# 6.3000: Signal Processing

**Filtering Images** 

April 29, 2025

Which of the following space-domain images can be constructed by filtering one of the other images by the DFT of another of them?



The brightnesses of the black pixels are zero. The brightnesses of the white pixels are greater than zero. The brightnesses of all white pixels in a given image are the same, but those of white pixels in one image may differ from those in a different image.

Filter model:



Space-domain interpretation:

$$x[r,c] \longrightarrow h[r,c] \longrightarrow y[r,c] = \frac{1}{RC} (x \circledast h)[r,c]$$

Frequency-domain interpretation:

$$X[k_r, k_c] \longrightarrow H[k_r, k_c] \longrightarrow Y[k_r, k_c] = X[k_r, k_c]H[k_r, k_c]$$

We should be able to understand the previous problem both ways.

Which of the following images can be constructed by

- circularly convolving two of the other images
- inverse transforming the product of the DFTs of two images



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#### Try the transform method.



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#### Try the transform method.

 $DFT(D) \propto DFT(A) \times DFT(C)$  $DFT(D) \propto DFT(B) \times DFT(C)$ 



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which of A-F (if any) shows the iDFT of the real part of X?



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which of A-F (if any) shows the iDFT of the real part of X? C



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of the imaginary part of X?



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of the imaginary part of X? None



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of j times the imaginary part of X?



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of j times the imaginary part of X? E



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after setting X[0,0] = 0.



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after setting X[0,0] = 0. A



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after multiplying every value by  $e^{j\pi}$ .



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after multiplying every value by  $e^{j\pi}.$  D



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after multiplying every value except X[0,0] by  $e^{j\pi}.$ 



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after multiplying every value except X[0,0] by  $e^{j\pi}.~{\rm B}$ 



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after negating the phase of each point in X.



Let  $X[k_r, k_c]$  represent the 2D DFT of the following image.



Which (if any) shows the iDFT of X after negating the phase of each point in  $X.\ {\rm F}$ 

