Basics of Digital Imaging

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Digital imaging looks at individual pixel values in (x, y) format.

Introduction

An **image** is an array of values that describe the color at a point.

We sometimes want to store a series of images, maybe from some video stream. We have to think of that as **sampling**[1] the environment x times per second.

Since there are only a finite set of values that the image can take digitally, we might need to **quantize** the result. Quanitization means that we assign a discrete set of values to numbers which originally might not be discrete.

Image zooming refers to showing a part of the image at a different size. How do we calculate the values of the new images? There are a couple methods.

The first is a **nearest neighbor** method, where we interpolate the values of the surrounding pixels. This means that an individual pixel's value will be a linear combination of surrounding pixels. The way we determine the nearest pixels would be comparing the one in the image with the one in the zoomed image.

Other methods, such as **bilinear** and **trilinear** take some combination of surrounding pixels.

[1] **Sampling** refers to getting the values at discrete points in the spatial/temporal domains.
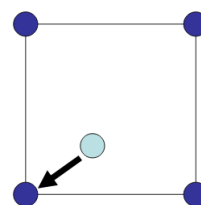
Nearest-neighbor

Figure 1: The nearest neighbor method will assign the pixel the same value as the closest pixel.

Geometric Transformations

Geometric transformations change the spatial arrangement of pixels but do not really change the relationship between the pixels themselves. In **affine** transformations any straight line and parallelism are preserved.

The usual way that this is done involves finding the mapping in reverse direction. We call this an **inverse mapping**. This mapping involves starting at the transformed image coordinates and trying to find the mapping to go to the original image.

$$\begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = A^{-1} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix}$$