Homework3

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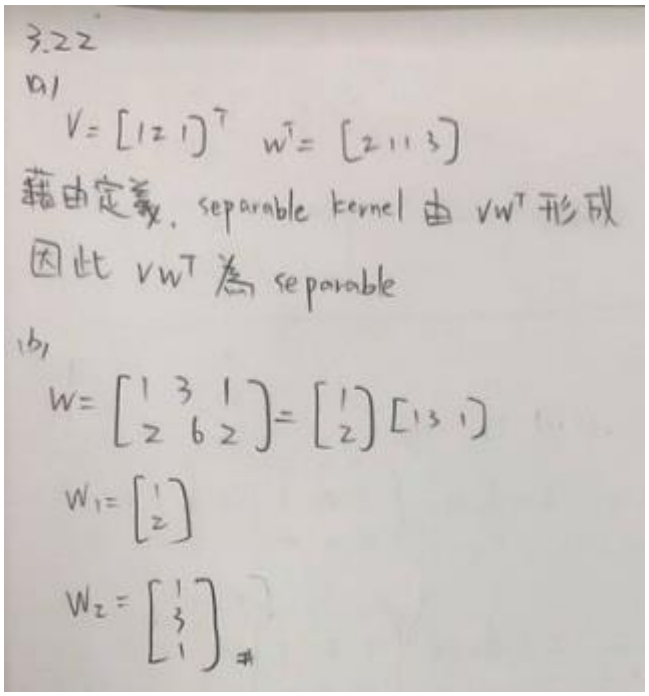
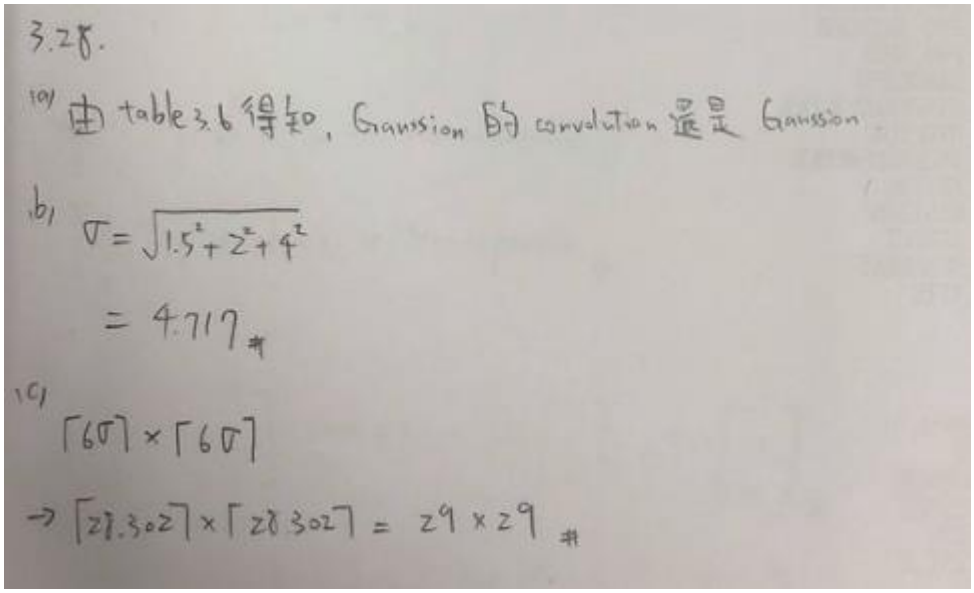
Part 1

3.22



3.28



3.44

3.44

(a)

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 0 & 0 \end{bmatrix} \quad \text{rank} = 2 \rightarrow \text{Nonseparable} \ \#$$

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 0 & 0 & 0 \end{bmatrix} \quad \text{rank} = 2 \rightarrow \text{Nonseparable} \ \#$$

(b)

$$\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \quad \text{rank} = 2 \rightarrow \text{Nonseparable} \ \#$$

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \quad \text{rank} = 2 \rightarrow \text{Nonseparable} \ \#$$

(c)

$$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \quad \text{rank} = 1 \quad V = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} \quad W = \begin{bmatrix} -1 \\ -2 \\ -1 \end{bmatrix} \ \#$$

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \quad \text{rank} = 1 \quad V = \begin{bmatrix} -1 \\ -2 \\ -1 \end{bmatrix} \quad W = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} \ \#$$

4.3

4.3

(a)

$$\delta(t) * \delta(t-t_0) = \int_{-\infty}^{\infty} \delta(\tau)\,\delta(t-t_0-\tau)\,d\tau = \delta(t-t_0) \ \#$$

(b)

$$\delta(t-t_0) * \delta(t+t_0) = \int_{-\infty}^{\infty} \delta(\tau-t_0)\,\delta(t+t_0-\tau)\,d\tau$$

$$\text{Let } \lambda = \tau - t_0$$

$$\tau = \lambda + t_0$$

$$\Rightarrow \int_{-\infty}^{\infty} \delta(\lambda)\,\delta(t-\lambda)\,d\lambda = \delta(t) \ \#$$

4.51

4.51

Laplacian kernel: $f(x+1,y)+f(x-1,y)+f(x,y+1)+f(x,y-1)-4f(x,y)$

從 table 4.4 得知

$$G(u,v)=F(u,v)\left[e^{j\frac{2\pi u}{M}}+e^{-j\frac{2\pi u}{M}}+e^{j\frac{2\pi v}{N}}+e^{-j\frac{2\pi v}{N}}-4\right]$$

$$=F(u,v)H(u,v)$$

$H(u,v)$ is the filter transfer function in frequency-domain

$$H(u,v)=2\left(\cos\frac{2\pi u}{M}+\cos\frac{2\pi v}{N}-2\right)$$

$H(u,v)$ 在 $\left[-\frac{M}{2},\frac{M}{2}\right]$ 的週期中.
- 在原点附近 → 靠近 0.
- 在極值附近 → 有最大的負值

∴ Laplacian kenel → high pass filter #