Auto-encoders for Anomaly Detection: Efficiency and Trade-Offs

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Anomaly detection (AD) is an important research area with diverse application domains: cybersecurity, finance, medical sciences, risk management, etc. AD presents many challenges to the data analyst: the data is generally high-dimensional; anomalies can be quite heterogeneous; they are rare; and they typically arise from unknown data-generating mechanisms. Deep learning and generative modeling have provided a promising approach to address these challenges. By learning the distribution of normal data, anomaly scores can be developed by comparing observations with how well they can be reconstructed by the model. In particular, many auto-encoders have been proposed that seem to perform well on given datasets. However, it can be difficult to compare and contrast these different architectures. In this talk, we present our review of 11 auto-encoder architectures for anomaly detection, divided in three categories: classical models, variational models, and regularized models. We use the MNIST and Fashion-MNIST datasets to assess the following characteristics: reconstruction ability, sample generation, latent space visualization, and anomaly detection accuracy. During our experimentation, we also carefully observed the scope of reproducibility with different training parameters. Using these results, we discuss the efficiency and trade-offs of each architecture.