

# CS4040/5040 Homework # 4

due Wednesday, November 3, 2021  
(CS4040 50 pts / CS5040 60 pts)

1. (10 pts.) Give the optimal parenthization of the matrices, and the number of multiplications required for the optimal solution of the following **chain matrix multiplication** problem. Show all work, including any tables required.  
Matrix dimensions are:  $A[10 \times 2]$ ,  $B[2 \times 8]$ ,  $C[8 \times 12]$ ,  $D[12 \times 100]$ ,  $E[100 \times 4]$ ,  $F[4 \times 44]$ .
2. (10 pts.) What is the solution to the problem (with the same matrices as the previous question) if instead of trying to minimize the number of multiplications, we instead want to find the maximum amount of multiplications? Give the optimal parenthization of the matrices (for this new version of the problem), and the number of multiplications required for the optimal solution of this **chain matrix multiplication** problem. Show all work, including any tables required.
3. (10 pts.) What modification to QuickSort will guarantee that it runs in  $O(n \lg n)$  time in the worst case?
4. (10 pts.) Compute the **Longest Common Subsequence** of the following strings representing DNA strands. Show all work, including any tables required.  
String A = "CGCCGATGTCCGATCC", B = "GGCCCTTTAAGTCAGCA"
5. (10 pts.) Activity Selection. Give the solution to the following activity selection problem. Show all work.

Activity #	$s_i$	$f_i$
1	2	3
2	1	2.5
3	8	10
4	1	5
5	7	8
6	2	5
7	4	5
8	8	11
9	2	6
10	5	9
11	3	4

6. (10 pts.) **CS5040 only** Suppose you have a list of  $n$  unsorted distinct numbers and you want to find which ones are closest to the median. In particular, you want to find the  $m$  numbers closest to the median in this list of numbers. Give an algorithm to find these  $m$  numbers that runs in time  $O(n)$ .