



## 2. Local alignment

- (a) Compute the local alignment of `SCIONS` with `CONSCIENCES`, using the following scoring system: matches = 4, mismatches = -3, indels = -3. Show your alignment matrix with scores and traceback on the alignment template, which you can find on the syllabus page.
- (b) What is the score of the optimal local alignment? There is more than one non-overlapping optimal alignment. Show all optimal local alignments.

### 3. Comparing semiglobal and local alignments:

Although the semiglobal and local alignment algorithms both have provisions for forgiving indels in specific situations, the algorithms are fundamentally different. However, for some inputs and scoring functions, both algorithms will produce the same output. There are also cases where both algorithms can produce the same output given the same input, but only when given different scoring functions. In yet other cases, the results obtained with one algorithm cannot be obtained with the other algorithm with *any* scoring function.

In this question, we consider whether we can force the semiglobal alignment algorithm to find the same alignment of **SCIONS** and **CONSCIENCES** as the local alignment algorithm, and vice versa.

- (a) The semiglobal alignment in Problem 1 contains one of the optimal local alignments found in Problem 2, but not the other(s). Is there *any* scoring function that could result in a semiglobal alignment that incorporates two non-overlapping, optimal local alignments found in Problem 2? If so, give it. If not, explain why not.

- (b) Find a scoring function (i.e., give values of  $M$ ,  $m$ , and  $g$ ) for which the local alignment algorithm yields a *single optimal* alignment of **SCIONS** with **CONSCIENCES** that is the same as the semiglobal alignment you obtained in Problem 1 (disregarding the leading overhang). Your alignment will not necessarily have the same score as the semiglobal alignment in Problem 1.
- (c) In fact, there is a set of scoring functions for which the local alignment algorithm yields a *single optimal* alignment of **SCIONS** with **CONSCIENCES** that is the same as the semiglobal alignment you obtained in Problem 1 (disregarding the leading overhang). Give a set of inequalities that specify the set of all possible scoring functions for which this is true.