Unsupervised Learning

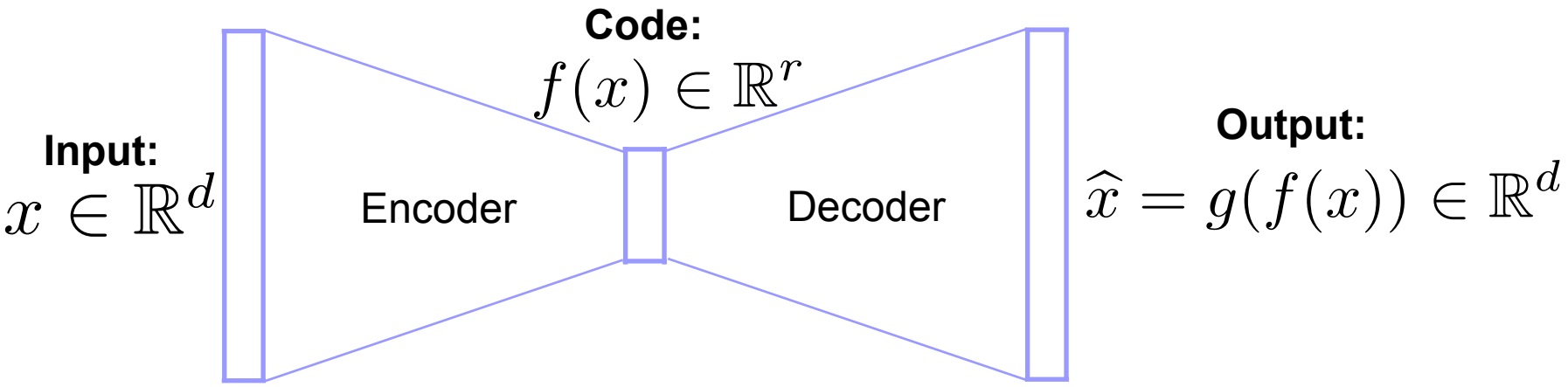
Machine Learning – CSE446

Kevin Jamieson
University of Washington

June 3, 2019

Autoencoders

Find a low dimensional representation for your data by predicting your data



$$\underset{f,g}{\text{minimize}} \sum_{i=1}^{n} \|x_i - g(f(x_i))\|_2^2$$

PCA is a linear transformation

Three major applications
1. De-noising
2. Feature extraction
3. Manifold learning

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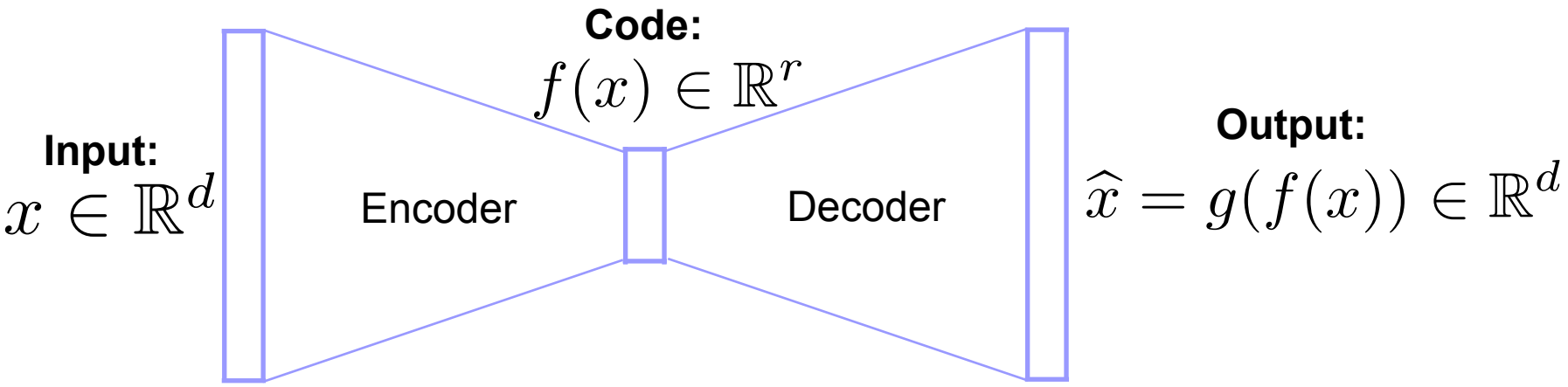
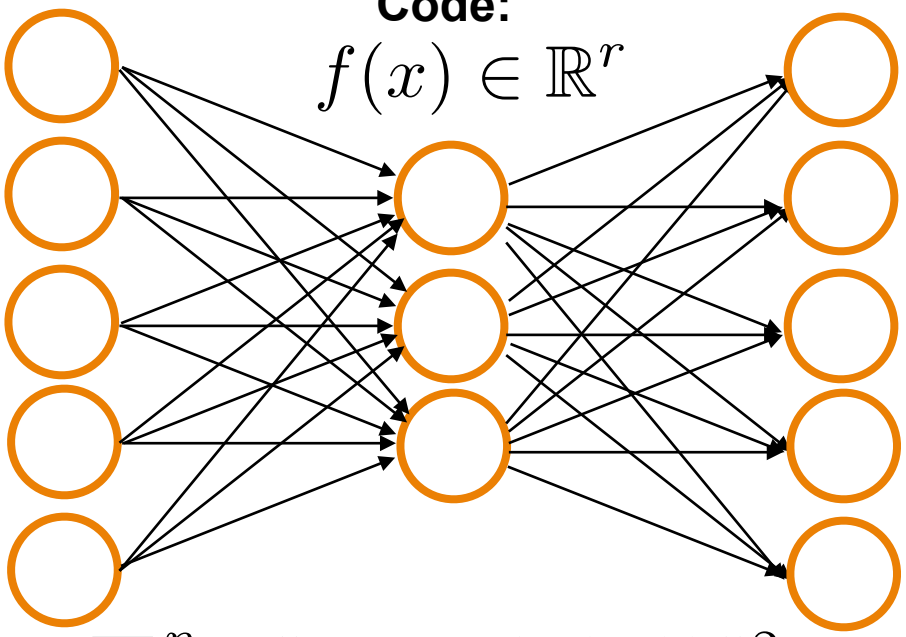


$$\underset{f,g}{\text{minimize}} \sum_{i=1}^{n} \|x_i - g(f(x_i))\|_2^2$$

Sparse Autoencoder

$$\underset{f,g}{\text{minimize}} \sum_{i=1}^{n} \|x_i - g(f(x_i))\|_2^2 + \lambda \|f(x_i)\|_1$$

Autoencoders



What if $f(X) = Ax$ and $g(y) = By$?

This will just pretty much be PCA…

Autoencoders

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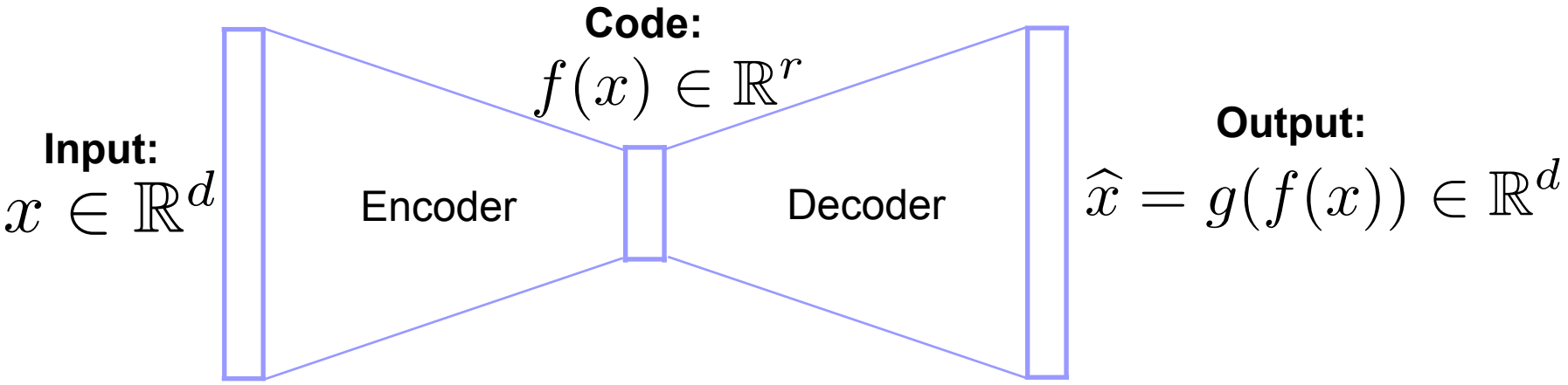

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Three major applications
1. De-noising
2. Feature extraction
3. Manifold learning

Related application: *Generating new samples (see autoencoder)*

GAN (Generative Adversarial Networks)

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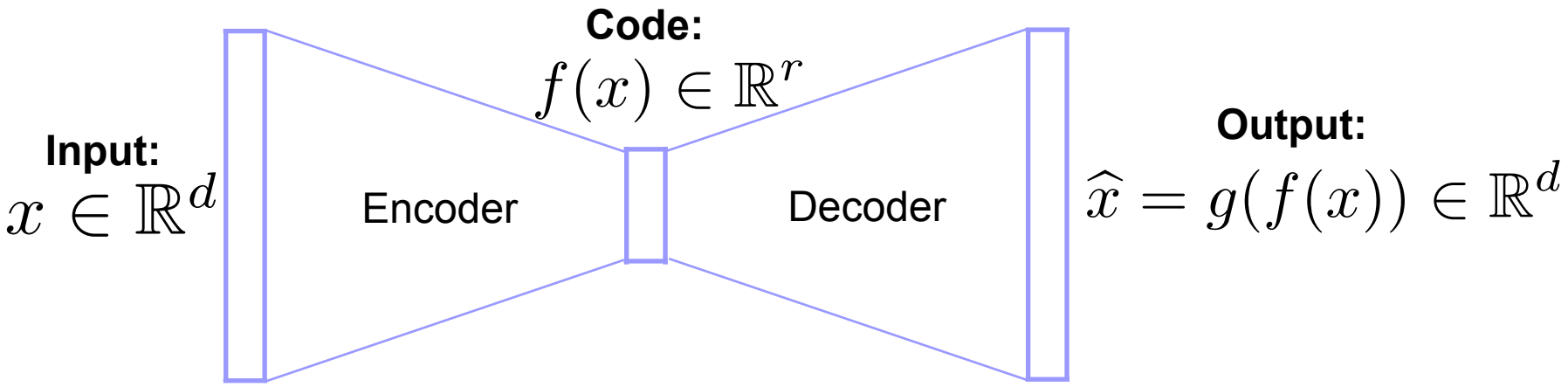

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Three major applications
1. De-noising
2. Feature extraction
3. Manifold learning

Related application: *Generating new samples* (see variational autoencoders (VAE) or generative adversarial networks (GAN)

Sequences and Recurrent Neural Networks

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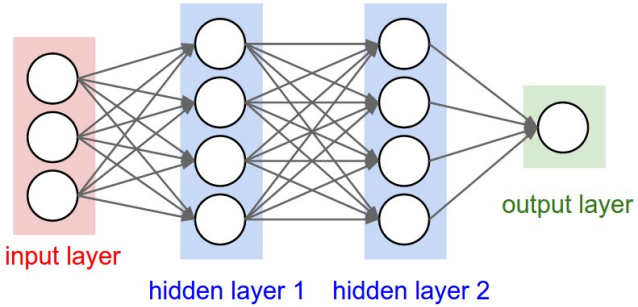
Variable length sequences

Images are usually standardized to be the same size (e.g., 256x256x3)

Neural Network



Variable length sequences

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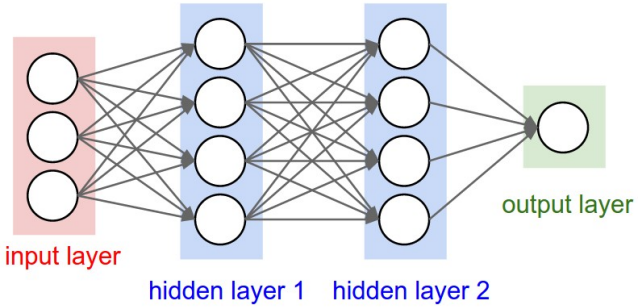
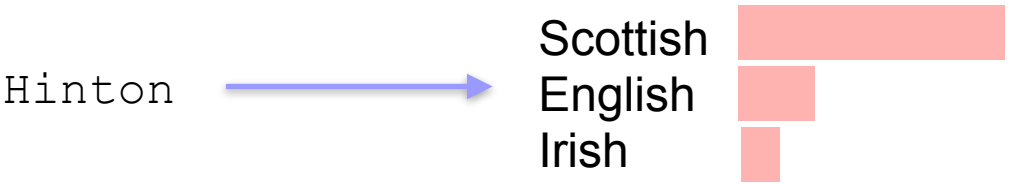
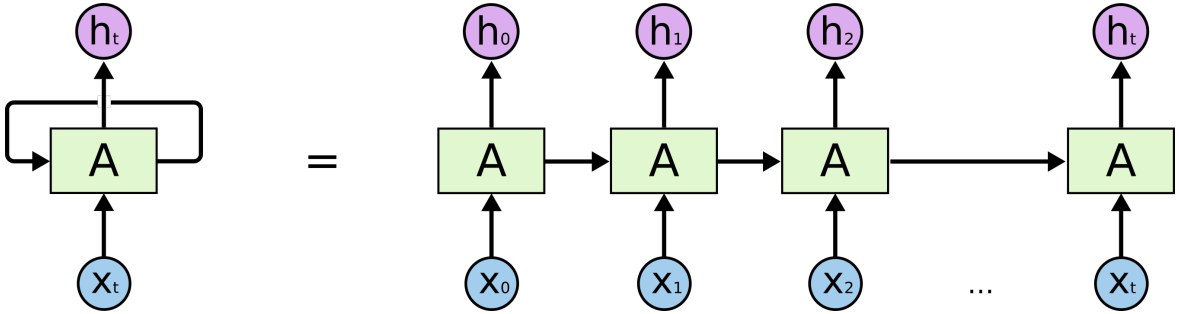
Neural Network



But what if we wanted to do classification on country-of-origin for names?

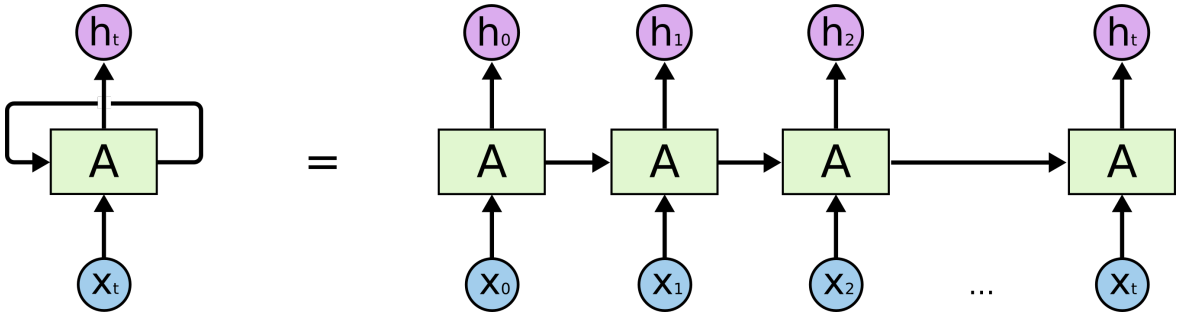


Recurrent Neural Network

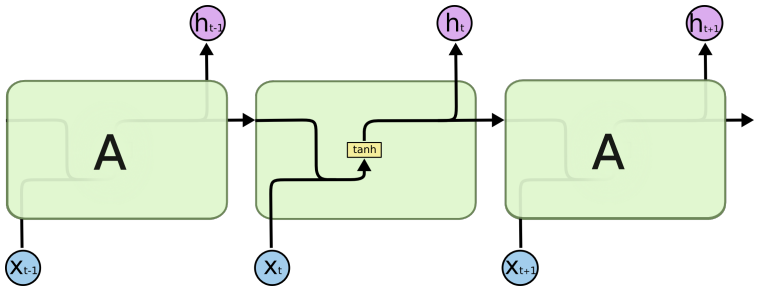


Variable length sequences

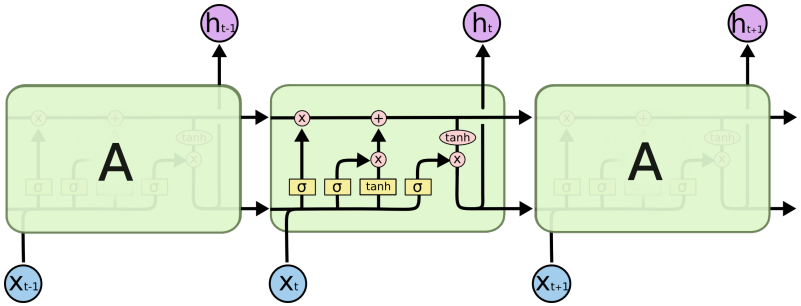
Recurrent Neural Network

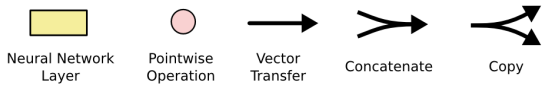


Standard RNN



Gated RNN
LSTM





Slide: http://colah.github.io/posts/2015-08-Understanding-LSTMs/