(1)

Question 2-a

→ We have a 3 bit image $L = 2^3 = 8$ gray levels

→ dimensions 64×64 pixels → $MN = 4096$

→ calculation of new pixel values which are s_k

$$s_k = \left((L-1)\sum_{j=0}^{k}\frac{n_j}{MN}\right) = \left(7\sum_{j=0}^{k} p_r(r_j)\right)$$

(we have to round the results)

pixel counts = n_k

input levels = r_k

$r_0 = 0 \rightarrow n_0 = 790$ pixels

$r_1 = 1 \rightarrow n_1 = 1023$ pixels

$r_2 = 2 \rightarrow n_2 = 850$ pixels

!

→ calculation of p_r

The probability of each intensity level is $p_r(r_k) = \frac{n_k}{MN}$

for $r_0 = p_r(r_0) = 0.19$

for $r_1 = p_r(r_1) = 0.25$

for $r_2 = p_r(r_2) = 0.21$

Applying the Transformation formula (s_k)

→ Calculation for $k=0$ (intensity 0):

$$s_0 = 7 \times \left[\sum_{j=0}^{0} p_r(r_j)\right] = 7 \times 0.19 = 1.33 \text{ which round to } 1$$

→ which means input pixel 0 becomes output pixel 1

(2)

→ Calculation for $k=1$; (intensity = 1)

$$s_1 = 7 \times \left[\sum_{j=0}^{1} Pr(r_j) \right] = 7 \left[0.19 + 0.25 \right] = 3.08 \xrightarrow{\text{round}} \underline{\underline{3}}$$

→ Which means input pixel 1 becomes output pixel 3

→ Calculation for $k=2$; (intensity = 2)

$$s_2 = 7 \times \left[\sum_{j=0}^{2} Pr(r_j) \right] = 7 \left[0.19 + 0.25 + 0.21 \right] = 4.55 \xrightarrow{\text{round}} \underline{\underline{5}}$$

Which means input pixel 2 becomes output pixel 5

⊛ Transformation effectively spreads the intensity to cover the full range, increasing contrast.

$0 \rightarrow 1$

$1 \rightarrow 3$

$2 \rightarrow 5$