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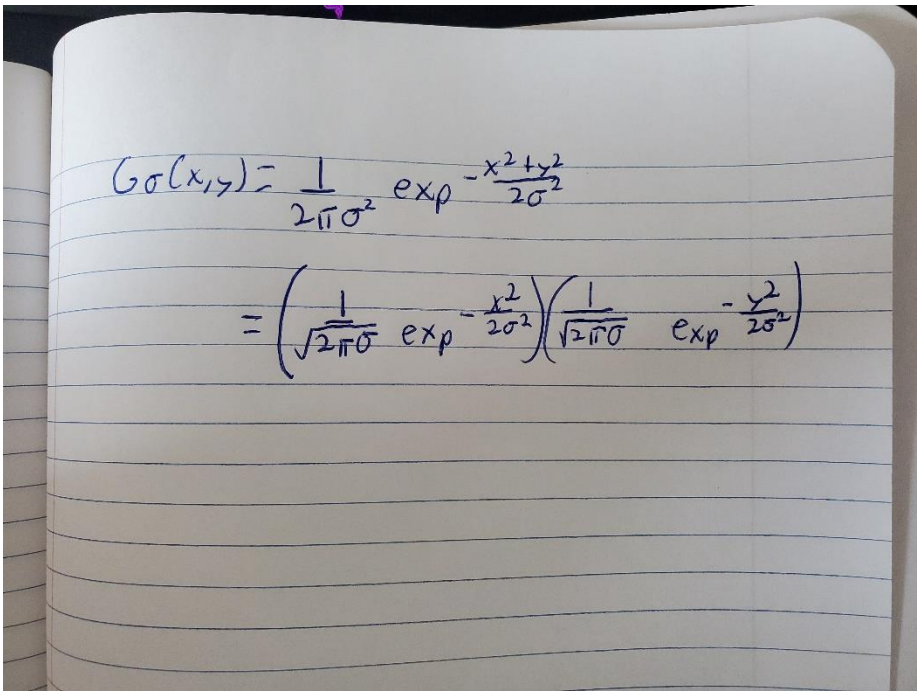
Assignment 3- CS 4442

Contents

Question 1

Show that convolution with a 2D Gaussian kernel is a spatially separable convolution, i.e. there are two 1D kernels if applied to the image row-wise and column-wise in sequence, it is equivalent to convolving that image with the 2D Gaussian kernel.

i) Is Sobel kernel spatially separable?



Yes it is, here is an example Sobel kernel used for edge detection

-1	0	1
-2	0	2
-1	0	1

=

1
2
1

x

-1	0	1

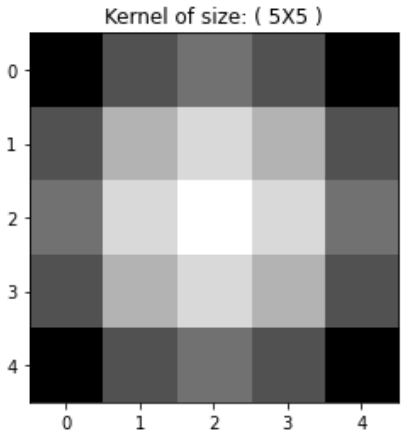
ii) Why separable convolutions are preferred?

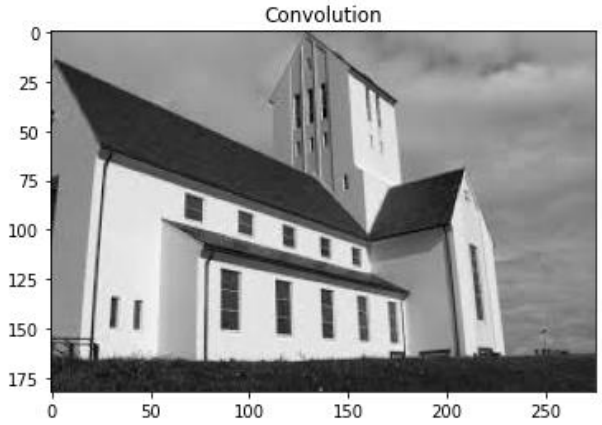
Separability means that a 2D convolution can be reduced to two 1D convolutions, this becomes important when considering time complexity. For example, complexity filtering an nxn image with a mxm kernel you will get a time complexity of $O(n^2m^2)$ but if the kernel is separable the complexity will be $O(n^2m)$.

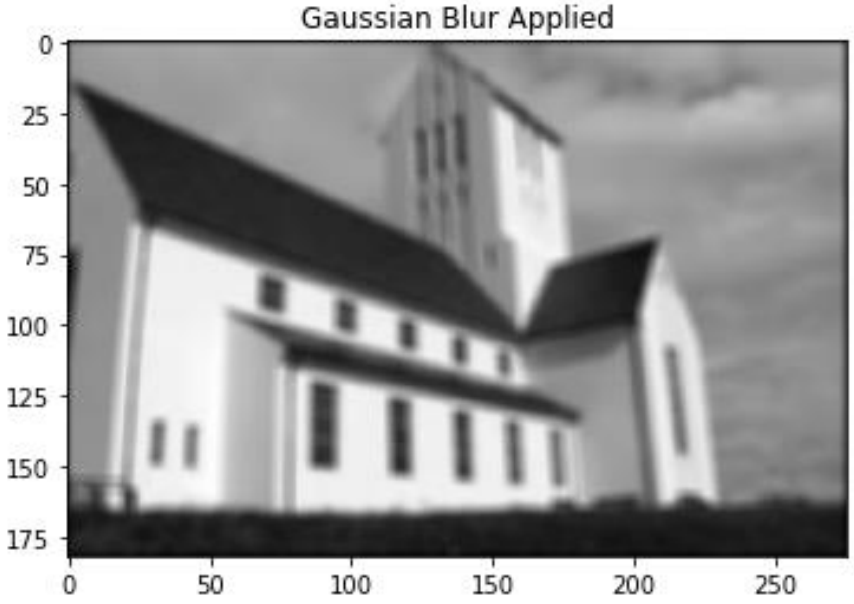
Question 2

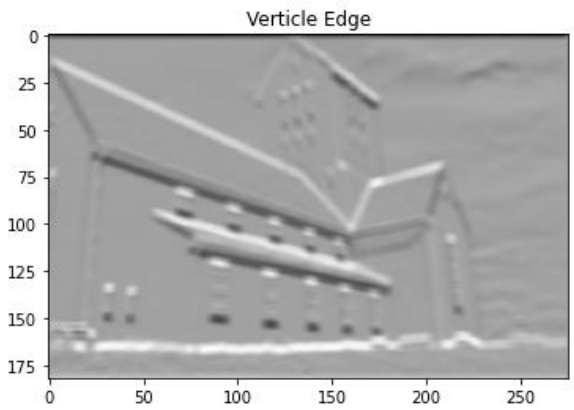
Please refer to python code iborwick_250950449_asn3_q2.py for source code

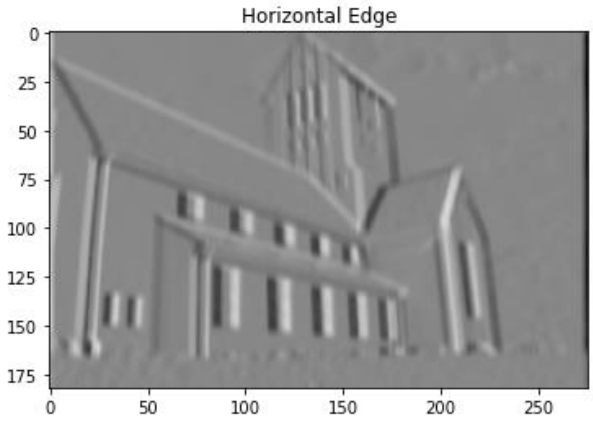
Sigma = 3 Low threshold =2 High threshold =20

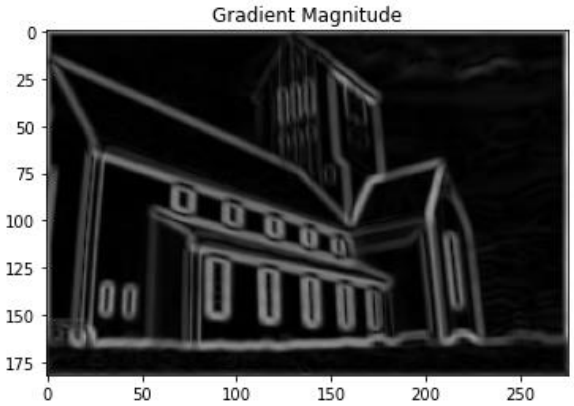


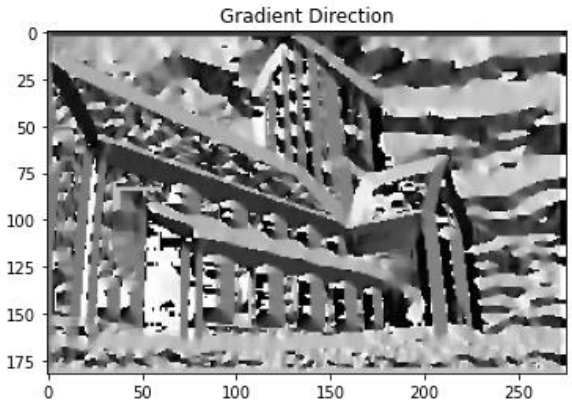


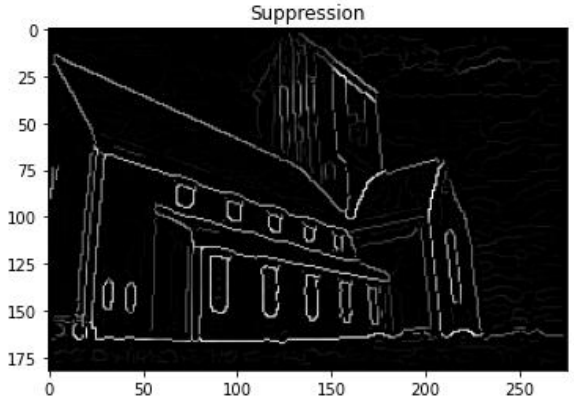




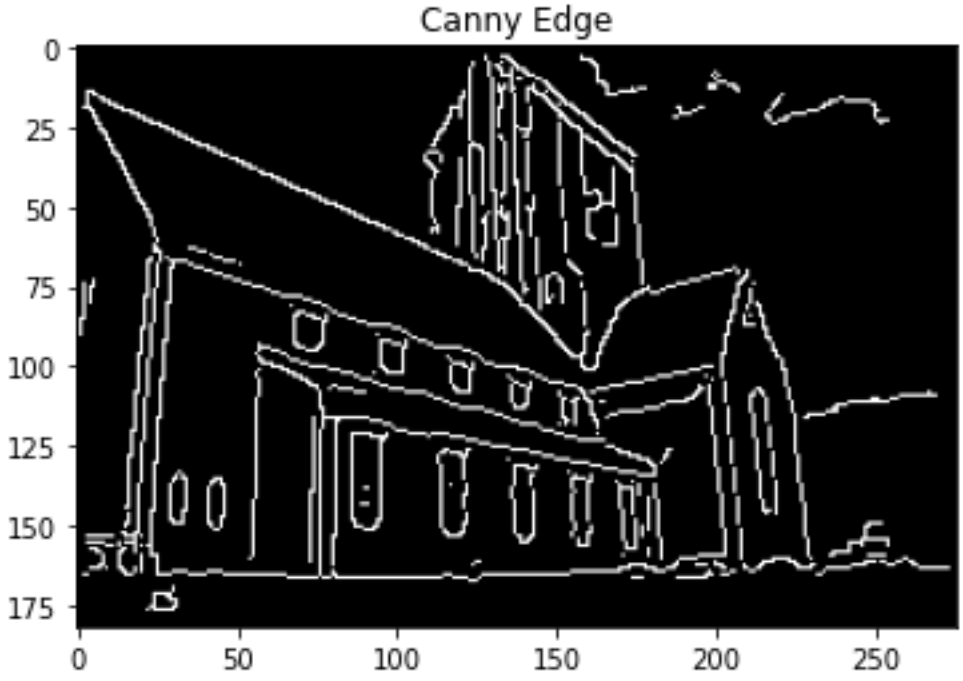



Gradient Magnitude


Gradient Direction


Suppression


threshold


Canny Edge

Question 3

Please refer to python code iborwick_250950449_asn3_q3.py for source code

Window size = 4 k =0.1 threshold = 100000000