Suppose $A, B \in \mathbb{R}^{(m+n)\times(m+n)}$ are thought of as adjacency matrices (ie symmetry, simplicity, hollowness, etc etc not required), partitioned as

$$A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \qquad B = \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} \qquad \text{order of these matrices being } (m+n)\times(m+n)$$

such that the first m vertices of A and B's graphs are "hard seeds" (ie known to match 1 to 1, 2 to 2, 3 to 3,... m to m) and the other n vertices are matched in an unknown way.

The objective function of interest which we wish to maximize over the permutation matrices $P \in \{0,1\}^{n\times n}$, temporarily relaxed to the doubly stochastic matrices $P \in \mathbb{R}^{n\times n}$, is

$$\begin{aligned}
f(P) &= \text{trace}\left(\begin{bmatrix} A_{11}^T & A_{21}^T \\ A_{12}^T & A_{22}^T \end{bmatrix} \begin{bmatrix} I_{m\times m} & 0_{m\times n} \\ 0_{n\times m} & P \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} \begin{bmatrix} I_{m\times m} & 0_{m\times n} \\ 0_{n\times m} & P^T \end{bmatrix} \right) \\
&= \text{trace}\left(\begin{bmatrix} A_{11}^T & A_{21}^T \\ A_{12}^T & A_{22}^T \end{bmatrix} \begin{bmatrix} B_{11} & B_{12}P^T \\ PB_{21} & PB_{22}P^T \end{bmatrix} \right) \\
&= \text{trace}A_{11}^T B_{11} + \text{trace}A_{21}^T P B_{21} + \text{trace}A_{12}^T B_{12} P^T + \text{trace}A_{22}^T P B_{22} P^T \\
&= \text{trace}A_{11}^T B_{11} + \text{trace}P^T A_{21} B_{21}^T + \text{trace}P^T A_{12}^T B_{12} + \text{trace}A_{22}^T P B_{22} P^T
\end{aligned}$$

which has gradient

$$G(P) := A_{21}B_{21}^T + A_{12}^T B_{12} + A_{22} P B_{22}^T + A_{22}^T P B_{22}.$$

Given any particular doubly stochastic matrix $\hat{P} \in \mathbb{R}^{n\times n}$, the Frank-Wolfe-step linearization involves maximizing trace$Q^T G(\hat{P})$ over all of the doubly stochastic matrices $Q \in \{0,1\}^{n\times n}$. The Hungarian Algorithm will in fact find the optimal Q, call it $\hat{Q}$ (and it will be a permutation matrix). The next task in the Frank-Wolfe algorithm step will be maximizing the objective function over the line segment from $\hat{P}$ to $\hat{Q}$; ie maximizing $g(\alpha) := f(\alpha\hat{P} + (1-\alpha)\hat{Q})$ over $\alpha \in [0,1]$. Denote $c := \text{trace}A_{22}^T \hat{P} B_{22} \hat{P}^T$ and $d := \text{trace}(A_{22}^T \hat{P} B_{22} \hat{Q}^T + A_{22}^T \hat{Q} B_{22} \hat{P}^T)$ and $e := \text{trace}A_{22}^T \hat{Q} B_{22} \hat{Q}^T$ and $u := \text{trace}(\hat{P}^T A_{21} B_{21}^T + \hat{P}^T A_{12}^T B_{12})$ and $v := \text{trace}(\hat{Q}^T A_{21} B_{21}^T + \hat{Q}^T A_{12}^T B_{12})$. Then (ignoring the additive constant trace$A_{11}^T B_{11}$ without loss of generality, since it won't affect the maximization) we have $g(\alpha) = c\alpha^2 + d\alpha(1-\alpha) + e(1-\alpha)^2 + u\alpha + v(1-\alpha)$ which simplifies to $g(\alpha) = (c-d+e)\alpha^2 + (d-2e+u-v)\alpha + (e+v)$. Setting the derivative of g to zero yields potential critical point $\hat{\alpha} := \frac{-(d-2e+u-v)}{2(c-d+e)}$ (if indeed $0 \le \hat{\alpha} \le 1$); thus the next Frank-Wolfe algorithm iterate will either be $\hat{P}$ (in which case algorithm would halt) or $\hat{Q}$ or $\hat{\alpha}\hat{P} + (1-\hat{\alpha})\hat{Q}$. At termination of the Frank-Wolfe Algorithm, we would "unrelax" by maximizing trace$R^T\hat{P}$ over permutation matrices $R \in \{0,1\}^{n\times n}$ —using the Hungarian Algorithm—and the optimal permutation matrix R encodes our proposed bijection between the last n vertices of A's graph and the last n vertices of B's graph.