15 ((6 X) (4 Y) (4 Z))))$$

$$(5y^{-2}) * (5y^2)$$

$$(p * '((5((-2 y))))'((5((2 y))))))$$

$$((25 ((0 Y))))$$

$$(3x^2y^3) * (2)$$

$$(p * '((3((2 x)(3 y))))'((20))))$$

$$((6 ((2 X) (3 Y))))$$

$$(1.5x^2y^3) * (3.2x^2)$$

$$(p * '((1.5((2 x)(3 y))))'((3.2((2 X))))))$$

$$((4.8 ((4 X) (3 Y))))$$

$$(1.5x^{0.5}) * (3.2x^{0.5})$$

$$(p * '((1.5((0.5 x))))'((3.2((0.5 x))))))$$

$$((4.8 ((1.0 X))))$$

$$(10x^3 + 4y) * (0.5x^2)$$

$$(p * '((10((3 x))(4((1 y))))'((0.5((2 x))))))$$

$$((2.0 ((2 X) (1 Y))) (5.0 ((5 X))))$$

Addition, subtraction and multiplication

$$(((5x^3y^2z^2) * (-5x^3y^2z^2)) + (6x^4y^3)) - (-15x^2)$$

$$(p-(p+(p * '((5((3 x)(2 y)(2 z))))'((-3((3 x)(2 y)(2 z))(10))))'((6((4 x)(3 y))))'((-15((2 x))))))$$

$$((15 ((2 X))) (5 ((3 X) (2 Y) (2 Z))) (6 ((4 X) (3 Y))) (-15 ((6 X) (4 Y) (4 Z))))$$

$$((3x^3)+(3x^3)) - (6x^3)$$

$$(p-(p+ '((3((3 x))))'((3((3 x))))'((6((3 x))))))$$

$$NIL$$

$$((10x^3 + 4y) * (0.5x^2)) - (3x^5)$$

$$(p-(p * '((10((3 x))(4((1 y))))'((0.5((2 x))))'((3((5 x))))))$$

$$((2.0 ((2 X) (1 Y))) (2.0 ((5 X))))$$

$$((3x^3)+(3x^3)) * (0x^3)$$

$$(p*(p+ '((3((3 x))))'((3((3 x))))'((00))))$$

$$NIL$$

$$\begin{aligned}
& ((10x + 4y^4) - (5x^3 + 4z^3)) * (3y^2) \\
& (p*(p- '((10((1 x))) (4((4 y)))) '((5((3 x))) (4((3 z)))) '((3((2 y)))))) \\
& ((30 ((1 X) (2 Y))) (-12 ((2 Y) (3 Z))) (-15 ((3 X) (2 Y))) (12 ((4 Y) (3 Z))))
\end{aligned}$$