

Mathematical Induction and Proof of Recursion

10/10/2020

Prove Algebra 2 Induction Section (MATH 201)

PROVE SECTION 1.1.1, 1.1.2, 1.1.3, 1.1.4

Section 1.1.1

- $$\frac{(2n+1)(2n+2)(2n+3)}{6} - \frac{(2n)(2n+1)(2n+2)}{6} = \frac{(2n+1)(2n+2)(2n+3 - 2n)}{6} = \frac{(2n+1)(2n+2)(3)}{6} = \frac{(2n+1)(2n+2)}{2} = (2n+1)(n+1)$$
- $$\frac{(2n+1)(2n+2)(2n+3)}{6} - \frac{(2n)(2n+1)(2n+2)}{6} = \frac{(2n+1)(2n+2)(2n+3 - 2n)}{6} = \frac{(2n+1)(2n+2)(3)}{6} = \frac{(2n+1)(2n+2)}{2} = (2n+1)(n+1)$$
- $$\frac{(2n+1)(2n+2)(2n+3)}{6} - \frac{(2n)(2n+1)(2n+2)}{6} = \frac{(2n+1)(2n+2)(2n+3 - 2n)}{6} = \frac{(2n+1)(2n+2)(3)}{6} = \frac{(2n+1)(2n+2)}{2} = (2n+1)(n+1)$$
- $$\frac{(2n+1)(2n+2)(2n+3)}{6} - \frac{(2n)(2n+1)(2n+2)}{6} = \frac{(2n+1)(2n+2)(2n+3 - 2n)}{6} = \frac{(2n+1)(2n+2)(3)}{6} = \frac{(2n+1)(2n+2)}{2} = (2n+1)(n+1)$$

Section 1.1.2

- $$(n^2 - 1)^2 - (n^2 - 2n + 1)^2 = (n^2 - 1 - n^2 + 2n - 1)(n^2 - 1 + n^2 - 2n + 1) = (2n - 2)(2n^2 - 2n) = 2(n-1) \cdot 2n(n-1) = 4n(n-1)^2$$
- $$(n^2 - 1)^2 - (n^2 - 2n + 1)^2 = (n^2 - 1 - n^2 + 2n - 1)(n^2 - 1 + n^2 - 2n + 1) = (2n - 2)(2n^2 - 2n) = 2(n-1) \cdot 2n(n-1) = 4n(n-1)^2$$

Section 1.1.3

- $$1^2 + 3^2 + 5^2 + \dots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$$
- $$1^2 + 3^2 + 5^2 + \dots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$$

Section 1.1.4

- Prove by induction that $1^2 + 3^2 + 5^2 + \dots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$

n	Left Side	Right Side
1	1	1
2	1 + 9 = 10	2(3)(5)/3 = 10
3	1 + 9 + 25 = 35	3(5)(7)/3 = 35
4	1 + 9 + 25 + 49 = 84	4(7)(9)/3 = 84
5	1 + 9 + 25 + 49 + 81 = 165	5(9)(11)/3 = 165
- Prove by induction that $1^2 + 3^2 + 5^2 + \dots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$

n	Left Side	Right Side
1	1	1
2	1 + 9 = 10	2(3)(5)/3 = 10
3	1 + 9 + 25 = 35	3(5)(7)/3 = 35
4	1 + 9 + 25 + 49 = 84	4(7)(9)/3 = 84
5	1 + 9 + 25 + 49 + 81 = 165	5(9)(11)/3 = 165