CMPT 307
Summer 2020
Assignment 1
Due Wed June 3 at 23:59

Submit on CS Submission Server/CourSys.

4 problems; 10 points each.

1. Express $\sum_{i=0}^{n}(3i^3 - 6i + 2)$ as a polynomial p(n). Then prove that the sum = p(n) by induction.

2. *Aerosort* is a sorting algorithm.

```
Aerosort(A, i, j)                    // A is array to sort; i and j are start and end indices.
    n = j – i + 1
    If (n < 10)  {
        sort A[i…j] by insertion-sort
        return
    }
    m1 = i + 3 * n / 4
    m2 = i + n / 4
    Aerosort(A, i, m1)
    Aerosort(A, m2, j)
    Aerosort(A, i, m1)
```

   a. What is the asymptotic worst-case running time of Aerosort? Show your work.
   b. Prove that Aerosort(A, 1, n) correctly sorts an array A of n elements.

3. Devise a comparison-based algorithm (no bucket or radix sort, for instance) to simultaneously find the minimum and the maximum element in a list of *n* numbers using at most 3n/2 comparisons. Give pseudocode.

4. Give an efficient algorithm to convert a given β-bit (binary) integer to a decimal representation. Argue that if multiplication or division of integers whose length is at most β takes time M(β), then binary-to-decimal conversion can be performed in time Θ(M(β) log β). (Hint: use a divide-and-conquer approach, obtaining the top and bottom halves of the result with separate recursions.)