Homework 0

Homework 0 is optional. However, you will received extra credit points if you submit this work.

Please write your solutions in the LaTeX. You may use online compiler such as Overleaf or any other compiler you are comfortable with to write your solutions in the LaTeX.

Due date: Wednesday, Sept 06, 9:10 am EDT.

I will collect your submissions when the class meets on Wed, Sept 06. Please handover a printed copy of your Homework 0 solutions (preferably written in the LaTeX). Also, please make sure that you have your full name and student ID in your submission.

You can use the LaTeX submission template I have shared along with the homework. There are two .tex files (macros.tex, and main.tex). You can upload the zipped folder directly to Overleaf, and edit main.tex to write your solutions. macros.tex is mostly for macros (predefined commands). The zipped folder also contains Python files. You may want to edit those files in your code editor, mostly to check the correctness of your solution for Problem 4.

Handwritten solutions will also be accepted. Points will be deducted if handwritten solutions are not legible.

This assignment is essentially to assess understanding of students coming into the course, therefore, students are required to work on these problems individually. You may ask for logistical help regarding LaTeX formatting.

Problem 0-1. Let $A = \{2i \mid i \in \mathbb{Z} \text{ and } 0 \leq i \leq 4\}$ and $B = \{3i \mid i \in \{1, 2, 3, 4\}\}$. (3 points)

Evaluate:

(a) $A \cap B$

(b) $|A \cup B|$

(c) $|A - B|$

Problem 0-2. Prove **by induction** that $\sum_{i=1}^{n} i^2 = \left[\frac{n(n+1)(2n+1)}{6}\right]$ for all integers $n \geq 1$. (15 Points)

Problem 0-3. Given

$$f(x) = \begin{cases} 0 & x \leq 0 \\ x^2 & 0 < x \leq 5 \\ x + 1 & x > 5 \end{cases}$$

(4 points)

Evaluate:

(a) $f(-10)$

(b) $f(0)$

(c) $f(5)$

(d) $f(10)$

Problem 0-4. A pseudocode for insertion sort is provided below. (Borrowed from CLRS ch. 2 pg. 18). (10 points)

INSERTION-SORT(A)

1 **for** $j = 2$ **to** $A.length$
2 $key = A[j]$
3 // Insert $A[j]$ into the sorted sequence $A[1 \,..\, j-1]$.
4 $i = j - 1$
5 **while** $i > 0$ and $A[i] > key$
6 $A[i+1] = A[i]$
7 $i = i - 1$
8 $A[i+1] = key$

Note: The pseudocode uses 1*-based indexing, unlike* 0*-based indexing normally used in computer programming.*

Implement a Python program for the insertion sort using the pseudocode provided above. Please provide your code written in Python using the format provided below. You can check the correctness of your code using insertion_sort.py and tests.py.

```
def InsertionSort(A):
    '''
    Input:  A    | Python List of positive integers
    Output: A | Python List of positive integers in non-decreasing sorted order
    '''
    ##################
    # YOUR CODE HERE #
    ##################
```