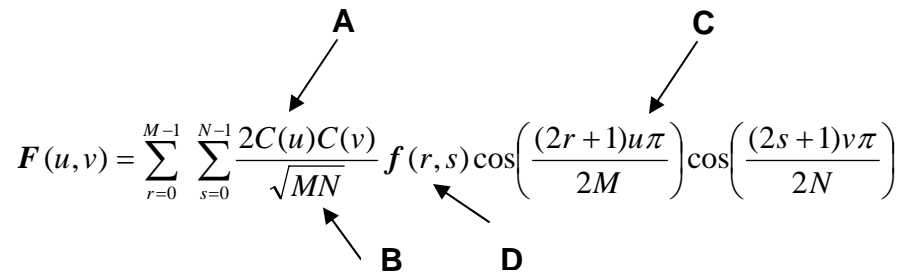


Supplement to Chapter 2 of *The Science of Digital Media* – Digital Image Representation

Worksheet – Digital Imaging > Discrete Cosine Transform¹

Before completing this worksheet, you should view the on-line interactive tutorial “Discrete Cosine Transform.” This tutorial can be accessed at the website for *The Science of Digital Media*.

1. Briefly explain what each of the following elements of the DCT equation represents.

$$F(u, v) = \sum_{r=0}^{M-1} \sum_{s=0}^{N-1} \frac{2C(u)C(v)}{\sqrt{MN}} f(r, s) \cos\left(\frac{(2r+1)u\pi}{2M}\right) \cos\left(\frac{(2s+1)v\pi}{2N}\right)$$


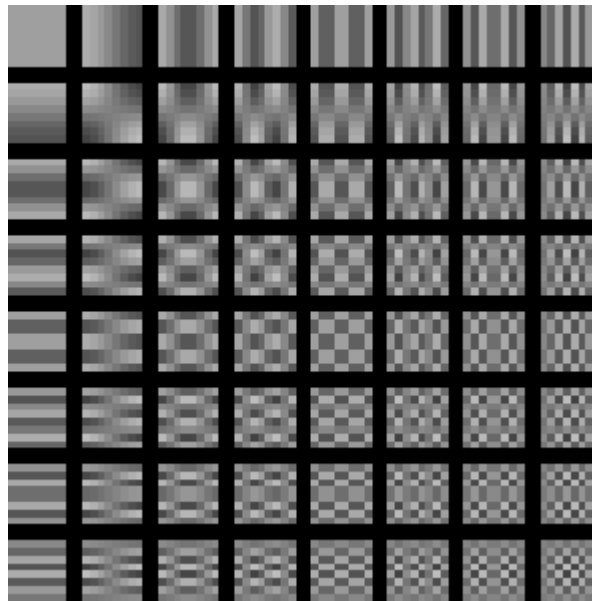
2. For the input array of pixel brightness values shown below, calculate the value of $F(0,2)$ using the above formula and the proper values for $C(u)$ and $C(v)$ as given below.

$$C(\delta) = \frac{\sqrt{2}}{2} \text{ if } \delta = 0 \text{ otherwise } C(\delta) = 1$$

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100	100	100	100	100	100	100	100
103	103	103	103	103	103	103	103
110	110	110	110	110	110	110	110
116	116	116	116	116	116	116	116
123	123	123	123	123	123	123	123
115	115	115	115	115	115	115	115
109	109	109	109	109	109	109	109
98	98	98	98	98	98	98	98

3. Is the value at $F(0,2)$ zero or nonzero? According to the explanation given in the tutorial and the values in the input array, why does this occur?



4. Briefly explain how the DCT can be utilized in image compression algorithms such as JPEG.