CSCI 576 HW3

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?

188	180	155	149	179	116	86	96
168	179	168	174	180	111	86	95
150	166	175	189	165	101	88	97
163	165	179	184	135	90	91	96
170	180	178	144	102	87	91	98
175	174	141	104	85	83	88	96
153	134	105	82	83	87	92	96
117	104	86	80	86	90	92	103

2D DCT Formula:

Discrete Cosine Transform

$$F(u,v) = \left(\frac{1}{4}C(u)C(v)\right)\left[\sum_{x=0}^{x=7}\sum_{y=0}^{y=7} f(x,y) \times \cos\frac{(2x+1)u\pi}{16}\cos\frac{(2y+1)v\pi}{16}\right]$$

64 DCT Value Table:

1016.25	215.975	-6.823	-27.171	29.25	-20.757	-11.245	7.951
136.146	52.632	-93.463	-7.274	34.007	-18.821	-11.256	10.64
-45.859	-49.209	13.925	53.763	11.096	-24.672	-0.146	8.412
8.844	38.067	47.949	15.613	-17.873	-10.855	4.172	3.684
-1.25	-5.916	-1.241	-4.717	0.75	6.6	4.844	0.242
-4.471	-1.202	3.348	8.12	7.01	6.124	-0.152	1.186
-2.923	-2.118	0.854	-1.456	0.004	-3.357	-0.925	-1.215
-0.824	-3.385	-0.586	-1.797	-4.205	-1.256	2.318	1.631

After rounding:

1016	216	-7	-27	29	-21	-11	8
136	53	-7	34	-19	-19	-11	11
-46	-49	54	11	-25	-25	0	8
9	38	48	-16	-18	-11	4	4
-1	-6	-1	-5	1	7	5	0
-4	-1	3	8	7	6	0	1
-3	-2	1	-1	0	-3	-1	-1
-1	-3	-1	-2	-4	-1	2	2

The table after quantization is :

64	20	-1	-2	1	-1	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.

AC: 20, 11, -3, 4, -1, -2, -7, -4, 1, 0, 2, 1, 0, 1, -1, 1, 2, 2, 0, 0, 0, 0, 0, 1, …… (followed by 39 0’s)

• For this zigzag AC sequence, write down the intermediary notation.

AC:

<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>
<0, 1> <-1>
<0, 1> < 1>
<0, 2> < 2>
<0, 2> < 2>
<5, 1> < 1>
EOB <0, 0>

• 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.

Elementary bitstream:

1101010100101110110100100100000010110000010001100111011100011100100000101100110111101011010

11010 10100 1011 1011 01 00 100 100 00 0 01 01 100

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

000 100 011 00 1 11011 10 00 1 1100 1 00 0 00 1 01

<-7> <0, 3> <-4> <0, 1> < 1> <1, 2> < 2> <0, 1> < 1> <1, 1> < 1> <0, 1> <-1> <0, 1> < 1> <0, 2>

10 01 10 1111010 1 1010

< 2> <0, 2> < 2> <5, 1> < 1> EOB <0, 0>

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

Bits = 91 bits from elementary bitstream for 63 pixels

Bits before compression: 8*8*8 = 512 bits for 64 pixels, and therefore 504 bits for 63 pixels.

Compression Ratio => 504/91 = 5.538:1