

unsupervised approaches, autoencoders, GANs

Variational Autoencoders (notes on deep learning book has covered this in more detail → high level idea here)

Supervised vs Unsupervised

Supervised Learning	Unsupervised Learning
Data: (x, y) x is data, y is label	Data: x Just data, no labels!
Goal: Learn a function to map $x \rightarrow y$	Goal: Learn some structure of the data
Examples: Classification, regression, object detection, semantic segmentation, image captioning, etc	Examples: Clustering, dimensionality reduction, feature learning, generative models, etc.

Autoencoders

Originally: Linear + nonlinearity (sigmoid)
Later: Deep, fully-connected
Later: ReLU CNN

Autoencoders

Autoencoders

Train for reconstruction with no labels!

Variational Autoencoder

A Bayesian spin on an autoencoder!

Assume our data $\{x^{(i)}\}_{i=1}^N$ is generated like this:

Intuition: x is an image, z gives class, orientation, attributes, etc

Problem: Estimate θ without access to latent states $z^{(i)}$!
Kingma and Welling, "Auto-Encoding Variational Bayes", ICLR 2014

Variational Autoencoder

Prior: Assume $p_\theta(z)$ is a unit Gaussian

Conditional: Assume $p_\theta(x | z)$ is a diagonal Gaussian, predict mean and variance with neural net

Mean and (diagonal) covariance of $p_\theta(x | z)$

μ^x Σ^x

Decoder network with parameters θ

Latent state z

Variational Autoencoder: Encoder

By Bayes Rule the posterior is:

$$p_\theta(z | x) = \frac{p_\theta(x | z)p_\theta(z)}{p_\theta(x)}$$

Use decoder network =)
Gaussian =)
Intractible integral = (

Kingma and Welling, ICLR 2014

Mean and (diagonal) covariance of $q_\phi(z | x)$

μ^z Σ^z

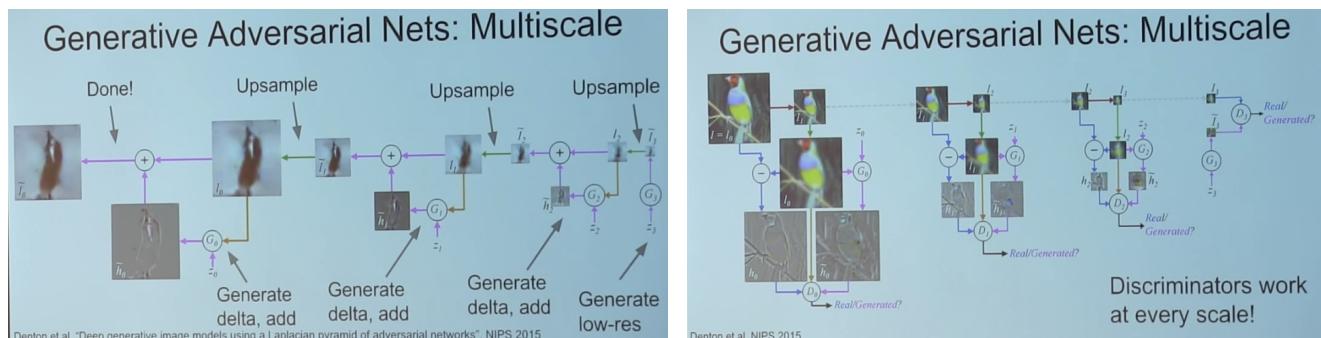
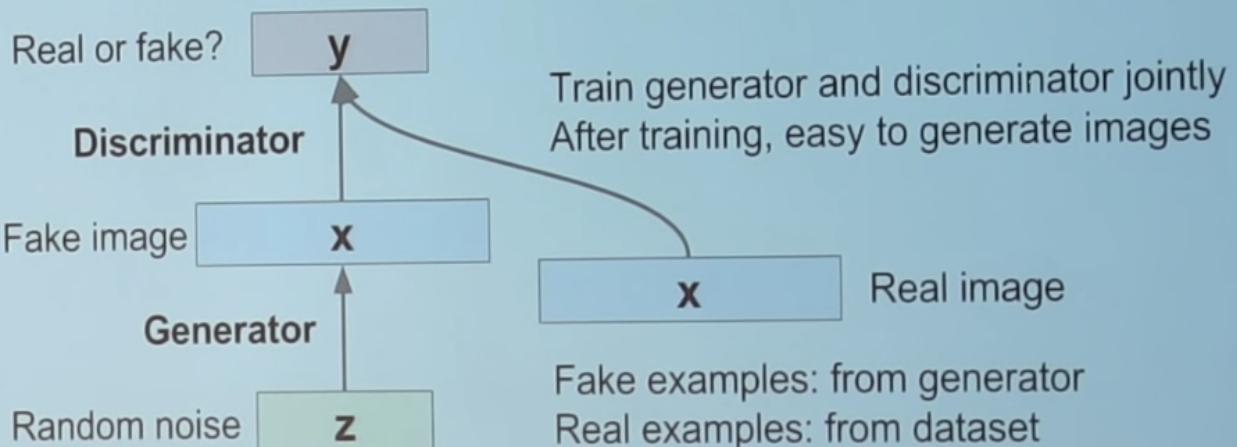
Encoder network with parameters ϕ

Data point x

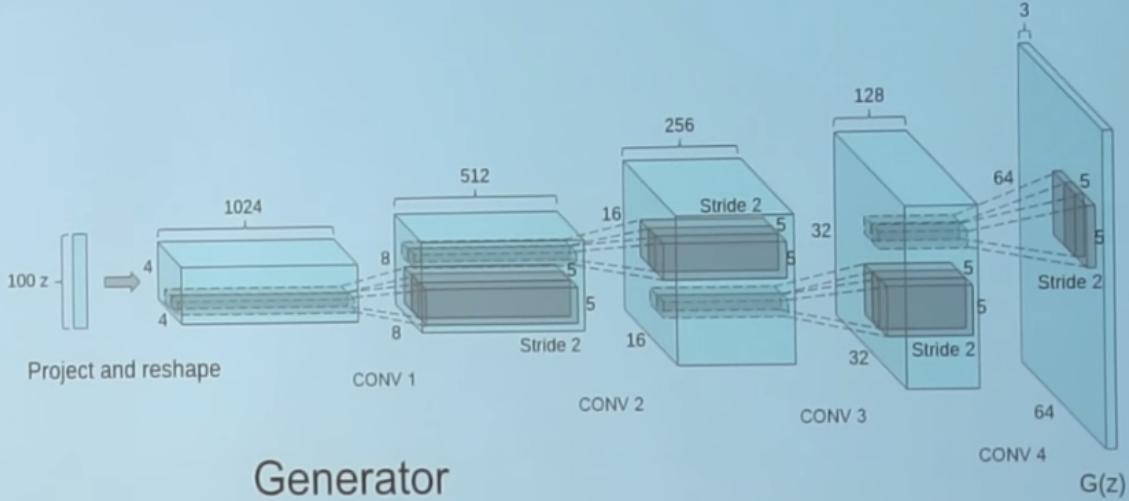
GANs

Generative Adversarial Nets

Can we generate images with less math?



Generative Adversarial Nets: Simplifying



Radford et al., "Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks", ICLR 2016

Generative Adversarial Nets: Simplifying

Interpolating
between
random
points in latent
space

Radford et al,
ICLR 2016



Generative Adversarial Nets: Vector Math

Radford et al, ICLR 2016

Smiling woman Neutral woman Neutral man

Samples
from the
model

Average Z
vectors, do
arithmetic



Smiling Man

