The AI Renaissance

Neural Networks

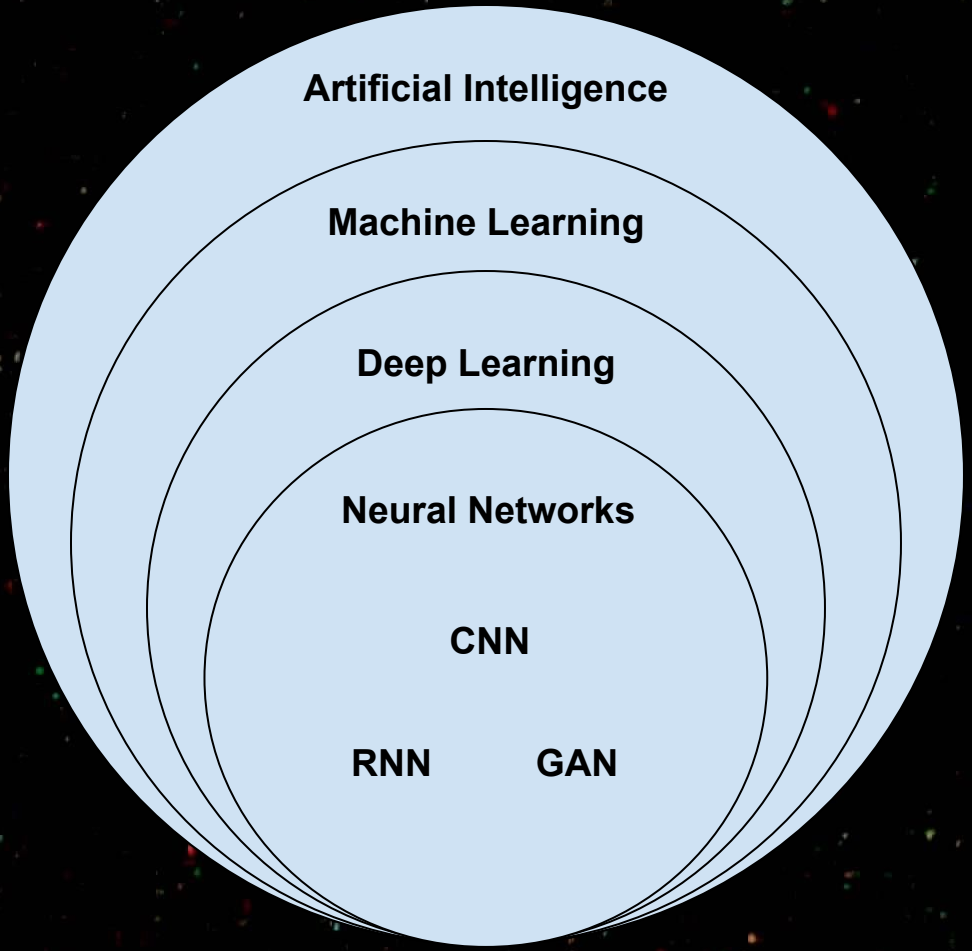
Kyler Nunery

June 1

How to spot opportunity:

"Look for disrupting technology that creates a gap between how things have been done and how they can be done."

- Aaron Levie (Box CEO)


Artificial Intelligence
Machine Learning
Deep Learning
Neural Networks
CNN
RNN
GAN

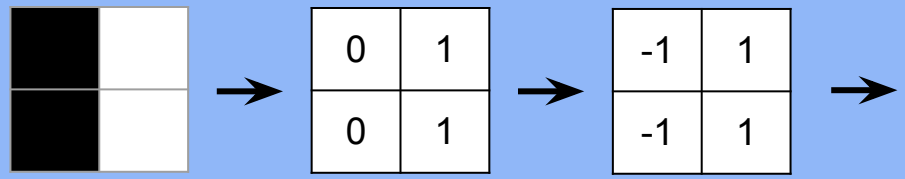

WUT?

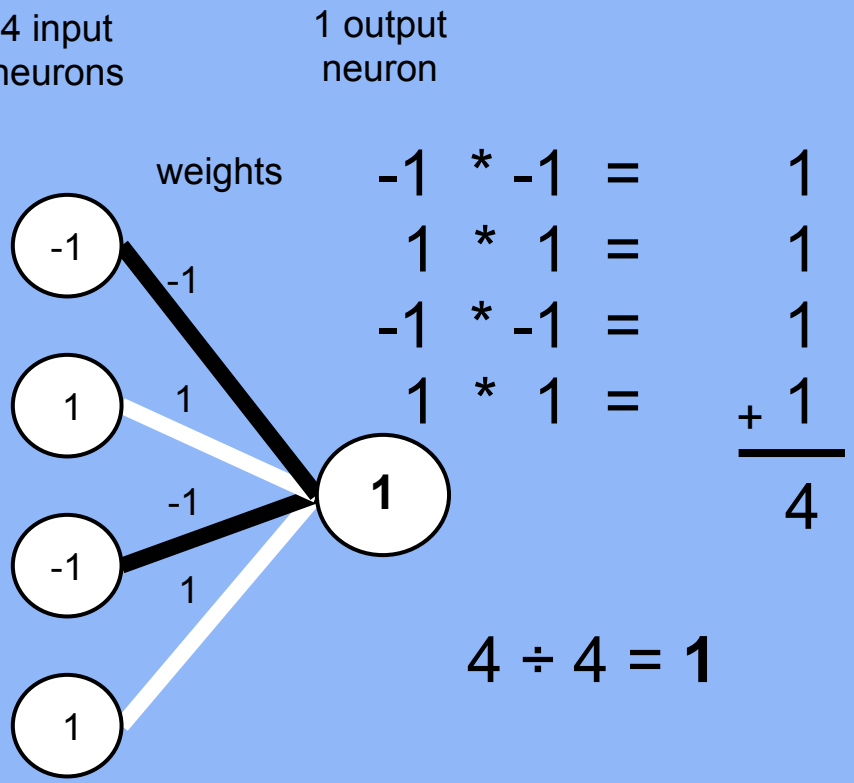
Neural Network Hello World

MNIST

Neural Network

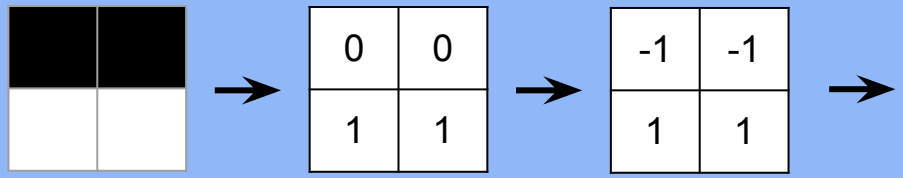
Ex: right side detector

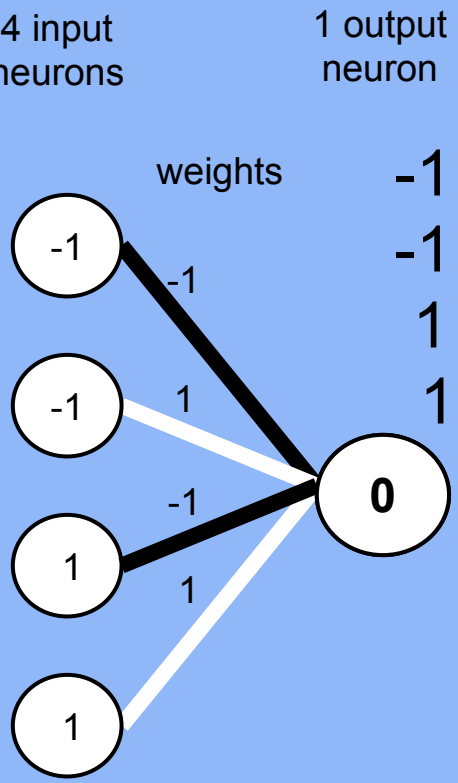




Neural Network

Ex: right side detector



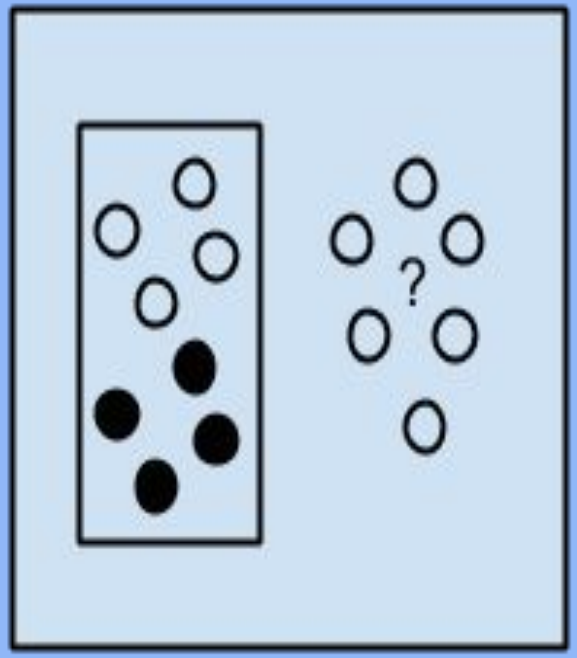


-1 * -1 = 1
-1 * 1 = -1
1 * -1 = -1
1 * 1 = + 1
0

0 ÷ 4 = **0**

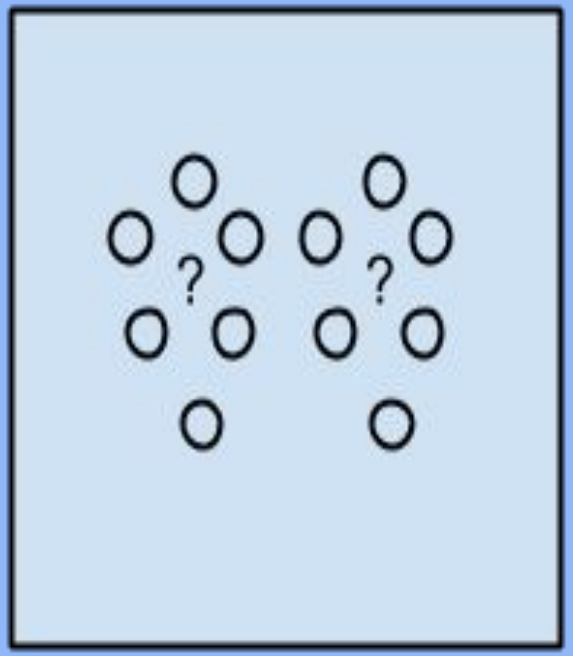
But wait, where did the *weights* come from?

Supervised Learning



Labelled Data

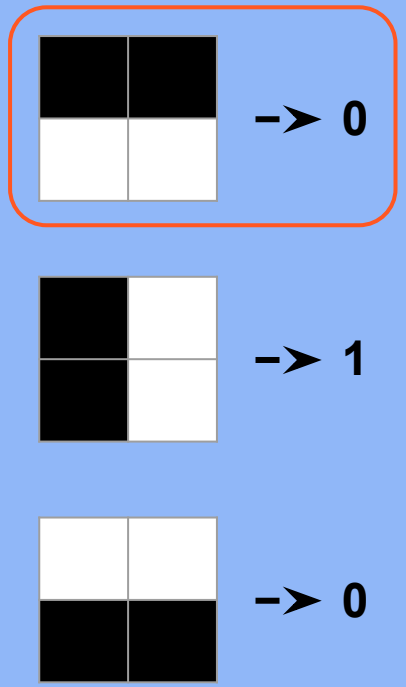
Unsupervised Learning

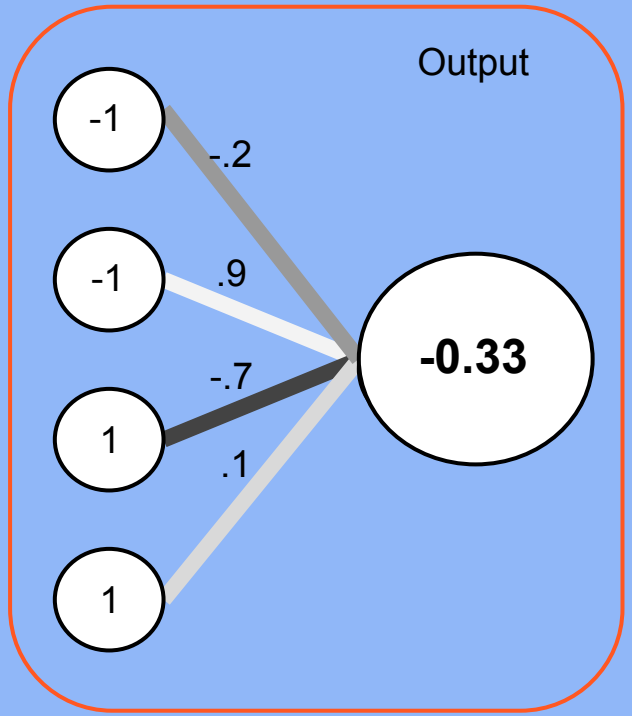


Neural Network

Ex: right side detector

Training Sets

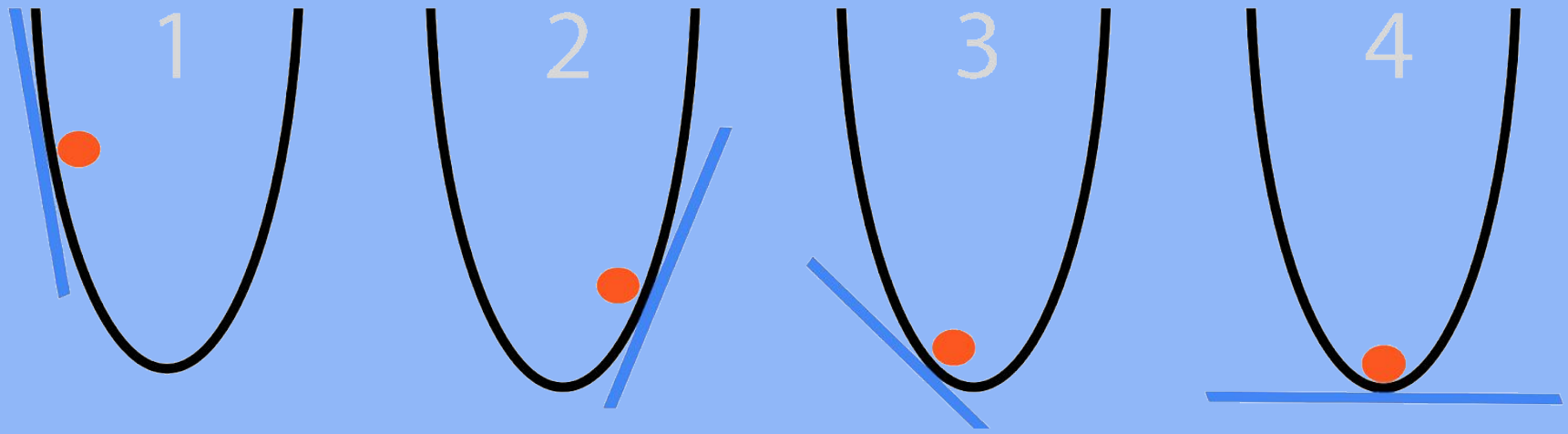




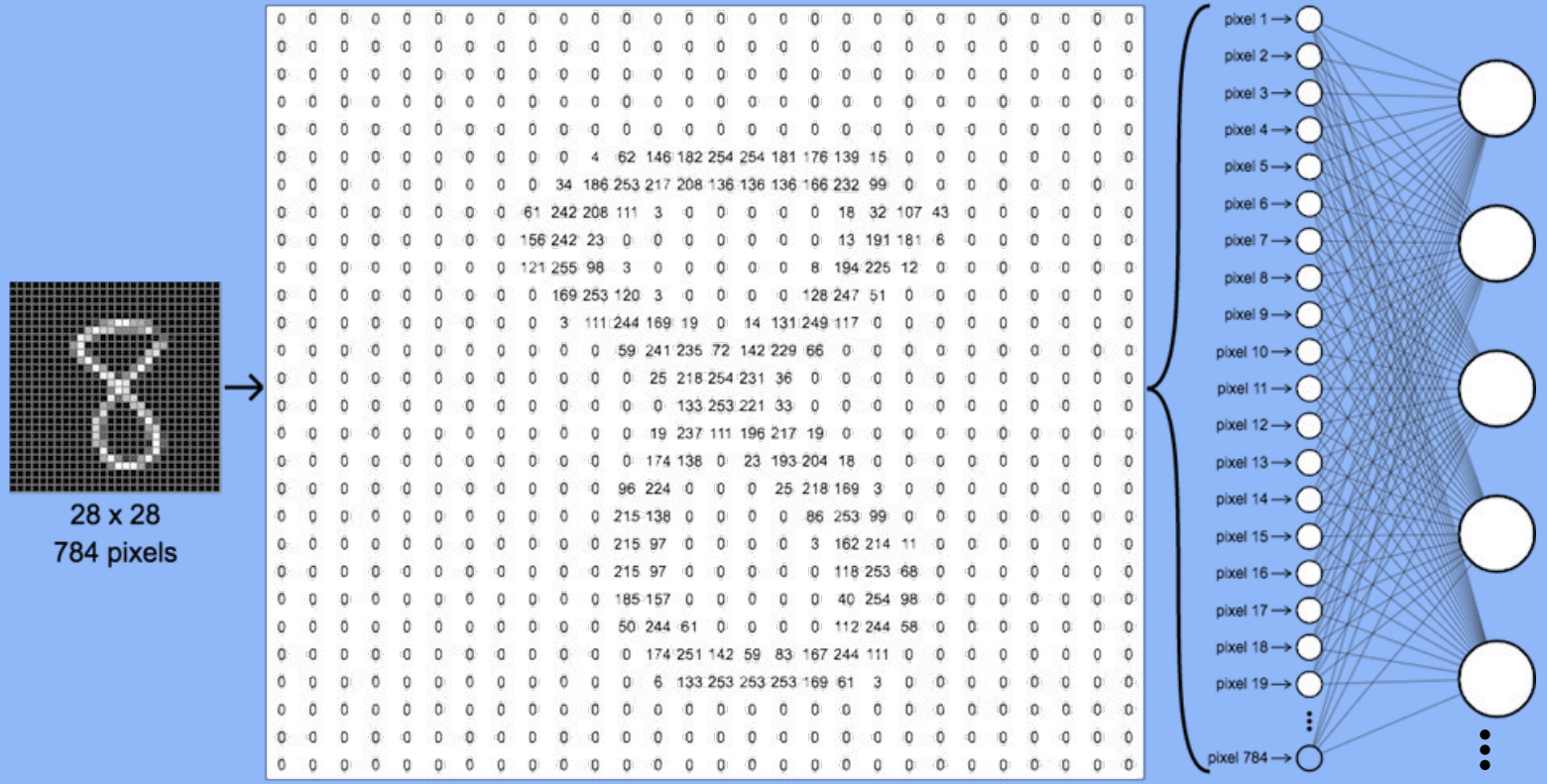
Should be **0**, so error is 0.33

...spreadsheet

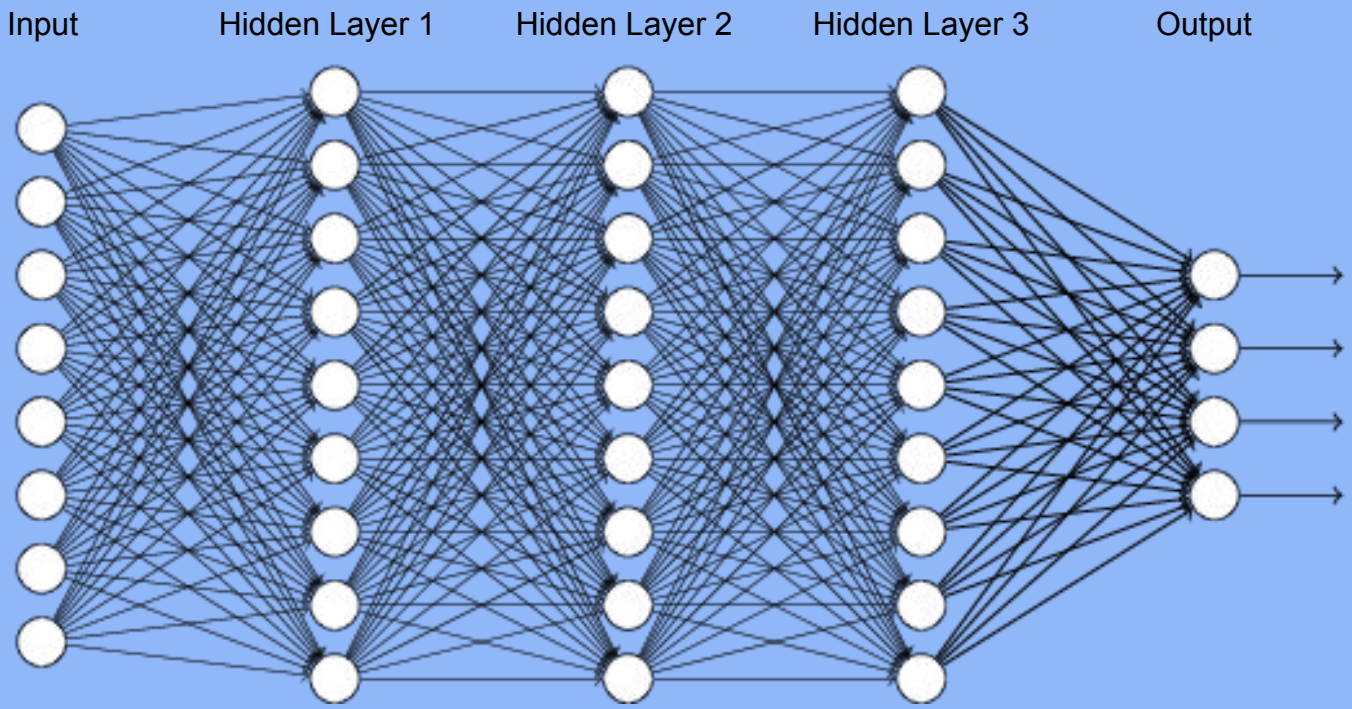
Stochastic Gradient Descent



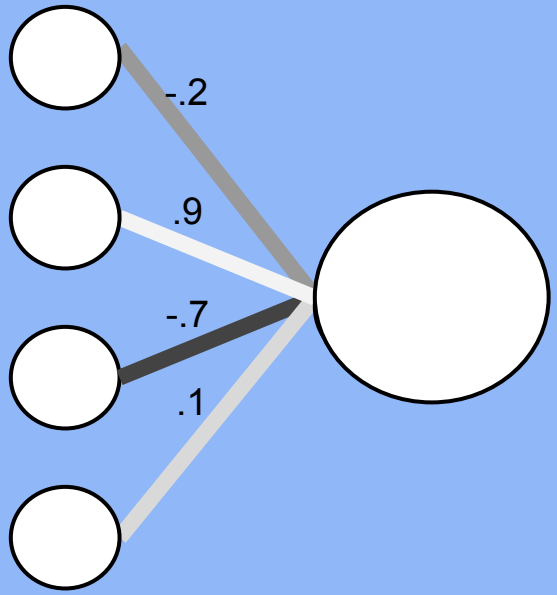
A harder problem: MNIST

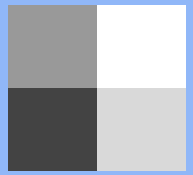


Deep Neural Network

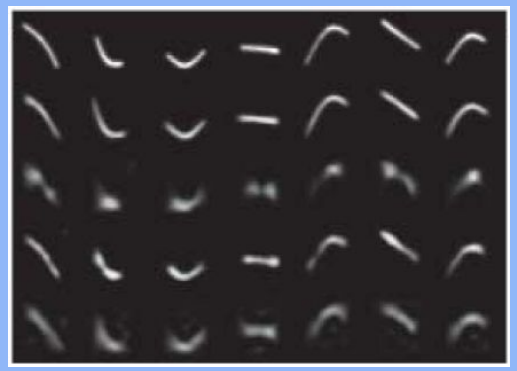


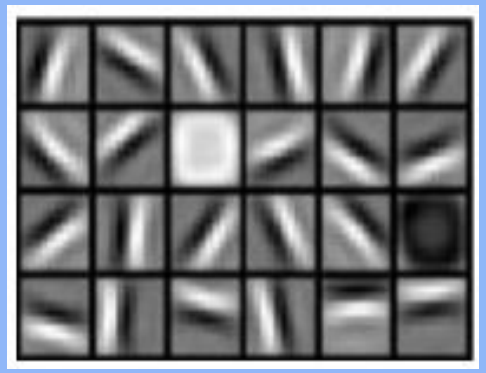
Convolutional Neural Network (CNN)

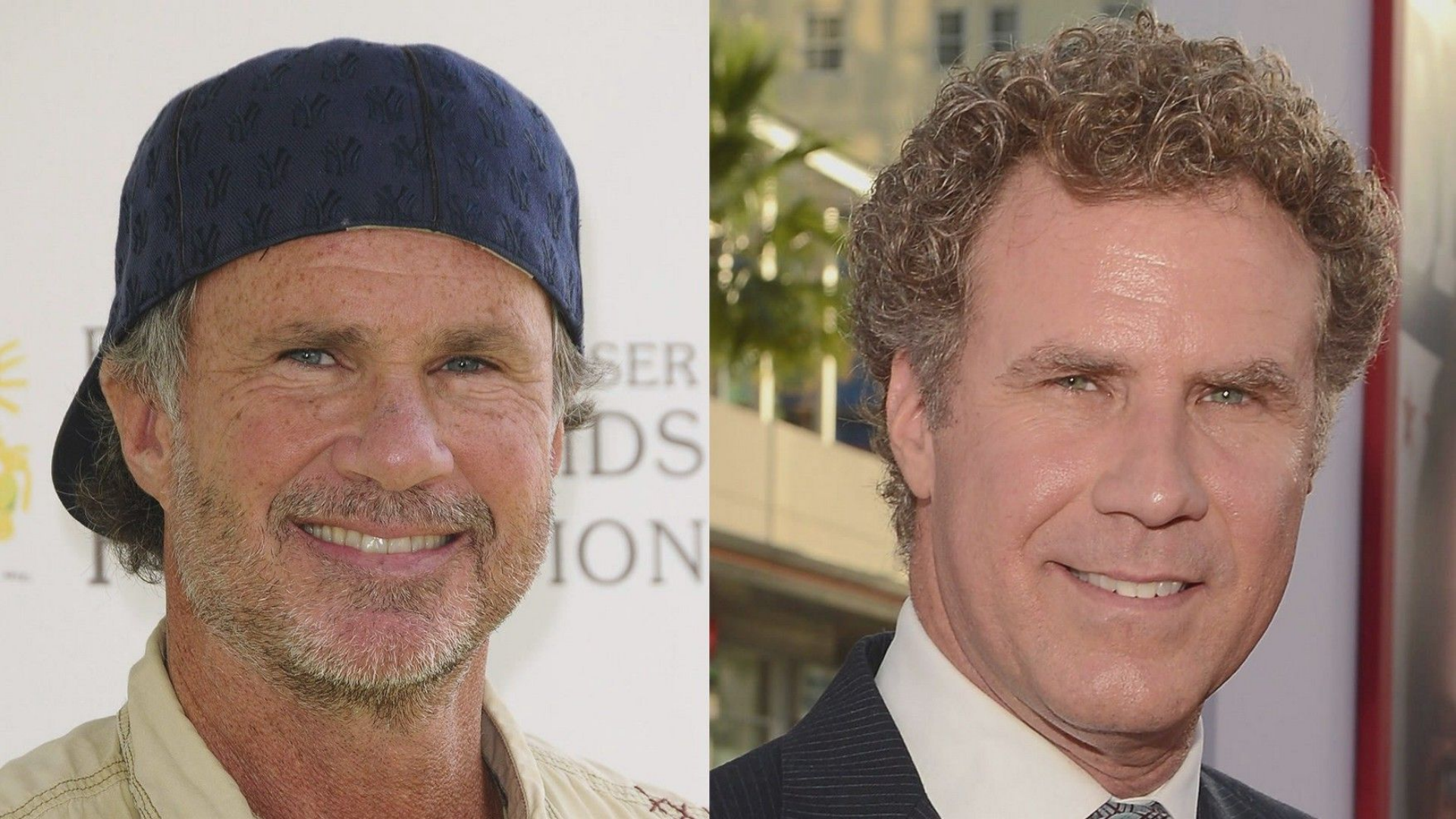




Convolutional Neural Network (CNN)







Designing Neural Networks

Choosing “Hyperparameters”...

- How many layers?
- How many neurons in each layer?
- What size convolution?
- What normalization function?
- What learning rate?

Designs that perform well...

LeNet

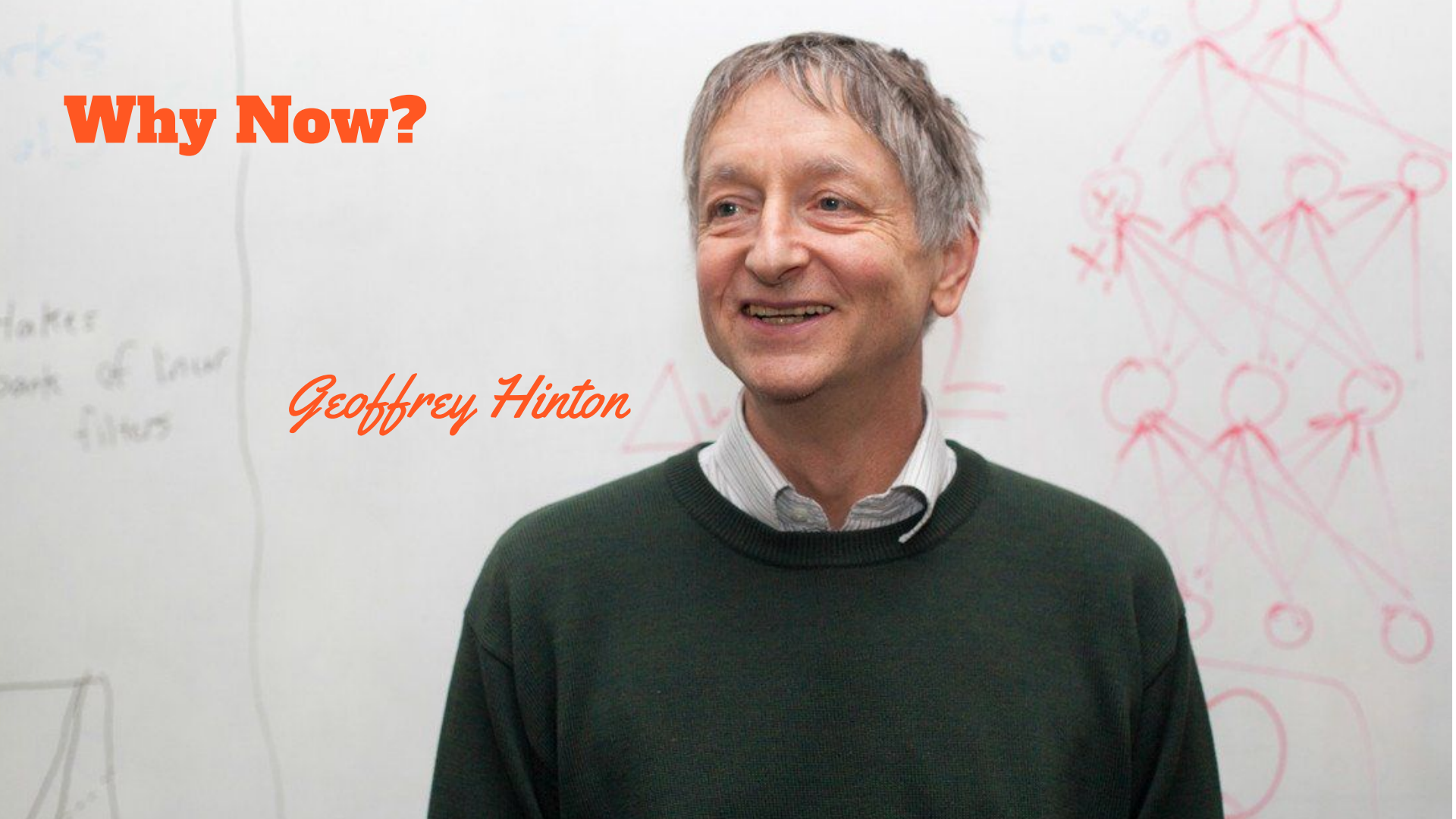
AlexNet

VGGNet

GoogLeN

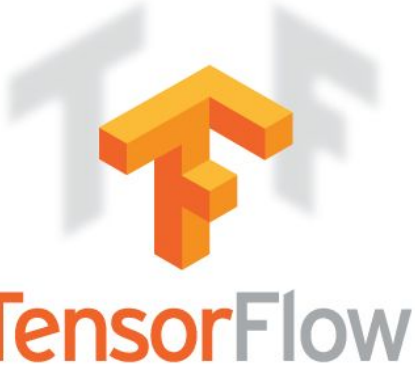
Caffe has a Model **"Zoo"**

Why Now?



Frameworks


PYTORCH


TensorFlow


Caffe


ConvNetJS
Deep Learning in your browser

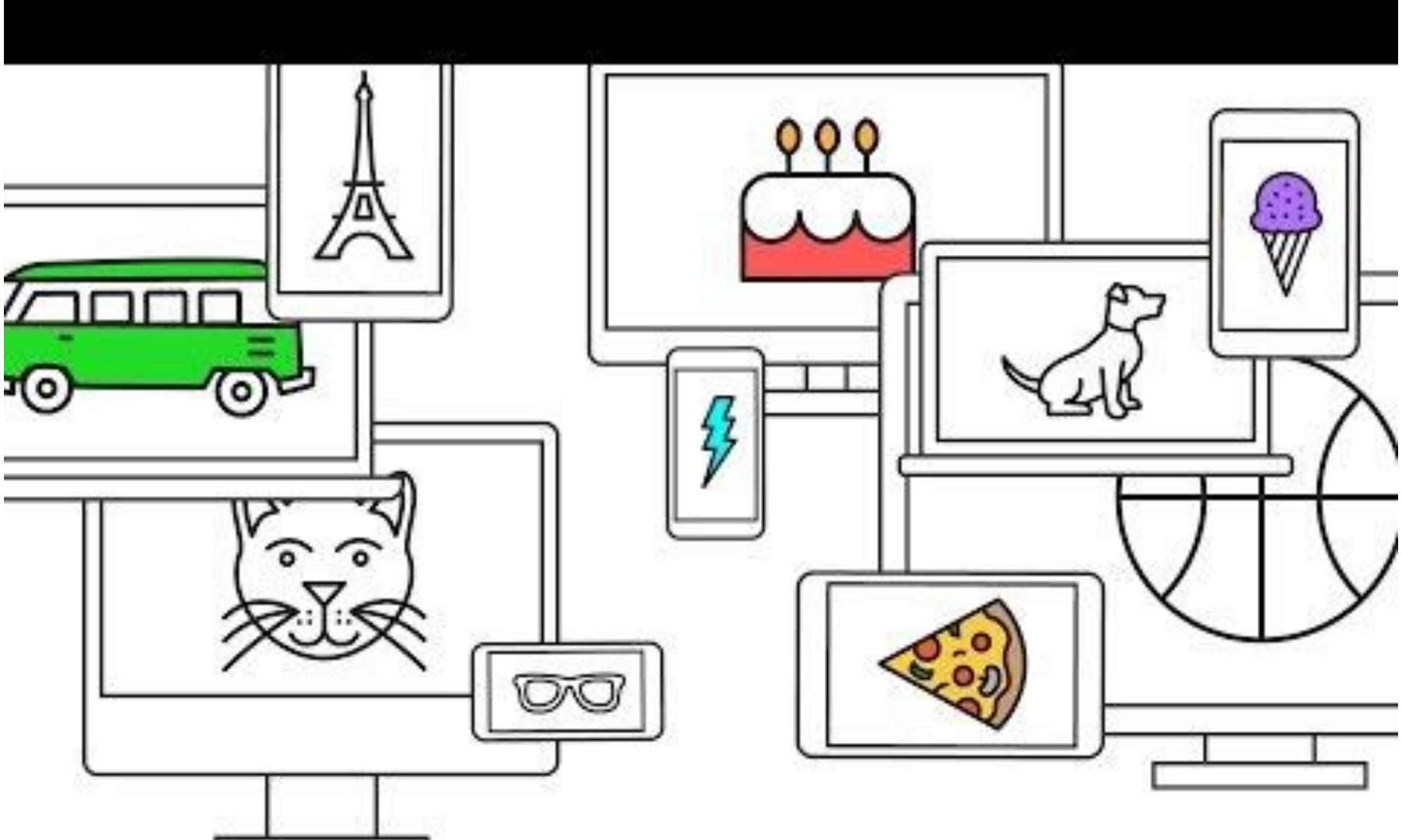

K
KERAS


torch


theano


DL4J
Deeplearning4j


Microsoft
CNTK



https://quickdraw.withgoogle.com/

Classification

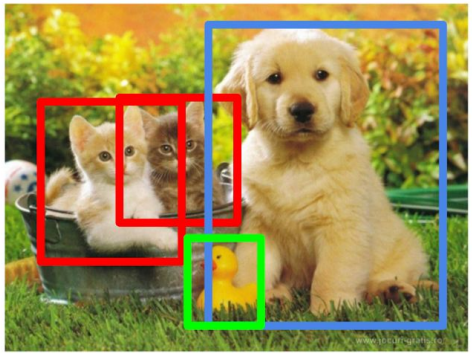
CAT

Classification + Localization

CAT

Single object

Object Detection



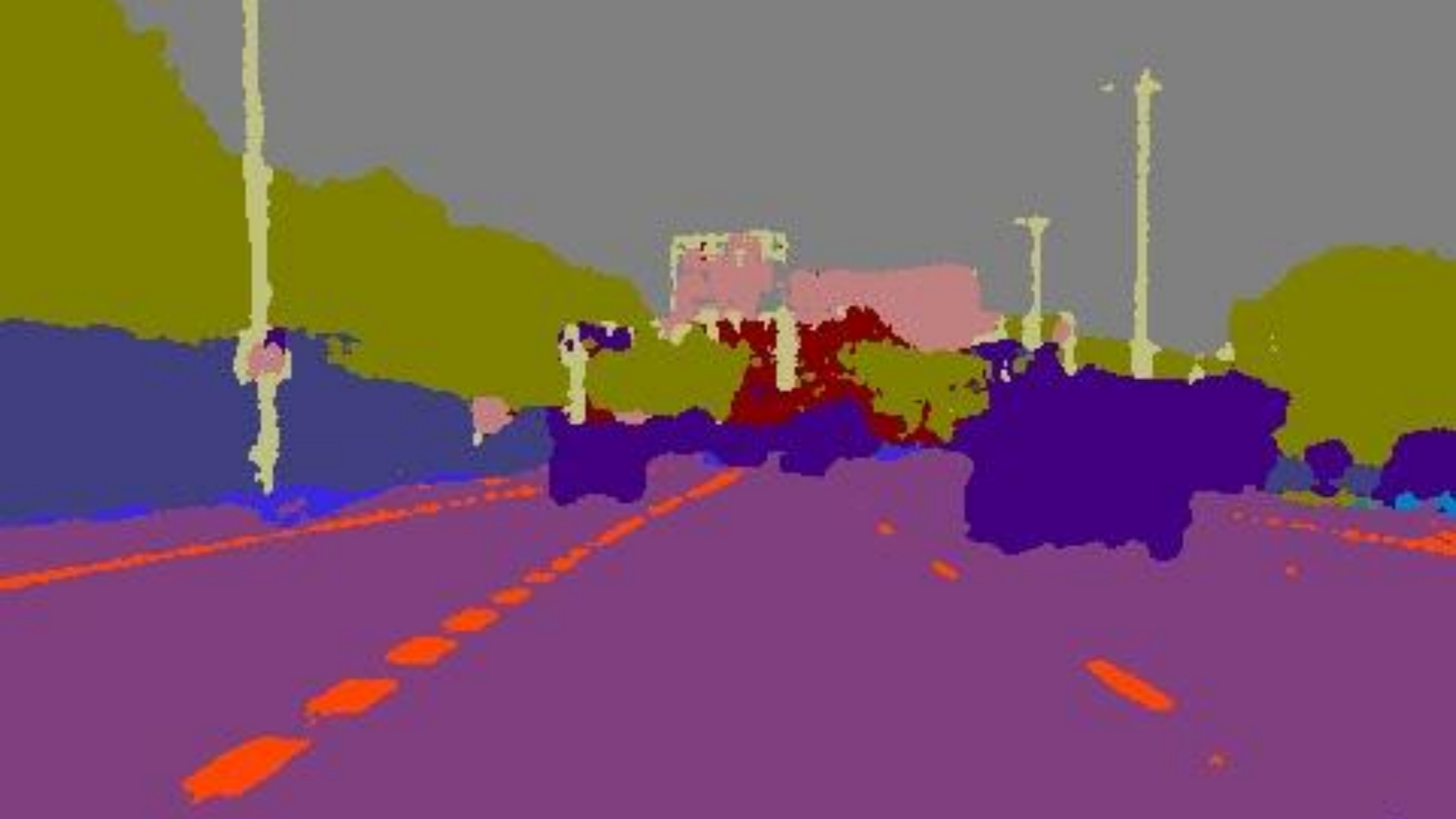
CAT, DOG, DUCK

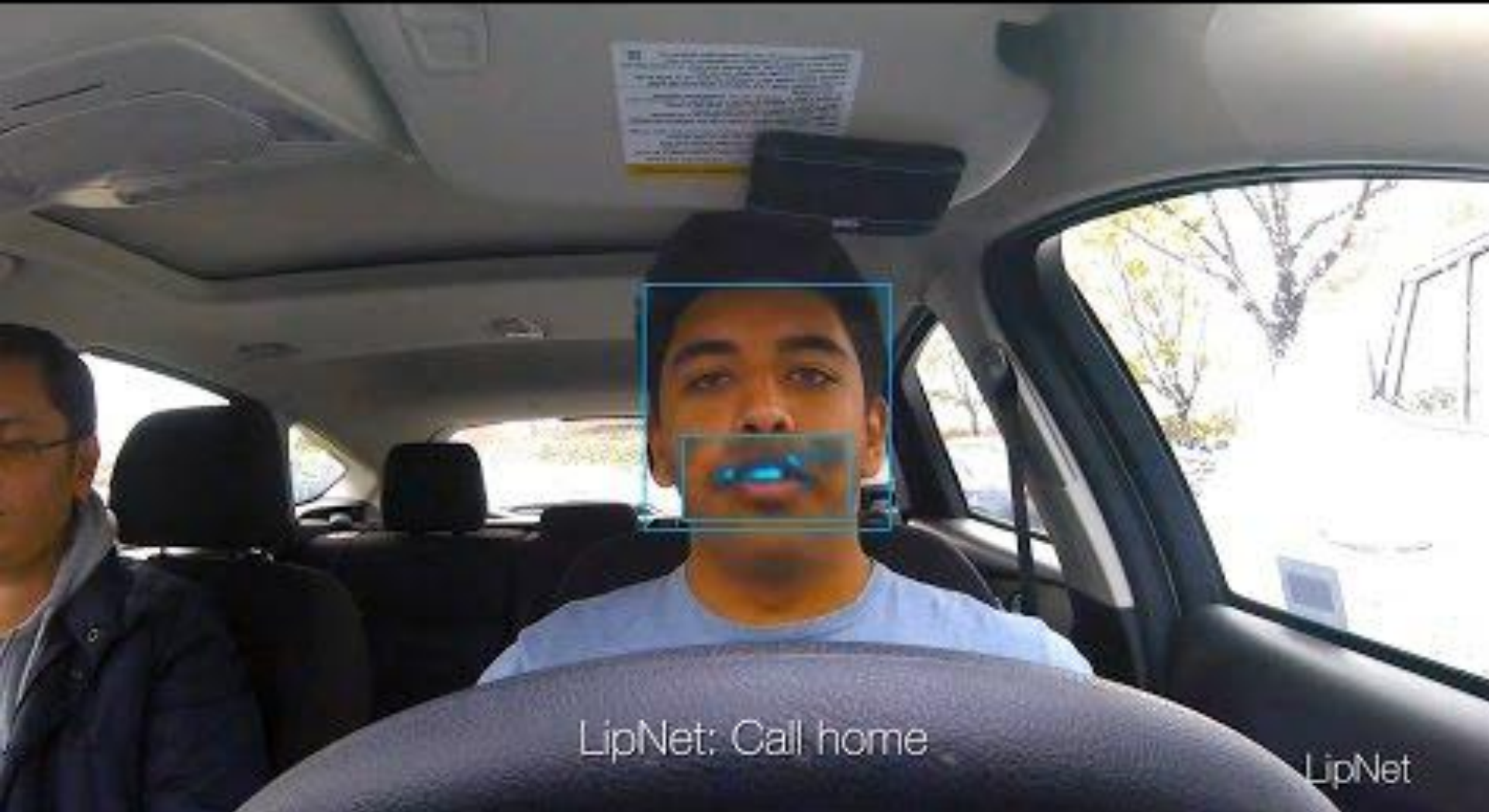
Instance Segmentation

CAT, DOG, DUCK

Multiple objects


car: 0.64
pedestrian: 0.90




LipNet: Call home
LipNet

Presented clip

Clip reconstructed from brain activity

Not just image recognition

Instead of...

Pixels → numbers in array

How about...

Sound → numbers in array	Think Shazam
Words → numbers in array	Think Contract Review
Activity → number in array	Think Fraud Detection

Use Cases

Classify ‘handedness’ of galaxy images
Predict crop yields, poverty from images
Detect engine noise indicating failure
Detect electrical noise indicating failure
Determine ordering supply chain parts
Detect people (not pets) security video
Do ‘Neural Forensic’ police work
FMRI ‘thought reader’ reconstruction
Identify radar signature of aircraft
Detect internet traffic irregularities
Detect executing application irregularities
Deduce gene sequence manifestations
Instruct robots to perform tasks

Drive a car
Trade stocks
Filter SPAM
Recognize handwriting
Detect speech from audio
Recognize specific faces
Recognition specific voices
Analyze text sentiment
Generate audio from text
Determine meaning from text
Count vehicles by FHWA class
Determine calorie count of food
Make product recommendations

The cutting edge...

RNN - Recurrent Neural Network - reinforcement learning

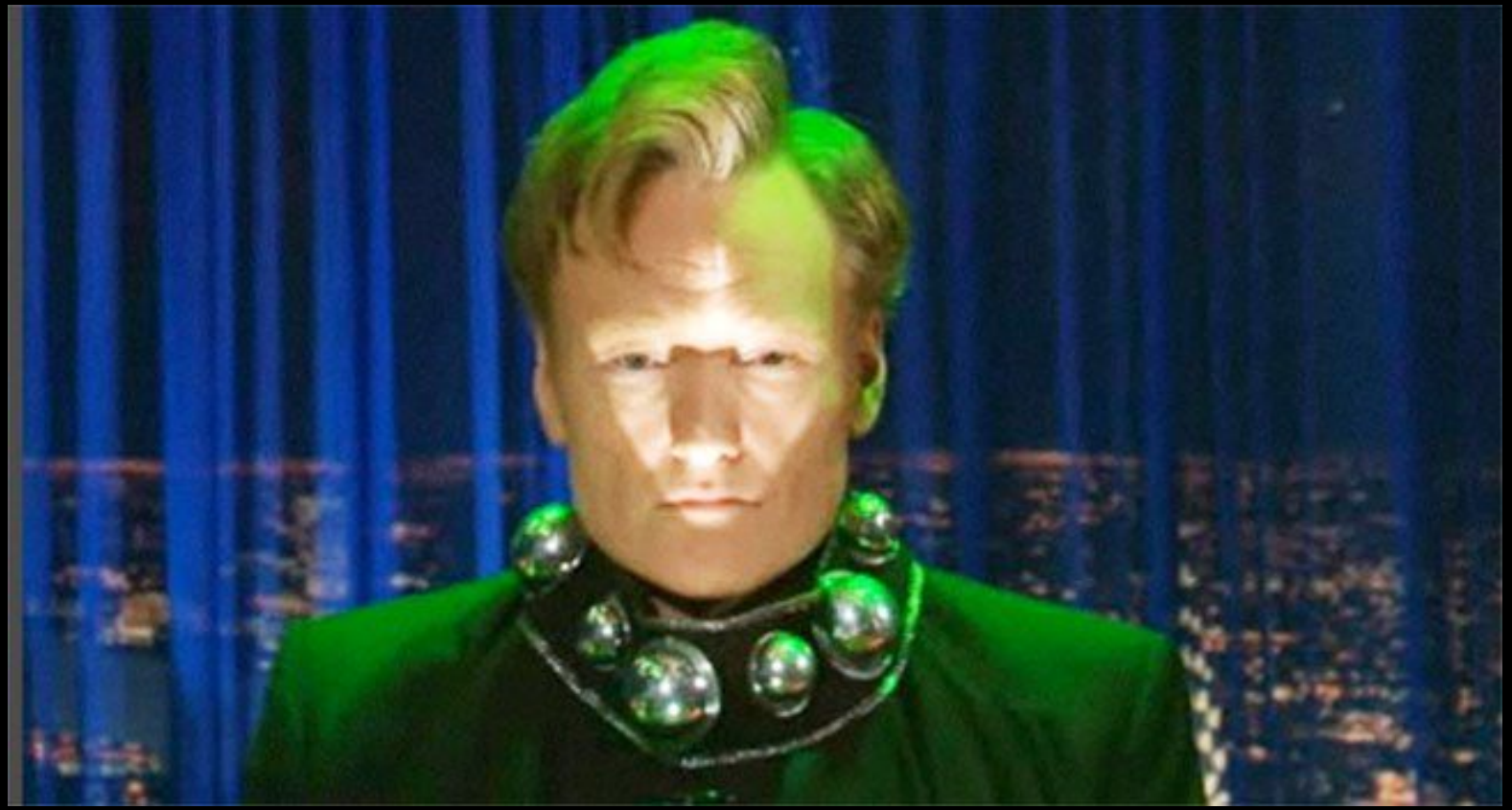
Use the output of the network as feedback input


B
X
Y
Up
Down
Left
Right


ima...
021 3 1

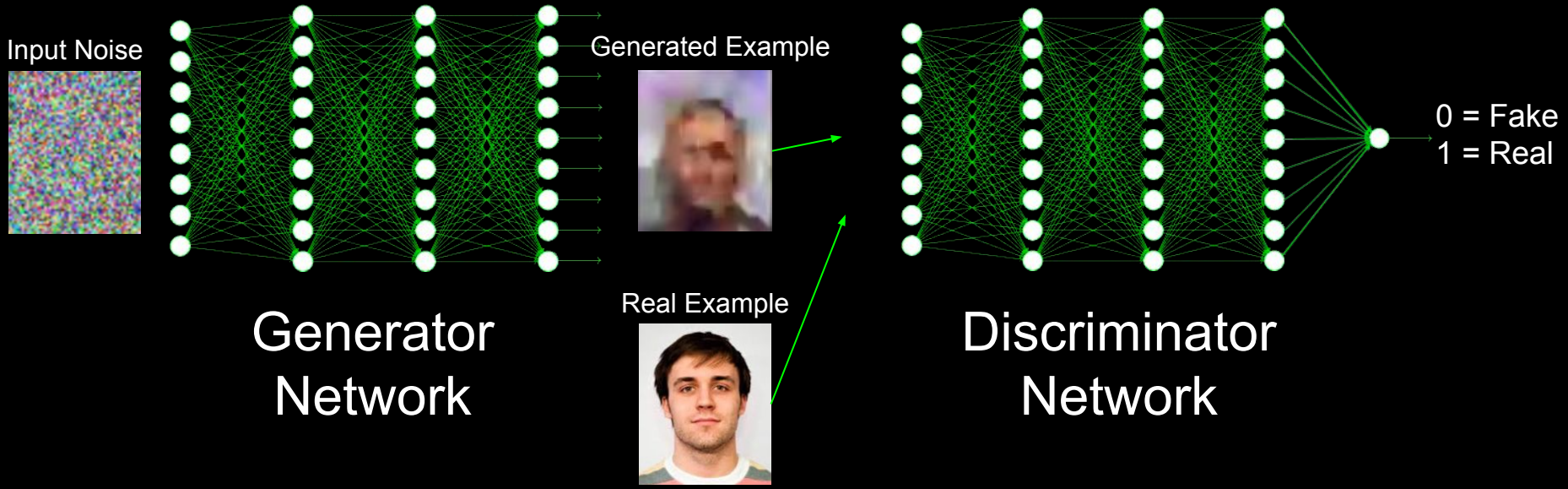

ima...
021 3 1

Where is all this going?



The Cutting Edge

GAN (Generative Adversarial Network) - can *generate* content




The Cutting Edge
Ian Goodfellow









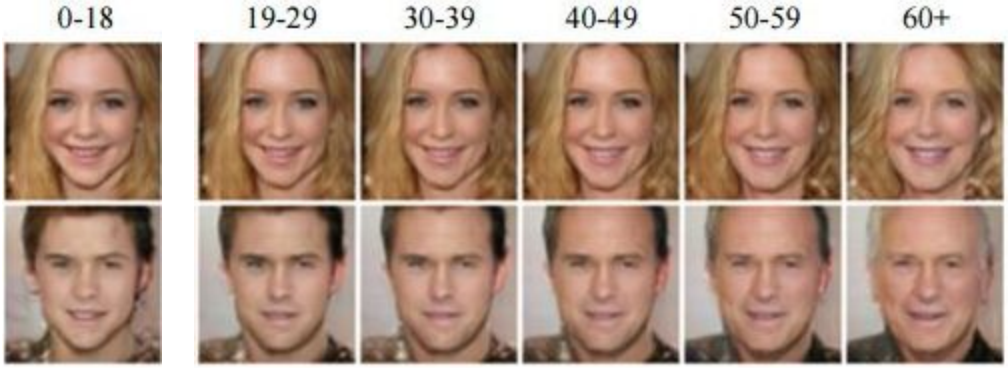


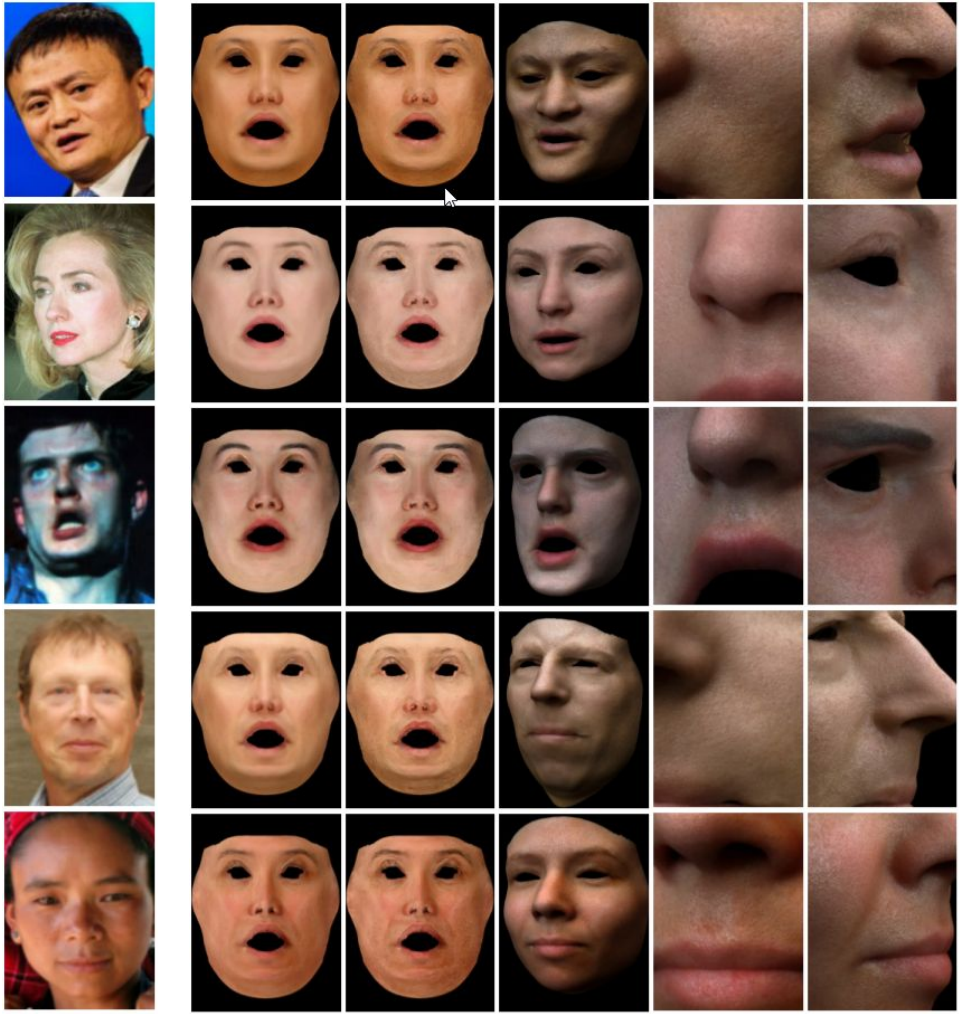









0-18
19-29
30-39
40-49
50-59
60+

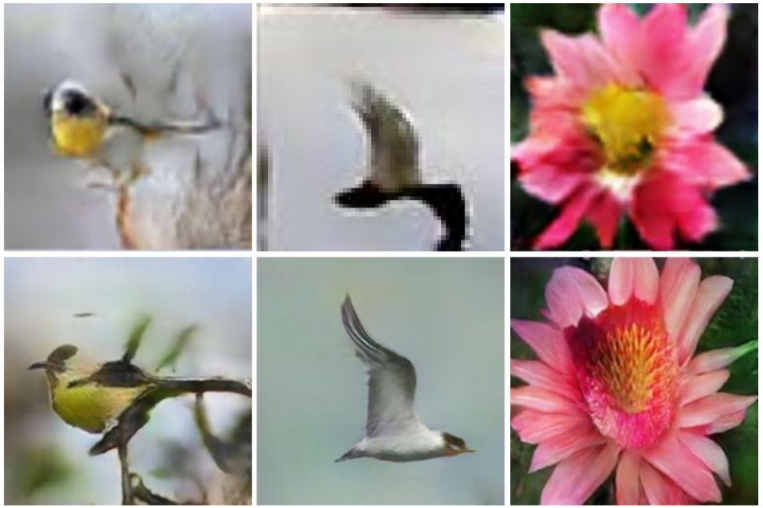


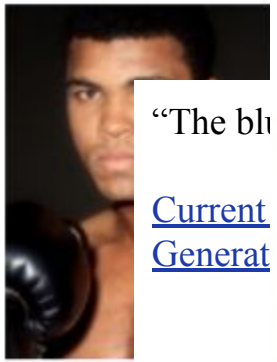
https://junyanz.github.io/CycleGAN/

This bird has a yellow belly and tarsus, grey back, wings, and brown throat, nape with a black face

This bird is white with some black on its head and wings, and has a long orange beak

This flower has overlapping pink pointed petals surrounding a ring of short yellow filaments



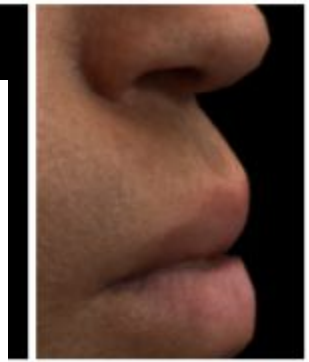


input picture

“The blu

Current
Generat

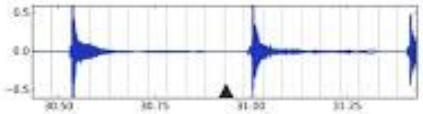
venture film.”



rendering

rendering (zoom)

Silent video



Predicted soundtrack

StackGAN: Text to Photo-realistic Image Synthesis with Stacked Generative Adversarial Networks

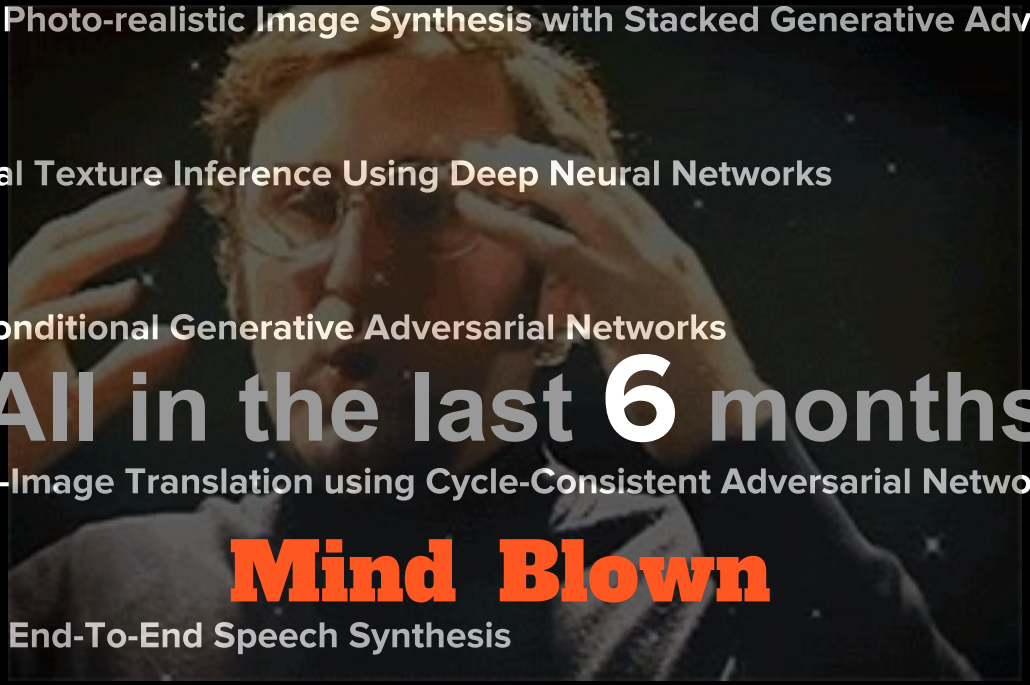
Dec 2016

Photorealistic Facial Texture Inference Using Deep Neural Networks

Dec 2016

Face Aging with Conditional Generative Adversarial Networks

Feb 2017



Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks

Mar 2017

Tacotron: Towards End-To-End Speech Synthesis

Apr 2017

Learning to Discover Cross-Domain Relations with Generative Adversarial Networks

May 2017

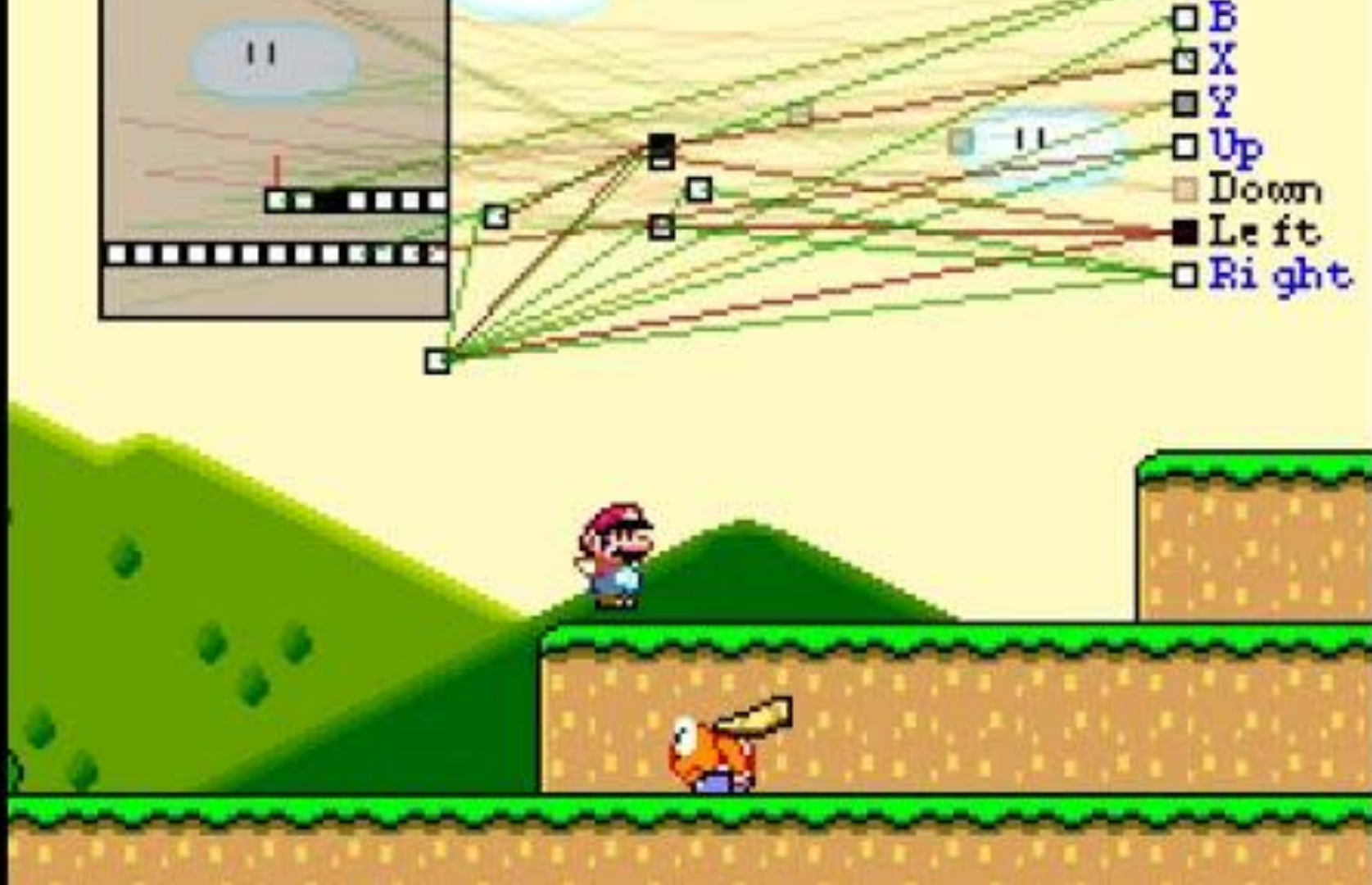
Fin


Machine Learning Algorithms
Bayesian
Naive Bayes
Averaged One-Dependence Estimators (AODE)
Bayesian Belief Network (BBN)
Gaussian Naive Bayes
Multinomial Naive Bayes
Bayesian Network (BN)
Decision Tree
Classification and Regression Tree (CART)
Iterative Dichotomiser 3 (ID3)
C4.5
C5.0
Chi-squared Automatic Interaction Detection (CHAID)
Decision Stump
Conditional Decision Trees
M5
Dimensionality Reduction
Principal Component Analysis (PCA)
Partial Least Squares Regression (PLSR)
Sammon Mapping
Multidimensional Scaling (MDS)
Projection Pursuit
Principal Component Regression (PCR)
Partial Least Squares Discriminant Analysis
Mixture Discriminant Analysis (MDA)
Quadratic Discriminant Analysis (QDA)
Regularized Discriminant Analysis (RDA)
Flexible Discriminant Analysis (FDA)
Linear Discriminant Analysis (LDA)
Instance Based
k-Nearest Neighbour (kNN)
Learning Vector Quantization (LVQ)
Self-Organizing Map (SOM)
Locally Weighted Learning (LWL)
Clustering
k-Means
k-Medians
Expectation Maximization
Hierarchical Clustering
Deep Learning
Deep Boltzmann Machine (DBM)
Deep Belief Networks (DBN)
Convolutional Neural Network (CNN)
Stacked Auto-Encoders
Ensemble
Random Forest
Gradient Boosting Machines (GBM)
Boosting
Bootstrapped Aggregation (Bagging)
AdaBoost
Stacked Generalization (Blending)
Gradient Boosted Regression Trees (GBRT)
Neural Networks
Radial Basis Function Network (RBFN)
Perceptron
Back-Propagation
Hopfield Network
Regularization
Ridge Regression
Least Absolute Shrinkage and Selection Operator (LASSO)
Elastic Net
Least Angle Regression (LARS)
Rule System
Cubist
One Rule (OneR)
Zero Rule (ZeroR)
Repeated Incremental Pruning to Produce Error Reduction (RIPPER)
Regression
Linear Regression
Ordinary Least Squares Regression (OLSR)
Stepwise Regression
Multivariate Adaptive Regression Splines (MARS)
Locally Estimated Scatterplot Smoothing (LOESS)
Logistic Regression

Source Actor

Real-time Reenactment

Reenactment Result


B
X
Y
Up
Down
Left
Right

School bus Ostrich problem