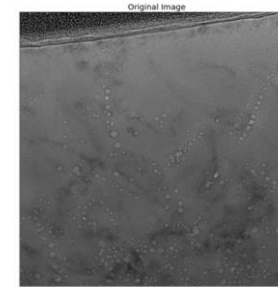


*Deep Learning for Microscopy Image Analysis
in Materials Science: Advancing Research
and Education Workshop*

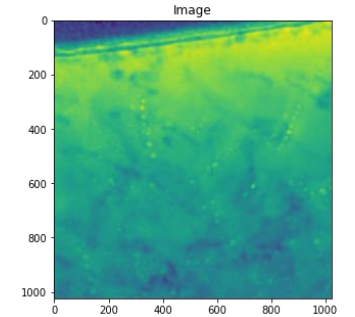
Data Augmentation Techniques

Dr. Shradha Agarwal, Tommy Wong

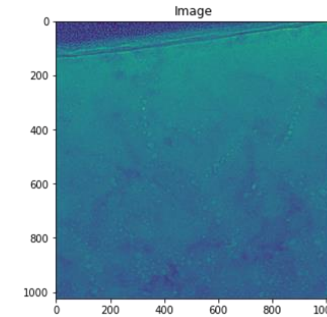
Original



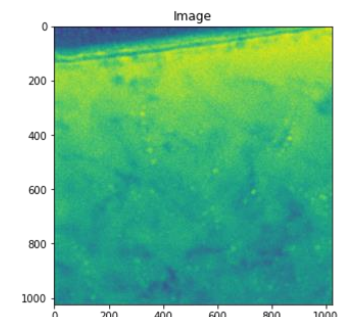
Blur



Salt & Pepper



Gaussian

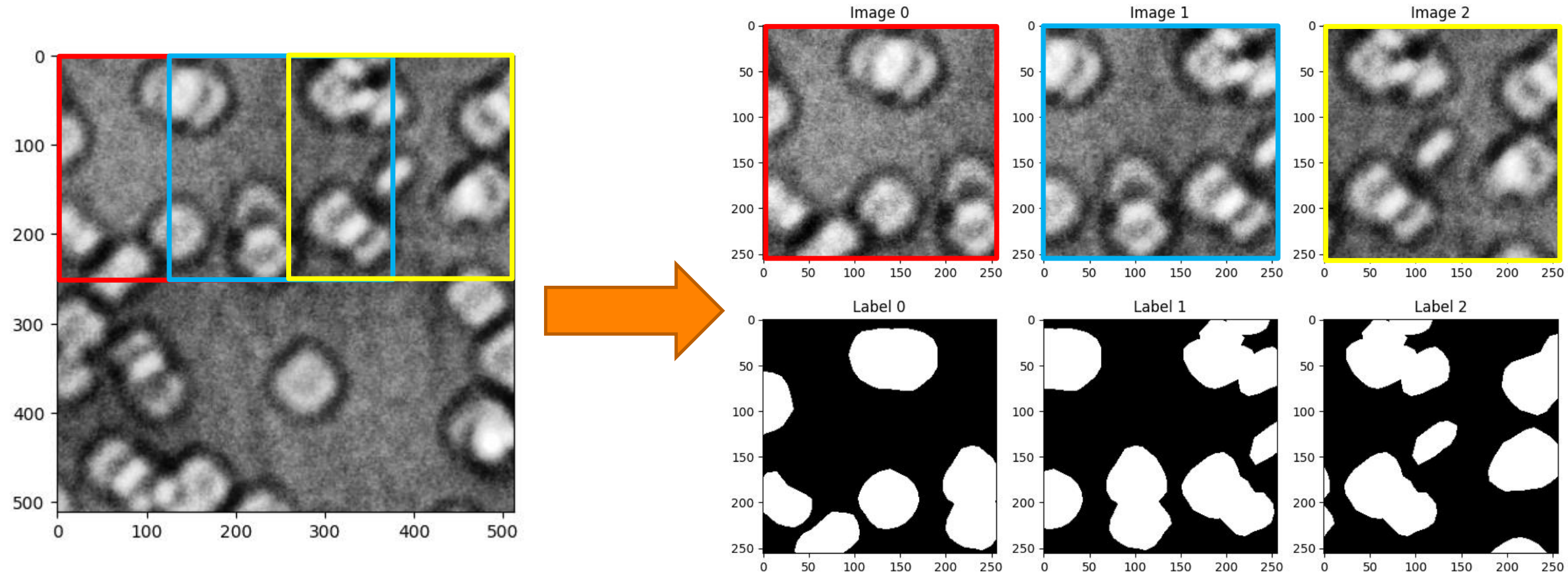


Data from Wang et al. (2019) <https://doi-org.utk.idm.oclc.org/10.1016/j.mtla.2018.100183>

Rationale: more varied data → less overfitting

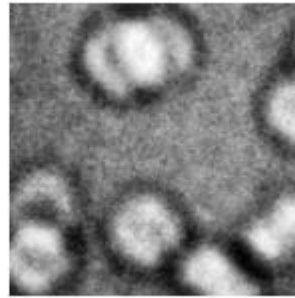
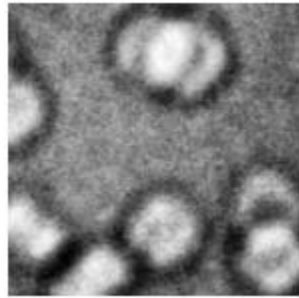
Electron microscopy experiments yield (relatively) small datasets
∴ requires augmentation

Use a sliding window cropper to enhance the dataset

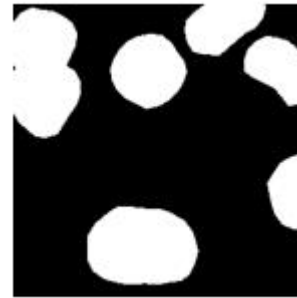
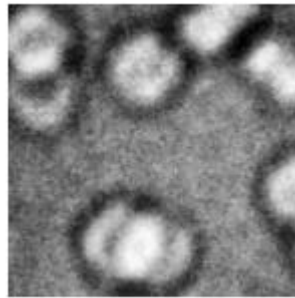


Rotate, flip, resize the image to increase variability

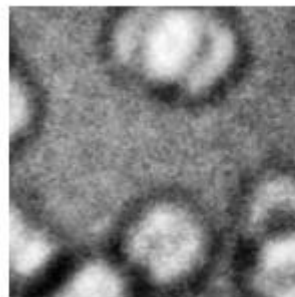
Original



Flipped/Mirrored



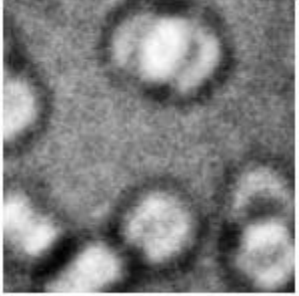
Rotated 180 degrees



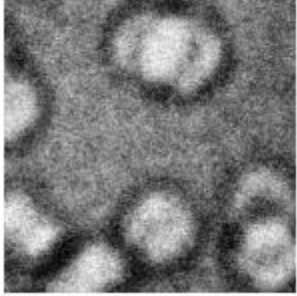
Zoomed in

Adding noise to simulate noises during imaging

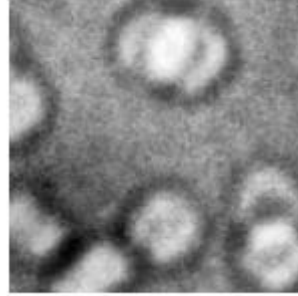
Original



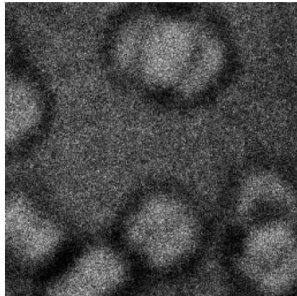
Gaussian



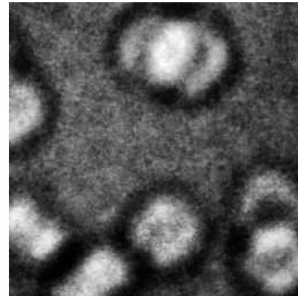
Background noise



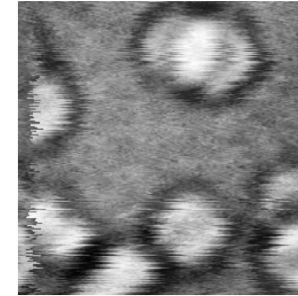
Poisson



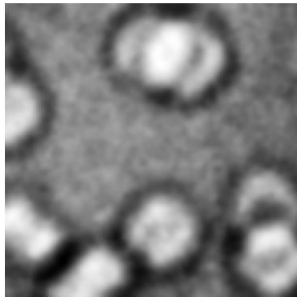
Contrast



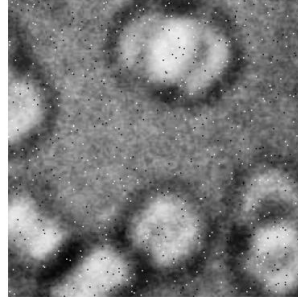
Jitter



Blur



Salt & pepper



Different ways of implementing augmentation

Roboflow.com web GUI

Augmentation Options

Augmentations Per Image

The number of derived images you want to generate for each source image.



Image Level Augmentations

☒ **Flip**
Add horizontal or vertical flips to help your model be insensitive to subject orientation.
☒ Horizontal
☒ Vertical

☒ **90-Degree Rotations**
Add 90-degree rotations to help your model be insensitive to camera orientation.
☒ Clockwise
☒ Counter Clockwise
☐ Upside Down

☐ **Random Crop**
Add variability to positioning and size to help your model be more resilient to subject translations and camera position.

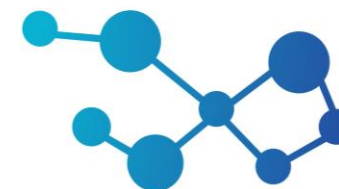
☐ **Random Rotation**
Add variability to rotations to help your model be more resilient to camera roll.



AtomAI Python functions

github.com/pycroscopy/atomai

```
images, labels = img_augmentor(nb_classes=1, images=train_images, labels=train_labels, seed=0,
                                zoom=zoom, rotation=True, gauss_noise=gauss_noise,
                                poisson_noise=poisson_noise, blur=blur, contrast=contrast,
                                salt_and_pepper=salt_and_pepper, jitter=jitter, background=True)
```



AtomAI

Deep Learning for Microscopy

Augmentation demonstration

https://github.com/shradhautk/AI-MICROSCOPY-WORKSHOP/blob/main/Day2_Education_Day/Data_Augmentation/DL_for_Microscopy_Data_Augmentation.ipynb