



Please make a zip file named HW1\_stdno\_lastname and upload in cw. Feel free to contact me (azizmalayeri.mohammad@gmail.com) if you have any questions.

### ***Theoretical***

1. Show that a random process which is stationary to order  $n$  is also stationary to all orders lower than  $n$ .
2.  $X$  is a random variable with PDF  $f_x(x) = \begin{cases} cx & 0 \leq x \leq 1 \\ x(2-x) & 1 \leq x \leq 2 \\ 0 & \text{o.w} \end{cases}$ . First calculate  $c$ . Next, calculate CDF and expected value for  $X$ .
3. What is separability in signals? Proof the separability property of 2D Fourier Transform.
4. Suppose we are given the following information about a signal  $x[n]$ :
  - a.  $x[n]$  is a real and even signal
  - b.  $x[n]$  has period  $N = 10$  and Fourier coefficients  $a_k$
  - c.  $a_{11} = 5$
  - d.  $\frac{1}{10} \sum_{n=0}^9 |x[n]|^2 = 50$

Show that  $x[n] = A \cos(Bn + C)$ , and specify numerical values for the constants  $A$ ,  $B$ , and  $C$ .

5. SSIM is a measure to quantify the visibility of errors (differences) between a distorted image and a reference image for the human visual system. Check the related paper " [Image Quality Assessment: From Error Visibility to Structural Similarity](#) " and explain this measure briefly.

### ***Practical***

1. A) Write a function which takes an image name and shows the image and the magnitude of its Fourier transform. Use numpy for implementing Fourier transform.  
B) Apply the function written in the previous part to the images in the 'images' folder and save the results in the folder named 'Practical\_1'.

C) Based on the results from previous part, what type of filter should be used to reduce the effect of white noise in an image? High-pass or Low-pass?

2.
  - A) Write a function which takes an image name and shows the grayscale image and the output of its convolution with sobel filters. Use numpy for implementing convolution.
  - B) Apply the function written in the previous part to the images in the 'images' folder and save the results in the folder named 'Practical\_2'.
  - C) Convolve images in the 'images' folder with both sobel filters using opencv library and save the results in the folder named 'Practical\_2'.
  - D) Compare the results from part B and C.