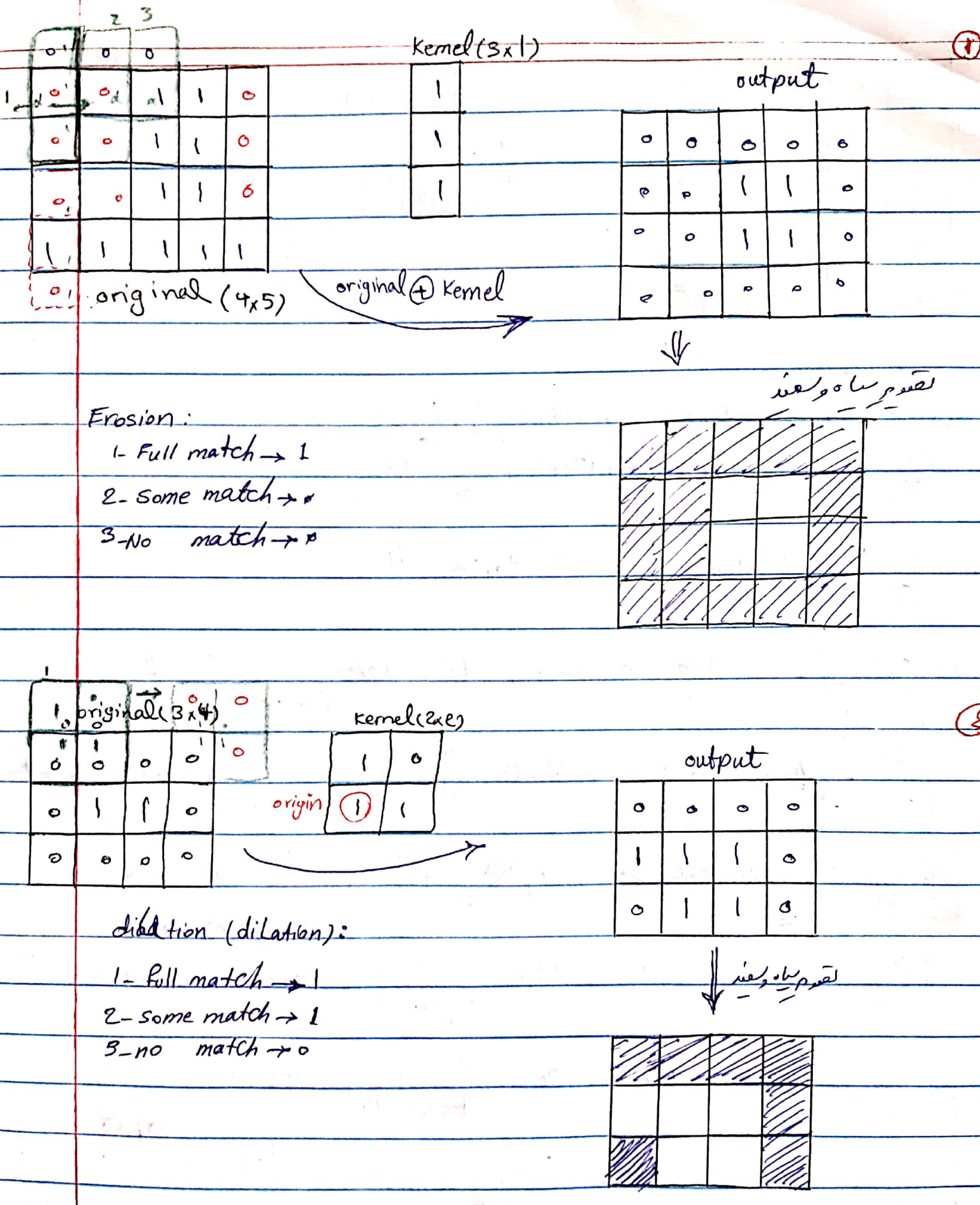

Kernel (3x1)
output
original (4x5)
original ⊕ Kernel
Erosion:
1- Full match → 1
2- Some match → 0
3- No match → 0
original (3x4)
Kernel (2x2)
origin
output
dilation (dilation):
1- full match → 1
2- some match → 1
3- no match → 0

| | | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 1 | | |
| 2 | 50 | 60 | 90 | 0 | 0 |
| 1 | 218 | 95 | 20 | 36 | 0 |
| 2 | 8 | 10 | 1 | 0 | 0 |
| 3 | 6 | 20 | 40 | 20 | 80 |
| 4 | 3 | p | p | 15 | p |

Gaussian Kernel (3x3)

$\frac{1}{16}$

| | | |
|---|---|---|
| 1 | 2 | 1 |
| 2 | 4 | 2 |
| 1 | 2 | 1 |

I. ⊛ K. = output

original image (5x5)

$A_{(0,0)} = \left(0+0+0+0+0+\frac{50\times4}{2}+\frac{60\times2}{12}+0+\frac{2\times18}{36}+\frac{95\times1}{95}\right)\times\frac{1}{16} = 28$

$(0,1) = (100+240+180+18+190+20)\times\frac{1}{16} = 46$

$(0,2) = \frac{1}{16}(120+360+0+95+40+36) = 41$

$(0,3) = \frac{1}{16}(180+20+72+0) = 17$ | $(0,4) = \frac{36}{16} = 2$

$(1,0) = \frac{1}{16}(100+60+72+190+16+10) = 28$ | $(1,1) = \frac{1}{16}(50+120+90+36+380+40+8+20+1) = 46$

$(1,2) = \frac{1}{16}(60+180+190+80+72+10+2) = 37$ | $(1,3) = \frac{1}{16}(90+40+144+1+0) = 17$

$(1,4) = \frac{1}{16}(72) = 4$

$(2,0) = \frac{1}{16}(36+95+32+20+12+20) = 13$ | $(2,1) = \frac{1}{16}(18+190+20+16+40+2+6+40+40) = 23$

$(2,2) = \frac{1}{16}(95+40+36+20+4+20+80+20) = 20$ | $(2,3) = \frac{1}{16}(20+72+2+40+40+80) = 16$

$(2,4) = \frac{1}{16}(36+20+100) = 10$ | $(3,0) = \frac{2}{16}(26+64+6) = 6$

$(3,1) = \frac{1}{16}(28+172+3) = 13$ | $(3,2) = \frac{1}{16}(12+240+15) = 17$

$(3,3) = \frac{1}{16}(1+320+30) = 22$ | $(3,4) = 23$

$(4,0) = 3$ $(4,1) = 6$ $(4,2) = 9$ $(4,3) = 14$ $(4,4) = 13$

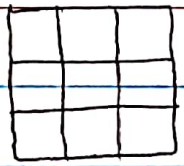
output

| | | | | |
|---|---|---|---|---|
| 28 | 46 | 41 | 17 | 2 |
| 28 | 46 | 37 | 17 | 4 |
| 13 | 23 | 20 | 16 | 10 |
| 6 | 13 | 17 | 22 | 23 |
| 3 | 6 | 9 | 14 | 13 |

original image

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| 0 | 50 | 60 | 90 | 0 | 0 |
| 1 | 18 | 95 | 20 | 36 | 0 |
| 2 | 8 | 10 | 1 | 0 | 0 |
| 3 | 6 | 20 | 40 | 20 | 80 |
| 4 | 3 | 0 | 0 | 15 | 0 |

Median Kernel(3,3)



(4)

O.I ⊛ M.K = output

output

| | | | | |
|---|---|---|---|---|
| 50 | 50 | 48 | 28 | 18 |
| 18 | 20 | 28 | 20 | 18 |
| 10 | 14 | 20 | 28 | 28 |
| 7 | 7 | 12 | 17 | 17 |
| 4 | 6 | 17 | 20 | 17 |

با روش استاد در کلاس
بدون در نظر گرفتن اعداد تکراری

(0,0) = {0, 18, 50, 60, 95}

(0,1) = {0, 18, 20, 50, 60, 90, 95}

(0,2) = {0, 20, 36, 60, 90, 95} : $\frac{36+60}{2}$ = 48

(0,3) : {0, 20, 36, 90} : $\frac{20+36}{2}$ = 28 (0,4) : {0, 36} : $\frac{36}{2}$ = 18 (1,0) = {0, 8, 10, 18, 50, 60, 95}

(1,1) : {1, 8, 10, 18, 20, 50, 60, 90, 95} : (1,2) : {0, 1, 10, 20, 36, 60, 90, 95} : 28 (1,3) : {0, 1, 20, 36, 90}

با در نظر گرفتن اعداد تکراری

| | | | | |
|---|---|---|---|---|
| ø | 20 | 20 | ø | ø |
| 10 | ø | 20 | ø | ø |
| 8 | 18 | ø | ø | ø |
| 3 | 6 | 10 | 1 | ø |
| ø | ø | ø | ø | ø |

(0,0) : {0, 0, 0, 0, 0, 18, 50, 60, 95}

(0,1) : {0, 0, 0, 18, 20, 50, 60, 90, 95}

(0,2) : {0, 0, 0, 0, 20, 36, 60, 90, 95}

(0,3) : {0, 0, 0, 0, 0, 20, 36, 90}

(0,4) : {0, 0, 0, 0, 0, 0, 0, 0, 36}

(1,0) : {0, 0, 0, 8, 10, 18, 50, 60, 95} (1,1) : 20 (1,2) : {0, 0, 1, 10, 20, 36, 60, 90, 95}

(1,3) : {0, 0, 0, 0, 1, 20, 36, 90}