

Computational Photography (CSCI 3240U) — In-class Exercise

Please hand in this paper to the instructor before the end of the lecture.

Lastname (PRINT): _____ Firstname: _____

Student number: _____ Date: _____

Q. Image Interpolation (1D & 2D)

(a) **1D linear interpolation.** Let $y[n]$ be discrete samples. For $x = i + t$ with $i \in \mathbb{Z}$ and $t \in [0, 1)$, the linear interpolant is

$$\hat{y}(x) = (1 - t)y[i] + ty[i + 1].$$

Given $y = [3, -1, 4, 2, 0]$ and $i = 2$ (0-based indexing), compute $\hat{y}(2.3)$ and $\hat{y}(2.75)$.

0 1 2 3 4
↑ ↑
2.3

$$\begin{aligned}\hat{y}(x) &= (1 - t)y[i] + ty[i + 1] \\ &= (0.7)(4) + (0.3)(2) \\ &= 2.8 + 0.6 \\ &= 3.4\end{aligned}$$

$$\begin{aligned}x &= i + t \\ t &= x - i \\ t &= 2.3 - 2 \\ &= 0.3\end{aligned}$$

(b) **2D bilinear interpolation.** Consider the 2×2 pixel block at integer coordinates

$$I(0, 0) = 100, \quad I(1, 0) = 120, \quad I(0, 1) = 80, \quad I(1, 1) = 140.$$

For a query point (u, v) with $u, v \in [0, 1]$ (relative to the top-left pixel), the bilinear value is

$$\hat{I}(u, v) = (1 - u)(1 - v)I(0, 0) + u(1 - v)I(1, 0) + (1 - u)vI(0, 1) + uvI(1, 1).$$

Compute $\hat{I}(0.25, 0.60)$.