

# Homework 2

CS 4390/5390  
Fall 2019

Due: 2 October 2019

This homework is worth 5 points out of the total 25 points of homework in the class.

1. **(1 Point, 1/4 point each)** Provide the edit distance, optimal global alignment, optimal local alignment, and the optimal global alignment with affine gaps costs of the two sequence **TTACTGTGTTT** and **CACCCCTGTG**. Also provide the needed matrices for the underlying algorithms. Use the following parameters:

Global & Local Alignment		Affine Gap	
$\delta(x, y)$ for $x \neq y$	-1	$\delta(x, y)$ for $x \neq y$	-1
$\delta(x, x)$	5	$\delta(x, x)$	5
$\delta(x, -)$ & $\delta(-, y)$	-0.5	$\alpha$	2
		$\beta$	0.5

2. **(2 points)** Given two sequences  $S$  and  $T$  (not necessarily the same length), let  $G$ ,  $L$ , and  $H$  be the scores of an optimal global alignment, an optimal local alignment, and an optimal global alignment without counting the indels at the beginning of  $S$  and the end of  $T$ , respectively.
  - (a) Give an example of  $S$  and  $T$  so that all 3 scores,  $G$ ,  $L$ , and  $H$ , are different.
  - (b) Prove or disprove the statement  $L \geq H \geq G$ .
3. **(2 Points)** Given two strings  $S[1..n]$  and  $T[1..m]$ , we would like to find the two non-overlapping alignments  $(S[i_1..i_2], T[j_1..j_2])$  and  $(S[i_3..i_4], T[j_3..j_4])$  such that  $i_2 < i_3$  and  $j_2 < j_3$  and the total alignment score is maximized in running time  $O(mn)$ . Hints: remember that the local alignment between two sequences is the alignment of a pair of substrings from  $S$  and  $T$  such that the alignment score is maximized, and that the question does not say anything about the relationship between  $i_1$  and  $i_2$  nor  $i_3$  and  $i_4$  that if  $i_3 > i_4$ ,  $S[i_3..i_4]$  is the empty string.