

Άσκηση 1 μέρος 1 Ερωτήσεις κων/νας θεωρητικά

$$\text{Άρχικα εξουφίε: } G(u) = \sum_{x=0}^{2N-1} g(x) W_{2N}^{xu} \quad (1)$$

$$F(u) = w(u) \sum_{x=0}^{N-1} f(x) \cdot \cos\left(\frac{(2x+1)\pi u}{2N}\right) \quad (1)$$

$$\text{και } g(x) = \begin{cases} f(x), & \text{για } 0 \leq x \leq N-1 \\ f(2N-1-x), & \text{για } N \leq x \leq 2N-1 \end{cases} \quad (3)$$

Όποτε από την (3) αντικαθιστώντας εξουφίε.

$$G(u) = \sum_{x=0}^{2N-1} f(x) \cdot W_{2N}^{xu} + \sum_{x=0}^{2N-1} f(2N-1-x) W_{2N}^{xu}$$

$$\text{Ξερούμε πως } W_{2N}^{xu} = e^{\frac{j(2x+1)\pi u}{2N}} \text{ αφού}$$

$$W_N = e^{-j\frac{2\pi}{N}} \text{ και } \left[\text{για χρήση των ταυτοτήτων του Euler εξουφίε: } \left(e^{j\theta} = \cos(\theta) + j\sin(\theta) \right) \right]$$

$$W_{2N}^{xu} = \cos\left(\frac{(2x+1)\pi u}{2N}\right) + j\sin\left(\frac{(2x+1)\pi u}{2N}\right) \quad (5)$$

Αντικαθιστώντας την (5) στην (1) εξουφίε:

$$G(u) = \sum_{x=0}^{2N-1} f(x) \left(\cos\left(\frac{(2x+1)\pi u}{2N}\right) + j\sin\left(\frac{(2x+1)\pi u}{2N}\right) \right) +$$

$$\sum_{x=0}^{2N-1} f(2N-1-x) \left(\cos\left(\frac{(2x+1)\pi u}{2N}\right) + j\sin\left(\frac{(2x+1)\pi u}{2N}\right) \right)$$

Χωρίζω σε πραγματικό και μηδαμίνιο κομμάτι:

$$\text{Real}(G(u)) = \sum_{x=0}^{2N-1} f(x) \cos\left(\frac{(2x+1)\pi u}{2N}\right) + \sum_{x=0}^{2N-1} f(2N-1-x) \cos\left(\frac{(2x+1)\pi u}{2N}\right)$$

$$\text{Imaginary}(G(u)) = \sum_{x=0}^{2N-1} f(x) \sin\left(\frac{(2x+1)\pi u}{2N}\right) + \sum_{x=0}^{2N-1} f(2N-1-x) \sin\left(\frac{(2x+1)\pi u}{2N}\right)$$

Αντικαθιστώντας τα δύο στο $f(u)$ (1) την $w(u)$ και το (6):

$$f(u) = \begin{cases} \frac{1}{\sqrt{N}} \text{Re}(G(u)) + j \frac{1}{\sqrt{N}} \text{Im}(G(u)), & \text{για } u=0 \\ \sqrt{\frac{2}{N}} \text{Re}(G(u)) + j \sqrt{\frac{2}{N}} \text{Im}(G(u)), & \text{για } u \neq 0 \end{cases}$$

Αποτελέσματα:

Τυχαίος πίνακας:

```
>> matrix
matrix =

 0.0152042  0.0801684  0.7453787  0.1082318  0.2885524  0.1322818  0.0986922  0.9138660
 0.2277930  0.1878731  0.3101725  0.2935561  0.7845034  0.2828714  0.7777891  0.6337638
 0.1061175  0.0817397  0.9848613  0.3357666  0.5889875  0.5765042  0.3964440  0.7819459
 0.0063792  0.5799657  0.0533932  0.0967629  0.5273945  0.3436962  0.5613131  0.4244256
 0.8220948  0.4395512  0.6313703  0.1399774  0.0197852  0.6967154  0.9546327  0.5096253
 0.0752056  0.8545808  0.7246062  0.8121315  0.1868435  0.9167439  0.6912856  0.5815131
 0.1575376  0.2667765  0.4923049  0.4427849  0.1851758  0.3896404  0.2578933  0.0250100
 0.3361023  0.7068791  0.2122679  0.0052390  0.1739375  0.6486797  0.1840051  0.4978731
```

To mydct2 και το dct2 του octave:

```
>> my_dct_result
my_dct_result =

 3.2956455  -0.5625597  0.1145763  -0.3381970  -0.5196238  -0.2026258  0.2429908  0.0956079
 -0.0311876  -0.4779133  -0.0562627  -0.3717727  0.4722968  -0.0978455  0.1185688  0.6592893
 -0.4726507  0.0776648  -0.0675490  -0.2235350  0.3076958  -0.2938144  0.2181644  0.0292664
 0.2304623  0.1047334  0.0571779  -0.2636696  -0.1851589  0.3401549  0.0659851  -0.2062259
 -0.3070351  0.0799243  0.6119609  0.1864706  -0.0262611  -0.2353571  0.0038300  -0.0015248
 -0.5320490  0.0908360  -0.3877238  -0.2971297  0.0844559  -0.1795877  0.0422430  -0.0159986
 0.3743876  -0.0674062  -0.0808811  -0.4336280  -0.1677996  -0.2315668  0.4181711  -0.2417034
 -0.0036699  0.1801335  0.1384816  -0.0822412  0.0010123  0.3652334  0.6077519  0.2781609

>> dct2_result
dct2_result =

 3.2956455  -0.5625597  0.1145763  -0.3381970  -0.5196238  -0.2026258  0.2429908  0.0956079
 -0.0311876  -0.4779133  -0.0562627  -0.3717727  0.4722968  -0.0978455  0.1185688  0.6592893
 -0.4726507  0.0776648  -0.0675490  -0.2235350  0.3076958  -0.2938144  0.2181644  0.0292664
 0.2304623  0.1047334  0.0571779  -0.2636696  -0.1851589  0.3401549  0.0659851  -0.2062259
 -0.3070351  0.0799243  0.6119609  0.1864706  -0.0262611  -0.2353571  0.0038300  -0.0015248
 -0.5320490  0.0908360  -0.3877238  -0.2971297  0.0844559  -0.1795877  0.0422430  -0.0159986
 0.3743876  -0.0674062  -0.0808811  -0.4336280  -0.1677996  -0.2315668  0.4181711  -0.2417034
 -0.0036699  0.1801335  0.1384816  -0.0822412  0.0010123  0.3652334  0.6077519  0.2781609
```

Η μεγιστη διαφορα και οι διαφορές:

```
>> max_difference
max_difference = 5.1764e-15
>> difference
difference =

 8.8818e-16  3.3307e-16  2.0817e-16  7.2164e-16  0.0000e+00  3.6082e-16  3.3584e-15  5.1764e-15
 4.0246e-16  1.1102e-16  1.3878e-17  5.5511e-17  6.1062e-16  3.8858e-16  1.2629e-15  5.5511e-16
 3.3307e-16  1.1102e-16  2.7756e-17  1.9429e-16  1.1102e-16  2.7756e-16  1.3878e-16  5.7593e-16
 1.3878e-16  1.3878e-17  1.1796e-16  5.5511e-17  1.1102e-16  3.3307e-16  9.7145e-17  1.6653e-16
 1.6653e-16  1.9429e-16  1.1102e-16  5.5511e-17  2.3245e-16  3.3307e-16  1.1102e-16  1.3357e-16
 5.5511e-16  2.7756e-17  4.4409e-16  2.2204e-16  1.6653e-16  5.5511e-17  3.4001e-16  7.8063e-16
 2.1094e-15  8.3267e-17  8.7430e-16  0.0000e+00  3.0531e-16  5.8287e-16  1.1102e-15  8.3267e-16
 3.9157e-15  2.7756e-17  0.0000e+00  2.7756e-17  1.1081e-15  4.9960e-16  3.3307e-16  8.8818e-16

>> check
Results match. Maximum absolute difference is very close to zero.
```

Μέρος 1ο:

Αποτελέσματα:

```
>> meros2
For Q1:
Entropy of quantized coefficients: 0.60422
Number of zeroed coefficients: 55852
PSNR: 31.7443
For Q2:
Entropy of quantized coefficients: 0.37494
Number of zeroed coefficients: 60789
PSNR: 28.0481
For Q3:
Entropy of quantized coefficients: 0.26751
Number of zeroed coefficients: 62546
PSNR: 25.9074
```

Εικόνες για Q1,Q2,Q3:

PSNR (dB) for Q1 = 31.7443



PSNR (dB) for Q2 = 28.0481



PSNR (dB) for Q3 = 25.9074

