

Homework 4 (Due: 6/12)

(1) Write a Matlab or Python program to measure the structural similarity (SSIM) of two images A and B. The sizes of A and B are equivalent.

$$\text{SSIM}(A, B, c1, c2)$$

where c1 and c2 are some adjust constants.

The program should be submitted by [ceiba](#). (20 scores)

(2) Suppose that there are 25 faces. When we apply a face detection algorithm, 23 faces are detected. However, among these 23 detected faces, 1 of them are wrong. Determine the precision rate, the recall rate, and the F1 score of the face detection algorithm. (10 scores)

(3) How do we implement the following matrix operations with the lest number of multiplications?

$$(a) \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} a & b & a \\ c & a & b \\ a & b & a \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

$$(b) \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} = \begin{bmatrix} a & c & -c & -b \\ d & a & a & c \\ b & a & a & d \\ -b & a & a & a \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} \quad (20 \text{ scores})$$

(4) Determining the numbers of real multiplications for the (a) 147-point DFT, (b) 154-point DFT, and the (c) 231-point DFT. (15 scores)

(5) Suppose that $\text{length}(x[n]) = 1200$. What is the best way to implement the convolution of $x[n]$ and $y[n]$ if

(a) $\text{length}(y[n]) = 200$, (b) $\text{length}(y[n]) = 30$,

(c) $\text{length}(y[n]) = 6$, and (d) $\text{length}(y[n]) = 2$?

Also show the number of real multiplications required for each case.

(25 scores)

(6) Suppose that a 1-D ridge detection filter is:

$$x_s[n] = x[n] * h[n] \quad h[1] = h[-1] = -0.35 \quad h[2] = h[-2] = -0.1$$

$$h[3] = h[-3] = -0.05 \quad h[0] = 1 \quad h[n] = 0 \text{ otherwise}$$

Design an efficient way to implement the above filter operation.

(10 scores)

(Extra): 根據你的學號來回答 5/22, 5/29, 6/5 上課影片中的問題 (一題)