Chapter 15
Deep Generative Models Insights and Applications

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ABSTRACT

A fundamental framework for reasoning with probabilities in probabilistic programming languages and visual representations is generative modeling. It is among the fascinating and quickly developing areas of artificial intelligence and statistical machine learning. The latest advances in stochastic optimization techniques along with the parameterization of generative models via deep neural networks have rendered it possible to represent complicated, high-dimensional data such as speech, text, and images in a scalable manner. This chapter examines the learning algorithms and probabilistic underpinnings of deep generative models, as well as the fields of application that have recently profited from deep generative models.

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INTRODUCTION

A specific type of machine learning methods called generative models aims to extract the basic framework of data patterns. Generative models seek to comprehend the entire range in contrast to discriminative models, primarily concentrate on identifying the boundaries between various classes inside the data. This allows them to produce novel samples which closely replicate the original information. This feature has tremendous promise in a variety of fields, such as anomaly detection, text production, and image synthesis.

The two primary categories of generative models are deep generative models and classical generative models. Although they have proven useful in many programs, traditional generative models like Hidden Markov Models (HMMs) and Gaussian Mixture Models (GMMs) often have difficulty incorporating high-dimensional, intricate data distributions. However, deep generative models use the strength of deep neural networks to get beyond these restrictions, allowing them to acquire data representations in a structured manner and produce impressively lifelike results.

Deep Generative Models

Deep Generative Models are neural networks that apply generative modeling techniques and are classified as Deep Learning sub domains (DGMs). The opposite approach, known as discriminative modeling, aims to choose the best course of action given the training data at hand. Sort the data into categories after determining what defines a decision boundary. On the other hand, the generative technique uses training data to gather the data distribution and then creates additional information based on the predicted or acquired distribution based on word origin. Based on unsupervised learning, discriminative modeling is commonly connected to supervised learning, while generative modeling is rooted in unsupervised learning (Luleci, Furkan., at.el 2023).

The topic of how data becomes available in a probability model is thus raised by deep generative models, whereas discriminative models seek to classify data utilizing preexisting training data. In order to produce new or comparable data, the generative models make an effort to comprehend the training data's probability distribution. This is the reason why deep generative models, like the neural network DALL-E, may be used to generate images from sample photos.

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