

Supplement to Chapter 3 of *The Science of Digital Media* – Digital Image Processing

Worksheet – Digital Imaging > Convolution Masks¹

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

1. In the space below, write out the calculation that the convolution mask shown below would make when placed over the pixels in the *top left* of the image below (highlighted in red). Then perform the calculations and give the result that would be substituted after the mask was applied.

255	255	255	255
255	255	255	255
255	255	255	255
0	0	0	0
0	0	0	0
0	0	0	0

-1	-1	-1
-1	9	-1
-1	-1	-1

2. Explain how a convolution mask is able to detect edges within an image *without* using a transform to convert it to the frequency domain.

¹This material is based on work supported by the National Science Foundation under Grant No. DUE-0340969. This worksheet was written by Todd Martin and Jennifer Burg.

3. Why is a convolution mask like the one shown below called a low-pass filter? (HINT: Think in the frequency domain.) How is it able to blur an image?

$1/9$	$1/9$	$1/9$
$1/9$	$1/9$	$1/9$
$1/9$	$1/9$	$1/9$

4. Briefly describe what each of the following convolution masks would do when applied to a digital image.

A.

1	1	1
0	0	0
-1	-1	-1

B.

-1	-1	-1
-1	9	-1
-1	-1	-1

C.

1	0	-1
1	0	-1
1	0	-1

5. Explain the purpose of unsharp masking in digital image processing. Then write out the three main steps in the unsharp masking process.

Step 1:

Step 2:

Step 3: