2812 Lab week 3:

Q1. $$G[i,j] = \sum_{u=-k}^{k} \sum_{v=-k}^{k} H[u,v]F[i-u, j-v]$$

Let $n = i - u \implies u = i - n$

$m = j - v \implies v = j - m$

$$G[i,j] = \sum_{i-n=-k}^{k} \sum_{j-m=-k}^{k} H[i-n, j-m]\, F[n,\ m]$$

$$G[i,j] = \sum_{n=i+k}^{k} \sum_{m=j+k}^{k} F[n,m]\, H[i-n, j-m]$$ F*H == H*F

Q2.

$$G[i,j] = \sum_{u=-k}^{k} \sum_{v=-k}^{k} H[u,v]F[i-u, j-v]$$ Convolution

$$G[i,j] = \sum_{u=-k}^{k} \sum_{v=-k}^{k} H[u,v]F[i+u, j+v]$$ Correlation

By cancelling common terms

$F[i-u,\ j-v] = F[i+u,\ j+v]$

Let $n = i-u$ && $m = j-v$

$F[n,\ m] = F[-n,\ -m]$

Q3.

$$g[n,m] = \frac{1}{9} \sum_{k=n-1}^{n+1} \sum_{l=m-1}^{m+1} f[k,l]$$

h

$\frac{1}{9}$

1	1	1
1	1	1
1	1	1

[n,m] is the centre of your 3x3 box

The two sum count all the boxes in the 3x3 box and add up the intensity of each square.

Then the intensity is averaged by dividing by 9.

This smoothes the centre square.

Q4.

Unfiltered	Gaussian Filter	Box Filter
		

Q5.

```
def G_1D(x, y, z):
    sum = 0
    kernel = np.array([1,2,1])
    for i in range(-1, 2):
        sum += kernel[i+1] * img[x][y+i][z]
    sum/=4
    return sum

def H_1D(x, y, z):
    sum = 0
    kernel = np.array([[1],[2],[1]])
    for i in range(-1, 2):
        sum += kernel[i+1] * img[x+i][y][z]
    sum = sum /4
    return sum
```

```
h = len(img)
w = len(img[0])

for i in range(0, h):
    for j in range(1, w-1):
        for k in range(3):
            img[i][j][k] = G_1D(i, j, k)

for i in range(1, h-1):
    for j in range(0, w):
        for k in range(3):
            img[i][j][k] = H_1D(i, j, k)
```

6.