

Assignment 2

Assigned: October 6, 2020

Due: October 13, 2020 by 11:59PM in Canvas

1. **(60 pts)** Write code to implement the Karatsuba multiplication algorithm in the file linked in Assignment 2 (karatsuba.cpp) in Canvas (please do not rename file or use `cout/cin` statements in your solution). As a reminder, the algorithm uses recursion to produce the results, so make sure you implement it as a recursive function. Please develop your code in small
The test program (karatsuba_test.cpp) is also given. PLEASE DO NOT MODIFY THE TEST FILE.
Upload only the completed karatsuba.cpp file. Make sure to double-check that you uploaded the correct file.
2. **(20 pts)** Write code for a function `int sumDigits (int num)` that will return the sum of the digits in an integer argument using recursion. The function must work for any integer entered. In `main()`, write a list of test cases (1 test per test case) and add comments for each test detailing what is being tested. Upload a single file named main.cpp with your code for `sumDigits` and `main`.
3. **(12 pts)** Programs A and B are analyzed and found to have worst-case running times no greater than $150N\log_2 N$ and N^2 , respectively. Answer the following questions:
 - a) Which program has the better guarantee on the running time for large values of N ($N > 10,000$)?
 - b) Which program has the better guarantee on the running time for small values of N ($N < 100$)?
 - c) Which program will run faster on average for $N = 1000$?
4. **(8 pts)** Solve the following recurrence relations using the Master theorem.
 - a) $T(n) = 3T\left(\frac{n}{3}\right) + \frac{n}{2}$
 - b) $T(n) = 4T\left(\frac{n}{2}\right) + n^{2.5}$