University of Al-Hamdaniya
Computer Science Department
Digital image processing

Zooming and Shrinking of Digital Images & Relationships between pixels

Lec-5

By

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Zooming and Shrinking Digital Images

1. Zooming

Zooming requires two steps :

1. Creation of new pixel locations

إنشاء مواقع بكسل جديدة

2. Assignment of gray levels to those new locations

تعيين مستويات الرمادي لتلك المواقع الجديدة

Zooming

1. Nearest neighbor interpolation (Zero order hold)

1. Nearest neighbor interpolation (zero order hold):

is performed by repeating the pixel values, thus creating checkerboard effect. Pixel replicate is used to increase the size of an image an integer number of times.

Example :

Enlarge the following 8-bit image 2 times.

20	**30**	**50**
33	**45**	**56**
87	**19**	**35**

Zooming

1. Nearest neighbor interpolation (Zero order hold)

Solution :

1. Enlarge the rows:

20	**20**	**30**	**30**	**50**	**50**
33	**33**	**45**	**45**	**56**	**56**
87	**87**	**19**	**19**	**35**	**35**

2. Enlarge the columns :

20	**20**	**30**	**30**	**50**	**50**
20	**20**	**30**	**30**	**50**	**50**
33	**33**	**45**	**45**	**56**	**56**
33	**33**	**45**	**45**	**56**	**56**
87	**87**	**19**	**19**	**35**	**35**
87	**87**	**19**	**19**	**35**	**35**

Zooming

2. Bilinear interpolation

is performed by using bilinear interpolation between adjacent pixels. Thus creating a blurring image. This can be done by finding the **average** gray values between two pixels and use that as pixel value between those two, starting also with rows and use the expanded result to enlarge the column.

Example :

Enlarge the following 8-bit image 2 times.

69	**50**	**80**
45	**60**	**66**
30	**55**	**80**

Zooming

2. Bilinear interpolation

Solution :

1. Enlarge the rows:

69	59	50	65	80
45	52	60	63	66
30	42	55	67	80

2. Enlarge the columns :

69	59	50	65	80
57	55	55	64	73
45	52	60	63	66
37	47	57	65	73
30	42	55	67	80

When the image size is M*N the bilinear enlarge image result will be

$$2M - 1 \times 2N - 1$$

In our example:

The image size is 3 x 3 *will be* (2 x 3 – 1) x (2 x 3 – 1) = 5 x 5

2. Shrinking

Is undersampling performing by detection of row and column

Example:

Shrinking the following 8-bit image ½ times.

20	**20**	**30**	**30**	**50**	**50**
20	**20**	**30**	**30**	**50**	**50**
33	**33**	**45**	**45**	**56**	**56**
33	**33**	**45**	**45**	**56**	**56**
87	**87**	**19**	**19**	**35**	**35**
87	**87**	**19**	**19**	**35**	**35**

2. Shrinking

Solution :

1. In the rows:

20	20	30	30	50	50
33	33	45	45	56	56
87	87	19	19	35	35

2. In the columns:

20	30	50
33	45	56
87	19	35

Relationships Between Pixels

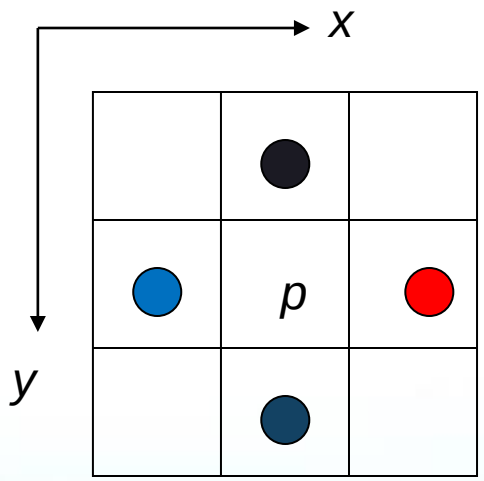
1. Pixel Neighbours

1. If an image *f(x,y)*, particular pixel p and q, pixel p at coordinates **(x,y)** has **four horizontal and vertical neighbors** whose coordinates are given by

$$(x+1, y), (x-1, y), (x, y+1), (x, y-1)$$

This set of pixels, called the **4-neighbors** of **p**, is denoted by $\mathbf{N_4(p)}$.

Each pixel is a unit distance from **(x,y)**

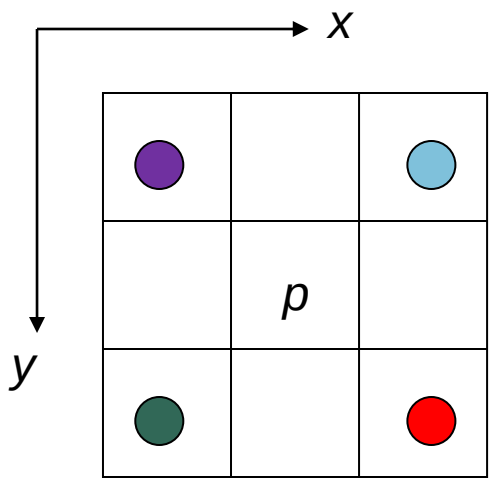


4-neighbour

1. Pixel Neighbours

2) The four diagonal neighbors of **p** have coordinates and are denoted by $N_D(p)$.

$(x + 1, y + 1)$, $(x + 1, y - 1)$, $(x - 1, y + 1)$, $(x - 1, y - 1)$

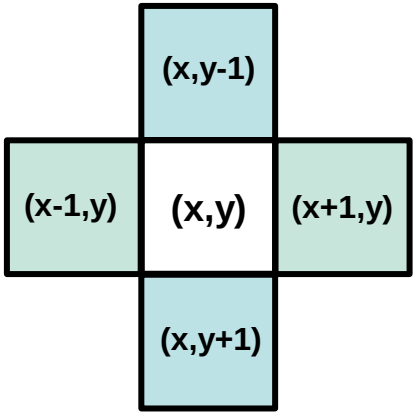


D-neighbour

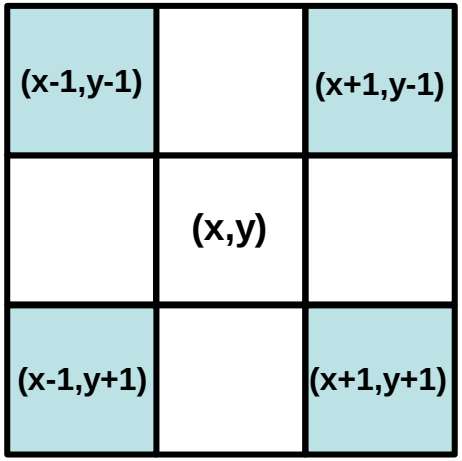
1. Pixel Neighbours

3) These points, together with 4-neighbors, are called the 8-neighbors of p denoted $N_8(p)$.

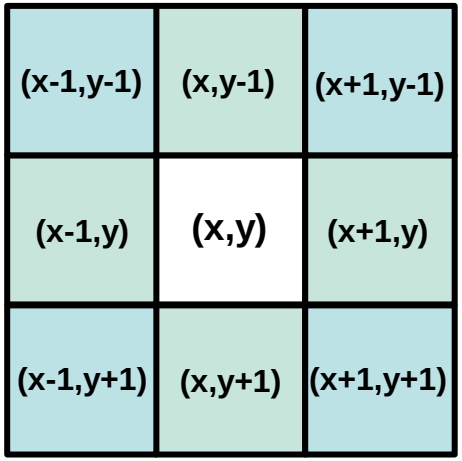
As before, some of the points in $N_D(p)$ *and* $N_8(p)$, fall outside the image if (x,y) is one the border of the image



4-neighbourhood



D-neighbourhood



8-neighbourhood

End of Lecture