Homework Assignment: 1
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1. Summation Practice

   (a)

$$\sum_{k=3}^{n+1} 1 = n - 1$$

   (b)

$$\sum_{i=1}^{100} (4 + 3i)$$

$$n(a_1 + \frac{d(n-1)}{2}) \begin{cases} a_1 = 7 \\ n = 100 \\ d = 3 \end{cases} \implies 100(7 + \frac{3(100-1)}{2}) = 15550$$

   (c)

$$\sum_{i=1}^{200} (i-3)^2 = \sum_{i=1}^{200} (i^2 - 6i + 9)$$

$$\sum_{i=1}^{200} i^2 - 6(\sum_{i=1}^{200} i) + \sum_{i=1}^{200} 9$$

$$= \frac{200(200+1)(400+1)}{6} - 6\left\{\frac{200(200+1)}{2}\right\} + 9(200)$$

$$= 2567900$$

   (d)

$$\sum_{i=10}^{80} (i^3 + i^2) = \sum_{i=10}^{80} i^3 + \sum_{i=10}^{80} i^2$$

$$(\sum_{i=1}^{80} i^3 - \sum_{i=1}^{9} i^3) + (\sum_{i=1}^{80} i^2 - \sum_{i=1}^{9} i^2)$$

$$= (\frac{80^2(80+1)^2}{4} - (\frac{9^2(9+1)^2}{4}) + (\frac{80(80+1)(160+1)}{6} - \frac{9(9+1)(18+1)}{6})$$

$$= 10669170$$

   (e)

$$\sum_{j=0}^{n-1} j(j+1) = \sum_{j=0}^{n-1} j^2 + 2(\sum_{j=0}^{n-1} j) + \sum_{j=0}^{n-1} 1$$

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

(f) Create a summation for the following sequence: 2+4+8+16+32+64

$$\sum_{i=1}^{6} 2^i$$

(g) Create a summation for the following sequence: 2+6+18+54+162

$$\sum_{i=1}^{5}(3^i - 3^{(i-1)})$$

(h) Create a summation for the following sequence: (-4)+(-1)+2+5+8+11+14

$$\sum_{j=1}^{7}(3i - 7)$$

2. Order of Growth

(a)

$$\sum_{i=2}^{n-1} lgi^2$$

$$= 2(\sum_{i=2}^{n-1} lg(i)) \implies \Theta(2(\sum_{i=2}^{n-1} lg(i))) = \Theta(lgi)$$

(b)

$$\sum_{i=0}^{n-1}\sum_{j=0}^{i-1}(i + j)$$

$$= \sum_{i=0}^{n-1}\sum_{j=0}^{i}(2i + j - 1) = \frac{1}{2}(\sum_{i=0}^{n-1} n^2 + ...) \implies \Theta(n^3)$$

3. Time Efficiency Analysis

(a) This algorithm finds if neighboring values in the array are unique.

(b)

$$\sum_{i=0}^{n-2}\sum_{j=i+1}^{n-1} 1 = \sum_{i=0}^{n-2}(-i + n - 1)$$

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

(c) polynomial: $O(n^2)$

(d) This algorithm calculates the summation of i^2 iterations of the loop to value n.

(e)

$$\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$$

(f) polynomial: $O(n^3)$