Computational Photography Assignment 2 - Image Resizing

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1. Theory Question 1

a) For nearest neighbor interpolation, we round the coordinates to the nearest integer values:

$$x_{nn} = \text{round}(2.7) = 3$$
$$y_{nn} = \text{round}(3.1) = 3$$

Therefore, the value of the nearest pixel is $I(3,3) = \boxed{5}$.

b) Given the grayscale image I and the pixel location at $x = 2.7$, $y = 3.1$,

The surrounding pixel values are: $A = 3$ at $(2,3)$, $B = 5$ at $(3,3)$, $C = 4$ at $(2,4)$, and $D = 4$ at $(3,4)$.

Interpolating at the x-axis,

$$\begin{aligned} f(x,y_1) &= (x_2 - x) \cdot f(A) + (x - x_1) \cdot f(B) \\ &= (3 - 2.7) \cdot 3 + (2.7 - 2) \cdot 5 \\ &= 0.9 + 3.5 \\ &= 4.4 \\ f(x,y_2) &= (x_2 - x) \cdot f(C) + (x - x_1) \cdot f(D) \\ &= (3 - 2.7) \cdot 4 + (2.7 - 2) \cdot 4 \\ &= 1.2 + 2.8 \\ &= 4.0 \end{aligned}$$

Interpolating at the y-axis,

$$\begin{aligned} f(x,y) &= (y_2 - y) \cdot f(x,y_1) + (y - y_1) \cdot f(x,y_2) \\ &= (4 - 3.1) \cdot 4.4 + (3.1 - 3) \cdot 4.0 \\ &= 0.9 \cdot 4.4 + 0.1 \cdot 4.0 \\ &= 3.96 + 0.4 \\ &= 4.36 \end{aligned}$$

Therefore, the interpolated value at $x = 2.7, y = 3.1$ is: $\boxed{f(x,y) \approx 4.36}$

2. Image Resizing

Figure 1: Original Image 1 (265 x 148)

Figure 2: Nearest Neighbor Interpolated Image 1 (132 x 74)

Figure 3: Nearest Neighbor Interpolated Image 1 (530 x 296)

Figure 4: Bilinear Interpolated Image 1 (132 x 74)

Figure 5: Bilinear Interpolated Image 1 (530 x 296)

Figure 6: Original Image 2 (229 x 148)

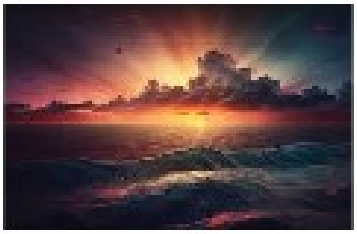

Figure 7: Nearest Neighbor Interpolated Image 2 (114 x 74)

Figure 8: Nearest Neighbor Interpolated Image 2 (458 x 296)

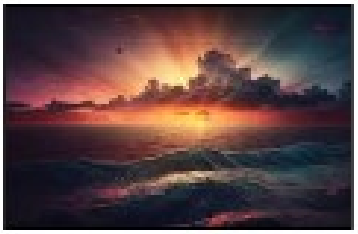

Figure 9: Bilinear Interpolated Image 2 (114 x 74)

Figure 10: Bilinear Interpolated Image 2 (458 x 296)