1.

Having more than one optimal path implies that there is a point in a backtrace where there was a tied score with 2 or 3 choices for which cell to choose next.

Initialize a path counter to 1 and begin the backtrace.

During the backtrace, if there are two traversable cells with the highest score, increment the path counter by 1.

If all three traversable cells have the same score, increment counter by 2 as there are three potential paths which is two more than the one we already are taking. As tied scores are encountered, continue along the backtrace normally, choosing the path by a predetermined tie-breaker decision.

When the backtrace reaches cell 0,0, return the final path counter count as the number of possible optimal global alignment paths.

2.

Changes to Hirschberg’s algorithm:

Begin by initializing the first row, (0,j) to zero instead of ((0,j-1) + (j\*penalty))

Initialize the first element of row 1 to zero also: (1,0) = zero

When performing the forward calculations, use Smith-Waterman rules and set any negative calculated values to zero.

Using this scoring method, proceed as normal using Hirschberg until row m/2, recording the j\* position and using it to split the matrix into 2 sub-matrices that will recursively be processed in the same manner as the primary matrix.

Recursively call the Hirschberg function for each submatrix, right submatrix first, left submatrix second.

When the recursive calls have been exhausted and the final alignment has been produced, begin at the left index and search for the index of the first match, let this be the new index zero.

Next, search from the right index backwards until the first match is found. Let this be the new end index. The string between the new zero index and the new end index is the optimal local alignment.