Homework 1

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1 PROBLEM 1

Prove by mathematical induction that

$$\sum_{i=1}^{p} i^3 = \frac{1}{4} p^2 (p+1)^2 \tag{1.1}$$

We will be using induction on p

1.1 BASE CASE

Proving holds for $p = 1$

$$\sum_{i=1}^{1} i^3 = 1 \tag{1.2}$$

$$\frac{1}{4}(1^2)(1+1)^2 = \frac{1}{4}(2)^2 = \frac{4}{4} = 1 \tag{1.3}$$

1.2 INDUCTION HYPOTHESIS

We will be using weak induction. Assume that 1.1 holds for $p = n$, thus

$$\sum_{i=1}^{n} i^3 = \frac{1}{4} n^2 (n+1)^2 \tag{1.4}$$

1.3 Induction Step

$$\sum_{i=1}^{n+1} i^3 = \sum_{i=1}^{n} i^3 + (n+1)^3$$

$$= \frac{1}{4} n^2 (n+1)^2 + (n+1)^3 \qquad \text{By Induction Hypothesis}$$

$$= (n+1)^2 (\frac{1}{4} n^2 + n + 1)$$

Which is the same as showing that

$$\sum_{i=1}^{n+1} i^3 = \frac{1}{4} (n+1)^2 (n+2)^2$$

$$= (n+1)^2 \frac{1}{4} (n^2 + 4n + 4) \tag{1.5}$$

$$= (n+1)^2 (\frac{1}{4} n^2 + n + 1))$$

1.4 Conclusion

Since we proved that blash bablah

1.4.1 Heading on level 3 (subsubsection)

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2 Lists

2.1 Example of list (3*itemize)

- First item in a list
  - First item in a list
    * First item in a list
    * Second item in a list
  - Second item in a list

- Second item in a list

2.2 Example of list (enumerate)

1. First item in a list

2. Second item in a list

3. Third item in a list