

# Day 10: Final Project Presentations & Going Further with ML/DL

## Summer STEM: Machine Learning

Department of Electrical and Computer Engineering  
NYU Tandon School of Engineering  
Brooklyn, New York

July 3, 2020

# Outline

- 1 Schedule**
- 2 Deep Learning Applications**
- 3 Supervised Learning**
- 4 Unsupervised Learning**
- 5 Social Impact of Machine Learning**
- 6 Course Takeaway**

# Schedule

- 1 Finishing Up Projects (10:00-11:30)
- 2 Presentations (11:30-13:00)
- 3 Lunch (13:00-14:30pm)
- 4 Final Lecture: Deep Learning Applications and its Social Impacts (14:30-16:00)
- 5 Goodbye! (16:00 - ∞?)

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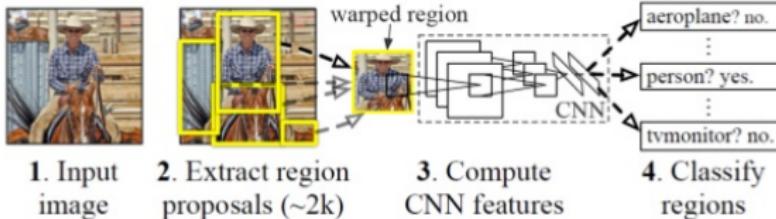
# Object Detection

- Faster-RCNN
- YoLo

# Object Detection

## R-CNN Architecture

**R-CNN: Regions with CNN features**

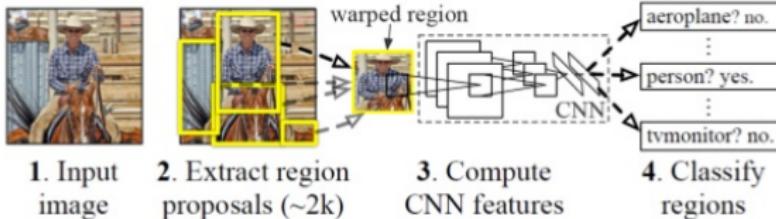


Region Proposal Based Object Detection

# Object Detection

## R-CNN Architecture

**R-CNN: Regions with CNN features**



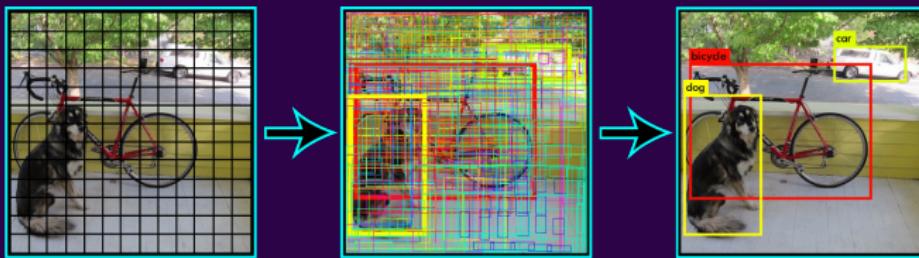
Region Proposal Based Object Detection

# Object Detection

## YOLO

- Divides the image into  $n \times n$  grid-cells
- For each grid cell,
  - predicts  $B$  bounding boxes and its box confidence score
  - Each box will have its class probability
  - All class probabilities are combined to detect one object

# Object Detection



YOLO (<https://pjreddie.com/darknet/yolo/>)

# Semantic Segmentation

- Every Pixel is associated with a class
- Encoder-decoder structure
- Decode using transposed convolution or deconvolution

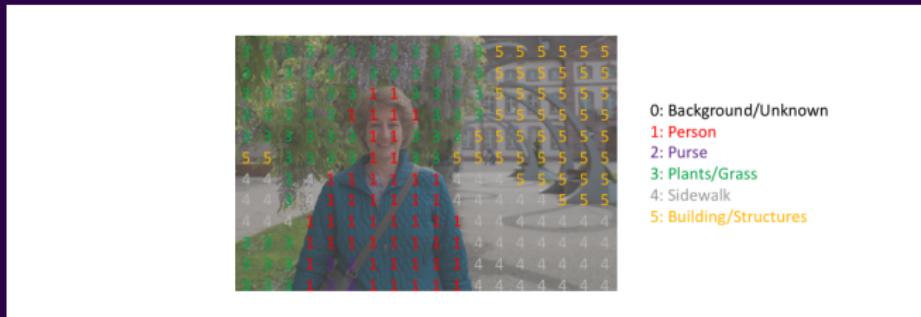


Image Segmentation (Source:  
<https://www.jeremyjordan.me/semantic-segmentation/>)

# Instance Segmentation

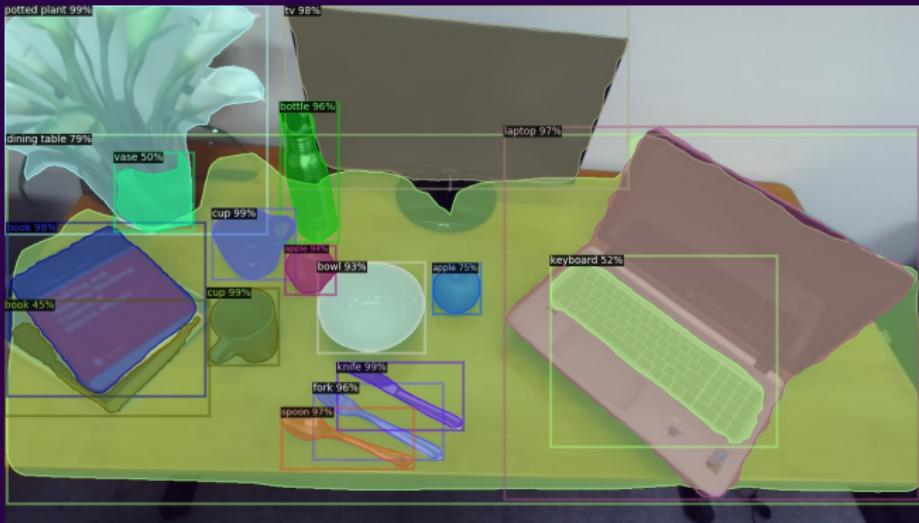
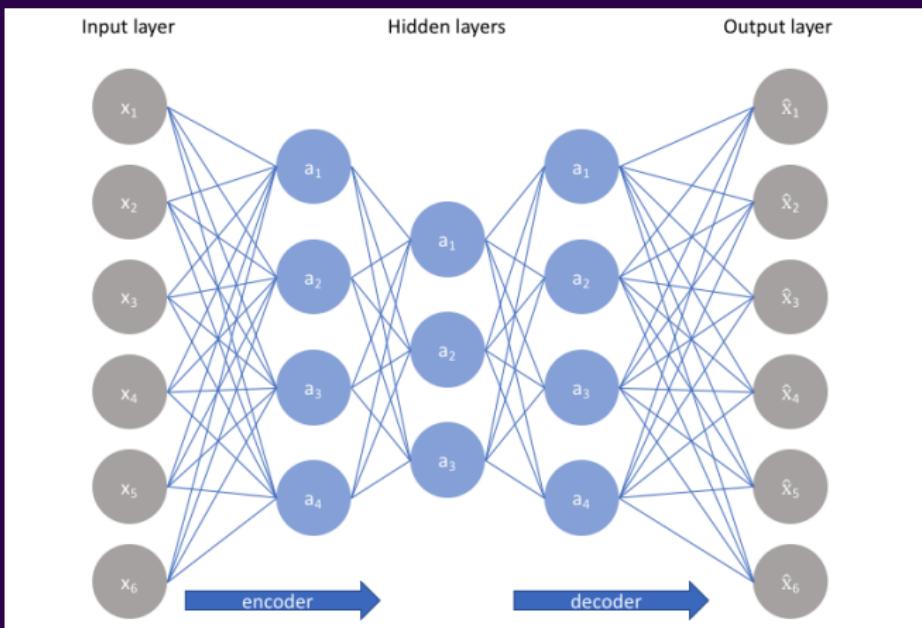


Image generated using Mask-RCNN  
(<https://github.com/facebookresearch/detectron2>)

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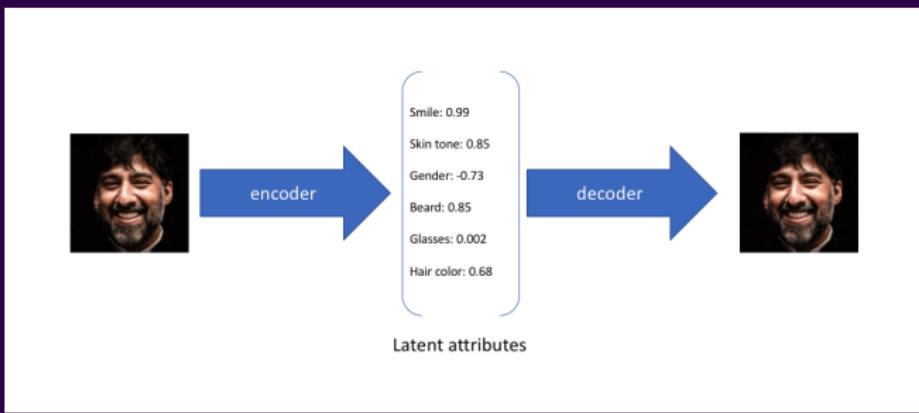
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# Autoencoders



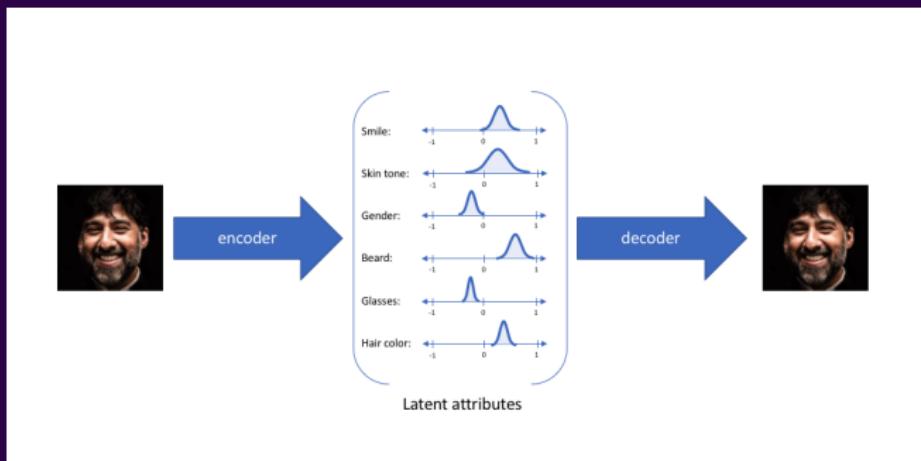
From Jeremy Jordan's Post on Autoencoders

# Autoencoders



From Jeremy Jordan's Post on Variational Autoencoders

# Variational Autoencoders



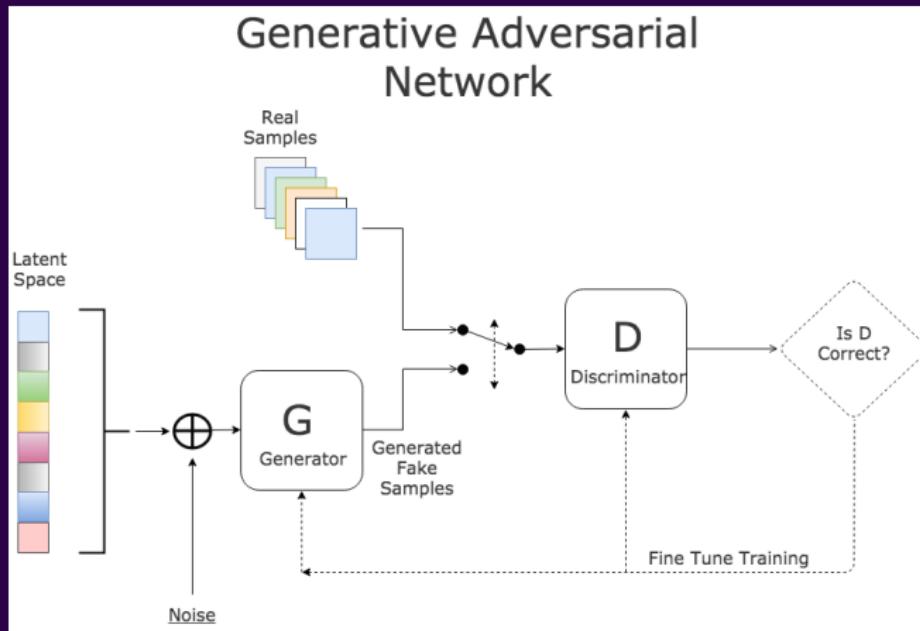
From Jeremy Jordan's Post on Variational Autoencoders

# Variational Autoencoders

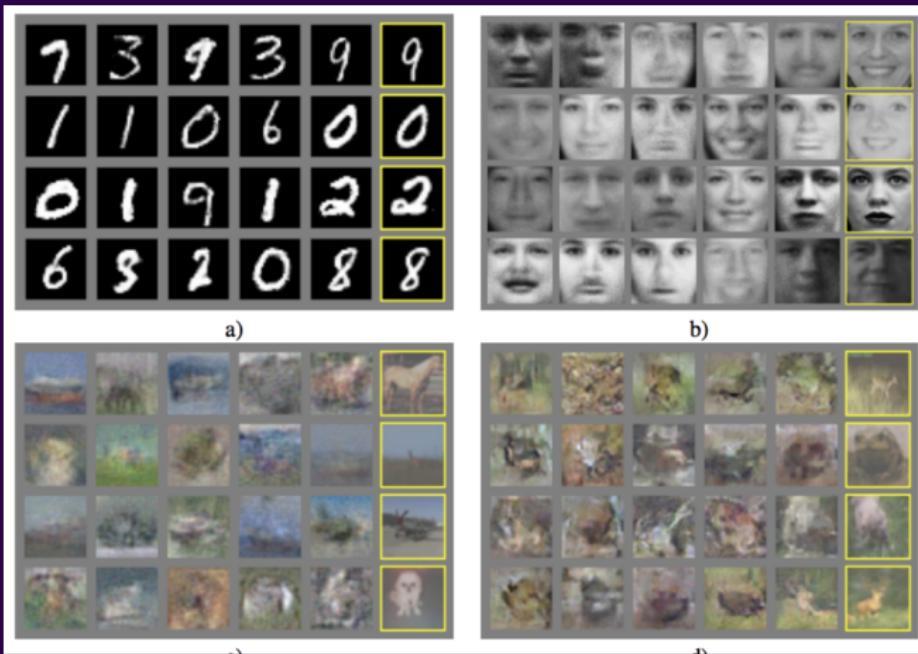


VAE face generation implemented by Wojciech Mormul

# GANs: Generative Adversarial Networks



# Beginning



Generated images (yellow) on a) MNIST b) TFD c) CIFAR-10 (MLP model) d) CIFAR-10 (Conv model)  
"Generative Adversarial Networks", Goodfellow et. al. 2014

# Progress



Improvement of GANs in producing photo-realistic faces over the years

# Celebrity Faces



Human face generation one of the most difficult tasks

# Applications of GANs



Image Colorization (Source: <https://github.com/jantic/DeOldify>)

# Applications of GANs

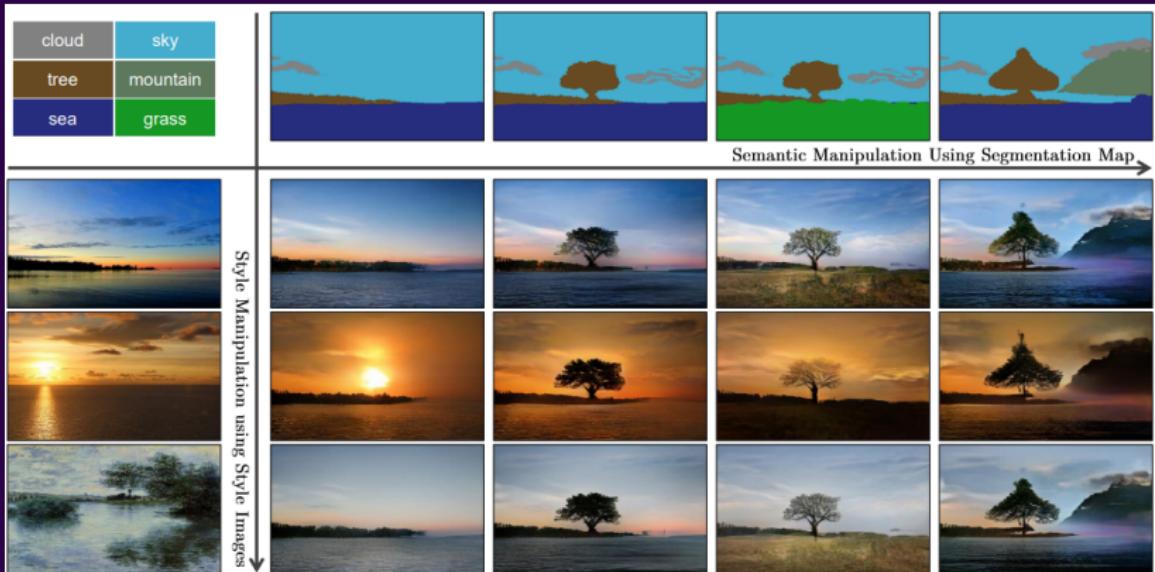


Image Synthesis (Source: <https://github.com/NVlabs/SPADEn>)

# Applications of GANs

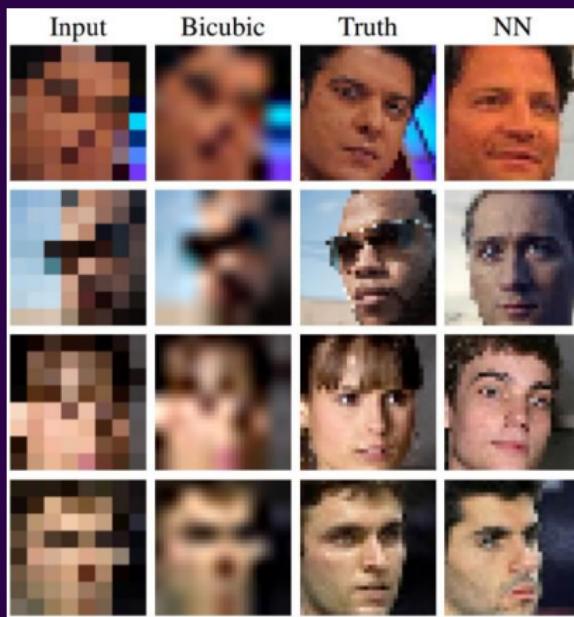


Image Super-Resolution (Source: Dahl et al., "Pixel recursive super resolution")

# Outline

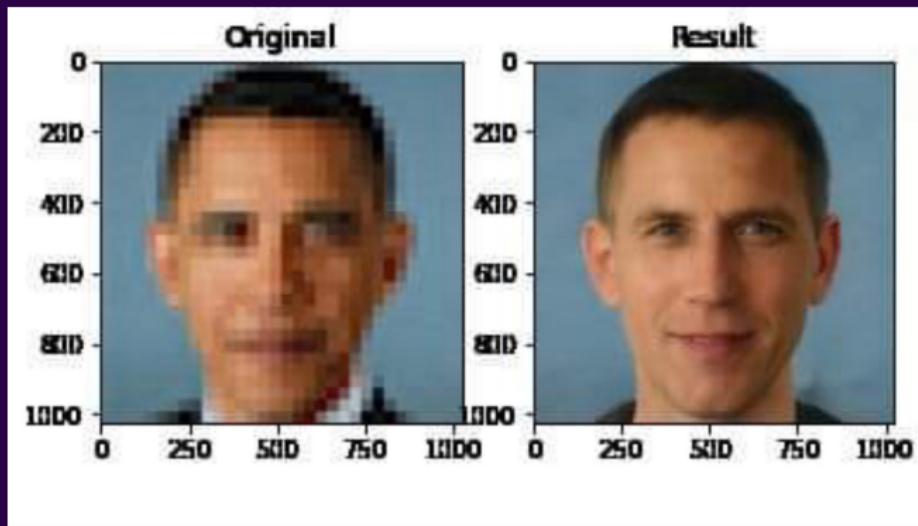
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# How Would You Use ML/DL?

- Think about potential applications with deep learning.
- Discuss its social implications.
- We will dive deeper into this topic later!

# Can AI/ML be Biased?

PULSE is a face depixelizing algorithm, but...



# Can AI/ML be Biased?

(From the article Design AI so that it's fair)

- When Google Translate converts news articles written in Spanish into English, phrases referring to women often become 'he said' or 'he wrote'.
- Software designed to warn people using Nikon cameras when the person they are photographing seems to be blinking tends to interpret Asians as always blinking.

## Other Sources of Bias

Now that we know biased data lead to biased model, are there any other sources of bias in our machine learning pipeline?

# De-Bias ML Can be Hard

How would you solve this problem?

The image shows a 2x3 grid of photographs. The top row contains three images: 'Skyscrapers' (two tall buildings), 'Airplanes' (a view from an airplane window), and 'Cars' (cars parked at night). The bottom row contains three images: 'Bikes' (a person riding a bicycle), 'Gorillas' (two gorillas), and 'Graduation' (people in graduation caps and gowns). Each image has a caption below it.

diri noir avec banan @jackyalcine · Jun 29  
Google Photos, y'all [REDACTED] My friend's not a gorilla.

813 394 TWITTER

# Safety of AI

Boston Dynamics Parkour Atlas: What machine learning algorithms might have been used here?

# Safety of AI

- The same model can have drastically different performance for different hyper-parameters.
- 100% accuracy is rarely achieved on unseen data.
- Should we let a medical robot with CNN-based vision system perform surgery autonomously?
- If a self-driving car crashes and hurts people, who should be responsible for it?

# Carbon Footprint of Deep Learning

## Common carbon footprint benchmarks

in lbs of CO<sub>2</sub> equivalent

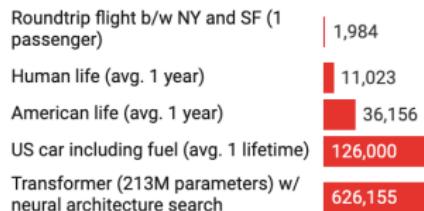


Chart: MIT Technology Review • Source: Strubell et al. • Created with Datawrapper

Source: MIT Tech Review

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# Course Takeaway

- ML is the combination of math and computer science.
- We've only shown you a subsection
  - Supervised Learning: Linear/Logistic Regression and Neural Networks
- Deep learning has wide applications, but we are also responsible for its consequences. —The greater the power, the greater the responsibility!

# Thank You!

■ Thank You!