1.2 $(f*h)[m,n] = \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} f[i,j]\cdot h[m-i, n-j]$

$(h*f)[m,n] = \sum_{p=-\infty}^{\infty} \sum_{k=-\infty}^{\infty} h[p,k]\cdot f[m-p, n-k]$

Let $p = m-i$, $k = n-j$, then $(h*f)[m,n] = \sum_{m-i=-\infty}^{\infty} \sum_{n-j=-\infty}^{\infty} h[m-i, n-j]\, f[$

$m-(m-i), n-(n-j)] = \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} h[m-i, n-j]\, f[i,j] = f*h[m,n]$

Thus, $f*h = h*f$, the convolution is commutative.

Scanned with CamScanner

1.3. $S[a \cdot f_1 + b \cdot f_2] = \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} (a \cdot f_1[i,j] + b \cdot f_2[i,j]) \cdot h[m-i, n-j]$

$= \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} (a \cdot f_1[i,j] \cdot h[m-i,n-j]) + (b \cdot f_2[i,j] \cdot h[m-i,n-j])$

$= a \cdot S[f_1] + b \cdot S[f_2]$

$\cancel{S[f[m-m_0]}$,

$S[f[m-m_0, n-n_0]] = \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} h[i,j] f[m-m_0-i, n-n_0-j]$

$= g[m-m_0, n-n_0]$

Scanned with CamScanner

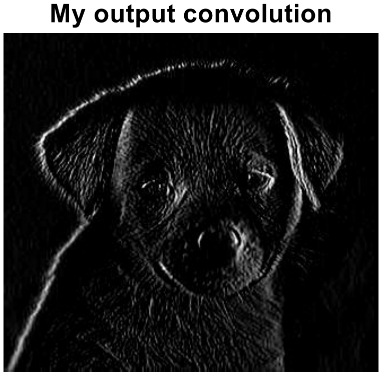
Hw1 – Xinmeng Li – A92092169

1.

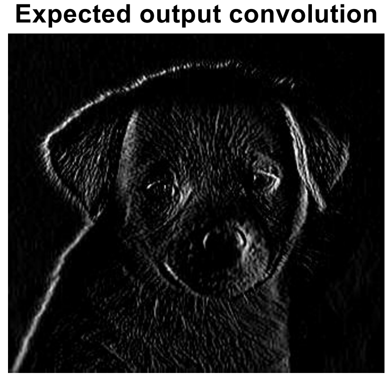
1.1

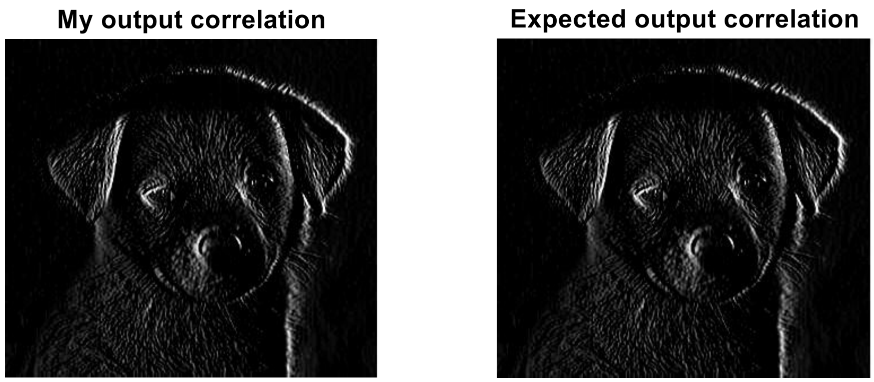
Original image

My output convolution



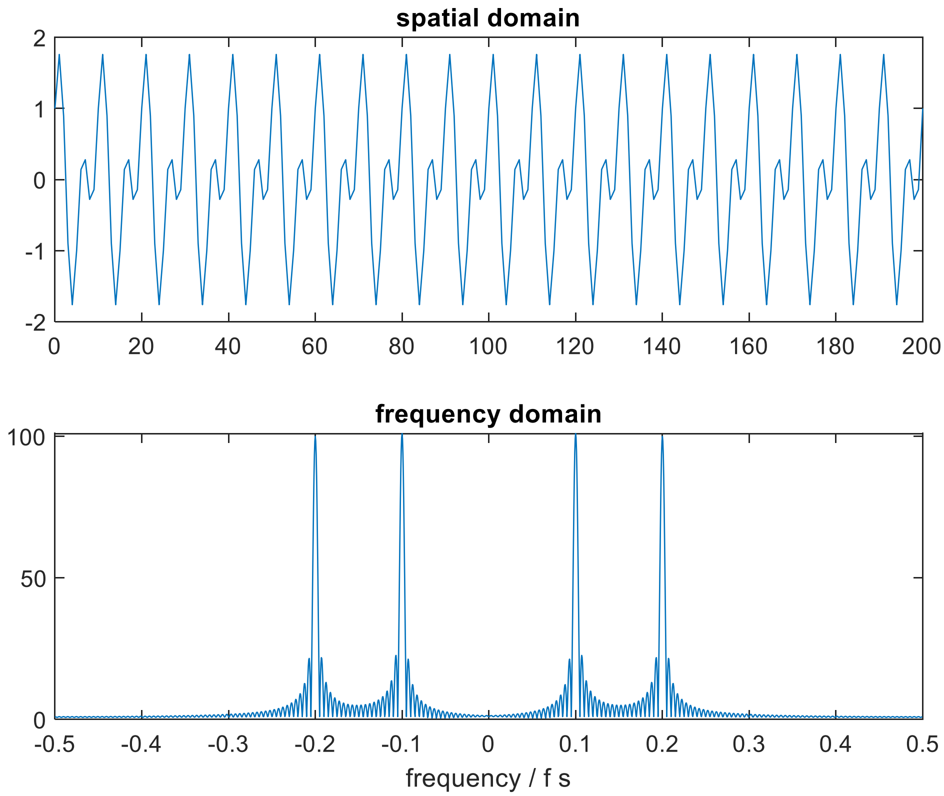
Expected output convolution



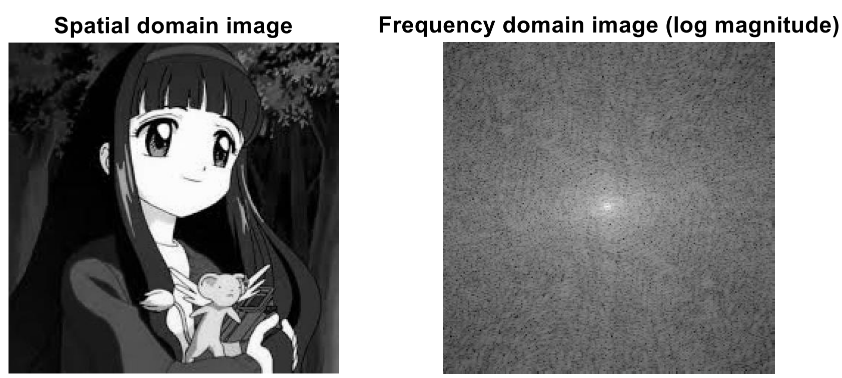


2.

2.1


spatial domain
frequency domain
frequency / f s

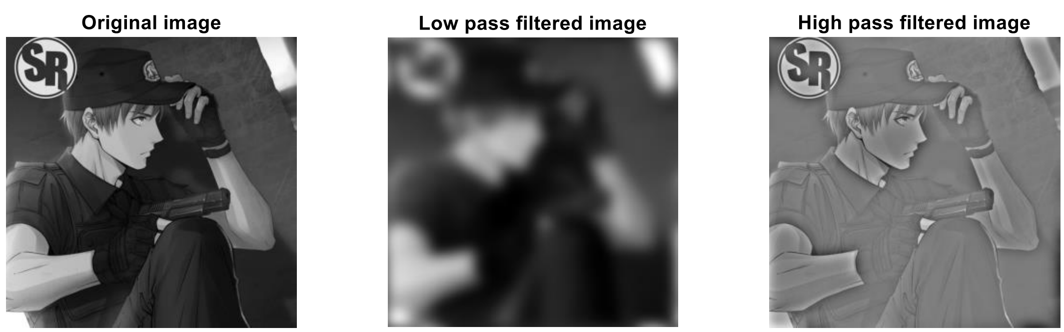
2.2


Spatial domain image
Frequency domain image (log magnitude)

2.3

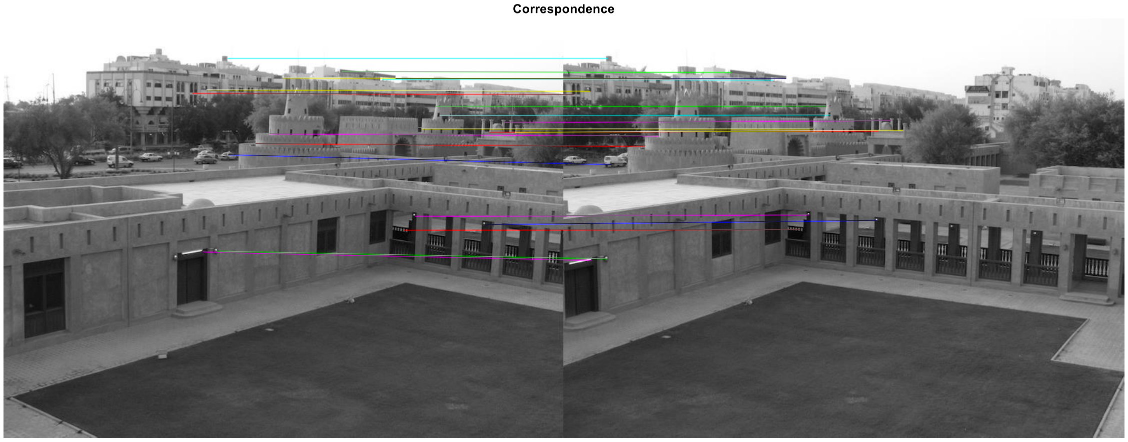

Original 237x274
Bad subsampling 119x137
Good subsampling 119x137
Correct subsampling 119x137

2.4


Original image
Low pass filtered image
High pass filtered image

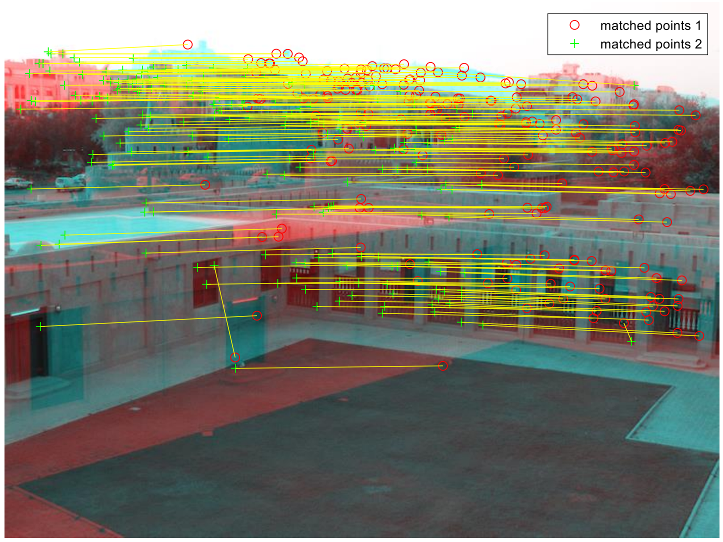
3.

Correspondence



Keypoints in image 1

Keypoints in image 2



4.

I chose filter 2 and 6.

Filter2 = -0.0680 -0.0658 -0.0416

-0.0499 -0.0804 -0.0728

0.0134 -0.0593 -0.0758

This filter blurs the image, as all of its entries are close, and thus the value for each point becomes the average of values of all of the neighbors times some coefficients.

It also flips the color, as it change the signs of all the pixels.

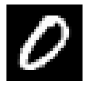
Filter6 = 0.1397 -0.0792 -0.0894

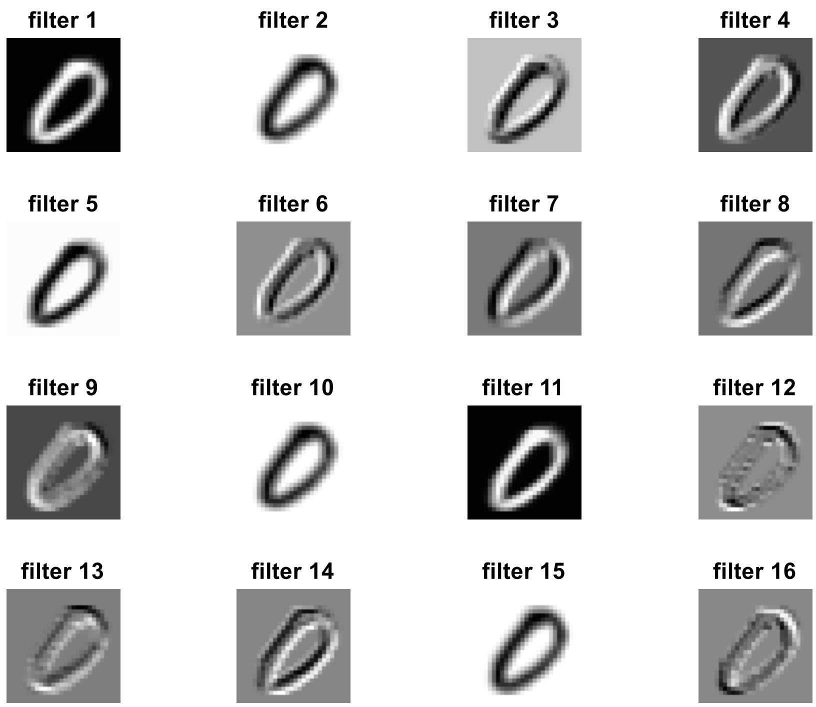
0.0793 -0.1105 -0.0060

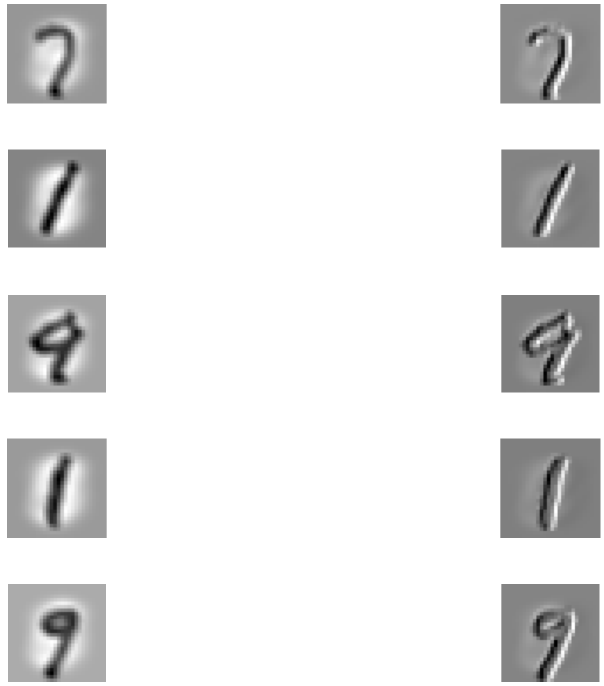
0.0073 -0.0438 0.0453

This filter addresses the vertical edge , as the left column entries are positive and most of the rest entries are negative.

Predicted: 0, Actual: 0

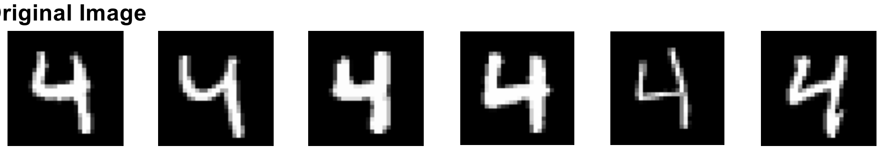






Original Image

Original Image



5. ~20 hours