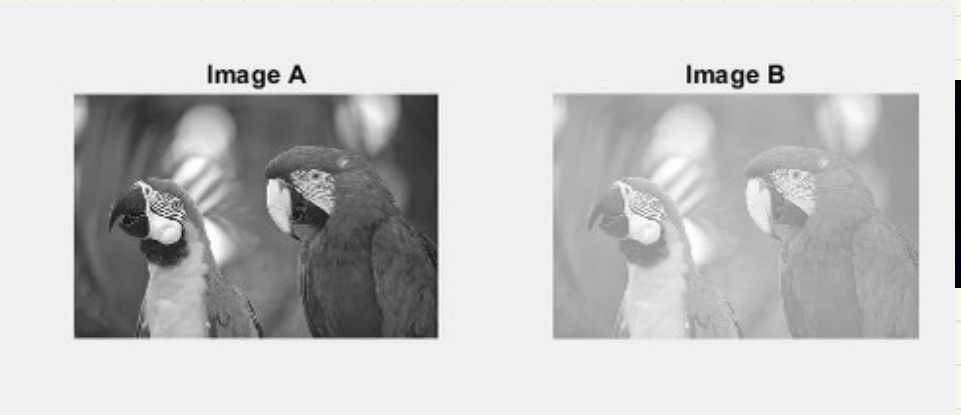
1.

$L = 255$

$C_1 \cdot C_2 = \frac{1}{\sqrt{L}}$

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>> HW4Q1
SSIM = 0.7209
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3.

$\exp(j\theta) = c + id$, $c = \cos\theta$, $d = \sin\theta$

$$\begin{bmatrix} c & -d \\ d & c \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

$\Rightarrow$

$$\begin{cases} \begin{bmatrix} \frac{\sqrt{3}}{2} & -\frac{1}{2} \\ \frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}, \theta = \frac{\pi}{6} \\ \begin{bmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix}, \theta = \frac{\pi}{4} \\ \begin{bmatrix} \frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{bmatrix}, \theta = \frac{\pi}{3} \\ \begin{bmatrix} -\frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & -\frac{1}{2} \end{bmatrix}, \theta = \frac{2}{3}\pi \end{cases}$$

$\Rightarrow \theta = \frac{i\pi}{6}$, $\theta = \frac{i\pi}{4}$ $(i \in \mathbb{N})$ //

4.

$M \times N \times P$ DCT = $M \times$ 1D N-Poing DCT + $N \times$ 1D M-Poing DCT

+ $P \times$ 2D $M \times N$ DCT

$\Rightarrow$ complexity = $MN \log N + NM \log M + PMN \log MN$

$= MN \log MN + PMN \log MN$

$= (P+1) MN \log MN$

#

5

$$\begin{bmatrix} X[1] \\ X[2] \\ X[3] \\ X[4] \end{bmatrix} = \begin{array}{c} \\ m=1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} \begin{array}{cccc} n=1 & 2 & 3 & 4 \end{array} \\ \begin{bmatrix} a & b & b & a \\ b & a & -a & -b \\ b & -a & -a & b \\ a & -b & b & -a \end{bmatrix} \end{array} \begin{bmatrix} x[1] \\ x[2] \\ x[3] \\ x[4] \end{bmatrix}$$

$a = 0.5878$

$b = 0.9511$

$$\Rightarrow \begin{cases} X[1] = a(x[1]+x[4]) + b(x[2]+x[3]) \\ X[2] = a(x[2]-x[3]) + b(x[1]-x[4]) \\ X[3] = -a(x[2]+x[3]) + b(x[1]+x[4]) \\ X[4] = a(x[1]-x[4]) + b(x[3]-x[2]) \end{cases}$$

$$\Rightarrow \begin{bmatrix} X[1] \\ X[3] \end{bmatrix} = \begin{bmatrix} a & b \\ b & a \end{bmatrix} \begin{bmatrix} x[1]+x[4] \\ x[2]+x[3] \end{bmatrix}$$

$$\Rightarrow 2MULs + 2MULs = 4MULs$$

$$\begin{bmatrix} X[2] \\ X[4] \end{bmatrix} = \begin{bmatrix} a & b \\ -b & a \end{bmatrix} \begin{bmatrix} x[2]-x[3] \\ x[1]-x[4] \end{bmatrix}$$

6.

(a)

$$MVL_{143} = 11MVL_{13} + 13MVL_{11}$$
$$= 11 \times 52 + 13 \times 40$$
$$= 572 + 520$$
$$= 1092$$

(b)

$$MVL_{195} = 15MVL_{13} + 13MVL_{15}$$
$$= 15 \times 52 + 13 \times 40$$
$$= 780 + 520$$
$$= 1300$$

(c)

$$MVL_{196} = 14MVL_{14} + 14MVL_{14}$$
$$= 14 \times 32 + 14 \times 32$$
$$= 896$$