



IIT Madras
ONLINE DEGREE

Multiplication of Polynomials

Multiply the following polynomials

$$p(x) = x^2 + x + 1 \text{ and } q(x) = 2x^3$$

$$p(x)q(x) = (x^2 + x + 1)(2x^3)$$

$$= 2x^{3+2} + 2x^{1+3} + 2x^3$$

$$= 2x^5 + 2x^4 + 2x^3.$$

Multiply the following polynomials

$$p(x) = x^2 + x + 1 \text{ and } q(x) = 2x + 1$$

$$p(x)q(x) = (x^2 + x + 1)(2x + 1)$$

$$= (x^2 + x + 1)(2x) + (x^2 + x + 1)$$

$$= 2x^{1+2} + 2x^{1+1} + 2x + x^2 + x + 1$$

$$= 2x^3 + (2+1)x^2 + (2+1)x + 1$$

$$= 2x^3 + 3x^2 + 3x + 1.$$

Multiplication of Polynomials

Multiply the polynomials $p(x) = a_2x^2 + a_1x + a_0$ and $q(x) = b_1x + b_0$.

$$\begin{aligned} p(x)q(x) &= (a_2x^2 + a_1x + a_0)(b_1x + b_0) \\ &= (a_2x^2 + a_1x + a_0)(b_1x) + (a_2x^2 + a_1x + a_0)b_0. \\ &= (a_2b_1x^{2+1} + a_1b_1x^{1+1} + a_0b_1x) + (a_2b_0x^2 + a_1b_0x + a_0b_0) \\ &= a_2b_1x^3 + (a_1b_1 + a_2b_0)x^2 + (a_0b_1 + a_1b_0)x + a_0b_0. \end{aligned}$$

Let $p(x) = \sum_{k=0}^n a_k x^k$, and $q(x) = \sum_{j=0}^m b_j x^j$. Then

$$p(x)q(x) = \sum_{k=0}^{m+n} \sum_{j=0}^k (a_j b_{k-j}) x^k.$$

Multiplication of Polynomials

Multiply the polynomials $p(x) = x^2 + x + 1$ and $q(x) = x^2 + 2x + 1$

Let $p(x) = \sum_{k=0}^n a_k x^k$, and $q(x) = \sum_{j=0}^m b_j x^j$. Then

$$p(x)q(x) = \sum_{k=0}^{m+n} \sum_{j=0}^k (a_j b_{k-j}) x^k.$$

k	a_k	b_k
0	1	1
1	1	2
2	1	1

The resultant polynomial is:

$$p(x)q(x) = x^4 + 3x^3 + 4x^2 + 3x + 1$$

k	Coefficient	Calculations
0	$a_0 b_0$	1
1	$a_1 b_0 + a_0 b_1$	1+2=3
2	$a_0 b_2 + a_1 b_1 + a_2 b_0$	1+2+1=4
3	$a_0 b_3 + a_1 b_2 + a_2 b_1 + a_3 b_0$	0+1+2+0=3
4	$a_0 b_4 + a_1 b_3 + a_2 b_2 + a_3 b_1 + a_4 b_0$	0+0+1+0+0=1