DIGITAL IMAGE PROCESSING

Digital Image Fundamentals : Session 2

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Today's Lecture

- **Image sampling and quantization – image interpolation**
- **Relationship between pixels**

Image Interpolation

- **Interpolation:** Process of using known data to estimate unknown values
  e.g., zooming, shrinking, rotating, and geometric correction

- **Interpolation** (or ***resampling***)**:** an imaging method to increase (or decrease) the number of pixels in a digital image.

Note: Some digital cameras use interpolation to produce a larger image than the sensor captured or to create digital zoom

Image Interpolation

Nearest Neighbor Interpolation

$f_1(x_2,y_2) =$
$f(\text{round}(x_2), \text{round}(y_2))$
$= f(x_1,y_1)$

$f(x_1,y_1)$

$f_1(x_3,y_3) =$
$f(\text{round}(x_3), \text{round}(y_3))$
$= f(x_1,y_1)$

Image Interpolation

Bilinear Interpolation

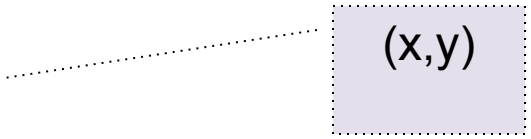

Image Interpolation

Bicubic Interpolation

Image Interpolation

Example

Image Interpolation

Example

Image Interpolation

Example

Relationship between Pixels

- **Neighbourhood**
- **Adjacency**
- **Connectivity**
- **Paths**
- **Regions and**

Relationship between Pixels

Relationship between Pixels

A. Adjacency

Let V be the set of intensity values.

a. 4-adjacency: Two pixels p and q with values from V are 4-adjacent if q is in the set $N_4(p)$.

b. 8-adjacency: Two pixels p and q with values from V are 8-adjacent if q is in the set $N_8(p)$.

Relationship between Pixels

c. m-adjacency: Two pixels p and q with values from V are m-adjacent if

i. q is in the set $N_4(p)$, or

ii. q is in the set $N_D(p)$ and the set $N_4(p) \cap N_4(p)$ has no pixels whose values are from V.

Relationship between Pixels

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Distance Measure

- Given pixels *p, q* and *z* with coordinates (x, y), (s, t), (u, v) respectively, the distance function D has following properties:

  a. $D(p, q) \geq 0$ $[D(p, q) = 0, \text{iff } p = q]$

  b. $D(p, q) = D(q, p)$

  c. $D(p, z) \leq D(p, q) + D(q, z)$

Relationship between Pixels

Distance Measure

The following are the different Distance measures:

- Euclidean Distance :

  $D_e(p, q) = [(x-s)^2 + (y-t)^2]^{1/2}$

- City Block Distance:

  $D_4(p, q) = |x-s| + |y-t|$

- Chess Board Distance:

  $D_8(p, q) = \max(|x-s|, |y-t|)$

		2		
	2	1	2	
2	1	0	1	2
	2	1	2	
		2		

2	2	2	2	2
2	1	1	1	2
2	1	0	1	2
2	1	1	1	2
2	2	2	2	2

Next Class

- **Digital Image Fundamentals**
  - Mathematical Operations in DIP

Thank you:
Question?