Project #1: Hybrid Images

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Problem Description

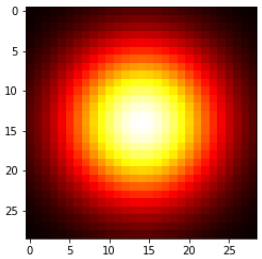
Hybrid images are superimposed images that will change when viewed from a distance versus viewed up close. To superimpose a hybrid image, a high pass filtered image is added up with a low pass filtered image. Tasks in this project are 1) defining a function that can perform convolution on images; creating a gaussian kernel with customized size and variance; and 3) performing image smoothing and image sharpening and then image superimposing.

Code Design

Function	Description
gaussin_kernal(size=(29,29),sigma=7)	Generate gaussin filter with defined size and variance
conv(img,kernal)	Takes image and kernel as inputs to convolve the image
convGray(img,kernal)	The same as conv(). However, it works for grayscale image
sharpen(img, kernel, scale_factor)	Sharpen the image
imposing(smooth_img,sharpen_img,ratio=(0.95,0.05))	Superimpose the low pass filtered and high pass filtered images to a hybrid image

Assumptions

To get a better result, I applied 29×29 sized filter with sigma as 7. The filter presented as below:



Running Code

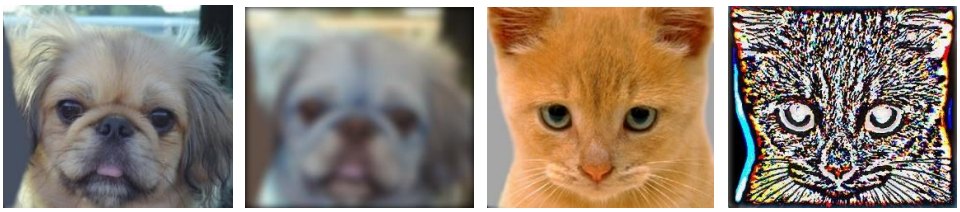
To run the code, open the terminal and run the code below

python3 ECE574_Project1.py dog.jpg cat.jpg 29 29 7 1 0.9 0.1 0

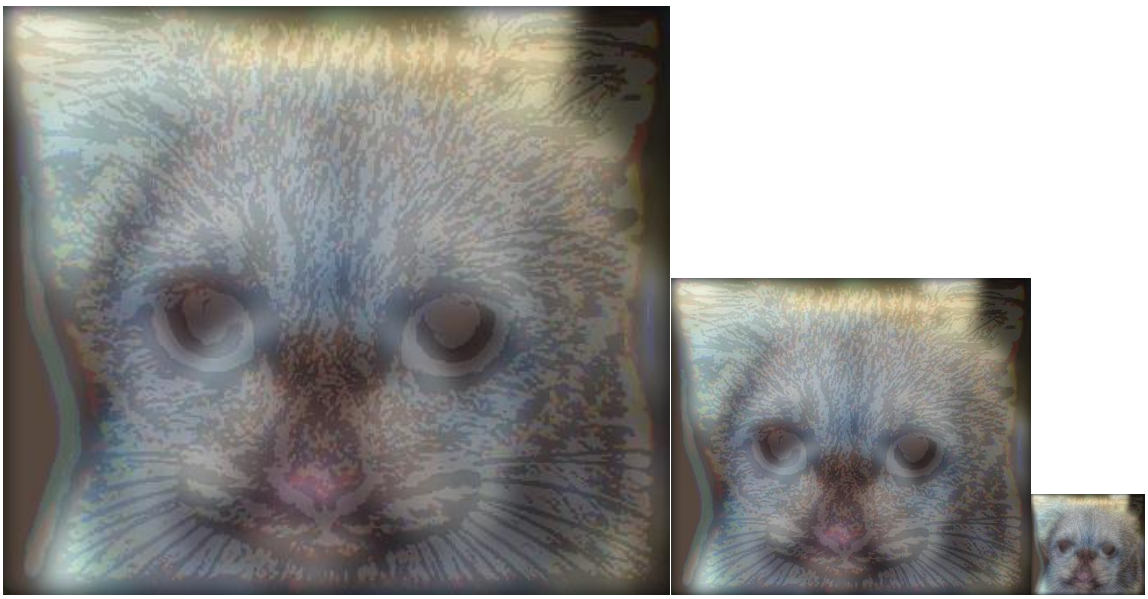
the first two arguments are the image that would be smoothed (low pass filtered) and the image that would be sharpened (high pass filtered), respectively. The following 3 arguments indicate the size of Gaussian kernel and the variance. The 6th parameter is used for how sharpened the image would be. The 7th and 8th parameters can be regarded as spatial scales for low pass filtered image and high pass filtered image, relatively. They are used in the step of superimposing. Finally, the binary "0" gives users the option of whether to deal with color or grayscale images.

Example Results

Original dog **High pass filtered** **Original cat** **High pass filtered**



Hybrid image



Conclusion

1. A larger size filter with a bigger variance convolves a more blurred image and creates a sharpened image after being subtracted by original image.
2. In this example, the balance for low pass and high pass images is 9/1. When high pass filtered image dominates the hybrid image, it turns hard to view the low pass filtered image. Changing the balance will determine how far the viewer can discriminate low pass from high pass.