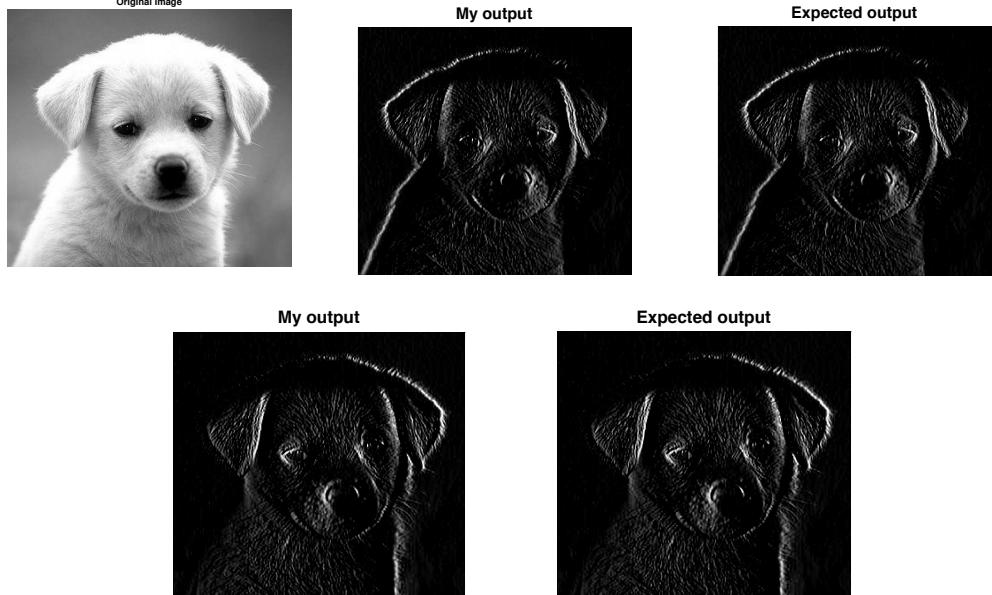


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CSE152 HW1

1.1



1.2

$$\begin{aligned}
 (f * h)[m, n] &= \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} f[i, j] \cdot h[m-i, n-j] \\
 &= \sum_{m'=-\infty}^{\infty} \sum_{n'=-\infty}^{\infty} f[m-m', n-n'] \cdot h[m', n'] \\
 &= \sum_{m'=-\infty}^{\infty} \sum_{n'=-\infty}^{\infty} h[m', n'] \cdot f[m-m', n-n'] \\
 &= (h * f)[m, n] \quad \# \text{ by definition}
 \end{aligned}$$

let $m' = m - i$
 $n' = n - j$
 $i = 0 \rightarrow m' = -\infty$
 $j = 0 \rightarrow n' = -\infty$
 $i = \infty \rightarrow m' = -\infty$
 $j = \infty \rightarrow n' = -\infty$
 $i = -\infty \rightarrow m' = \infty$
 $j = -\infty \rightarrow n' = \infty$

1.3 linearity

$$\begin{aligned}
 S[a \cdot f_1 + b \cdot f_2] &= (a \cdot f_1 + b \cdot f_2) * h = \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} (a \cdot f_1[i, j] + b \cdot f_2[i, j]) \cdot h[m-i, n-j] \\
 &= a \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} f_1[i, j] \cdot h[m-i, n-j] + b \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} f_2[i, j] \cdot h[m-i, n-j] = a \cdot (f_1 * h) + b \cdot (f_2 * h) \\
 &= a \cdot S[f_1] + b \cdot S[f_2] \quad \#
 \end{aligned}$$

Shift invariance

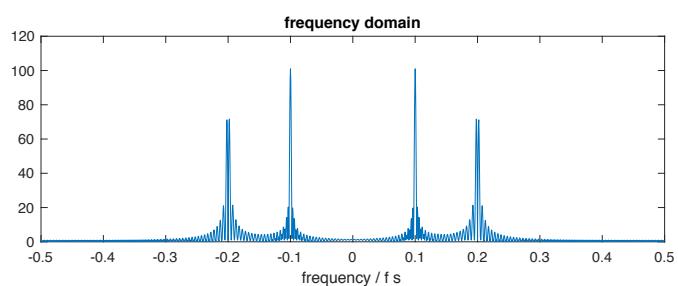
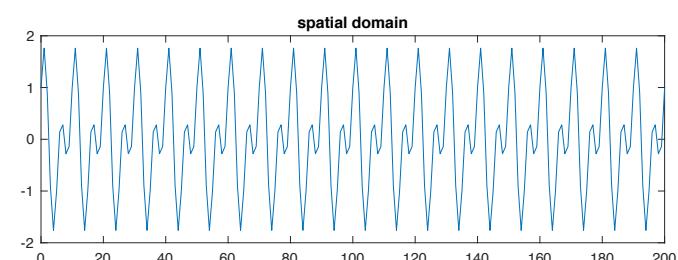
$$S[f[m, n]] = \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} h[i, j] f[m-i, n-j]$$

let $m' = m + m_0$, $n' = n + n_0$ Image translate from
 $m = m' - m_0$, $n = n' - n_0$ (m, n)

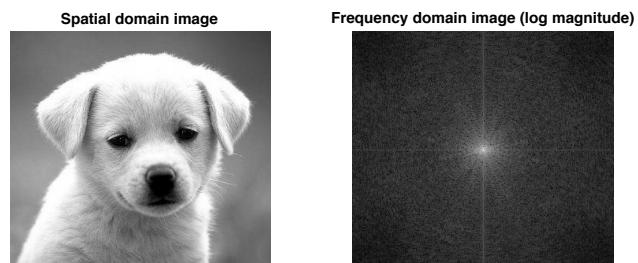
$$\sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} h[i, j] f[m'-m_0-i, n'-n_0-j] = S[f[m'-m_0, n'-n_0]]$$

#

2.1



2.2



2.3

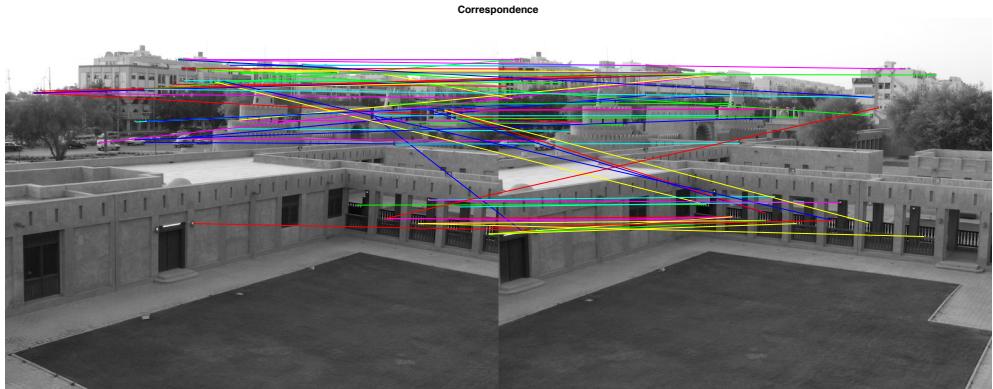


2.4

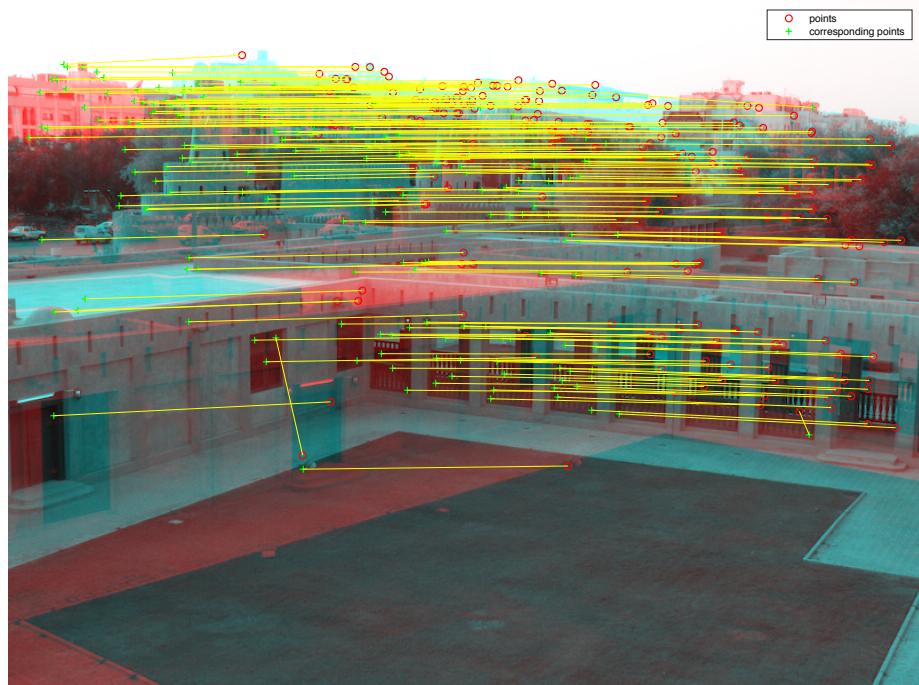


3.1



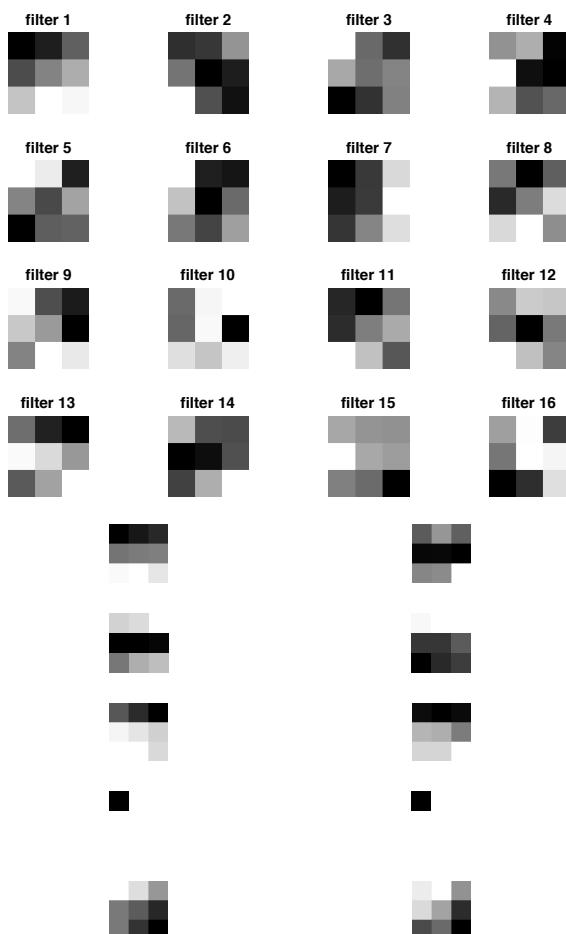


3.2



4

Predicted: 7, Actual: 7



leftmost pic is original.



leftmost pic is original.



leftmost pic is original.



5. 18hours