* Zooming → optical, digital — Types

3 methods

- Pixel Replication / nearest neighbour interpolation
- zero order hold method
- K-Times zooming

2) Pixel Replication

Step 1) Row wise zooming
2) Column wise zooming

Eg:

1	2
3	4

2- zooming factor

1)

1	1	2	2
3	3	4	4

2)

1	1	2	2
3	3	4	4

Ans →

1	1	2	2
1	1	2	2
3	3	4	4
3	3	4	4

Eg

1	2	3
4	5	6

zooming_factor = 3

①

1	1	1	2	2	2	3	3	3
4	4	4	5	5	5	6	6	6

②

1 1 1 2 2 2 3 3 3 ...

4 4 4 5 5 5 6 6 6

②

1	1	1	2	2	2	3	3	3
1	1	1	2	2	2	3	3	3
1	1	1	2	2	2	3	3	3
4	4	4	5	5	5	6	6	6
4	4	4	5	5	5	6	6	6
4	4	4	5	5	5	6	6	6

6*9

Eg

1	2
3	4

Row zoom factor → 2

Col " " → 3

(1)

1	1	2	2
3	3	4	4

1	1	1	2	2	2
3	3	3	4	4	4

(2)

1	1	2	2
1	1	2	2
1	1	2	2
3	3	4	4
3	3		
3	3		

1	1	1	2	2	2
1	1	1	2	2	2
3	3	3	4	4	4
3	3	3	4	4	4

Note

Input → n * m zf

Output → (n * zf (row)) * (m * zf (col))

Eg: Input → 2 × 2 R. zf → 2 C. zf → 3

Output → 4 × 6

(2) Zero Order Hold

columns → n

1	2
3	4

zf → 2 (not necessarily 2 twice)

zf

↑

Insert (n-1) columns in between existing column except (~~except~~ ending)

(1) Row

1	1+2/2	2
3	3+4/2	4

→

1	2	2
3	4	4

rows → n

zf

Insert (n-1) rows between existed row (except ending)

(2) Col

1	2	2
2	3	3
3	4	4

Eg

1	2	3
4	5	6

∴ zf → 3

(1) Row

1	2	2	2	3	3	3
4	5	5	5	6	6	6

(2) Col

1	2	2	2	3	3	3
3	4	4	4	5	5	5
3	4	4	4	5	5	5
4	5	5	5	6	6	6

4 × 7

Note [zf * (no. of rows) − 1] * [zf * (no. of col) − 1]

Eg 2 * 3 $\xrightarrow{zf \to 2}$ 3 * 5 $\xrightarrow{2}$ 5 * 9

2

9 * 17

6 time zoom

(3) K − Times zooming

K (zooming factor) = 3

15	30	10
30	15	30

Row → add (K−1) col

Steps (1) $\frac{\text{Higher} - \text{Lower value}}{K} = x$

15	1st	2nd	30			10
30	3rd	4th	15			30

→ for 1st

$$\frac{30 - 15}{3} \div 5 = x$$

1st value = lower + x

= 15 + 5

= 20

2nd value = 1st + x

= 20 + 5

= 25

∴

15	20	25	30	17	24	10
30	20	25	15	20	25	30

2) Now rearrange values

15	20	25	30	24	17	10
30	25	20	15	20 25	25 20	30

3) (c)

add (k-1) row

1	15	20	25	30	24	17	10
1	1st						
1	2nd						
	30	25	20	15	25	20	30

→ 1st

$$\frac{30-15}{3} = 5 = x$$

1st = lower + x = 15 + 5 = 20

2nd = 1st + x = 20 + 5 = 25

15	20	25	30	24	17	10
20	22	22	20	21	20	17
25	24	24	25	22	23	24
30	25	20	15	20	25	30

(4) Sort

15	20	25	30	24	17	10
20	22	24	25	22	20	17
25	24	22	20	21	23	24
30	25	20	15	20	25	30

4x7

Eg $K \to 4$

24	12
12	6
6	24

Note

Input → $n * m$ ... K

Output → $(K * (n-1) + 1) * (K * (m-1) + 1)$