DCT / IDCT (Based on the DCT wiki link shared on GS)

1D - DCT :-

Assume a 1D signal → $x_0, x_1, \ldots x_{N-1}$

Then its 1D - DCT transform is given by $X_0, X_1, \ldots, X_{N-1}$,

where,

$$X_k = \sqrt{\frac{2}{N}} \sum_{n=0}^{N-1} x_n \cos\left[\frac{\pi}{N}\left(n+\frac{1}{2}\right)\left(k+\frac{1}{2}\right)\right] \quad - (A)$$

$k = 0, 1, \ldots, N-1$

1D - IDCT :-

Assume you are given $X_0, X_1, \ldots X_{N-1}$ → 1D - DCT

To compute 1D signal you perform inverse DCT operati,

$$x_n = \sqrt{\frac{2}{N}} \sum_{k=0}^{N-1} X_k \cos\left[\frac{\pi}{N}\left(n+\frac{1}{2}\right)\left(k+\frac{1}{2}\right)\right] \quad - (B)$$

$n = 0, 1, \ldots, N-1$

Note that (A) & (B) are same functions. ~~expex except for~~ ~~[illegible]~~.

∴, if you have a function $y = \text{1D\_dct}(x)$ implemented in MATLAB ~~[illegible]~~ that is based on eqn (A). then,

$$\boxed{X = \text{1D\_dct}(x)}$$

where x is $N \times 1$ vector. X is $N \times 1$ vector.

To ~~compute~~ recover input from X we can use the Same function :-

$$\boxed{x_r = \text{1D\_dct}(X)}$$

2D - DCT :-

Assume your 2D input image is as follows:-

$$
N_1 \left\{ \underbrace{\begin{bmatrix} x_{0,0} & x_{0,1} & \cdots & x_{0,N_2-1} \\ x_{1,0} & & & \vdots \\ \vdots & & & \\ x_{N_1-1,0} & & \cdots & x_{N_1-1,N_2-1} \end{bmatrix}}_{N_2} \right.
$$

Then, 2D-DCT is given by :-

$$
X_{k_1,k_2} =
$$

$$
\sqrt{\frac{4}{N_1 N_2}} \sum_{n_1=0}^{N_1-1} \left(\sum_{n_2=0}^{N_2-1} x_{n_1,n_2} \cos\left[\frac{\pi}{N_2}\left(n_2+\frac{1}{2}\right)\left(k_2+\frac{1}{2}\right)\right] \right) \times \cos\left[\frac{\pi}{N_1}\left(n_1+\frac{1}{2}\right)\left(k_1+\frac{1}{2}\right)\right]
$$

for $k_1 = 0, \ldots, N_1 - 1$

$k_2 = 0, \ldots, N_2 - 1$

2D - IDCT :-

$$x_{n_1, n_2} =$$

$$\sqrt{\frac{4}{N_1 N_2}} \sum_{k_1=0}^{N_1-1} \left(\sum_{k_2=0}^{N_2-1} X_{k_1, k_2} \cos\left[\frac{\pi}{N_2}\left(n_2+\frac{1}{2}\right)\left(k_2+\frac{1}{2}\right)\right] \right) \cos\left[\frac{\pi}{N_1}\left(n_1+\frac{1}{2}\right)\left(k_1+\frac{1}{2}\right)\right]$$

for, $n_1 = 0, \ldots, N_1 - 1$
$n_2 = 0, \ldots, N_2 - 1$

Again, as in 1D-DCT case, if you have a function to implement 2D-DCT you could use the exact same function to compute 2D-IDCT. ~~and multiply by a factor~~