# ICCS208: Assignment 1

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## 1: Task 2: Oh My Magical Math (OHMM...)

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**(1)** Subtask II

Consider the first $n$ even numbers (including zero):

$$0, 2, 4, 6, 8, 10, ... \tag{1}$$

Consider that the common difference is 2, and comparing it with the sequence $2n$, which is {2,4,6,8,10}, We can see that the general pattern is $2n-2$ or $2(n-1)$ for the $n$th term of this sequence. The sum of said sequence can be written like the following:

$$S = 0 + 2 + 4 + 6 + 8 + ... + 2(n-1) \tag{2}$$

Writing the same sequence backwards looks like:

$$S = 2(n-1) + 2(n-2) + 2(n-3) + ... + 2 + 0 \tag{3}$$

Adding these two variations of the sums together gives us:

$$2S = (0 + 2(n-1)) + (2 + 2(n-2) + (4 + 2(n-3)) + ... + (2(n-2) + 2) + (2(n-1) + 0) \tag{4}$$

This simplifies to:

$$2S = (2n-2) + (2n-2) + (2n-2) + ... + (2n-2) + (2n-2) \tag{5}$$

Considering that there will be $n$ occurences of $2n-2$, so:

$$2S = n(2n-2) \tag{6}$$

$$\therefore S = \frac{n(2n-2)}{2} \tag{7}$$

$$= \frac{(n)(2)(n-1)}{2} \tag{8}$$

$$= n(n-1) \tag{9}$$

Therefore, the sum of the first $n$ even numbers, starting from 0, is $n(n-1)$.
To prove that it works, say $n = 5$ The first 5 even numbers would then be 0,2,4,6,8 with the sum of that being 0+2+4+6+8=20 Putting $n = 5$ in said formula would be $5(5-1) = 5(4) = 20$.

**(2)** Subtask III

Suppose we want to use the formula $n(n-1)$ instead of our Java function, the function would always take the same amount of steps regardless of what $n$ is. This gives us a time complexity of $O(1)$.