CSE4261: Neural Network and Deep Learning

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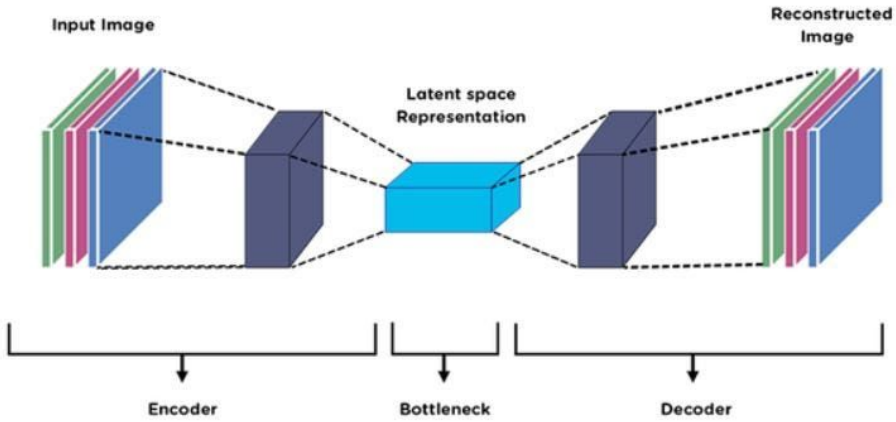
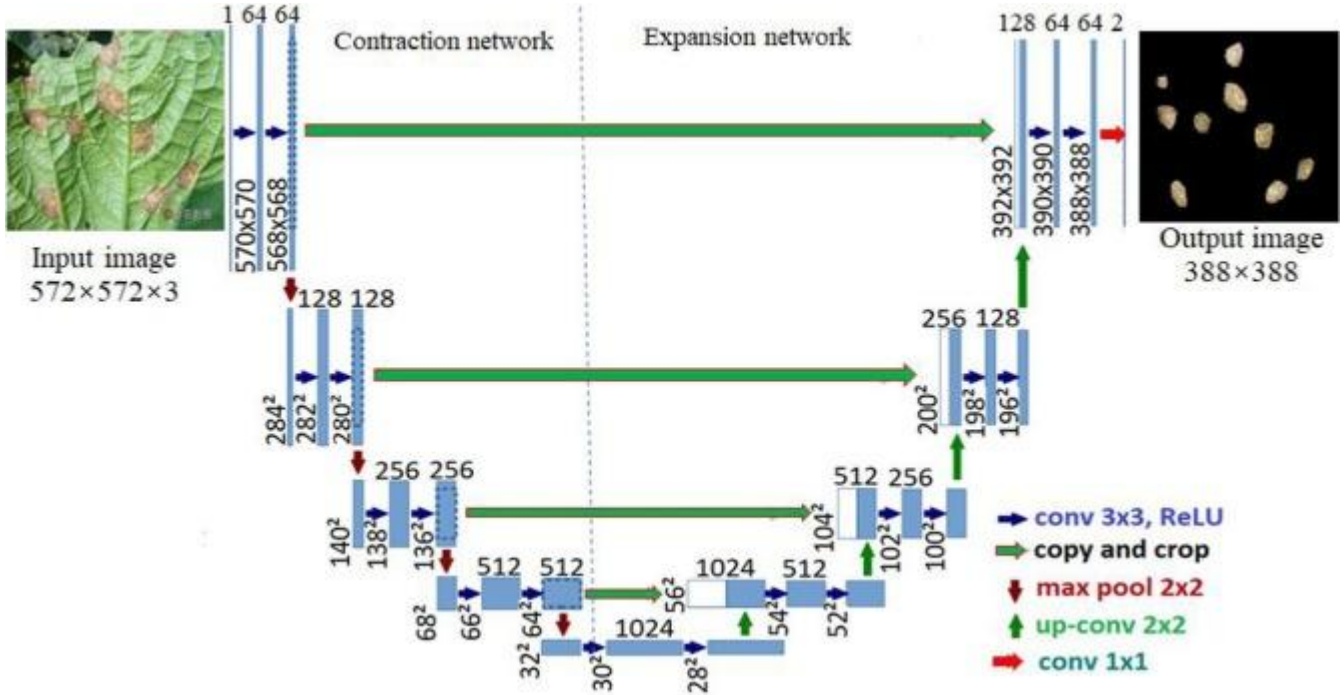
Encoder-Decoder Architecture

1. It is a NN framework widely used for sequence-to-sequence tasks, such as image translation, and image captioning.
2. It comprises two main components:
   a. **an encoder**: it processes the input sequence and transforms it into a fixed-size context vector (or latent space)
   b. **a decoder**: it uses this context vector to generate the output sequence.



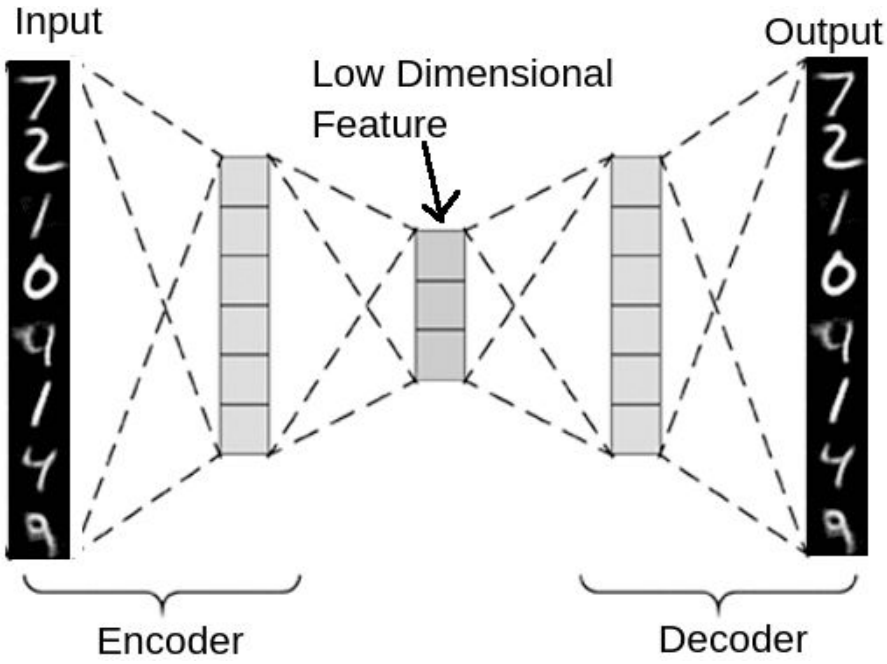
U-Net Segmenter [2015]



Code: https://keras.io/examples/vision/oxford_pets_image_segmentation/

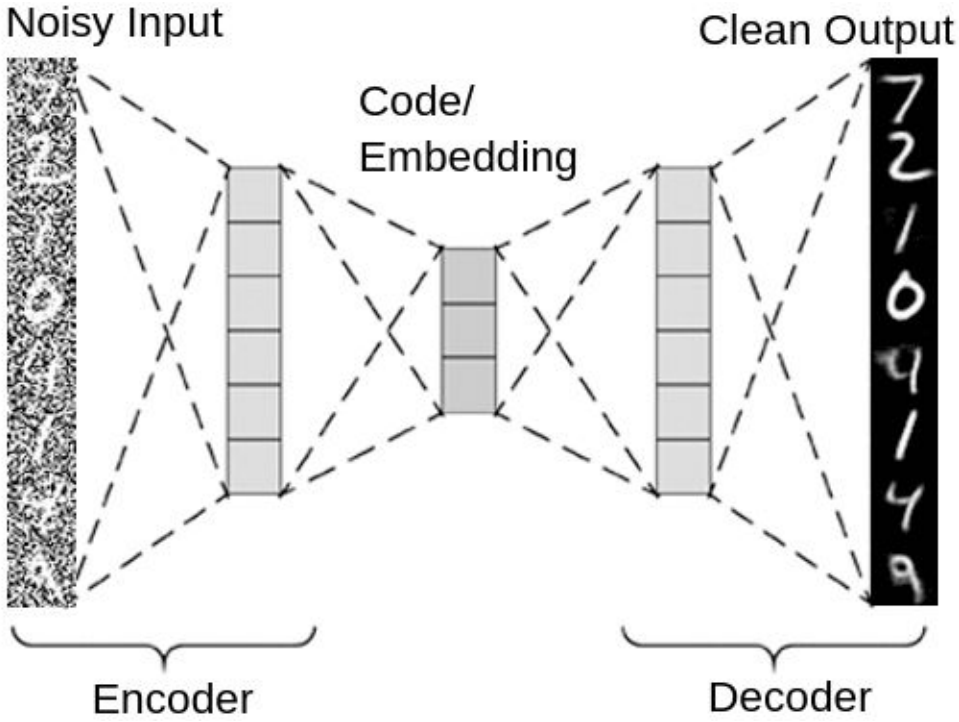
Autoencoder

- It is a type of NN used for **unsupervised learning**, specifically to learn efficient data codings.
- It learns to compress input data into a lower-dimensional representation and then reconstructs the original input from this compressed representation.



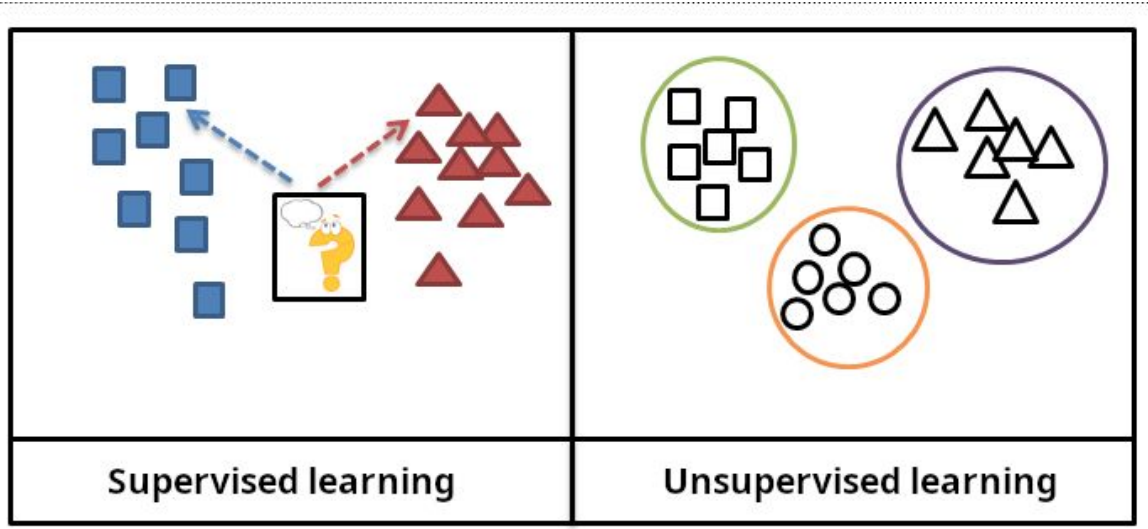
Denoising-Autoencoder

- It is an NN that learns to reconstruct clean data from a noisy input, effectively removing noise from the data.
- We need to intentionally add noise to the input during training
- We force the network to learn robust features that are less susceptible to noise and better capture the underlying data distribution.



Unsupervised Learning Vs Supervised Learning

- Supervised learning uses labeled data
  - uses $\{x_n, y_n\}$
- Unsupervised learning uses unlabeled data
  - uses $\{x_n, x_n\}$
  - or $\{x_n, T(x_n)\}$



$T(x_n)$: transformed input

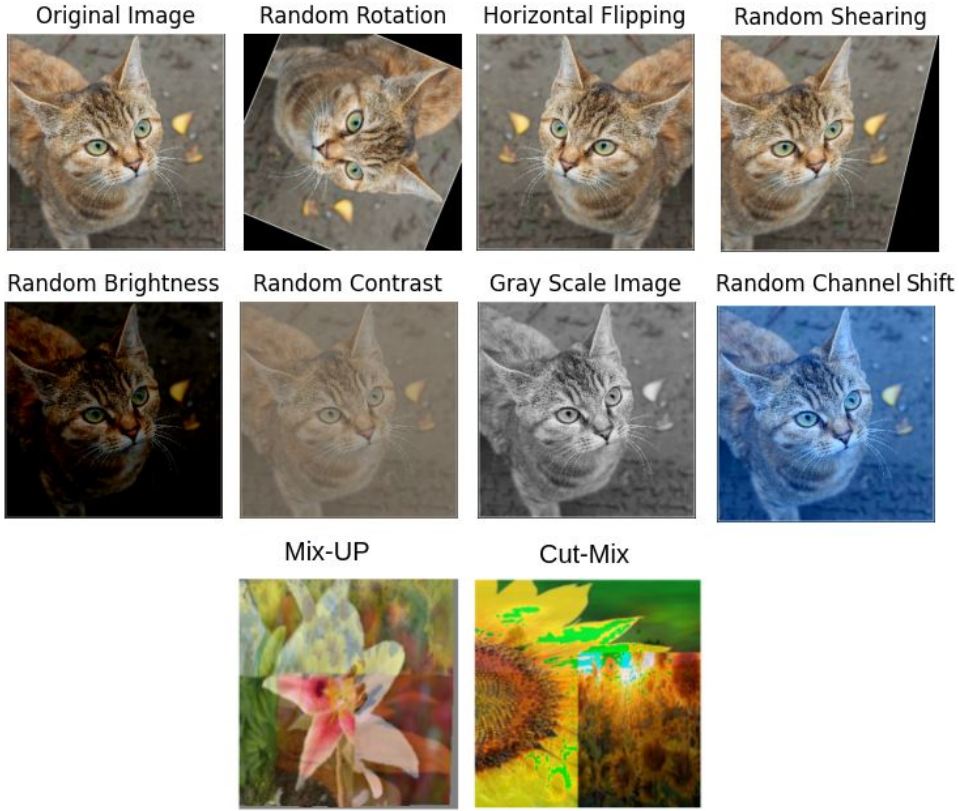
Transformation can be different single sample based data augmentation techniques

Data Augmentation (DA)

When training data is limited and we need to train a complicated NN with huge number of parameters, DA can save us by:

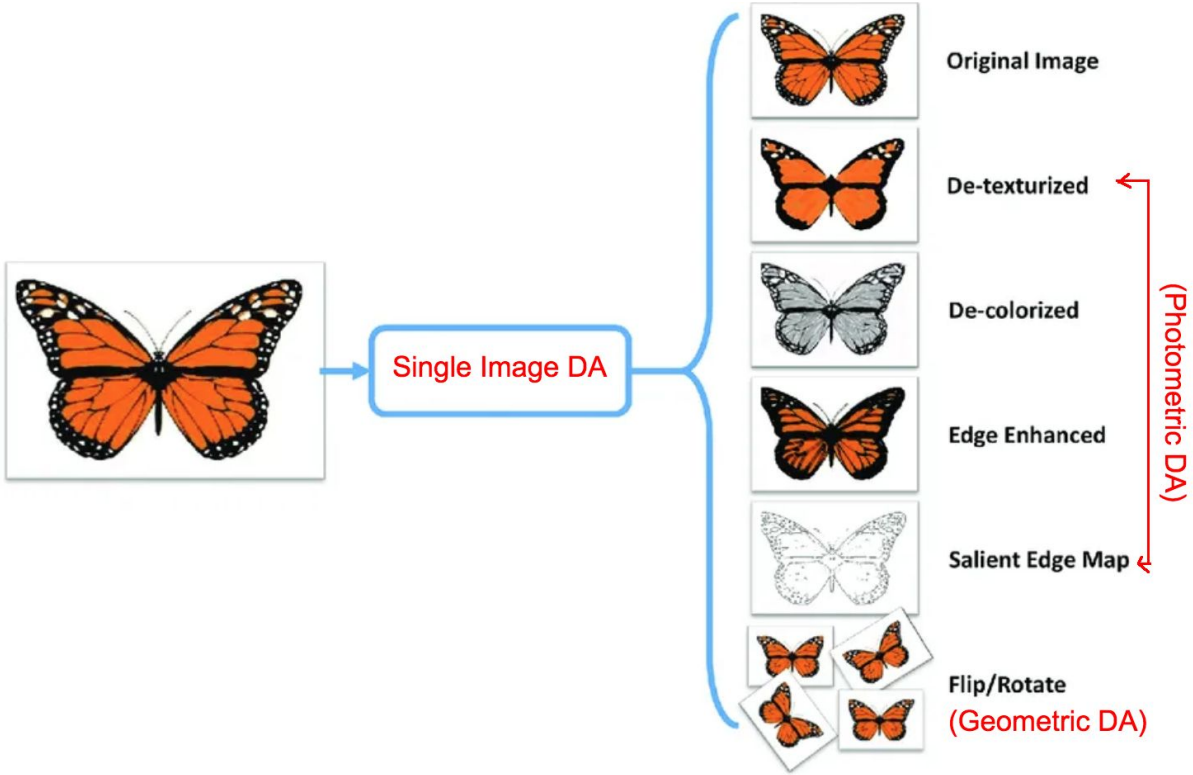
- Increasing amount of data
- Increasing variability in data
- Reducing possibility of overfitting

Random DA should not be used for validation and test sets during validation and testing



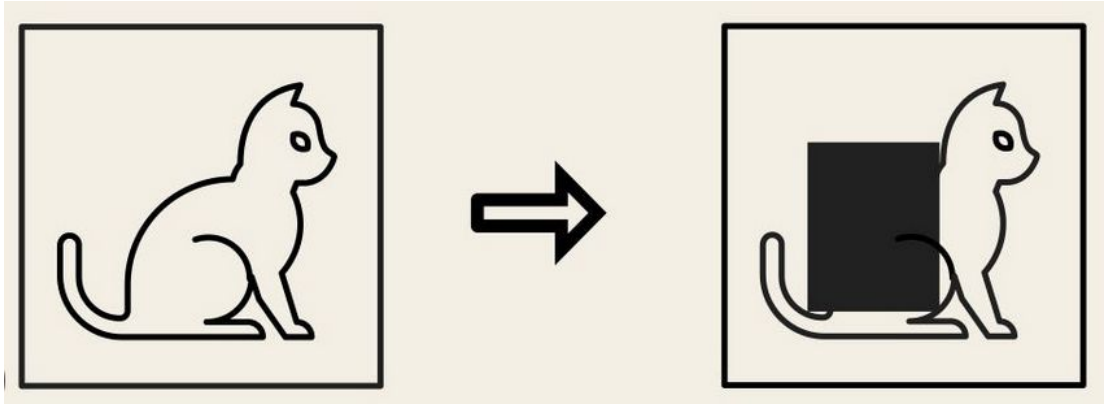
Types of DA

1. DA by a single image
   a. Photometric DA
   b. Geometric DA
2. DA by multiple images
   a. MixUp
   b. CutMix



Cutout DA

- **Cutout** DA randomly masks out square regions of input during training.
- It is a single-image based photometric DA technique.



- Cutout DA deals with the problem of object occlusion, which is commonly encountered in many computer vision tasks, such as object recognition, tracking, or human pose estimation.

Tensorflow’s Support for DA

- ImageDataGEnerator: https://www.tensorflow.org/api_docs/python/tf/keras/preprocessing/image/ImageDataGenerator
- Building powerful model with Little Data: https://blog.keras.io/building-powerful-image-classification-models-using-very-little-data.html

```
datagen = ImageDataGenerator(
        rotation_range=40,
        width_shift_range=0.2,
        height_shift_range=0.2,
        shear_range=0.2,
        zoom_range=0.2,
        horizontal_flip=True,
        fill_mode='nearest')
```