

The RL Probabilist

KL Divergence for Machine Learning

The objective of life is just to minimize a KL objective.

This post will talk about the **Kullback-Leibler Divergence** from a holistic perspective of reinforcement learning and machine learning. You've probably run into KL divergences before: especially if you've played with deep generative models like VAEs. Put simply, the KL divergence between two probability distributions measures how different the two distributions are.

I'll introduce the definition of the KL divergence and various interpretations of the KL divergence. Most importantly, I'll argue the following fact:

Both the problems of supervised learning and reinforcement learning are simply minimizing the KL divergence objective

What's the KL Divergence?

The *Kullback-Leibler divergence* (hereafter written as KL divergence) is a measure of how a probability distribution differs from another probability distribution. Classically, in Bayesian theory, there is some *true distribution* $P(X)$; we'd like to estimate with an *approximate distribution* $Q(X)$. In this context, the KL divergence measures the distance from the approximate distribution Q to the true distribution P .

Mathematically, consider two probability distributions P, Q on some space \mathcal{X} . The Kullback-Leibler divergence from Q to P (written as $D_{KL}(P||Q)$)

$$D_{KL}(P||Q) = \mathbb{E}_{x \sim P} \left[\log \frac{P(X)}{Q(X)} \right]$$

Properties of KL Divergence

There are some immediate notes that are worth pointing out about this definition.

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Pardha Viswanadha • 10 months ago

Nice post. Enjoyed the explanation. Very clear. Thanks!

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Daniel Seita • a year ago

Nice blog post! I enjoyed reading this and liked the distinction between forward mode and reverse mode. Just to be clear when you said:

> The simplified objective for the forward KL objective was

under the reverse mode KL divergence section, I assume you meant to say "objective for the *reverse* KL ...".

^ | ▾ • Reply • Share ▸



Daniel Seita → Daniel Seita • a year ago

Also your 'control as inference' link appears to be dead.

^ | ▾ • Reply • Share ▸