

# Super Resolution

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## 1. GAN

Today, we introduce a net named generative adversarial nets. It's for estimating generative models via adversarial nets, in which we simultaneously train two models: a generative model  $G$  that captures the data distribution, and a discriminative model  $D$  that estimates the probability that a sample came from the training data rather than  $G$ . The training procedure for  $G$  is to maximize the probability of  $D$  making a mistake. This framework corresponds to a minimax two-player game. In the space of arbitrary functions  $G$  and  $D$ , a unique solution exists, with  $G$  recovering the training data distribution and  $D$  equal to  $1/2$  everywhere. In the case where  $G$  and  $D$  are defined by multilayer perceptrons, the entire system can be trained with backpropagation. There is no need for any Markov chains or unrolled approximate inference networks during either training or generation of samples.

### 1.1. Introduction

The promise of deep learning is to discover rich, hierarchical models [1] that represent probability distributions over the kinds of data encountered in artificial intelligence applications, such as natural images, audio waveforms containing speech, and symbols in natural language corpora. So far, the most striking successes in deep learning have involved discriminative models, usually those that map a high-dimensional, rich sensory input to a class label [3]. These striking successes have primarily been based on the backpropagation and dropout algorithms, using piece wise linear units [2] which have a particularly well-behaved gradient. Deep generative models have had less of an impact, due to the difficulty of approximating many intractable probabilistic computations that arise in maximum likelihood estimation and related strategies, and due to difficulty of leveraging the benefits of piecewise linear units in the generative context. The authors propose a new generative model estimation procedure that sidesteps these difficulties.

In the proposed adversarial nets framework, the generative model is pitted against an adversary: a discriminative model that learns to determine whether a sample is from the model distribution or the data distribution. The generative model can be thought of as analogous to a team of counterfeiters, trying to produce fake currency and use it without detection, while the discriminative model is analogous to the police, trying to detect the counterfeit currency. Competition in this game drives both teams to improve their methods until the counterfeits are indistinguishable from the genuine articles.

## References

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- [3] G. Hinton, L. Deng, D. Yu, G. E. Dahl, A. R. Mohamed, N. Jaitly, A. Senior, V. Vanhoucke, P. Nguyen, and T. N. Sainath. Deep Neural Networks for Acoustic Modeling in Speech Recognition: The Shared Views of Four Research Groups. *IEEE Signal Processing Magazine*, pages 82–97, 2012. 1