

CSE 377 - Homework 1
Fall 2011
Due Thursday, September 22 in class

1. Complex numbers:

- a) Plot these numbers into the complex plane: $c_1=9+i4$ and $c_2=3-i4$.
- b) Compute their magnitudes and angles.

For the following exercises, give an indication of your solution and draw the result in a coordinate system, with the axes properly labeled with numbers. No rough free-form sketching.

2. Convolution of discrete signals:

- a) Draw discrete signal $s_1(x)=4 \cdot \Pi(x/4)$ for all $\{x \mid -10 \leq x \leq 10, x \in \mathbb{Z}\}$, *i.e.*, x is an integer in the range $\{-10, 10\}$ and s_1 is a box centered at $x=0$, with amplitude 4 and a total width of 4.
- b) Draw discrete signal s_2 for all $\{x \mid -10 \leq x \leq 10, x \in \mathbb{Z}\}$: $s_2=0$ for all $x < 0$ and $x > 5$, and else $s_2(x)=20 \cdot G_{\mu=0, \sigma=2}(x)$, where G is the Gaussian function (see handout), here with mean $\mu=0$, standard deviation $\sigma=2$, and amplitude 20, but only non-zero for positive x less than 5.
- c) Now convolve the two signals and draw the result $s_3(x)$ for $\{x \mid -10 \leq x \leq 10, x \in \mathbb{Z}\}$.
- d) What do you observe, with respect to the original Gaussian of s_2 ?

2. Image processing: smoothing, filtering and transfer functions

See next page for an “image”. Fill in the various plots/images given (label the axes with numbers where appropriate).

image

100	100	10	10	40	40	40
100	100	10	10	40	40	40
100	100	10	10	40	200	40
100	255	10	10	40	40	40
100	100	10	250	10	10	10
100	100	10	10	10	10	10
100	100	10	10	10	10	10

image smoothed with 3x3 box (average) filter

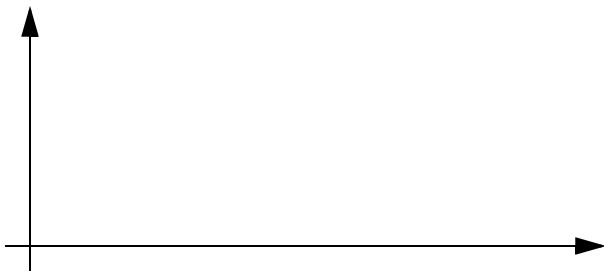
-	-	-	-	-	-	-
-						-
-						-
-						-
-						-
-						-
-	-	-	-	-	-	-

image smoothed with median filter

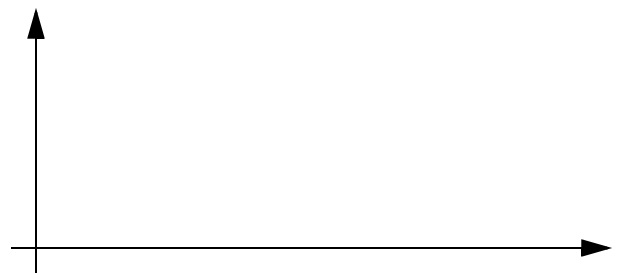
-	-	-	-	-	-	-
-						-
-						-
-						-
-						-
-						-
-	-	-	-	-	-	-



histogram of median filtered image



histogram of median filtered image after transfer function application



transfer function to maximize contrast in median filtered image

3. Image processing: edge detection

See next page for an “image”. Use the Sobel filter to find the dx and dy components of the image gradients. Then combine these using the formula $|dx|+|dy|$. You will get values greater than 255, normalize by scaling the values by a factor $255/\text{maxvalue}$, where maxvalue is the highest value that occurs in your edge image.

original image

10	10	200	200	200	10	10
10	10	200	200	200	10	10
10	10	200	200	200	10	10
10	10	200	200	200	10	10
10	10	200	200	200	10	10
10	10	200	200	200	10	10
10	10	200	200	200	10	10

x-edge filtered

-	-	-	-	-	-	-
-						-
-						-
-						-
-						-
-						-
-	-	-	-	-	-	-

y-edge filtered

-	-	-	-	-	-	-
-						-
-						-
-						-
-						-
-						-
-	-	-	-	-	-	-

edge-detected (combine x and y)

-	-	-	-	-	-	-
-						-
-						-
-						-
-						-
-						-
-	-	-	-	-	-	-

normalized (scaled) to [0, 255]

-	-	-	-	-	-	-
-						-
-						-
-						-
-						-
-						-
-	-	-	-	-	-	-