# Congratulations! You passed!

**Grade received** 100%

**Latest Submission Grade** 100%

**To pass** 70% or higher

**Go to next item** Retake the assignment in **7h 59m**

**1.** Which of the following operations would fall in the category of pixel processing? **1 / 1 point**

- (selected) $I_2(x,y) = I_1^2(x,y) + \log I_1(x,y)$
- $I_2(x,y) = I_1(x^2, y^2)$
- $I_2(x,y) = I_1(ax+b, cx+d)$
- $I_2(x,y) = I_1(\log x, \log y)$

**Correct**
Pixel processing is changing the intensity at each pixel based solely on the current value of the intensity at the pixel.

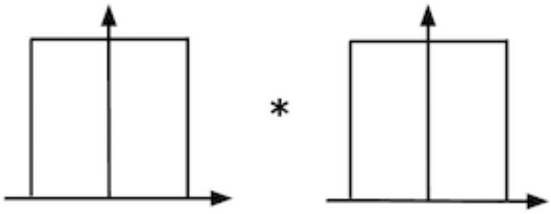
**2.** Which of the following is the expression for 1D convolution? **1 / 1 point**

- $g(x) = \int_{-1}^{1} f(\tau)h(x-\tau)d\tau$
- $g(x) = \int_{-\infty}^{\infty} f(\tau)h(\tau-x)d\tau$
- $g(x) = f(\tau)\int_{-\infty}^{\infty} h(x-\tau)d\tau$
- (selected) $g(x) = \int_{-\infty}^{\infty} f(\tau)h(x-\tau)d\tau$

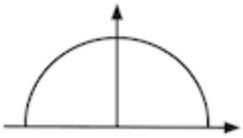
**Correct**
See definition of convolution.

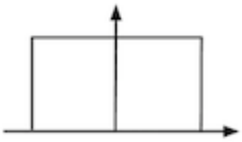
**3.**

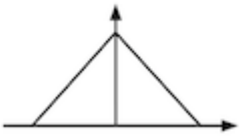
**2 / 2 points**

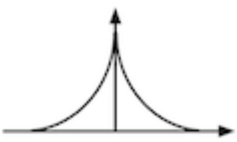


Which of these is the result of the convolution of the two 1D signals shown?

- [ ] 

- [ ] 

- [x] 

- [ ] 

**Correct**

Sketch out the solution.

**4.** Given two images $A$ and $B$, suppose that after convolving each image with function $f$ we get a circle and a square, respectively, centered at the origin. Suppose we shift $A$ to the left and $B$ to the right and overlay the two images to form image $C$. What is the result of convolving image $C$ with $f$? **2 / 2 points**

- ( ) A circle to the right of a square
- (•) A circle to the left of a square
- ( ) A circle and square centered at the origin
- ( ) None of the above

**Correct**
Convolution is a LSIS which means that adding, shifting or scaling inputs before a convolution is equivalent to applying those same transformations after convolution.

**5.** There exists a convolution which can flip an image about its horizontal axis: **2 / 2 points**

- ( ) True
- (•) False

**Correct**
Convolutions must be shift invariant. Shifting all the pixels of an image up and then flipping is not equivalent to flipping an image and then shifting it up by the same amount.

**6.** You can find the impulse response (point blur function) of a camera by showing it: **1 / 1 point**

- ( ) The sun
- ( ) The moon
- ( ) The sky
- (•) A distant star

**Correct**
A distant bright star is equivalent to an impulse function, which is

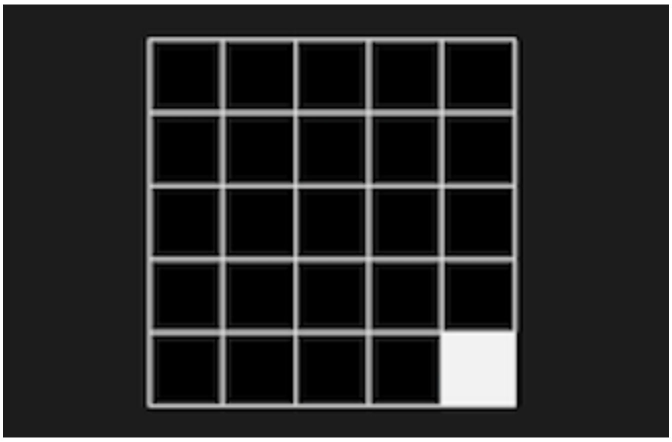
infinitesimally small and very bright (like a delta function). The image of the star directly yields the impulse response.

**7.** Which of the following is not a property of convolution? **1 / 1 point**

- ○ $a(x) * b(x) = b(x) * a(x)$
- ○ $(a(x) * b(x)) * c(x) = a(x) * (b(x) * c(x))$
- ○ $a(x) * b(x) + a(x) * c(x) = a(x) * (b(x) + c(x))$
- ◉ $a(x) \cdot b(x) = a(x) * b(x)$

**Correct**
The first answer choice is the commutative property, the second answer choice is the associative property, and the third answer choice is the distributive property of convolution. The last answer choice is not valid.

**8.** **1 / 1 point**

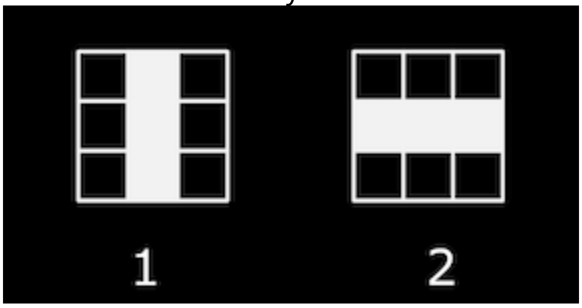


The convolution of an image with the mask shown above will:

- ○ Not effect the image
- ○ Shift the image left and up by 2 pixels each
- ◉ Shift the image right and down by 2 pixels each
- ○ Brighten the image

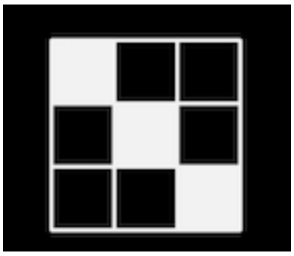
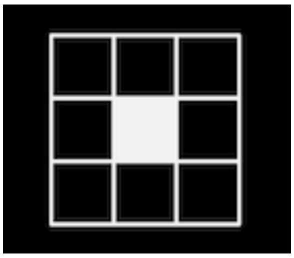
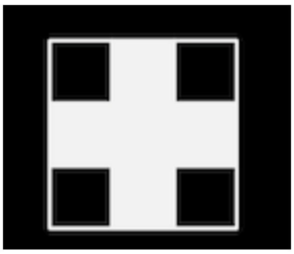
Correct

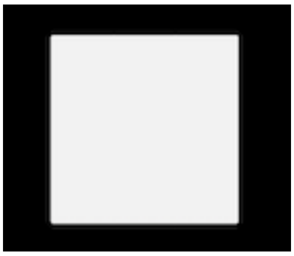
See how convolution works. Note that the mask will be flipped vertically and horizontally.

**9.** 


**2 / 2 points**

Convolving an image with the masks 1 and 2 in succession is equivalent to convolving the image with the following single mask:

- 
- 
- 



Correct

The single mask is simply a convolution of the first two. This is the associative property of convolution.

**10.** Median filtering for noise removal can be implemented as: **1 / 1 point**

- Convolution
- Correlation
- Gaussian smoothing
- None of the above

Correct

Median filtering is a non-linear operation, since it involves selecting a median (a non-linear operation). All the other operations listed are all linear.

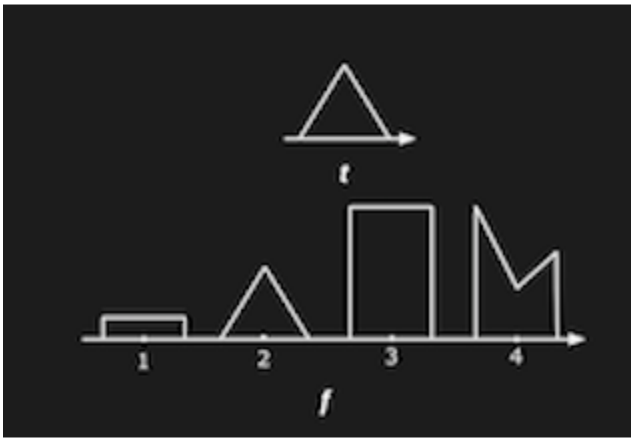
**11.** Which of the following is the expression for 2D discrete correlation? **1 / 1 point**

- $R_{tf}[i,j] = \sum_m \sum_n f[m,n]t[i-m,j-n]$
- $R_{tf}[i,j] = \sum_m \sum_n f[m,n]t[m-i,n-j]$
- $R_{tf}[i,j] = \sum_m \sum_n f[m,n] + t[m-i,n-j]$
- $R_{tf}[i,j] = \sum_m \sum_n t[m-i,n-j]$

Correct

See definition of 2D discrete correlation.

**12.** 




**2 / 2 points**

The simple correlation $R_{tf}[i, j]$ between the template $t$ and the signal $f$ would produce a maximum value at:

- ○ 1
- ○ 2
- ◉ 3
- ○ 4

**Correct**

At 3 the value of the integral of the product of the template $t$ and the signal $f$ would be maximized.