

Nearest neighbor interpolation (Zero order hold)

by using Nearest neighbor interpolation zooming this image

49	30	60				49	49	30	30	60	60
35	40	46				35	35	40	40	46	46
10	35	60				10	10	35	35	60	60

49	49	30	30	60	60
35	35	40	40	46	46
10	10	35	35	60	60

49	49	30	30	60	60
49	49	30	30	60	60
35	35	40	40	46	46
35	35	40	40	46	46
10	10	35	35	60	60
10	10	35	35	60	60

$$\begin{bmatrix} 69 & 50 & 80 \\ 45 & 60 & 66 \\ 30 & 55 & 80 \end{bmatrix} = \begin{bmatrix} 69 & 69 & 50 & 50 & 80 & 80 \\ 45 & 45 & 60 & 60 & 66 & 66 \\ 30 & 30 & 55 & 55 & 80 & 80 \end{bmatrix} = \begin{bmatrix} 69 & 69 & 50 & 50 & 80 & 80 \\ 69 & 69 & 50 & 50 & 80 & 80 \\ 45 & 45 & 60 & 60 & 66 & 66 \\ 45 & 45 & 60 & 60 & 66 & 66 \\ 30 & 30 & 55 & 55 & 80 & 80 \\ 30 & 30 & 55 & 55 & 80 & 80 \end{bmatrix}$$

Bilinear interpolation (First-order hold)

by using Bilinear interpolation zooming this image

49	30	60		49	39	30	45	60
35	40	46	→	35	37	40	43	46
10	35	60		10	22	35	47	60

49	39	30	45	60
35	37	40	43	46
10	22	35	47	60

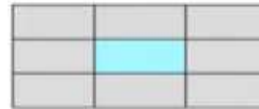
49	39	30	45	60
42	38	35	44	53
35	37	40	43	46
22	29	37	45	53
10	22	35	47	60

$$\begin{bmatrix} 69 & 50 & 80 \\ 45 & 60 & 66 \\ 30 & 55 & 80 \end{bmatrix} = \begin{bmatrix} 69 & 59 & 50 & 65 & 80 \\ 45 & 52 & 60 & 63 & 66 \\ 30 & 42 & 55 & 67 & 80 \end{bmatrix} = \begin{bmatrix} 69 & 59 & 50 & 65 & 80 \\ 57 & 55 & 55 & 64 & 73 \\ 45 & 52 & 60 & 63 & 66 \\ 37 & 47 & 57 & 65 & 73 \\ 30 & 42 & 55 & 67 & 80 \end{bmatrix}$$

Minimum filter

minimum filter

8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8



minimum filter

0	0	0			
0	8	9	10	11	12
0	12	8	9	10	11
	13	12	8	9	10
	14	13	12	8	9
	15	14	13	12	8

// خطوات الحل

- 1- كتابة ماسك حسب الحجم المطلوب والاغلب 3*3
- 2- نحدد رقم المطلوب عمل فلتر عليها من المصفوفة المعطاة
- 3- نضع مركز الماسك على رقم المطلوب عمل فلتر له
- 4- اذا كان الماسك متبقي فيه مربعات فنضع لها صفر
- 5- نكتب الارقام التي تكونت داخل الماسك

minimum filter

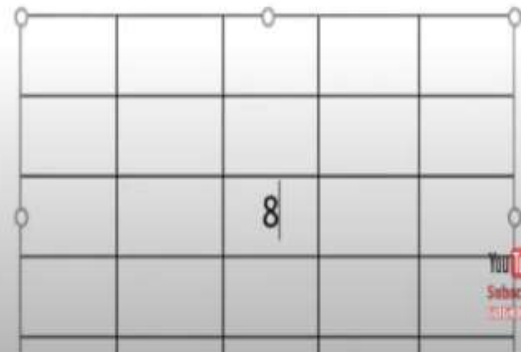
0	0	0			
0	8	9	10	11	12
0	12	8	9	10	11
	13	12	8	9	10
	14	13	12	8	9
	15	14	13	12	8

0				

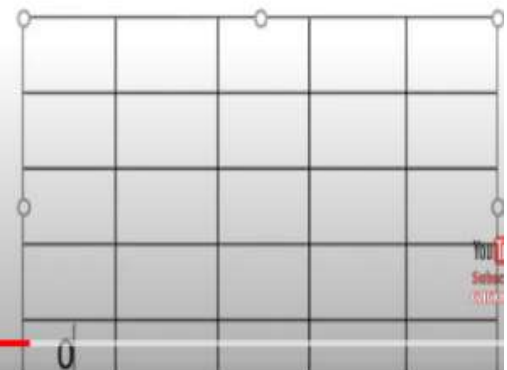
8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8

	8			

8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8



	8	9	10	11	12
	12	8	9	10	11
	13	12	8	9	10
0	14	13	12	8	9
0	15	14	13	12	8
0	0	0			



8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8



0	0	0	0	0
0	8	8	8	0
0	8	8	8	0
0	8	8	8	0
0	0	0	0	0

Consider the following image what will be the new value of the pixel (2,2) if smoothing to done using 3x3 neighborhood

- a. Median filter
- b. Max filter
- c. Min filter

0	1	0	2	7
2	7	7	4	0
4	6	4	3	3
1	1	0	7	5
5	4	2	2	5

Consider the following image what will be the new value of the pixel (2,2) if smoothing to done using 3x3 neighborhood

- a. Median filter
- b. Max filter
- c. Min filter = 0

0	1	0	2	7
2	7	7	4	0
4	6	4	3	3
1	1	0	7	5
5	4	2	2	5

7 7 4 6 4 3 1 0 7

Median filter

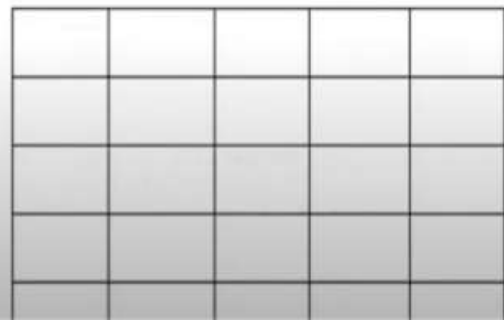
The **median filter** is a non-linear digital filtering technique, often used to remove noise from an image

Median filter

8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8

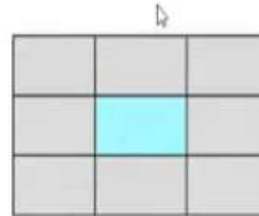


0 0 0 0 0 8 8 9 12



Median filter

8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8



// خطوات الحل

1- كتابة ماسك حسب الحجم المطلوب والاغلب 3×3
 2- نحدد رقم المطلوب عمل فلتر عليها من المصفوفة المعطاة

3- نضع مركز الماسك على رقم المطلوب عمل فلتر له
 4- اذا كان الماسك متبقي فيه مربعات فنضع لها صفر
 نرتب الارقام التي تكونت داخل الماسك تصاعديا او تنازليا

0 0 0 0 0 8 8 8 9 12

0	0	0			
0	8	9	10	11	12
0	12	8	9	10	11
	13	12	8	9	10
	14	13	12	8	9
	15	14	13	12	8

Median filter

0	0	0			
0	8	9	10	11	12
0	12	8	9	10	11
	13	12	8	9	10
	14	13	12	8	9
	15	14	13	12	8

0 0 0 0 0 8 8 9 12

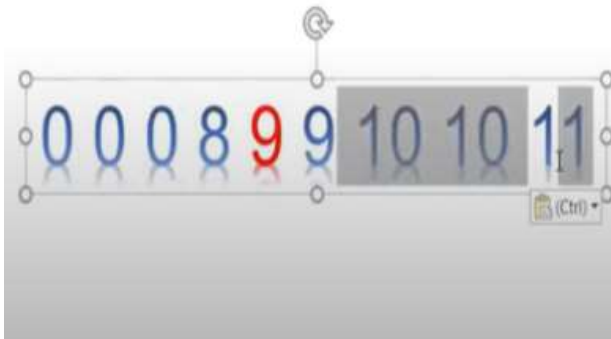
0				

0	0	0		
8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8

0 0 0 8 8 9 9 10 12

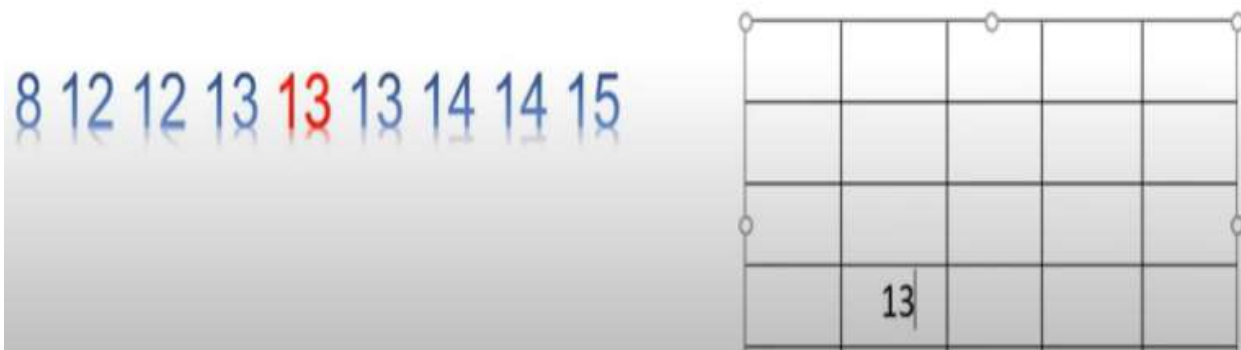
	8			

8	9	10	11	12	
12	8	9	10	11	0
13	12	8	9	10	0
14	13	12	8	9	0
15	14	13	12	8	



				9

8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8



Consider the following image what will be the new value of the pixel (2,2) if smoothing to done using 3x3 neighborhood

- Median filter = 4
- Min filter
- Max filter

0	1	0	2	7
2	7	7	4	0
4	6	4	3	3
1	1	0	7	5
5	4	2	2	5

0 1 3 4 4 6 7 7 7

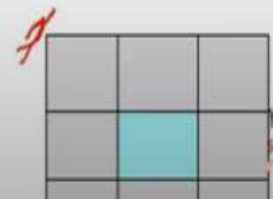


Consider the following image what will be the new value of the pixel (2,2) if smoothing to done using 3x3 neighborhood

- Median filter = 4
- Min filter
- Max filter

	0	1	2	3	4
0	0	1	0	2	7
1	2	7	7	4	0
2	4	6	4	3	3
3	1	1	0	7	5
4	5	4	2	2	5

0 1 3 4 4 6 7 7 7



Consider the following image what will be the new value of the pixel (2,2) if smoothing to done using 3x3 neighborhood

- Median filter
- Min filter
- Max filter

	0	1	2	3	4
0	0	1	0	2	7
1	2	7	7	4	0
2	4	6	4	3	3
3	1	1	0	7	5
4	5	4	2	2	5

0 1 3 4 4 6 7 7 7

Consider the following image what will be the new value of the pixel (2,2) if smoothing to done using 3x3 neighborhood

- Median filter = 4
- Min filter
- Max filter

	0	1	2	3	4
0	0	1	0	2	7
1	2	7	7	4	0
2	4	6	4	3	3
3	1	1	0	7	5
4	5	4	2	2	5

0 1 3 4 4 6 7 7 7

8	9	10	11	12
12	8	9	10	11
13	12	8	9	10
14	13	12	8	9
15	14	13	12	8



0	8	9	10	0
8	9	9	10	10
12	12	9	9	9
13	13	12	9	8
0	13	12	8	0