6.300: Signal Processing

Tutorial Topic 2D Convolution
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2D Convolution

Convolution of 2D signals in the spatial domain corresponds to multiplication of 2D DTFTs.

$$(f_1 * f_2)[r, c] = \text{DTFT}^{-1}\{F_1(\Omega_r, \Omega_c)F_2(\Omega_r, \Omega_c)\}$$

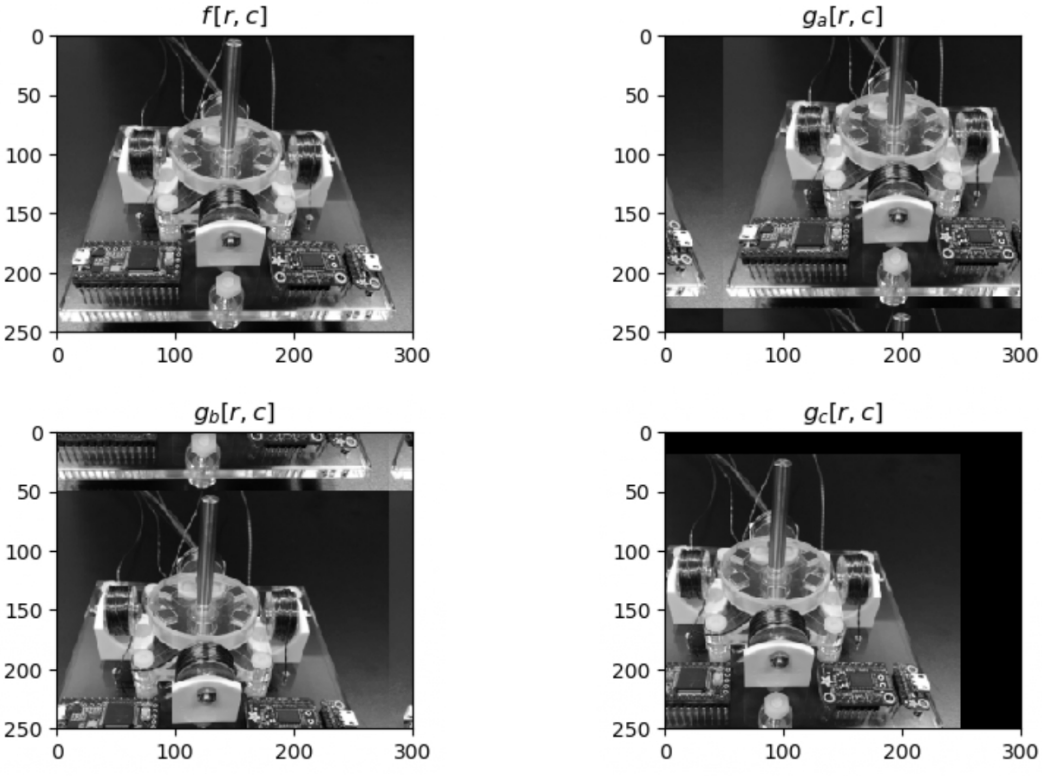
2D Circular Convolution

Circular convolution of 2D signals in the spatial domain corresponds to multiplication of 2D DFTs.

$$(f_1 \circledast f_2)[r, c] = RC \cdot \text{DFT}^{-1}\{F_1[k_r, k_c]F_2[k_r, k_c]\}$$

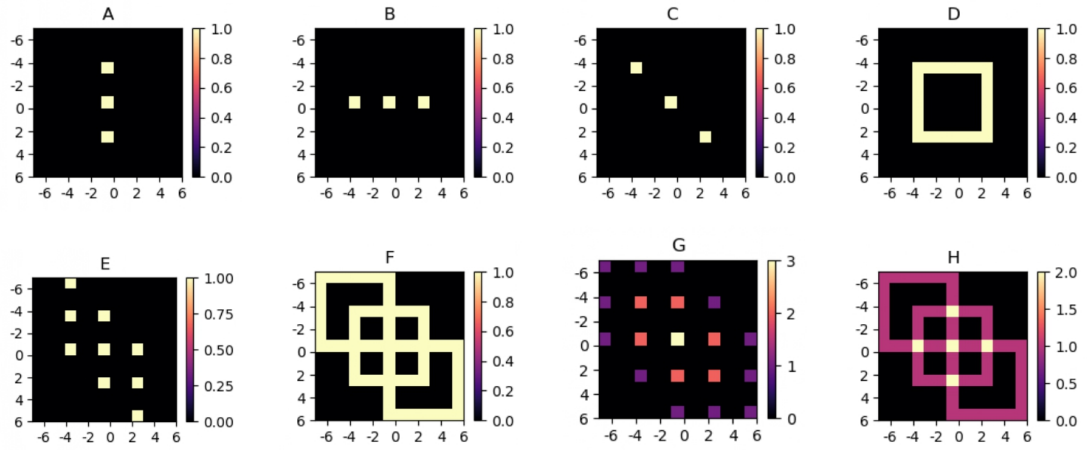
Picture Convolutions: Match an Expression to Each Image

$$g_1[r, c] = f[r, c] * \delta[r{-}20, c{+}50] \qquad g_4[r, c] = f[r, c] \circledast \delta[r{-}20, c{+}50]$$
$$g_2[r, c] = f[r, c] * \delta[r{+}20, c{-}50] \qquad g_5[r, c] = f[r, c] \circledast \delta[r{+}20, c{-}50]$$
$$g_3[r, c] = f[r, c] * \delta[r{-}50, c{+}20] \qquad g_6[r, c] = f[r, c] \circledast \delta[r{-}50, c{+}20]$$



2D Convolution

Which of the following images can be constructed by convolving two of the other images?



2D Circular Convolution

Which of the following images can be constructed by circularly convolving two of the other images?