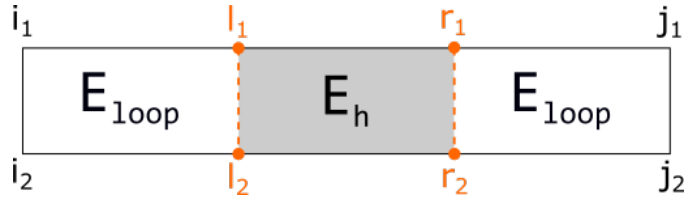


# 1 Recursions

## 1.1 Variables

$S^1, S^2$  target and query sequences  
 $i_1, j_1, i_2, j_2$  interaction boundaries  
 $si_1, sj_1, si_2, sj_2$  seed boundaries  
 $N$  the maximum interaction length ( $\sim 150$ )  
 $M$  the maximum loop length ( $\sim 15$ )

## 1.2 Recursion 1 ( $n^4$ space + time)



Initialization:

$$E_h^{(si_1, sj_1)}(si_2, sj_2) = E_{seed} + ED_1(si_1, sj_1) + ED_2(si_2, sj_2)$$

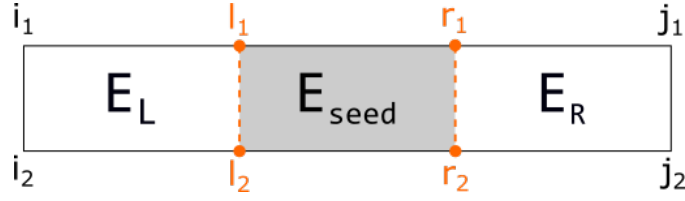
$$\forall_{\substack{si_1 < i_1 \leq j_1 < sj_1 \\ si_2 < i_2 \leq j_2 < sj_2}} E_h^{(i_1, j_1)}(i_2, j_2) = \infty$$

Recursion:

$$E_h^{(i_1, j_1)}(i_2, j_2) = \begin{cases} \infty & : \text{if no matching base pair} \\ \infty & : \text{if } j_1 - i_1 > N \text{ oder } j_2 - i_2 > N \\ \min_{\substack{i_1 < l_1 \leq r_1 < j_1 \\ i_2 < l_2 \leq r_2 < j_2 \\ l_1 - i_1 < M \\ j_1 - r_1 < M \\ l_2 - i_2 < M \\ j_2 - r_2 < M}} \left( E_{loop}^{(i_1, l_1)}(i_2, l_2) + E_h^{(l_1, r_1)}(l_2, r_2) + E_{loop}^{(r_1, j_1)}(r_2, j_2) \right) & : \text{otherwise.} \end{cases}$$

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### 1.3 Recursion 2 ( $n^2$ space + $n^4$ time)



Recursion:

$$E_h(i_1, j_1, i_2, j_2) = \min_{\substack{j_1 - i_1 < N \\ j_2 - i_2 < N}} (ED_1 + ED_2 + E_{seed} + E_L + E_R)$$

$$\forall_{i_1, i_2} E_L(i_1, i_2) = \begin{cases} \infty & : \text{if no matching base pair} \\ \min_{l_1, l_2} (E_L(l_1, l_2) + E_{loop}(i_1, l_1, i_2, l_2)) & : \text{otherwise.} \end{cases}$$

$$\forall_{j_1, j_2} E_R(j_1, j_2) = \begin{cases} \infty & : \text{if no matching base pair} \\ \min_{r_1, r_2} (E_{loop}(r_1, r_2, j_1, j_2) + E_R(r_1, r_2)) & : \text{otherwise.} \end{cases}$$