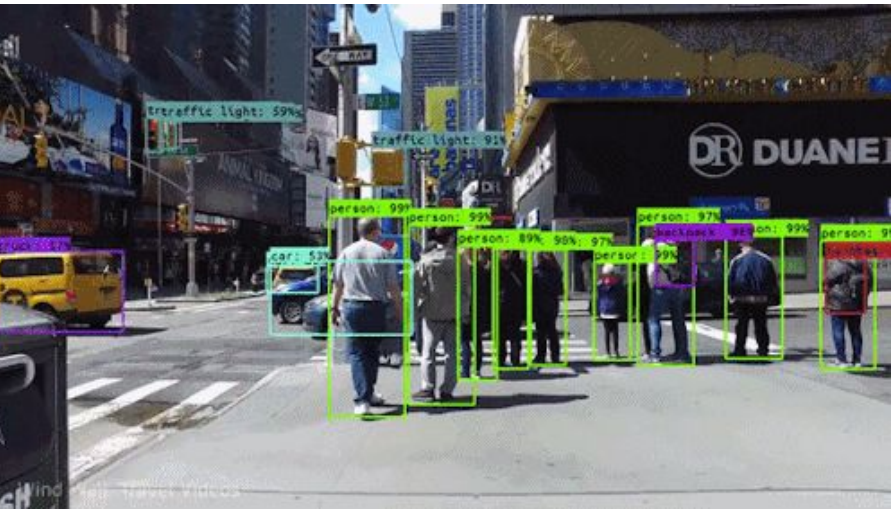
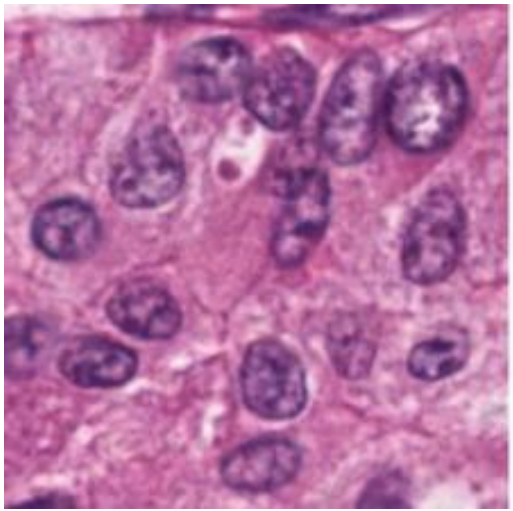
Image processing basics in Python

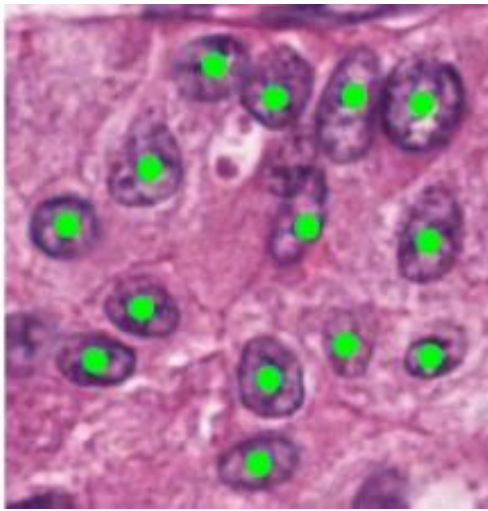
BILD 62

From self driving cars to segmenting nuclei, image processing is important!



From [this article]





From [this paper]

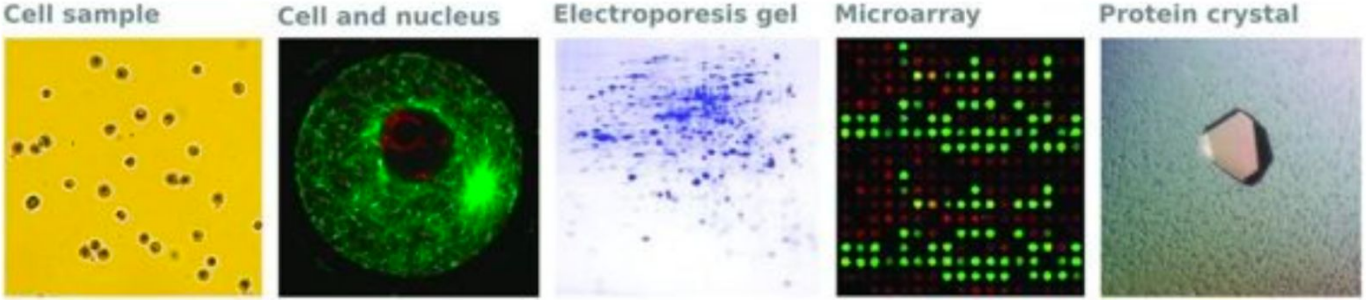


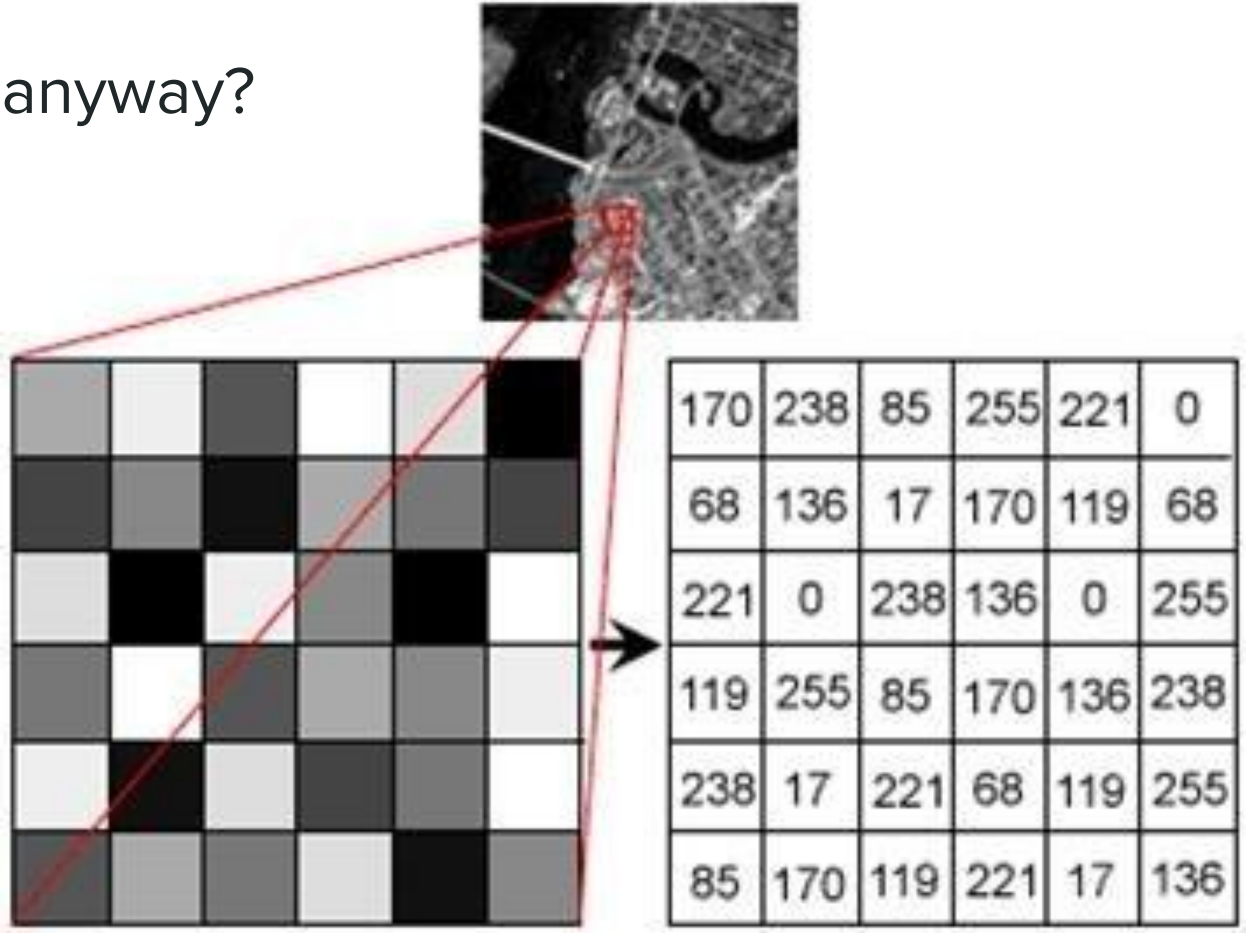
Figure 18.1 (Plate 5). Examples of a variety of different kinds of images used in biology. Shown from left to right are: a microscope image of a mammalian cell culture (courtesy Dr. Anja Winter, University of Leicester); a red-green fluorescence microscope image of an oocyte and its nucleus (courtesy Dr. Melina Schuh, MRC Laboratory of Molecular Biology); a two-dimensional electrophoresis gel of a plant proteome (courtesy Prof. Paul Dupree, University of Cambridge); an image of a DNA microarray (courtesy Karen Howarth, University of Cambridge); a protein crystal that has been grown for structure determination by X-ray crystallography (courtesy Dr. Aleksandra Watson, University of Cambridge).

We use lots of images in biology

Figure from Python Programming for Biology

What are images, anyway?

Gray scale images mean each pixel has just one value

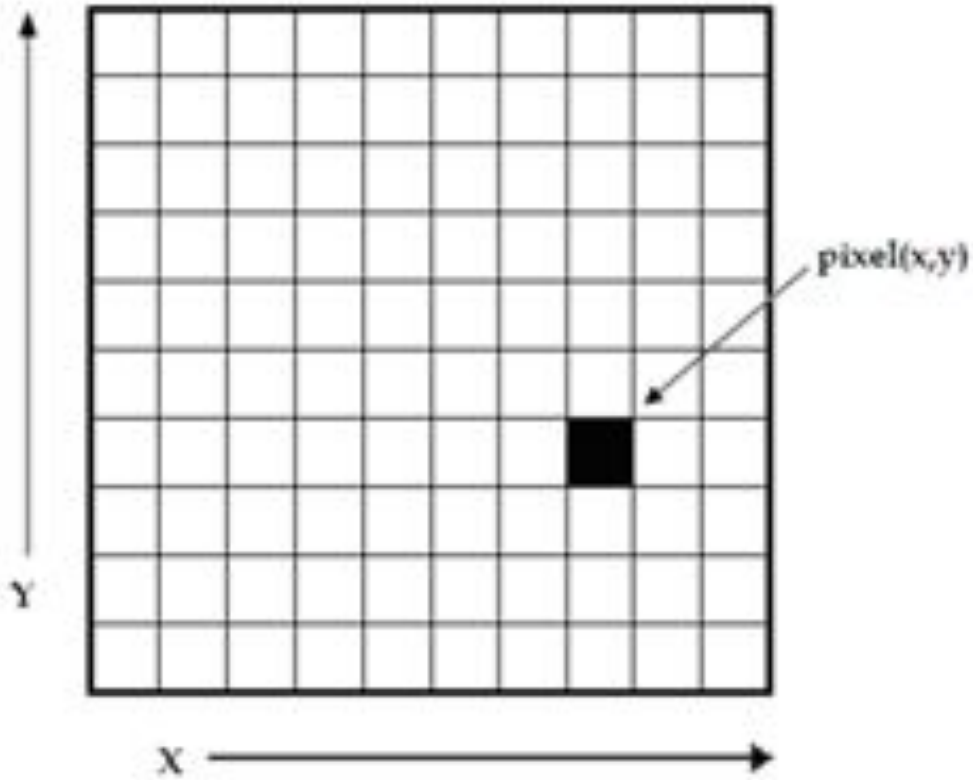


170	238	85	255	221	0
68	136	17	170	119	68
221	0	238	136	0	255
119	255	85	170	136	238
238	17	221	68	119	255
85	170	119	221	17	136

What are images, anyway?

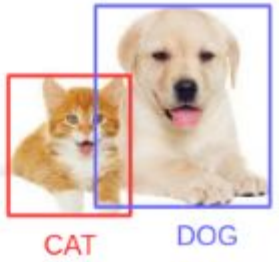
Images can be represented as 2D arrays

By convention [0,0] is the top left corner



Often, we want to perform different types of image segmentation: localization or object detection

Image Localization

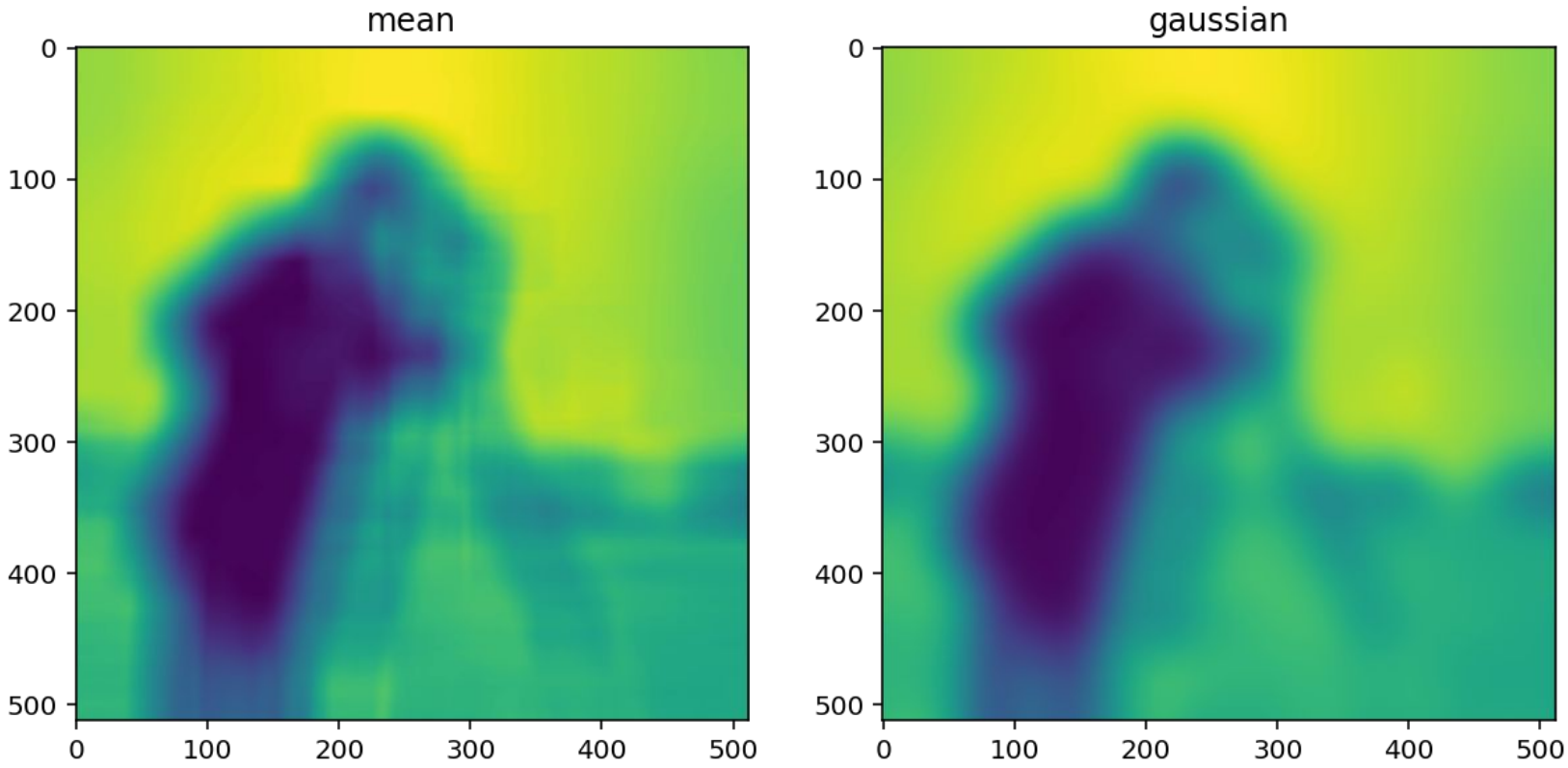


Object Detection

https://www.analyticsvidhya.com/blog/2019/04/introduction-image-segmentation-techniques-python/

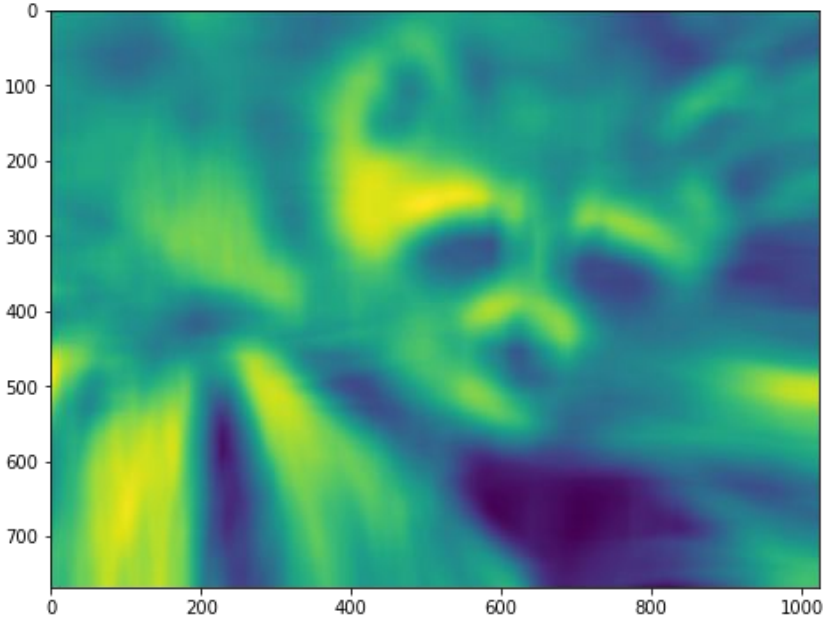
Commonly used filters for biological images

- Gaussian filter — to smooth and remove irregularities
- Edge filters — to detect edges
  - Sobel filter

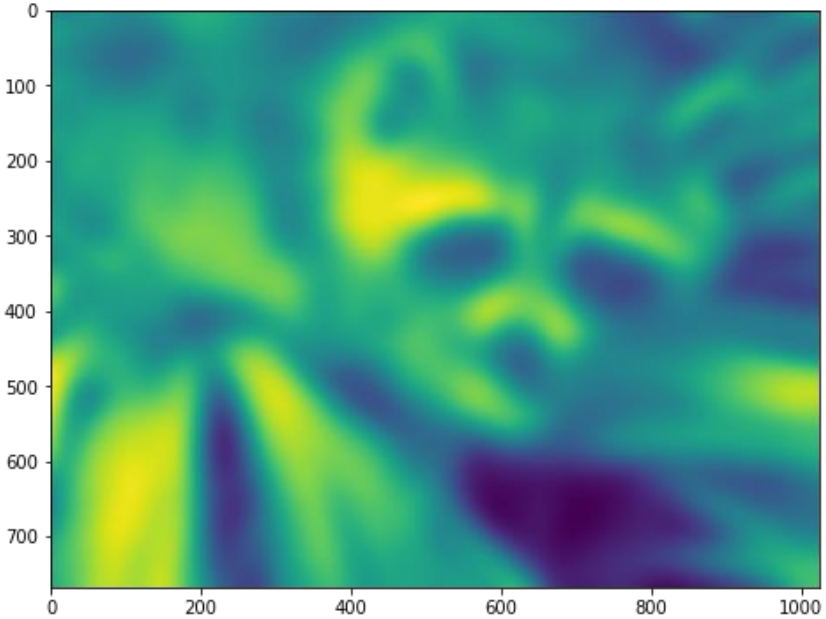


Mean vs. Gaussian smoothing

mean



gaussian



Mean vs. Gaussian smoothing

Image processing tools based in Python

cellpose https://github.com/MouseLand/cellpose

Napari https://github.com/napari/napari

Additional resources

https://www.youtube.com/watch?v=1GUgD2SBl9A

https://www.youtube.com/watch?v=uihBwtPIBxM

https://www.analyticsvidhya.com/blog/2019/04/introduction-image-segmentation-techniques-python/

https://jni.github.io/i2k-skimage-napari/lectures/0_i2k_bioimage_analysis_fundamentals.html