Three Matrices

We now keep 3 different matrices:

M[i,j] = score of best alignment of x[1..i] and y[1..j] ending with a character-character **match or mismatch**.

X[i,j] = score of best alignment of x[1..i] and y[1..j] ending with a **space in X**.

Y[i,j] = score of best alignment of x[1..i] and y[1..j] ending with a **space in Y**.

$$M[i,j] = \text{match}(i,j) + \max \begin{cases} M[i-1,j-1] \\ X[i-1,j-1] \\ Y[i-1,j-1] \end{cases}$$

$$X[i,j] = \max \begin{cases} M[i,j-k] - \text{gap}(k) & \text{for } 1 \le k \le j \\ Y[i,j-k] - \text{gap}(k) & \text{for } 1 \le k \le j \end{cases}$$

$$Y[i,j] = \max \begin{cases} M[i-k,j] - \text{gap}(k) & \text{for } 1 \le k \le i \\ X[i-k,j] - \text{gap}(k) & \text{for } 1 \le k \le i \end{cases}$$