**Geometric transformations**

**flipping**

**cropping**

**Scaling**

**Rotation**

**Padding**

**noise injection**

* ***Gaussian noise.***
* ***Salt and Pepper noise.***
* ***Speckle Noise.***

<https://debuggercafe.com/adding-noise-to-image-data-for-deep-learning-data-augmentation/>

**random erasing**

his is a data augmentation technique that replaces regions of the image with random values, or the mean pixel value of training set. Typically, it is implemented with varying proportion of image erased and aspect ratio of erased area. Functionally, this becomes a regularization technique, which prevents our model from memorizing the training data and overfitting.

**Cutout —**square regions are masked during training. Cutout regions are only hidden from the first layer of the CNN. This is very similar to random erase, but with a constant value in the overlaid occlusion. The purpose is similar: we reduce overfitting.

**Hide and Seek —**Divide the image into a grid of SxS patches. Hide each patch with some probability (p\_hide). This allows the model to learn what an object looks like without learning only what a single portion of the object looks like.

**MixUp —**convex overlaying of image pairs and their labels

**CutMix —**Combine images by cutting parts from one image and pasting them onto the augmented image. Cutouts of the image force the model to learn to make predictions based on a robust amount of features. See “Hide and Seek” above where, without cutouts, the model relies specifically on a dog’s head to make a prediction. That is problematic if we want to accurately recognize a dog whose head is hidden (perhaps behind a bush). In CutMix, the cutout is replaced with a part of another image along with the second image’s ground truth labeling. The ratio of each image is set in the image generation process (for example, 0.4/0.6). In the picture below, you can see how the authors of CutMix demonstrate that this technique can work better than simple MixUp and Cutout.

**Mosaic data augmentation —**Mosaic data augmentation combines 4 training images into one in certain ratios. Mosaic is the first *new*data augmentation technique introduced in YOLOv4. This allows for the model to learn how to identify objects at a smaller scale than normal. It also encourages the model to localize different types of images in different portions of the frame.

**Translation**

* Shifting

**Affine transformation**

**Color augmentation**

* **Brightness**
* **Contrast**
* **Saturation**
* **Hue**
* Grayscale