Normalizing Flows to generate distributions

Sergio Hernan Garrido Mejia

1   Motivation

Normalizing Flows (NF) are a tool to transform known tractable densities (such as the Gaussian) into more complex ones. These distributions can be used to, among others, compute likelihood of data or sample from more complex distributions. They are useful when known tractable distributions fall short for our required purposes. However, they keep the tractability and properties of their base distributions, meaning that, for instance, you could do the reparametrization trick on a Gaussian transformed by a NF.

2   Background

NF were formalized by Jimenez and Mohamed as a mean to choose approximate distributions for variational learning. These more flexible distributions offer a better performance than the usual distributions used for the same purpose. The main idea of NF is to iteratively apply invertible functions to a known distribution. This transformations warp the distribution providing a richer distribution family. The purpose of using invertible functions is to keep tractability of the likelihood of the data for the transformed distribution. These transformations are condensed in a neural network.

3   Milestones

The main objective of the final project is two-fold. First, a survey (and understanding) of NF will be done, including how to implement them on TensorFlow distributions. In principle, only the most basic normalizing flows will be implemented, but if time is not a constraint, more complex, state of the practice networks will be used. Second, to use this tool for a probability density estimation for a transportation task.

4   References

1. Adam Kosoriek's post
2. Eric Jang's post, part 1 and part 2
3. Variational Inference with Normalizing Flows
4. MADE: Masked Autoencoder for Distribution Estimation
5. Conditional Density Estimation with Bayesian Normalising Flows
6. Masked Autoregressive Flow for Density Estimation
7. Sylvester Normalizing Flows for Variational Inference
8. Parallel WaveNet:Fast High-Fidelity Speech Synthesis