365 Written Assignment 3

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1 Question 8

1.1 Question 8.4

An 8x8 block will have 64 total elements, so 1/64 as there is only one out of all of them that is a DC component.

1.2 Question 8.5a

For ranges from 0..255, white would be the brightest so 255 grey scale value. The highest coefficient would be in the DC component, so i = j = u = v = 0. Taking equation 8.17 from the textbook, we can see for each value of i and j iterating in the sum, we get

$$\frac{\frac{\sqrt{2}}{2} * \frac{\sqrt{2}}{2}}{4} * cos(0) * cos(0) * 255 = \frac{255}{8} \tag{1}$$

As the u = v = 0 means we can just iterate over i and j, not worrying about cosine and C(u) and C(v) coefficients, we get $\frac{255}{8}$ 64 times. Because we have the same value added together 64 times, this is just 64*(255/8) = 255*8 = 2040.

2 Question 9

2.1 Question 9.2

Without the luminance component, some of the apparent brightness in the colours would be lost. This losses would increase the compression ratio and make the image appear more "blocky". Another change to the image would be edges and textures being lost as luminance defines the brightness present on sharp dark edges.

2.2 Question 9.4a

Looking at equation 8.17 again, u = v = 0 so we get

$$\frac{\frac{\sqrt{2}}{2}\frac{\sqrt{2}}{2}}{4}\sum_{i=0}^{7}\sum_{j=0}^{7}cos(\frac{0}{16})cos(\frac{0}{16})f(i,j) \tag{2}$$

$$\frac{1}{8}\sum_{i=0}^{7}\sum_{j=0}^{7}f(i,j) \tag{3}$$

This is the sum of all entries divided by 8.

$$\frac{16*20+16*80+16*140+16*200}{8}=880 \tag{4}$$

3 Example Question 1

Encoder Pseudo Code

Symbol	Prob.
1	0.8
2	0.02
3	0.18

- Keep track of LOW, HIGH, RANGE
  - Any two are sufficient, e.g., LOW and RANGE.

```
low=0.0, high=1.0;
while (not EOF) {
    n = ReadSymbol();
    RANGE = HIGH - LOW;
    HIGH = LOW + RANGE * CDF(n);
    LOW = LOW + RANGE * CDF(n-1);
}
output LOW;
```

Input	HIGH	LOW	RANGE
Initial	1.0	0.0	1.0
1	0.0 + 1.0*0.8 = 0.8	0.0 + 1.0*0 = 0.0	0.8
2	0.0 + 0.8*0.82 = 0.656	0.0 + 0.8*0.8 = 0.64	0.016
3	0.64 + 0.016*1.0 = 0.656	0.64 + 0.016*0.82 = 0.65312	0.00288
1	0.65312 + 0.00288*0.8 = 0.655424	0.65312 + 0.00288*0 = 0.65312	0.002304

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Encoder Pseudo Code

Symbol	Prob.
1	0.8
2	0.02
3	0.18

- Keep track of LOW, HIGH, RANGE
  - Any two are sufficient, e.g., LOW and RANGE.

1 - No scaling
2 - E2, E1, E2, E1, E1
3 - E2, E2, E2
1 - No scaling

```
low=0.0, high=1.0;
while (not EOF) {
    n = ReadSymbol();
    RANGE = HIGH - LOW;
    HIGH = LOW + RANGE * CDF(n);
    LOW = LOW + RANGE * CDF(n-1);
}
output LOW;
```

Input	HIGH	LOW	RANGE
Initial	1.0	0.0	1.0
1	0.0 + 1.0*0.8 = 0.8	0.0 + 1.0*0 = 0.0	0.8
2	0.0 + 0.8*0.82 = 0.656 --> 0.992	0.0 + 0.8*0.8 = 0.64 --> 0.48	0.512
3	0.48 + 0.512*1.0 = 0.992 --> 0.936	0.48 + 0.512*0.82 = 0.89984 --> 0.19872	0.73728
1	0.19872 + 0.73728*0 .8 = 0.788544	0.19872 + 0.73728*0 = 0.19872	0.589824

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4 Example Question 2

15 38 87 16 0 0 54 0 0 0 0 0 0 12 0 0 3 0 0 0 ... (total 64 coefficients)

4.1 2(i)

(0,15), (0,38), (0,87), (0,16), (2,54), (6,12), (0,3), (47,0), (0,0)

4.2 2(ii)

(0,15), (0,38), (1,54), (4,87), (2,12), (0,3), (3,16), (47,0), (0,0)