Quiz3:

Get the IDCT for the block of 2x2 image below:

9.5	3.5
2.5	4.5

Ans.:

N=2 → u and v=0,1

$$f(0,0) = \sum_{x=0}^{1}\sum_{y=0}^{1}\sqrt{\frac{1}{2}}\times\sqrt{\frac{1}{2}}\times C(x,y)$$

$$f(0,0) = \sum_{x=0}^{1}\sum_{y=0}^{1}\frac{1}{2}\times f(x,y) = 0.5\ \times (9.5+3.5+2.5+4.5)$$

$$f(0,0) = 10$$

$$f(0,1) = \sum_{x=0}^{1}\sum_{y=0}^{1}\sqrt{\frac{1}{2}}\times\sqrt{\frac{2}{2}}\times C(x,y)\cos\left[\frac{\pi(2y+1)}{4}\right]$$

$$f(0,1) = 0.7071\times[(9.5\times 0.7071)+(3.5\times -0.7071)+(2.5\times 0.7071)+(4.5\times -0.7071)]$$

$$f(0,1) = 0.7071\times[6.71745-2.47485+1.76775-3.18195]$$

$$f(0,1) = 1.99994246 \cong 2$$

$$f(1,0) = \sum_{x=0}^{1}\sum_{y=0}^{1}\sqrt{\frac{2}{2}}\times\sqrt{\frac{1}{2}}\times C(x,y)\cos\left[\frac{\pi(2x+1)}{4}\right]$$

$$f(1,0) = 0.7071\times[(9.5\times 0.7071)+(3.5\times 0.7071)]+[(2.5\times -0.7071)+(4.5\times -0.7071)]$$

$$f(1,0) = 0.7071\times[3.5355+0.7071+0+1.4142]$$

$$f(1,0) = 0.7071\times 5.6568 = 2.99992328 \cong 3$$

$$f(1,1) = \sum_{x=0}^{1}\sum_{y=0}^{1}\sqrt{\frac{2}{2}} \times \sqrt{\frac{2}{2}} \times C(x,y)\cos\left[\frac{\pi(2x+1)}{4}\right]\cos\left[\frac{\pi(2y+1)}{4}\right]$$

$$f(1,1) = 1 \times [(9.5 \times 0.7071 \times 0.7071) + (3.5 \times 0.7071 \times -0.7071)] + [(2.5 \times -0.7071 \times 0.7071) + (4.5 \times -0.7071 \times -0.7071)]$$

$$f(1,1) = [2.49995205 - 0.49999041 + 0 - 0.99998082]$$

$$f(1,1) = 3.99998082 \cong 4$$

The result of DCT:

10	2
3	4

Tutorials:

To compute the entropy of a fair image, we first define its distribution: P(X = 1) = 0.5 , P(X = 2) = 0.5

Ans:

$$H(P) = -\sum_{x\in\{1,2\}} P(x)\ \log P(x)$$

$$H(P) = -\lfloor 0.5\ \times \log 0.5\ + 0.5\ \times \log 0.5 \rfloor$$

$$H(P) = -\lfloor -0.5 + \ -0.5 \rfloor$$

$$H(P) = 1.$$

Find the Channel Capacity (C), if the signal-noise ratio =20 dB and N=2

Ans.:

$$\mathrm{C} = \frac{N}{2ln2}\ln\left[1 + \frac{\gamma^2}{\sigma^2}\right]$$

$$\mathrm{C} = \frac{2}{(2*0.69)} * \ln[1+20]$$

$$\mathrm{C} = 1.442 * \ln[21]$$

$$\mathrm{C} = 1.442 * 3.0445$$

C= 4.39

If σ^2> Th; what is the value of γ^2.

Ans.:

If the conditions of the threshold are

$$\begin{cases} \gamma_i^2 + \sigma_i^2 = Th, & if \ \ \sigma_i^2 < Th \\ \gamma_i^2 = 0, & if \ \ \sigma_i^2 > Th \end{cases}$$

Therefore,

$\boldsymbol{\gamma^2 = 0}$

Let X be of image with probability distribution defined by P(X = 1) = 1/2 , P(X = 2) = 1/4 , P(X = 3) = 0, P(X = 4) = 0, P(X = 5) = 1/8 , and P(X = 6) = 1/8; Find the Entropy, then Find the signal-noise ratio SNR, if the signal power =91 and the noise power=5 .

Ans.:

$$H(P) = -\sum_{x\in\{1,2,3,4,5,6\}} P(x)\ \log P(x)$$

$$H(P) = -\left[1/2\ \times \log 1/2\ + 1/4\ \times \log\frac{1}{4} + + 0\log 0\ +\ 0\log 0\ +\ 1/8\log 1/8\ +\ 1/8\log 1/8\right]$$

$$H(P) = -\left[-1/2\ +\ -1/2\ +\ 0\ +\ 0\ +\ -3/8\ +\ -3/8\right]$$

$\mathbf{E = 1.75}$.

$$SNR = \ln\frac{\gamma^2}{\sigma^2}$$

$$SNR = \ln\frac{91^2}{5^2} = \ln\frac{8{,}281}{25} = 5.802\text{dB}$$

$\mathbf{SNR = 5.802dB}$