For a pair of bipartite networks expressed as an mxn matrices $\mathbf{A}, \mathbf{B}$, we seek to find an $m \times m$ matrix, $\mathbf{T}$, such that we minimize the loss function

$$L(\mathbf{T}) = \sum_{gene=1}^{N} ||\mathbf{b}_{gene} - \mathbf{a}_{gene}\mathbf{T}||^2$$

First calculate covariance matrix, $cov(\mathbf{A}, \mathbf{B})$.

This (and later steps) is made easier by centering and scaling both $\mathbf{A}$ and $\mathbf{B}$. So define

$$\mathbf{S}_{m \times m} = \mathbf{B}^T \mathbf{A}$$

And calculate the Singular Value Decomposition (SVD), such that

$$\mathbf{S} = \mathbf{U}\mathbf{D}\mathbf{V}^T$$

Define a vector, $\mathbf{c}$, such that

$$\mathbf{c}_k = \sum_{gene=1}^{N} [\mathbf{a}_{gene}\mathbf{V}]_k [\mathbf{b}_{gene}\mathbf{U}]_k$$

and a corresponding diagonal matrix, $\mathbf{E}$ with diagonal equal to $sign(\mathbf{c})$.

We then define

$$\mathbf{T} = \mathbf{V}\mathbf{E}\mathbf{U}^T$$

and $\mathbf{T}$ is the solution to the least squares transition matrix problem.