

Pairwise Sequence Alignment ILP Model

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$$\text{parameter } a_{ij} = \begin{cases} 1 & \text{if } S_1[i] = S_2[j] \\ 0 & \text{otherwise} \end{cases}$$

$$\begin{aligned} \text{minimize } z = & \sum_{j=1}^m \sum_{i=1}^n x[i, j] \cdot r + \sum_{i=1}^n y[i] \cdot gp + \sum_{j=1}^m z[j] \cdot gp + \\ & mp \cdot \sum_{i=1}^n \left(1 - \sum_{j=1}^m x[i, j] + y[i] \right) + v \cdot gp; \end{aligned}$$

$$s.t. \quad \sum_{j=1}^m x_{ij} + y_i \leq 1 \quad i = 1, \dots, n \quad (1)$$

$$\sum_{i=1}^n x_{ij} + z_j \leq 1 \quad j = 1, \dots, m \quad (2)$$

$$x_{ij} + x_{kh} \leq 1 \quad i = 1, \dots, n, \quad j = 1, \dots, m, \quad k < i, \quad h > j \quad (3)$$

$$x_{ij} + x_{kh} \leq 1 \quad i = 1, \dots, n, \quad j = 1, \dots, m, \quad k > i, \quad h < j \quad (4)$$

$$x_{ij} \leq a_{ij} \quad i = 1, \dots, n, \quad j = 1, \dots, m \quad (5)$$

$$x_{ij} \cdot \left(\sum_{k=1}^i y[k] - \sum_{h=1}^j z[h] \right) = x_{ij} \cdot (i - j) \quad i = 1, \dots, n, \quad j = 1, \dots, m \quad (6)$$

$$-v \leq \left(n + \sum_{j=1}^m z[j] \right) - \left(m + \sum_{i=1}^n y[i] \right) \leq v \quad i = 1, \dots, n, \quad j = 1, \dots, m \quad (7)$$

$$x_{ij} \in \{0, 1\} \quad i = 1, \dots, n, \quad j = 1, \dots, m \quad (8)$$

$$y_{ij} \in \{0, 1\} \quad i = 1, \dots, n, \quad j = 1, \dots, m \quad (9)$$

$$z_{ij} \in \{0, 1\} \quad i = 1, \dots, n, \quad j = 1, \dots, m \quad (10)$$

$$v \geq 0 \quad (11)$$