Topics in Module-3

- Convolution layers
- Max pool layers,
- ELU Gradient Descent,
- Training CNN-initialization,
- CNN architectures VGG, Google Net,
- ResNet,
- **Data augmentation**,
- Transfer learning,

Data Augmentation

Augmented vs. Synthetic data

- **Augmented data** is driven from **original data** with some minor changes. In the case of image augmentation, we make **geometric and color space transformations** (flipping, resizing, cropping, brightness, contrast) to increase the size and diversity of the training set.
- **Synthetic data** is **generated artificially** without using the original dataset. It often uses DNNs (Deep Neural Networks) and GANs (Generative Adversarial Networks) to generate synthetic data.

When to use data augmentation?

- To prevent models from **overfitting.**
- The initial training set is too small.
- To improve the model accuracy.
- To reduce the **operational cost of labeling** and cleaning the raw dataset.

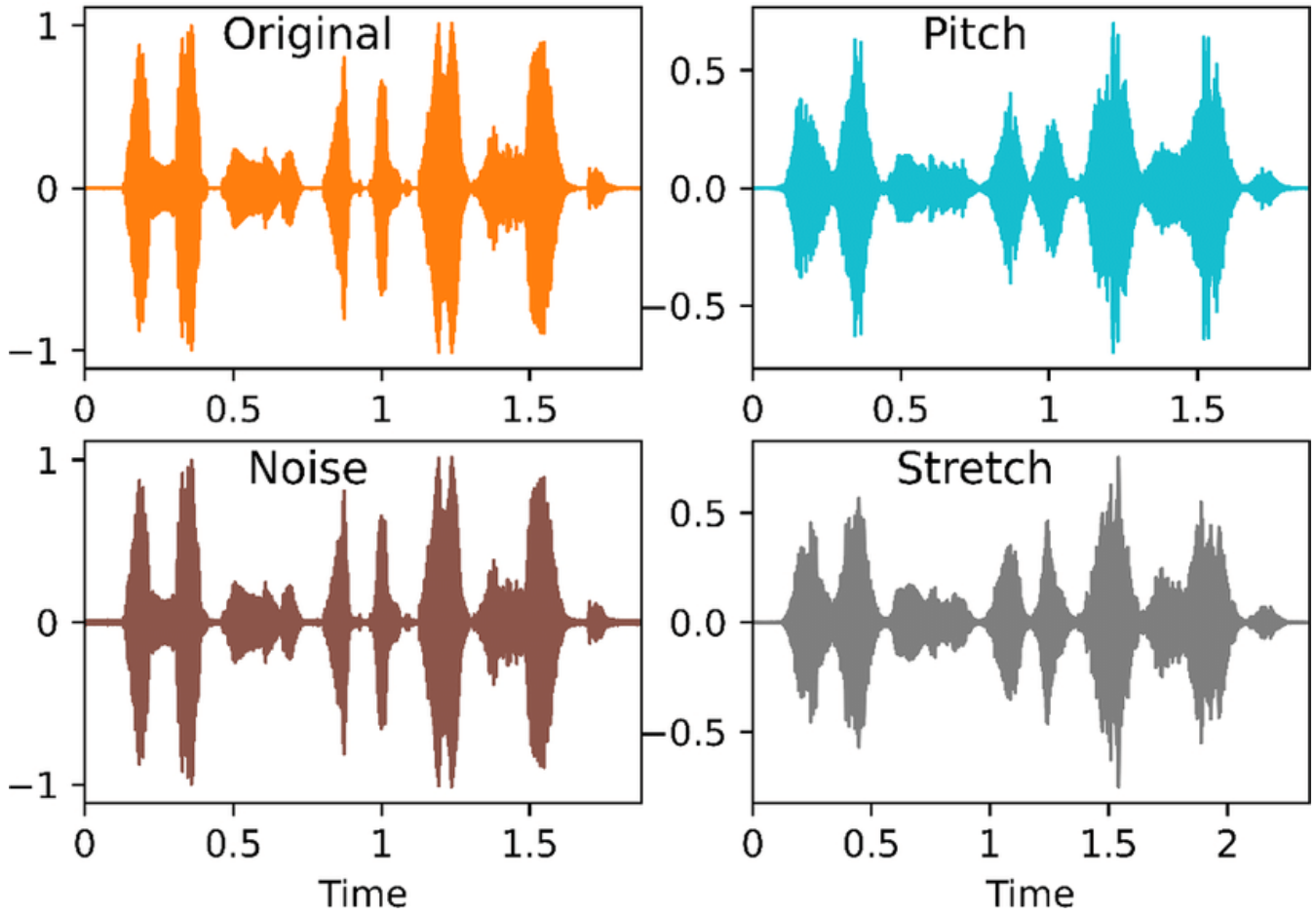
Audio and text Data Augmentation

- **Noise injection**: add gaussian or random noise to the audio dataset to improve the model performance.
- **Shifting**: shift audio left (fast forward) or right with random seconds.
- **Changing the speed**: stretches times series by a fixed rate.
- **Changing the pitch**: randomly change the pitch of the audio.

Text Data Augmentation

- **Word or sentence shuffling**: randomly changing the position of a word or sentence.
- **Word replacement**: replace words with synonyms.
- **Syntax-tree manipulation**: paraphrase the sentence using the same word.
- **Random word insertion**: inserts words at random.
- **Random word deletion**: deletes words at random.

Audio based data augmentation



Text based data augmentation

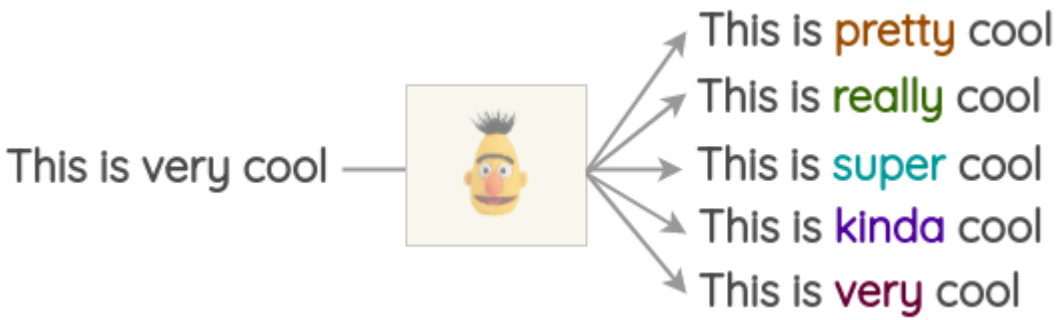
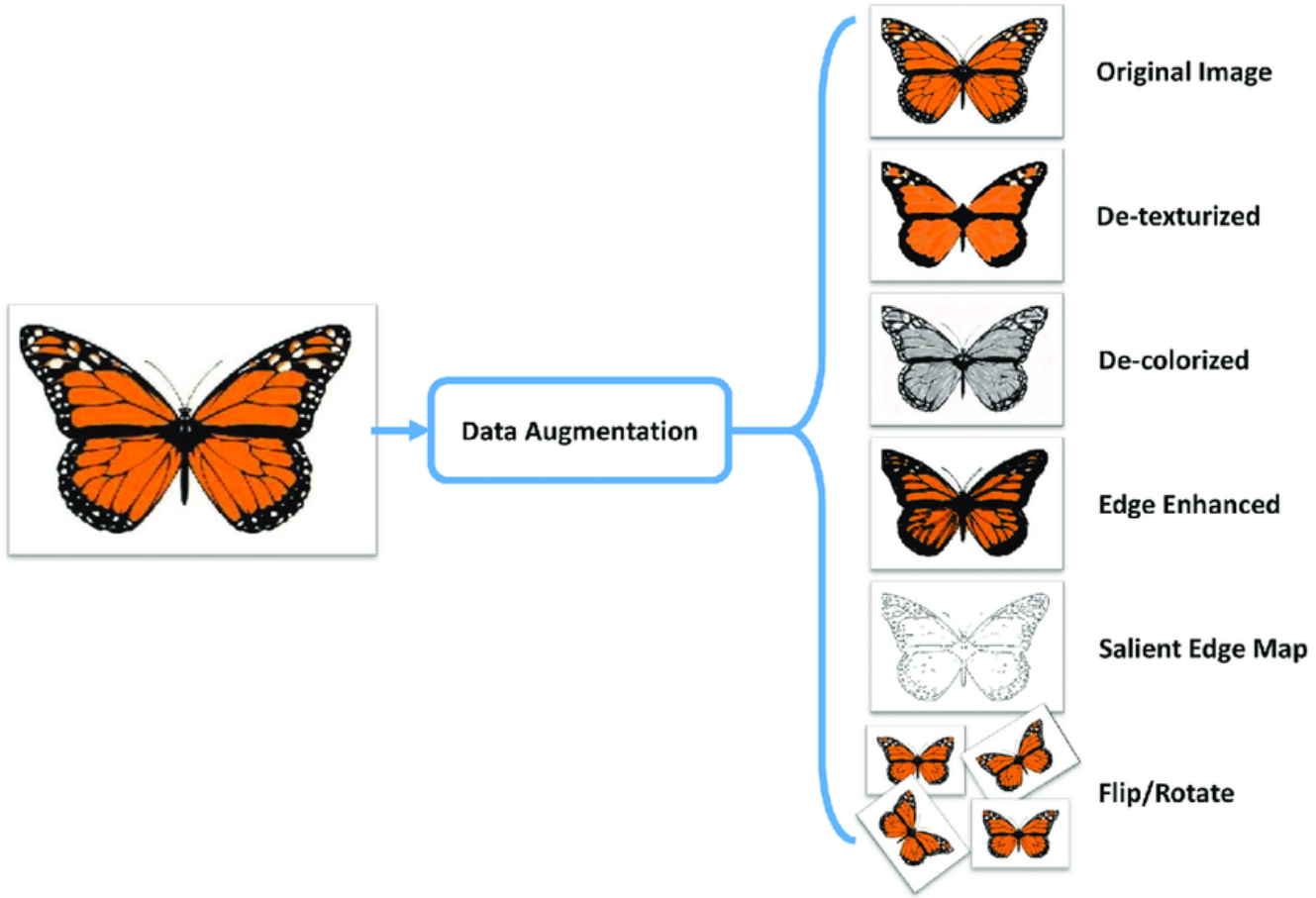


Image Augmentation

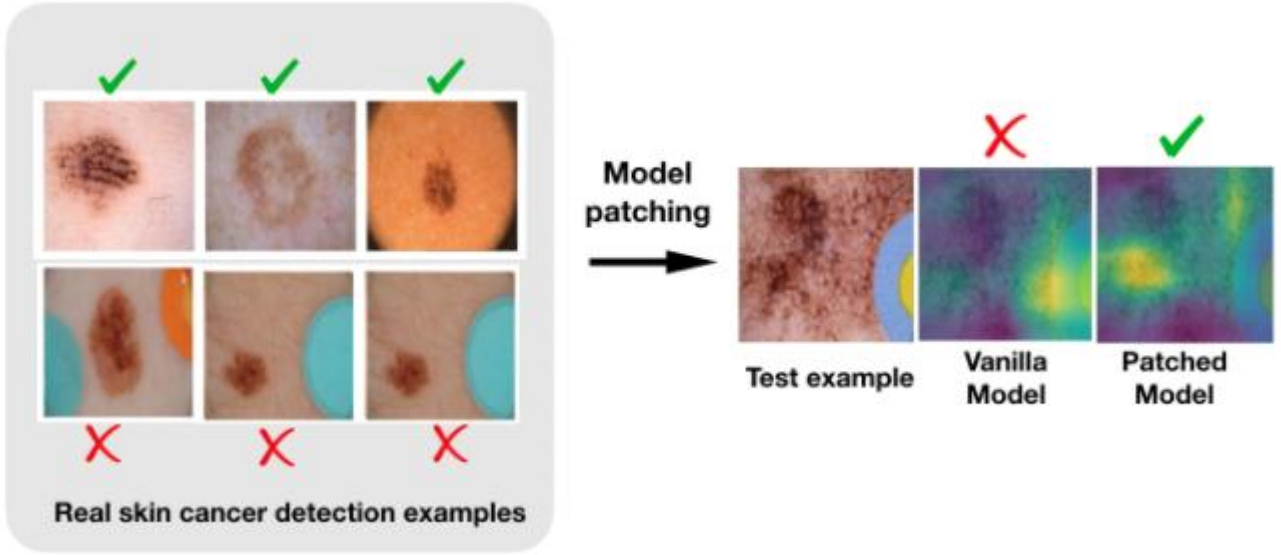
- **Geometric transformations**: Randomly flip, crop, rotate, stretch, and zoom images. You need to be careful about applying multiple transformations on the same images, as this can reduce model performance.
- **Color space transformations**: Randomly change RGB color channels, contrast, and brightness.
- **Kernel filters**: Randomly change the sharpness or blurring of the image.
- **Random erasing**: Delete some part of the initial image.
- **Mixing images**: Blending and mixing multiple images.

Image based data augmentation

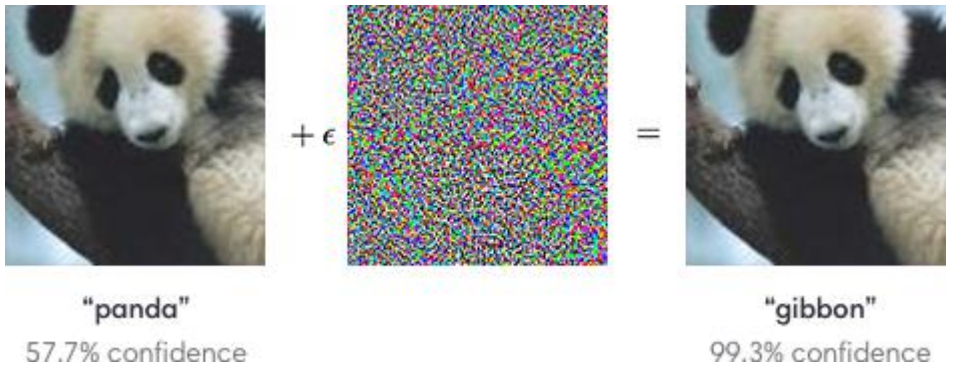


Data augmentation for model patching

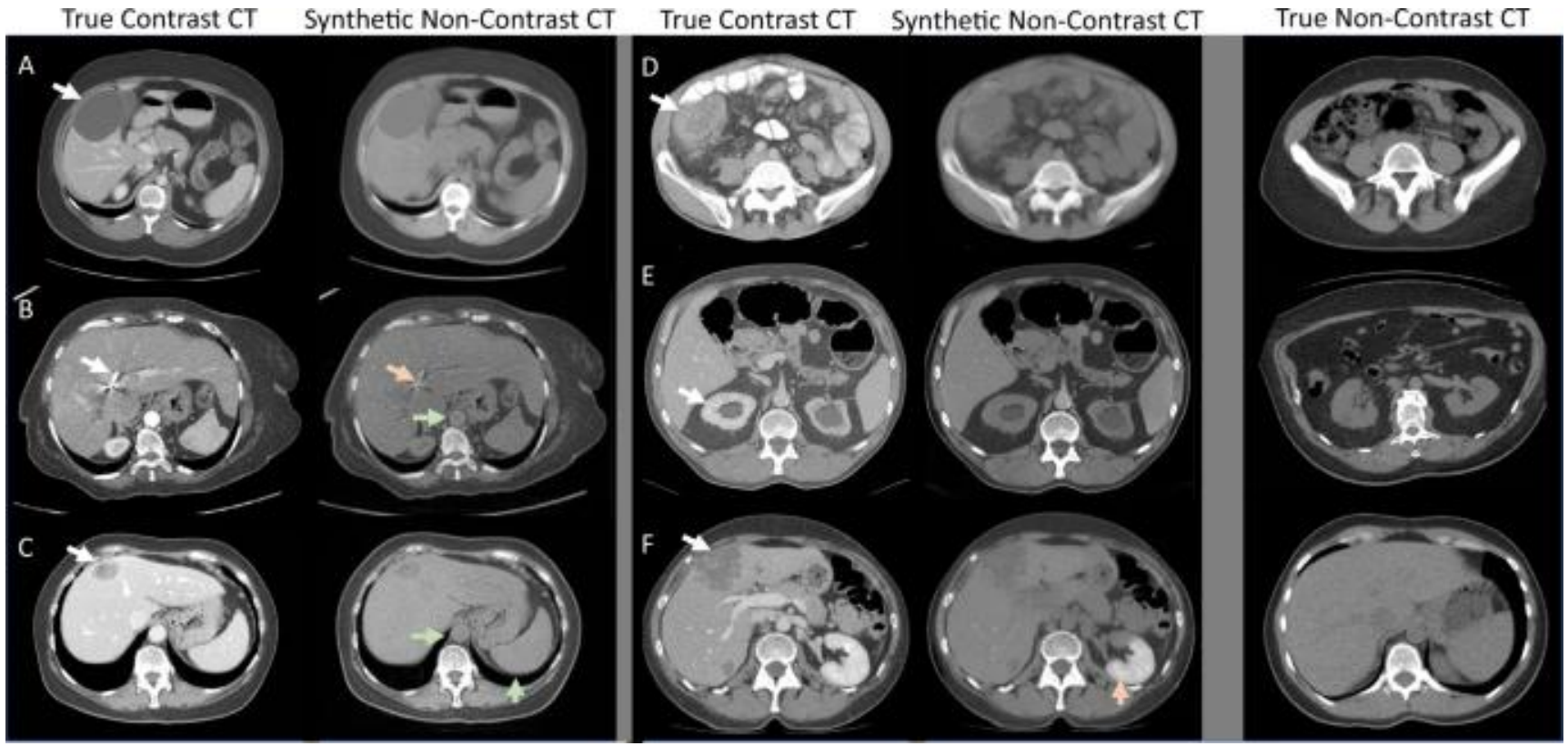
- Model patching is becoming a late-breaking area that would alleviate the major problem in safety-critical systems, including healthcare (e.g. improving models to produce MRI scans free of artifact) and autonomous driving (e.g. improving perception models that may have poor performance on **irregular objects or road conditions).**



- by adding a small amount of noise to an image can confuse the AI classifier and classifies a panda as a gibbon.



- CT scan images generated by a cycleGAN, which is a variation of GAN.
- This is how GAN-generated CT scan images are being used in the medical field to increase the dataset.
- Once the dataset is created, it can be used for classification or any other task.


True Contrast CT
Synthetic Non-Contrast CT
True Contrast CT
Synthetic Non-Contrast CT
True Non-Contrast CT
A
B
C
D
E
F

Neural Style Transfer-based augmentation

- A series of convolutional layers are trained such that the images are deconstructed where content and style can be separated.
- After separation, the content from an image is composed with the style of another image to create an augmented style image.
- Thus, the content remains the same but the style is changed.
- This **increases the robustness of the model** as the model is working independently of the style of the image.