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Euclidean Random Assignment Problems, old and new

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An Euclidean Random Assignment Problem (ERAP in short) is as follows:

- there are two n-sets $\mathcal{B} = (B_i)_{i=1}^n$ (blue points) and $\mathcal{R} = (R_i)_{I=1}^n$ (red points) of i.i.d. random variables valued on a metric space (Ω, D) according to a prob. measure ν (disorder);
- for a permutation (or assignment) $\pi : \mathcal{B} \to \mathcal{R}$, there is an energy $\mathcal{H}(\pi) = \sum_{i=1}^n D(b_i, r_{\pi(i)})^p$, where $p \in \mathbb{R}$;

what can one say about the random variable $H_{\text{opt}} = \min_\pi \mathcal{H}(\pi)$, depending on the choice of (Ω, D), on the disorder ν, and p?

ERAPs were pioneered in statistical physics by Mézard and Parisi in the '80s as toy models for finite-dimensional spin glasses; and any ERAP is Monge-Kantorovich optimal transport problem for the empirical measures of blue and red points, in which $W_p^p(\rho_{\mathcal{B}}, \rho_{\mathcal{R}}) = \frac{1}{n} H_{\text{opt}}$, where W_p is p-Wasserstein distance.

Despite these connections, ERAPs have been exceedingly difficult to understand, and surprisingly few results have been proven to date.

In this talk I will review some selected ideas and results on ERAPs focusing on low dimensions of the underlying space Ω. If time allows, I will discuss current work in progress and touch upon a few research perspectives.

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