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Transport metrics in image and shape processing

Entropic Regularization of Wasserstein Barycenters

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Abstract: The computation of Wasserstein barycenters is the cornerstone that allows to unleash the power of optimal transport (OT) methods to applications such a imaging sciences and machine learning. Indeed, it enables to extend traditional problems in these fields, such as texture synthesis, color normalization, clustering and principal component analysis from Euclidean settings to the OT's world. This is crucial to advance the front of research in these areas, because OT takes into account some underlying ground metric, which exploits correlations and structures between the considered variables (color and edges locations/directions for images, bag of features for machine learning). The computation of OT barycenters is however a challenging task when one considers large-scale setups where thousands of histograms of giga-samples need to be averaged. A recent breakthrough in this area is the idea of extending the entropic regularization of OT (which dates back to early works of Schrodinger, and was recently revitalized by Marco Cuturi in machine learning) to the setting of more advance variational problems such as Wasserstein barycenters. Relying on this idea, I will show how several algorithms can be derived from either the primal or the dual formulation, and how this relates to classical convex optimization methods exploiting the geometry of the Kullback-Leibler divergence. I will show several promising results, and argue that this new computational paradigm has the potential to deeply impact the machine learning and imaging communities. This is a joint work with Marco Curturi, Luca Nenna, Jean-David Benamou and Guillaume Carlier.