

```
In [ ]: import numpy as np
```

```
In [ ]: I = np.array([[154,123,123,123,123,123,123,136],
                     [192,180,136,154,154,154,136,110],
                     [254,198,154,154,180,154,123,123],
                     [239,180,136,180,180,166,123,123],
                     [180,154,136,167,166,149,136,136],
                     [128,136,123,136,154,180,198,154],
                     [123,105,110,149,136,136,180,166],
                     [110,136,123,123,123,136,154,136]])
```

```
In [ ]: M = I -128
```

```
In [ ]: T = np.zeros((8,8))
for i in range(8):
    for j in range(8):
        if i == 0:
            T[i,j] = np.sqrt(1/8)
        else:
            T[i,j] = np.sqrt(1/4) * np.cos((2*j + 1)*i*np.pi/16)
```

```
In [ ]: D = np.dot(np.dot(T,M),np.transpose(T))
```

```
In [ ]: Q = np.array([
    [16, 11, 10, 16, 24, 40, 51, 61],
    [12, 12, 14, 19, 26, 58, 60, 55],
    [14, 13, 16, 24, 40, 57, 69, 56],
    [14, 17, 22, 29, 51, 87, 80, 62],
    [18, 22, 37, 56, 68, 109, 103, 77],
    [24, 35, 55, 64, 81, 104, 113, 92],
    [49, 64, 78, 87, 103, 121, 120, 101],
    [72, 92, 95, 98, 112, 100, 103, 99]
])
```

```
In [ ]: C = np.round(D/Q)
R = Q * C
N = np.round(np.dot(np.dot(np.transpose(T),R),T)+128)
```

```
In [ ]: print("M",M)
print()
print("Q",Q)
print()
print("D",D)
print()
print("C",C)
print()
print("R",R)
print()
print("I",I)
print()
print("N",N)
```

```

M [[ 26  -5  -5  -5  -5  -5  -5  8]
   [ 64  52   8  26  26  26   8 -18]
   [126  70  26  26  52  26  -5  -5]
   [111  52   8  52  52  38  -5  -5]
   [ 52  26   8  39  38  21   8   8]
   [  0   8  -5   8  26  52  70  26]
   [ -5 -23 -18  21   8   8  52  38]
   [-18   8  -5  -5  -5   8  26   8]]

```

```

Q [[ 16  11  10  16  24  40  51  61]
   [ 12  12  14  19  26  58  60  55]
   [ 14  13  16  24  40  57  69  56]
   [ 14  17  22  29  51  87  80  62]
   [ 18  22  37  56  68 109 103  77]
   [ 24  35  55  64  81 104 113  92]
   [ 49  64  78  87 103 121 120 101]
   [ 72  92  95  98 112 100 103  99]]

```

```

D [[ 1.62250000e+02  4.05989816e+01  2.00026918e+01  7.23294009e+01
    3.02500000e+01  1.24848354e+01 -1.96505043e+01 -1.14971452e+01]
   [ 3.04792937e+01  1.08415970e+02  1.04730992e+01  3.22925175e+01
    2.76990885e+01 -1.55048925e+01  1.84075948e+01 -1.99566961e+00]
   [-9.41445075e+01 -6.00511329e+01  1.22980970e+01 -4.34188963e+01
    -3.12878702e+01  6.06690905e+00 -3.33058262e+00  7.14403453e+00]
   [-3.85675018e+01 -8.33575149e+01 -5.41238759e+00 -2.21698602e+01
    -1.35195286e+01  1.54918916e+01 -1.33187181e+00  3.53461026e+00]
   [-3.12500000e+01  1.79340053e+01 -5.52404638e+00 -1.23555600e+01
    1.42500000e+01 -5.96236717e+00  1.14884686e+01 -6.02384997e+00]
   [-8.64681444e-01 -1.17637950e+01  1.27762672e+01  1.81231416e-01
    2.80712006e+01  1.25731431e+01  8.35255975e+00  2.93590135e+00]
   [ 4.62997947e+00 -2.42141001e+00  1.21694174e+01  6.56145155e+00
    -1.87001117e+01 -1.27532960e+01  7.70190296e+00  1.20313688e+01]
   [-9.95302906e+00  1.11936702e+01  7.81185357e+00 -1.62885238e+01
    2.14648676e+01  2.17022289e-02  5.90622636e+00  1.06807473e+01]]

```

```

C [[10.  4.  2.  5.  1.  0. -0. -0.]
   [ 3.  9.  1.  2.  1. -0.  0. -0.]
   [-7. -5.  1. -2. -1.  0. -0.  0.]
   [-3. -5. -0. -1. -0.  0. -0.  0.]
   [-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.]]

```

```

R [[160.  44.  20.  80.  24.  0. -0. -0.]
   [ 36. 108.  14.  38.  26. -0.  0. -0.]
   [-98. -65.  16. -48. -40.  0. -0.  0.]
   [-42. -85. -0. -29. -0.  0. -0.  0.]
   [-36.  22. -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.]]

```

```

I [[154 123 123 123 123 123 123 136]
   [192 180 136 154 154 154 136 110]
   [254 198 154 154 180 154 123 123]
   [239 180 136 180 180 166 123 123]
   [180 154 136 167 166 149 136 136]
   [128 136 123 136 154 180 198 154]
   [123 105 110 149 136 136 180 166]]

```

[110 136 123 123 123 136 154 136]]

N [[149. 134. 119. 116. 121. 126. 127. 128.]
[204. 168. 140. 144. 155. 150. 135. 125.]
[253. 195. 155. 166. 183. 165. 131. 111.]
[245. 185. 148. 166. 184. 160. 124. 107.]
[188. 149. 132. 155. 172. 159. 141. 136.]
[132. 123. 125. 143. 160. 166. 168. 171.]
[109. 119. 126. 128. 139. 158. 168. 166.]
[111. 127. 127. 114. 118. 141. 147. 135.]]

In []: