***Question 1 DCT Coding***

* Using the 2D DCT formula, compute the 64 DCT values. Assume that you quantize your DCT coefficients using the luminance quantization table K1 on page 143 of the uploaded ITU-T JPEG standard. What does your table look like after quantization?

Given DCT equation:

Where:

We can computer our DCT table shown as below:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1016 | 215 | -6 | -27 | 29 | -20 | -11 | 7 |
| 136 | 52 | -93 | -7 | 34 | -18 | -11 | 10 |
| -45 | -49 | 13 | 53 | 11 | -24 | 0 | 8 |
| 8 | 38 | 47 | 15 | -17 | -10 | 4 | 3 |
| -1 | -5 | -1 | -4 | 0 | 6 | 4 | 0 |
| -4 | -1 | 3 | 8 | 7 | 6 | 0 | 1 |
| -2 | -2 | 0 | -1 | 0 | -3 | 0 | -1 |
| 0 | -3 | 0 | -1 | -4 | -1 | 2 | 1 |

After obtaining our DCT table, we can divide each value with its responding quantization parameter from K1 table:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 64 | 20 | -1 | -2 | 1 | 0 | 0 | 0 |
| 11 | 4 | -7 | 0 | 1 | 0 | 0 | 0 |
| -3 | -4 | 1 | 2 | 0 | 0 | 0 | 0 |
| 1 | 2 | 2 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

* In the JPEG pipeline, the quantized DCT values are then further scanned in a zigzag order. Ignoring your DC value, show the resulting zigzag scan AC values.

We will count the 8x8 matrix in a zig-zag order to output our DCT values:

[20, 11, -3, 4, -1, -2, -7, -4, 1, 0, 2, 1, 0, 1, 0, 1, 2, 2, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]

* For this zigzag AC sequence, write down the intermediary notation

'<0,5> <20>', '<0,4> <11>', '<0,2> <-3>', '<0,3> <4>', '<0,1> <-1>', '<0,2> <-2>', '<0,3> <-7>', '<0,3> <-4>', '<0,1> <1>', '<1,2> <2>', '<0,1> <1>', '<1,1> <1>', '<1,1> <1>', '<0,2> <2>', '<0,2> <2>', '<5,1> <1>'

* For these are luminance values, write down the resulting JPEG bit stream. You will need to consult standard luminance code tables on page 150 of the ITU-T JPEG standard

11010 10100 1011 1011 01 00 100 100 00 0 01 01 100 000 100 011 00 1 11011 10 00 1 1100 1 1100 1 01 10 01 10 1111010 1

* What compression ratio do you get for this luminance block?