

An Advantage of Estimating Mutual Information through Entropies

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Abstract: We study a recent promising neural estimation of mutual information proposed by Belgahzi et al.. The method, called the mutual information neural estimation (MINE), trains the neural network to maximize a tractable lower bound of the divergence in terms of its Fenchel-Legendre transform. We point out a limitation of MINE where the network fails to learn at the initial training phase, leading to slow convergence in the number of training iterations. To solve this problem, we propose a faster method called the mutual information neural entropic estimation (MI-NEE). Our solution first generalizes MINE to estimate the entropy using a custom reference distribution. The entropy estimate can then be used to estimate the mutual information. We argue that the seemingly redundant intermediate step of entropy estimation allows one to improve the convergence by an appropriate reference distribution. In particular, we show that MI-NEE reduces to MINE in the special case when the reference distribution is the product of marginal distributions, but faster convergence is possible by choosing the uniform distribution as the reference distribution instead. Compared to the product of marginals, the uniform distribution introduces more samples in low-density regions and fewer samples in high-density regions, which appear to lead to an overall larger gradient for faster convergence. For more details: <https://github.com/ccha23/MI-NEE>