Image Retrieval with Deeplearning

Jeffrey Tang

Who am I ?

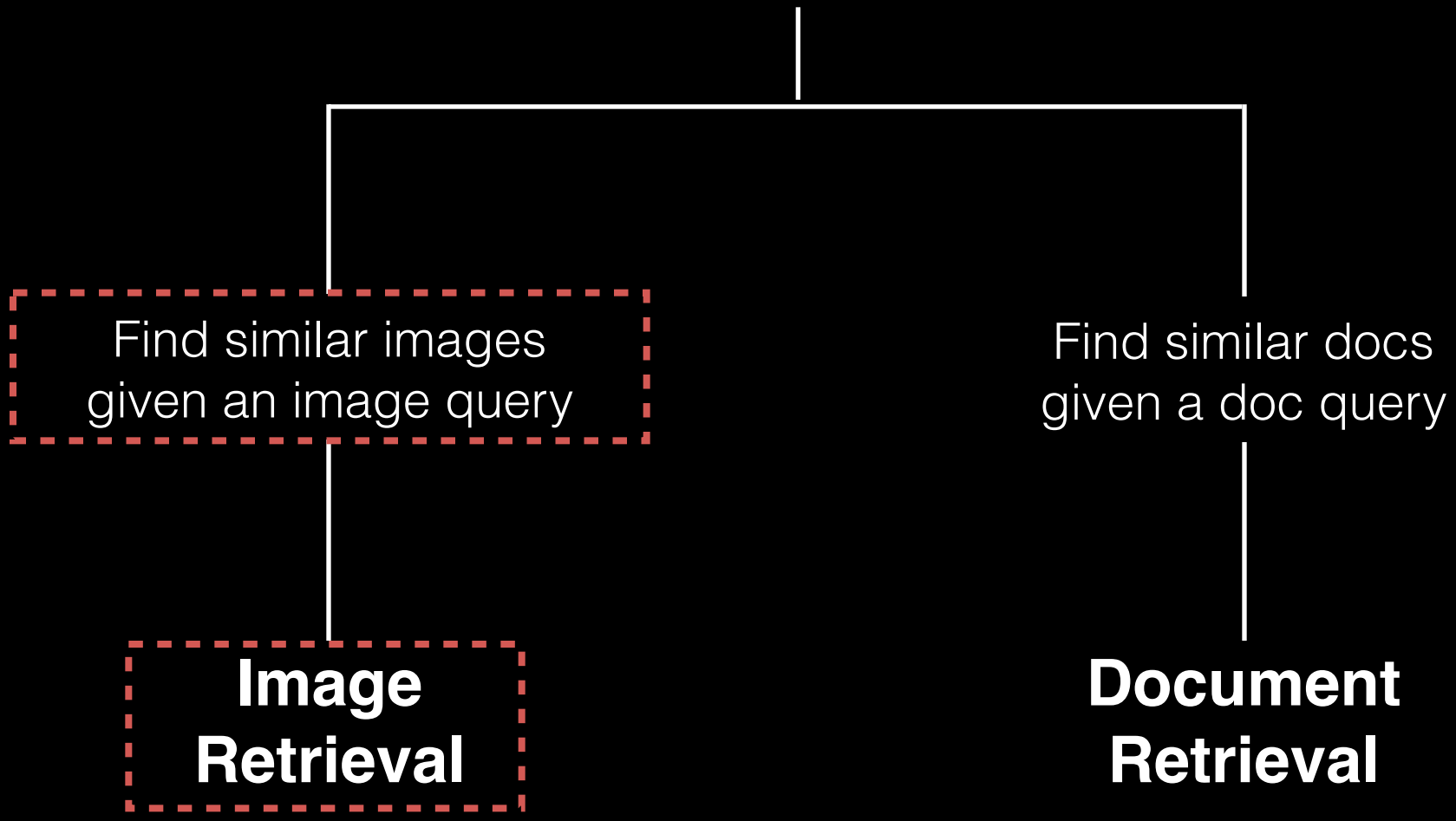
- **Software Engineer at Skymind.io**
  - Python Interface to deeplearning4j (Java)
  - Optimization of deep learning on Spark
- **(Ex-)Data Science Instructor at Galvanize**

Goals

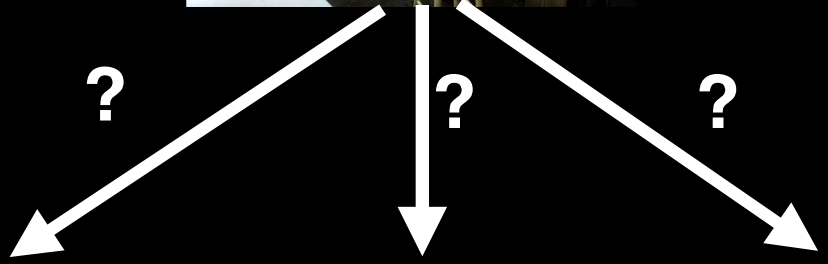
- **Image Retrieval**
  - ⋆ Application & Overview
- **Deep Learning**
  - ⋆ Image Retrieval using Auto-Encoders
  - ⋆ Code Example
- **Deep Learning Ecosystem**

Image Retrieval Overview

Information Retrieval



Applications: Real Estate



Applications: Place Matching

?

?

?

Carribean

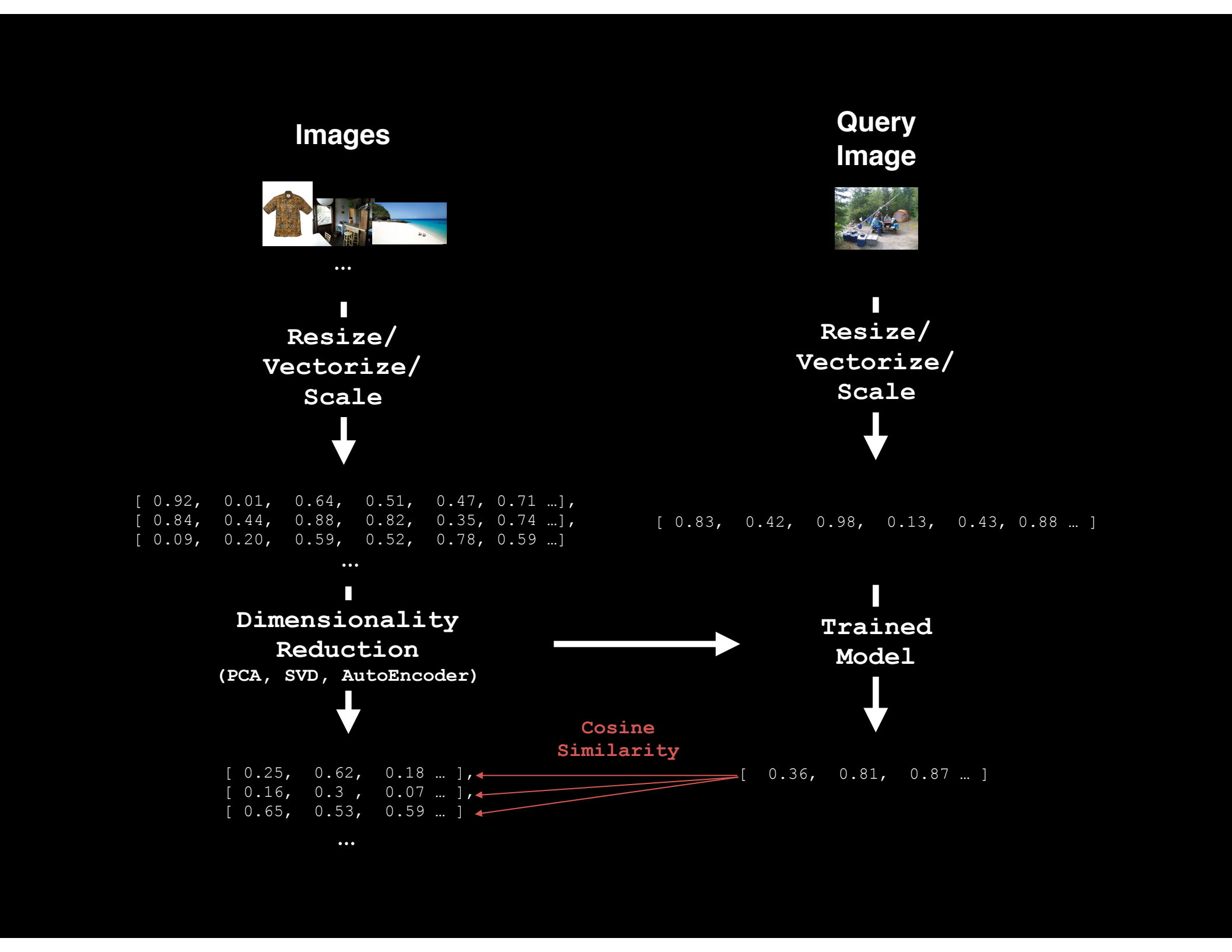
Camping

Shopping

Applications: Product Matching

High Level

- Image Retrieval == Image Recommenders
- Find similar images based on a query image
- Cosine similarity
- Compare query to every stored image


Images
...
Resize/
Vectorize/
Scale
[0.92, 0.01, 0.64, 0.51, 0.47, 0.71 …],
[0.84, 0.44, 0.88, 0.82, 0.35, 0.74 …],
[0.09, 0.20, 0.59, 0.52, 0.78, 0.59 …]
...
Dimensionality
Reduction
(PCA, SVD, AutoEncoder)
[0.25, 0.62, 0.18 …],
[0.16, 0.3 , 0.07 …],
[0.65, 0.53, 0.59 …]
...
Query
Image
Resize/
Vectorize/
Scale
[0.83, 0.42, 0.98, 0.13, 0.43, 0.88 …]
Trained
Model
Cosine
Similarity
[0.36, 0.81, 0.87 …]

Why Reduce Dimension ?

- Yields a more **generalized (and better)** representation of the image (less noise)
- **Faster computations** (Compare fewer dimensions)

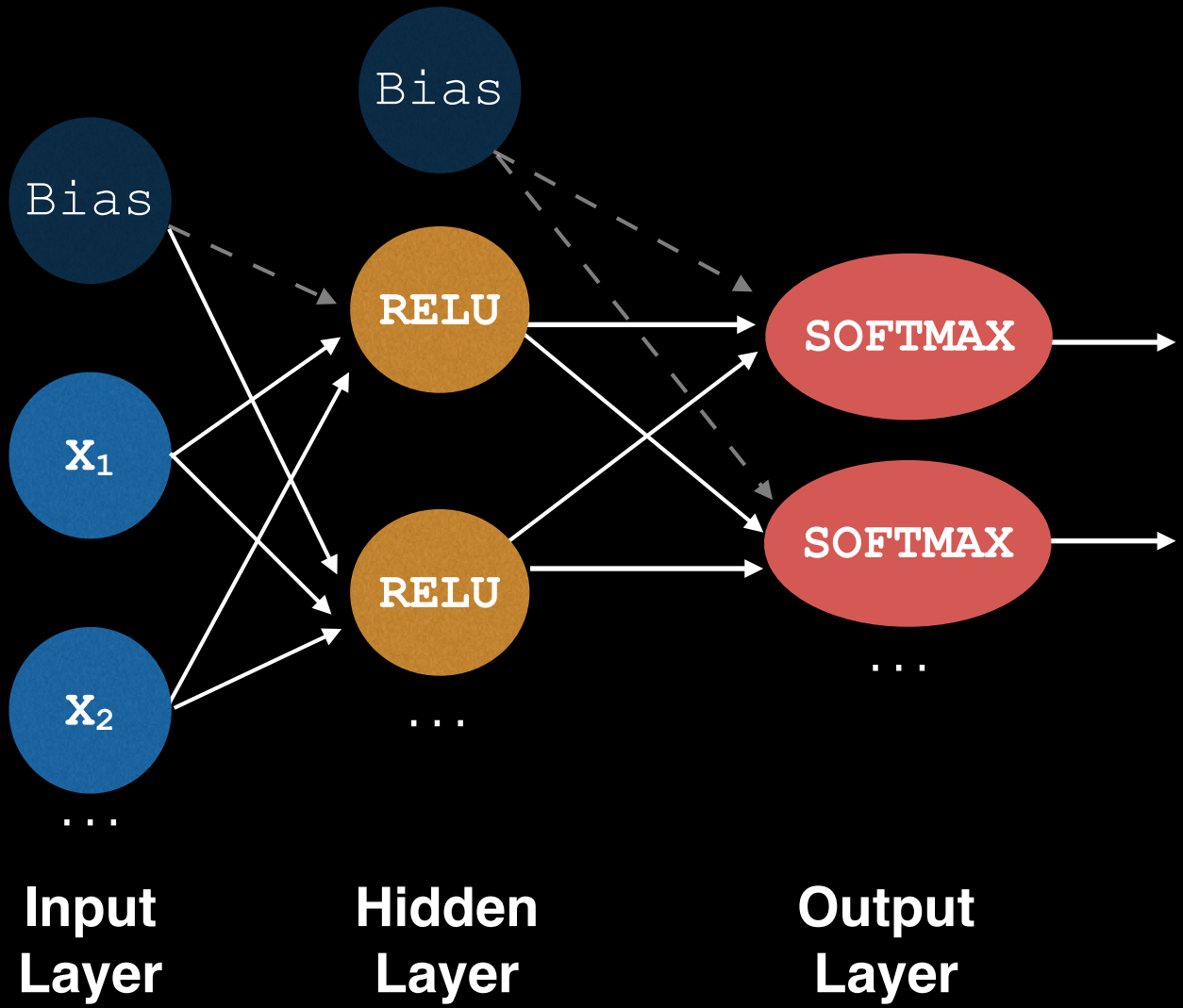
Why Deep Learning ?

- **PCA / SVD** reduces dimension assuming **linear manifold** of the original feature space
- **AutoEncoders** is capable of reconstructing a **non-linear manifold**
- AutoEncoders yield better representation

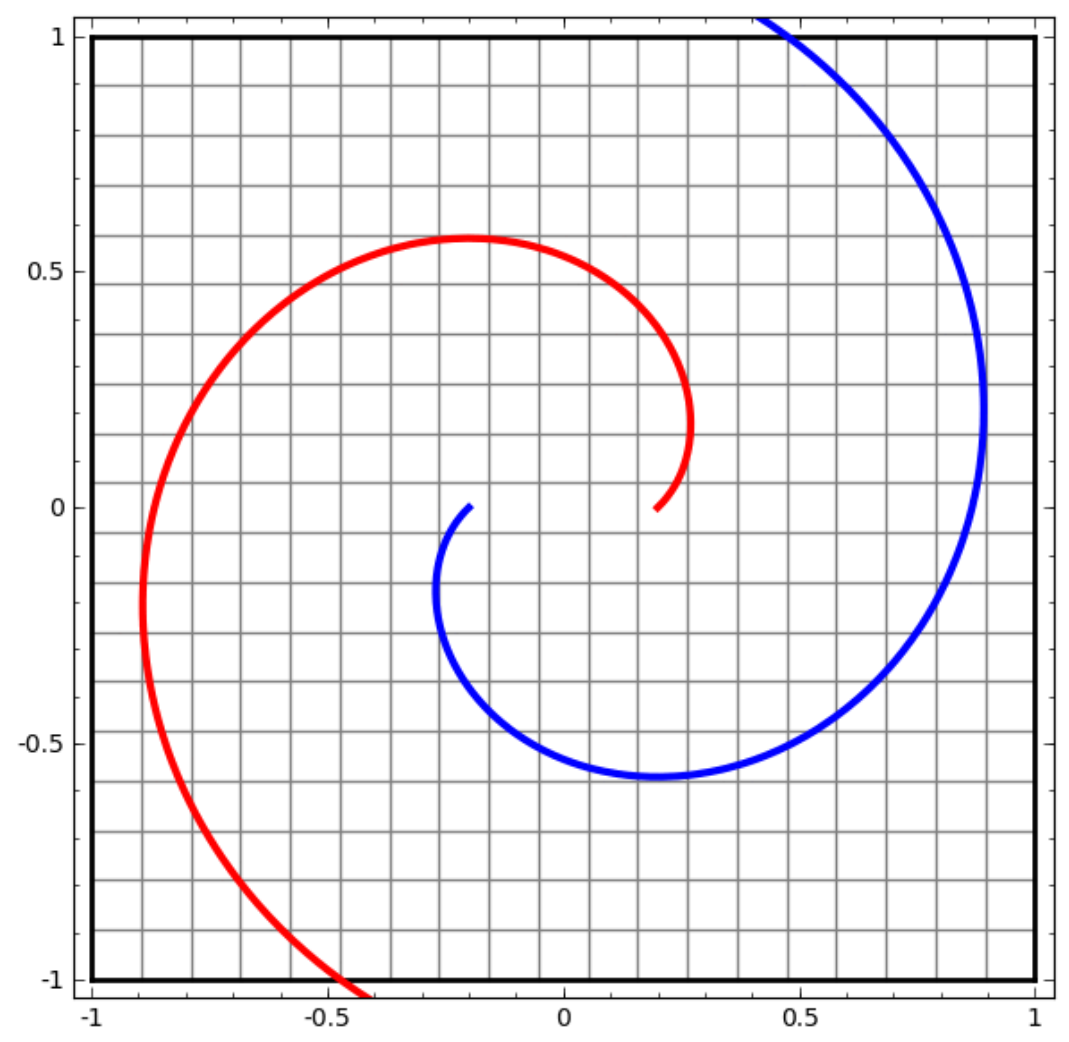
Deep Learning

Introduction

FeedForward Neural Network

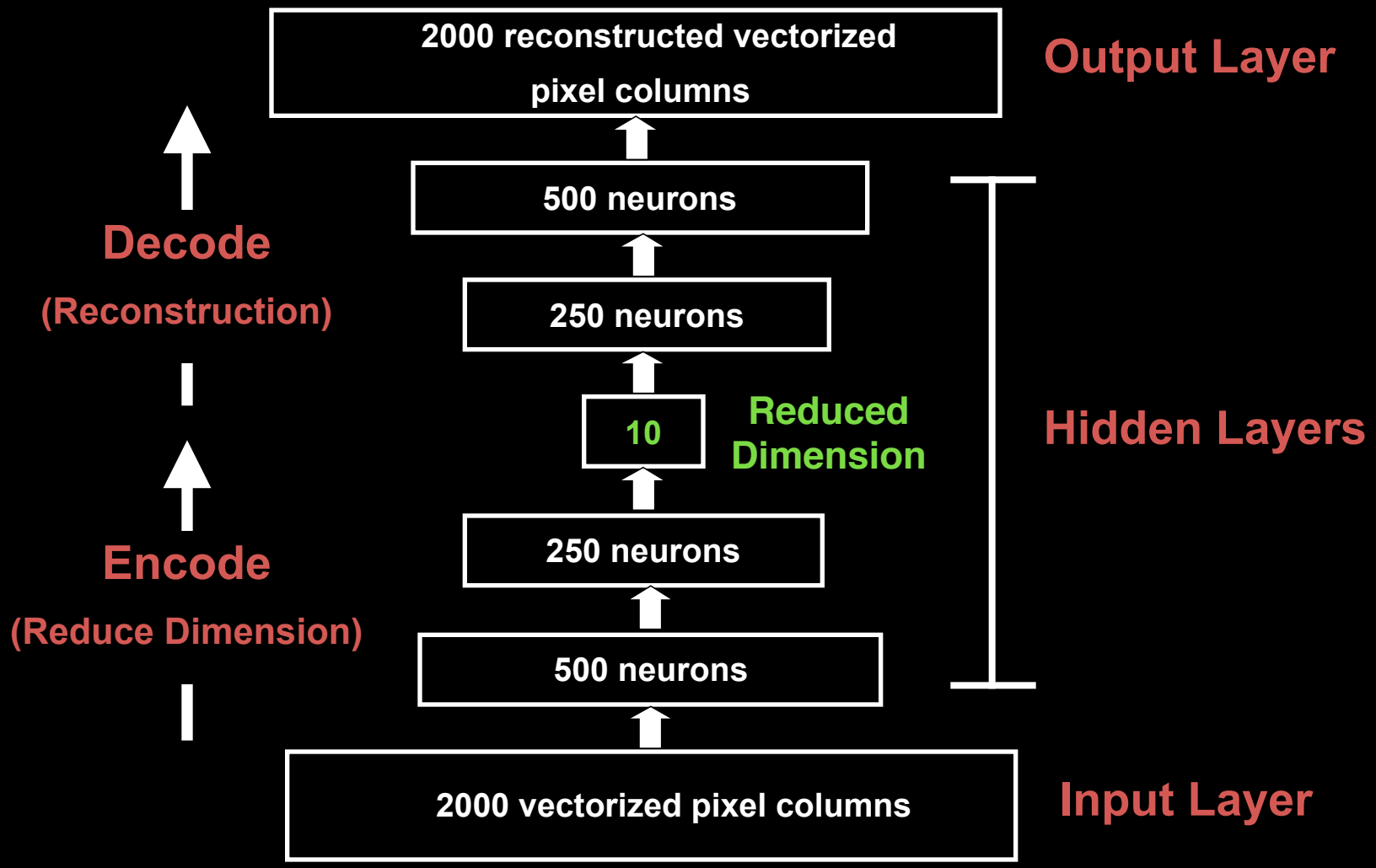


Hidden Layer Transformation



http://colah.github.io/posts/2014-03-NN-Manifolds-Topology/

AutoEncoder



Training AutoEncoder

- **Output Layer reconstructs Input Layer**
- **Error** from reconstruction is **back-propagated through hidden layer** to update the weights
- Tricks for training deep AutoEncoders
  (Geoffrey Hinton et al 2006 Science)

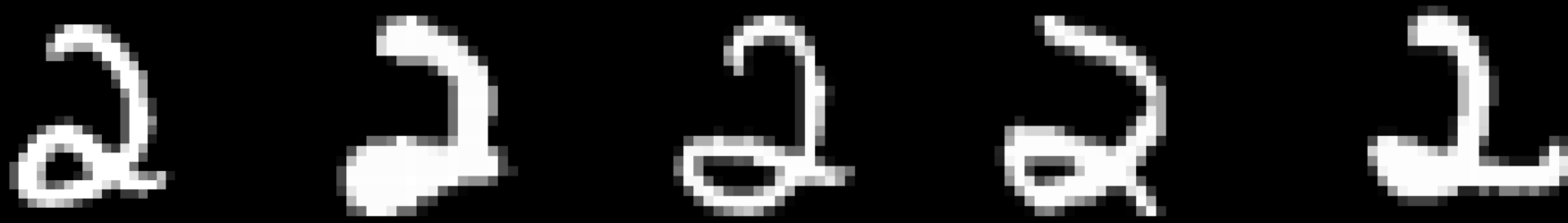
Alternative Approach

- Train Convolutional NN given features and labels
- Store output as vector with reduced dimension

MNIST Example

Query Image

5 most similar images



Link to code

Deep Learning Ecosystem

Deep Learning Libraries

Python	Java	C
Lasagne	Deeplearning4j	Theano
Sknn	Neuralnetworks	Caffe
Deepy		SINGA
OpenDeep		
Theano		
Caffe		

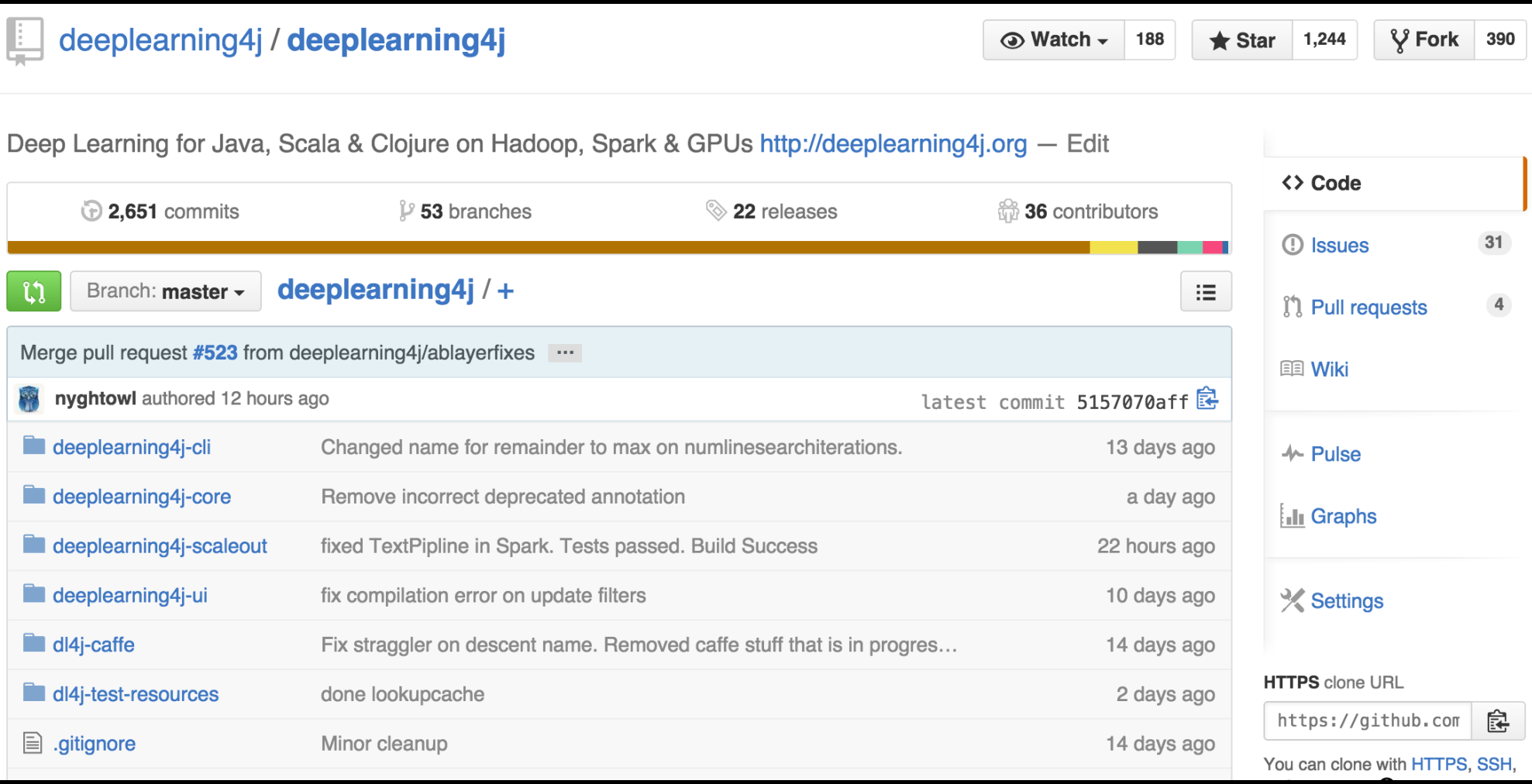
Why DeepLearning4j

- **Java:**
  Better integration with production systems
- **NN Features:**
  AutoEncoder, RBM and Recurrent (LSTM)
- **Distributed:**
  Training on distributed GPU (Spark)

Road Map

- **Stable Release:** Aug / Sep, 2015
- **Optimized Release:** Oct / Nov, 2015
- **Python Interface:** Oct / Nov, 2015

DL4J Github Repo



Toady's Github Repo

https://github.com/jyt109/autoencoder_image_search