Assignment 4

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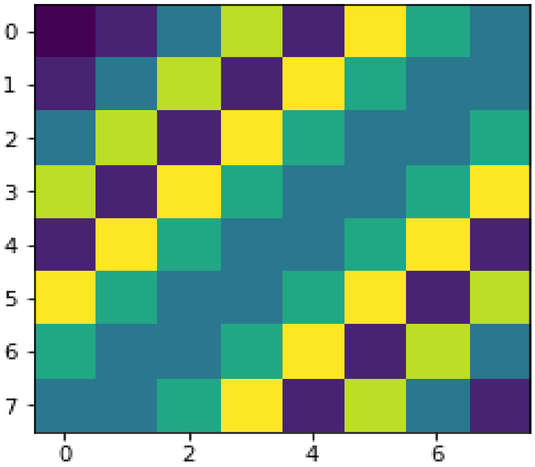
Question 4:

Original Matrix

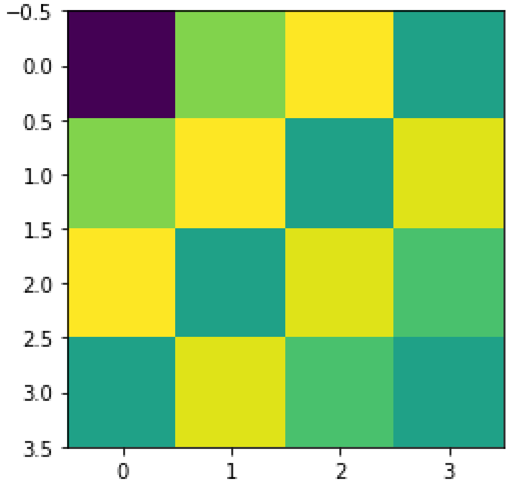
```
[[ 0.  1.  4.  9.  1. 10.  6.  4.]

 [ 1.  4.  9.  1. 10.  6.  4.  4.]
 [ 4.  9.  1. 10.  6.  4.  4.  6.]
 [ 9.  1. 10.  6.  4.  4.  6. 10.]
 [ 1. 10.  6.  4.  4.  6. 10.  1.]
 [10.  6.  4.  4.  6. 10.  1.  9.]
 [ 6.  4.  4.  6. 10.  1.  9.  4.]
 [ 4.  4.  6. 10.  1.  9.  4.  1.]]
```



First Level Decomposition:

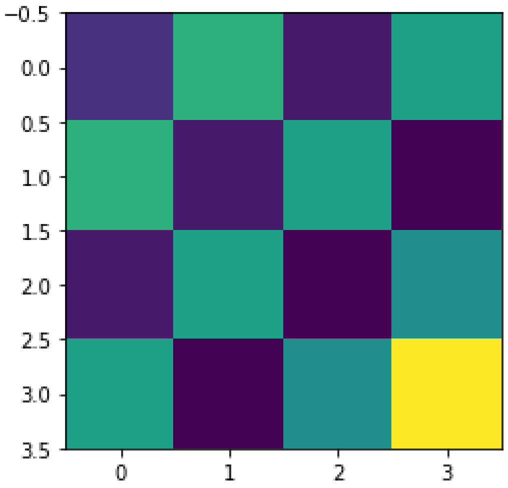
ca

```
array([[ 3. , 11.5, 13.5,  9. ],

       [11.5, 13.5,  9. , 13. ],
       [13.5,  9. , 13. , 10.5],
       [ 9. , 13. , 10.5,  9. ]])
```



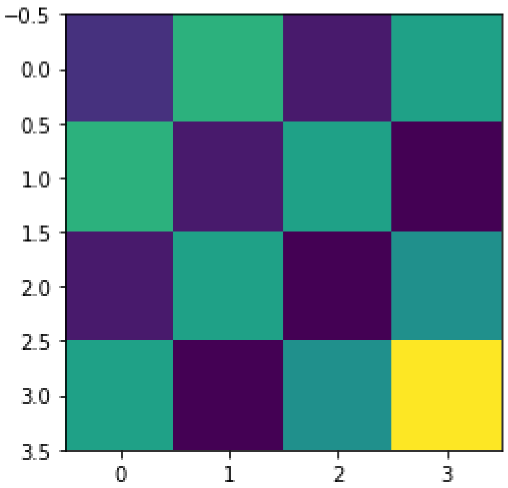
ch

```
array([[-2. ,  1.5, -2.5,  1. ],

       [ 1.5, -2.5,  1. , -3. ],
       [-2.5,  1. , -3. ,  0.5],
       [ 1. , -3. ,  0.5,  4. ]])
```



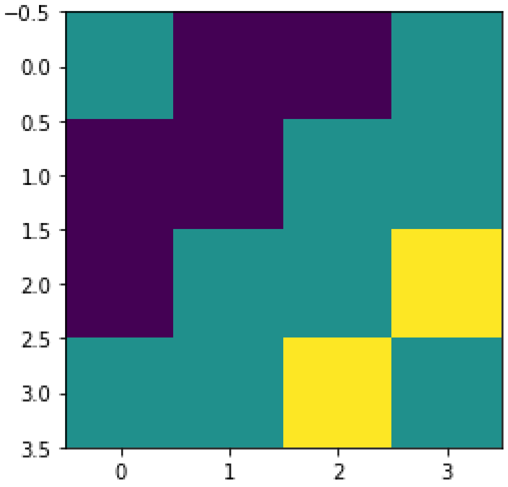
cv

```
array([[-2. ,  1.5, -2.5,  1. ],

       [ 1.5, -2.5,  1. , -3. ],
       [-2.5,  1. , -3. ,  0.5],
       [ 1. , -3. ,  0.5,  4. ]])
```



cd

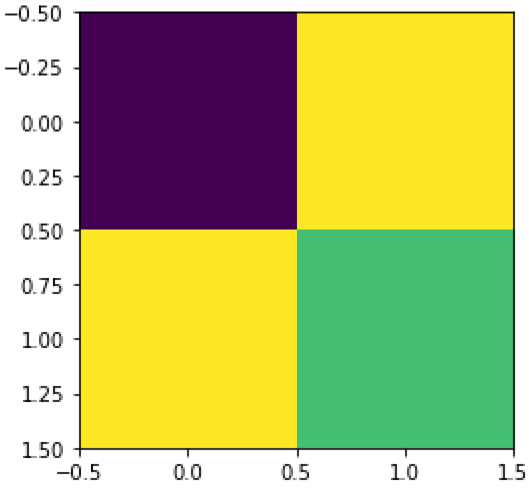
```
array([[ 1. , -6.5, -6.5,  1. ],

       [-6.5, -6.5,  1. ,  1. ],
       [-6.5,  1. ,  1. ,  8.5],
       [ 1. ,  1. ,  8.5,  1. ]])
```



Second Level decomposition:

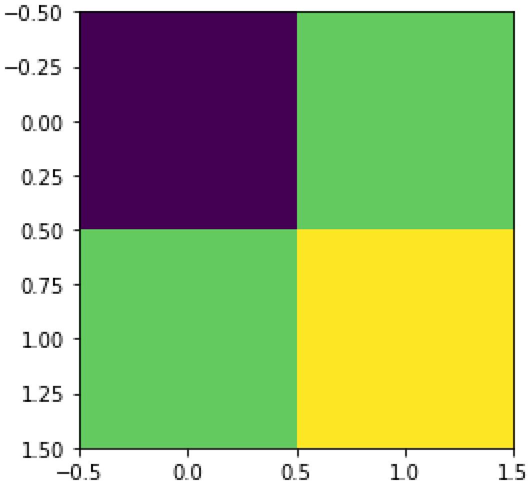
c_a

```
array([[19.75, 22.25],

       [22.25, 21.5 ]])
```



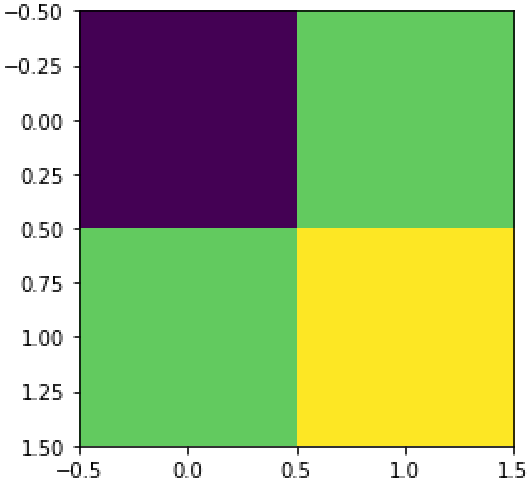
c_h

```
array([[-5.25,  0.25],
       [ 0.25,  2.  ]])
```



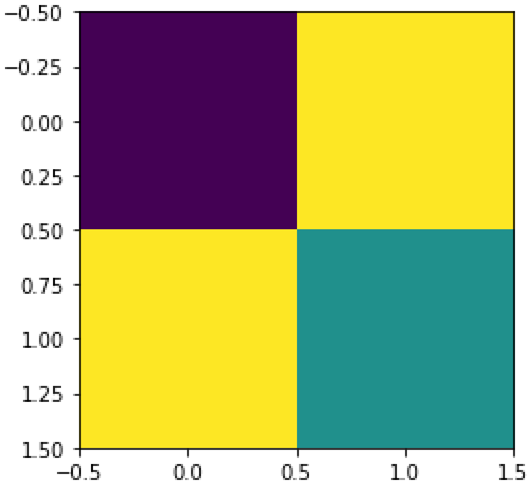
cv

```
array([[-5.25,  0.25],
       [ 0.25,  2.  ]])
```



cd

```
array([[-3.25,  4.25],
       [ 4.25,  0.5 ]])
```



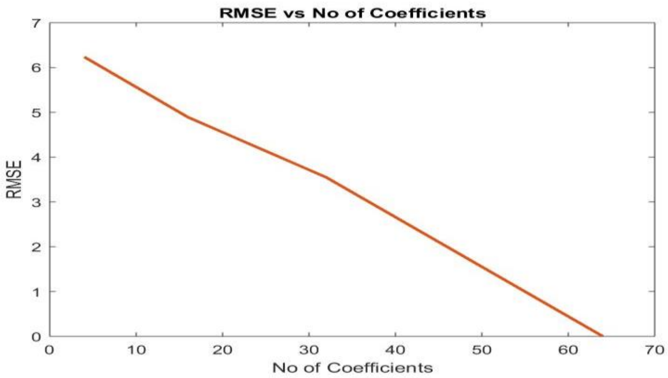
Question 5:

No of Coefficients in 8 X 8 block	RMSE
4	6.235
16	4.89
32	3.548
64	0.001

Threshold Coding:

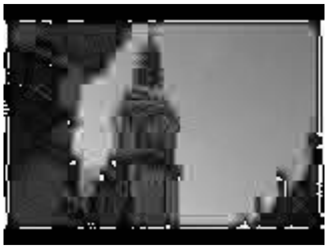
Nikon Image:

Graph:

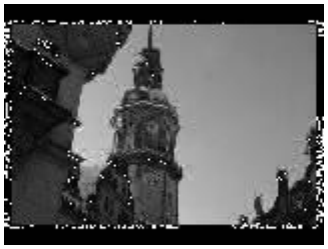


Reconstructed Image:

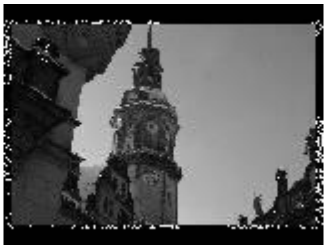
Original Image



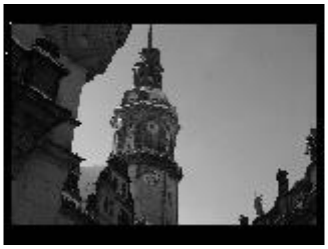
4 coefficients in 8 X 8 block



16 coefficients in 8 X 8 block



32 Coefficients in 8 X 8 block

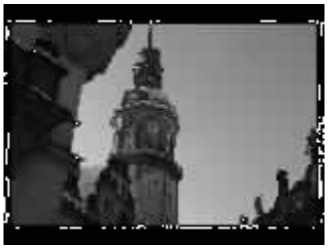


64 coefficients in 8 X 8 block

Extra Credit Part:

Zonal Coding:

Original Image (size = 9.8 kB)



Compressed Image (Size=5.2 kB)

Jpeg Compressed through online

(Standard JPEG algo) (size= 4.36 kB)

Huffman Table:

bits	code	(value)	symbol
10	1100110100	(820)	_EOF
3	111	(7)	' '
4	1101	(13)	'('
3	010	(2)	')'
2	00	(0)	','
5	11000	(24)	'-'
3	011	(3)	'.'
3	101	(5)	'0'
4	1000	(8)	'1'
5	10010	(18)	'2'
6	100110	(38)	'3'
7	1100111	(103)	'4'
7	1001110	(78)	'5'
7	1001111	(79)	'6'
9	110011011	(411)	'7'
8	11001100	(204)	'8'
10	1100110101	(821)	'9'
7	1100100	(100)	'['
7	1100101	(101)	']'