if 1d

2d

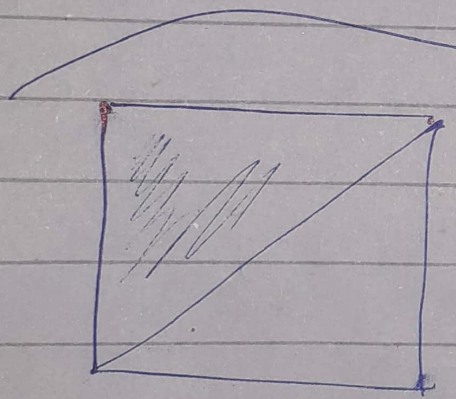
3d

	0	1
0	A	B
1	C	D

2 × 2 = 4

A	B	C	D
0	1	2	3

$i_1 \times D_2 + i_2$



1+2-3*1+1

Formula row-based = $cols \times i - \frac{(i(i-1))}{2} + j$

00, 01, 02, 03, 04, 11, 12, 13, 14, 22, 23, 24, 31, 32, 33, 34

40, 41, 42, 43, 44.

cols x

rows $xj - j(j-1) + i$

$3 \times 1 - 3 + 1$ $\quad \frac{}{2}$

cols - 1 +

cols - 2

cols - 3

	0	1	2
0	A	B	C
1	D	E	
2	F		

A D F B E C

0 1 2 3 4 5

	0	1	2
0			A
1		B	C
2	D	E	F

~~A B C D E F~~

~~0 1 2 3 4 5~~

D B E A C F (2,1)

0 1 2 3 4 5

rows $i \times cols$, ~~cols~~ $- \frac{i(i+1)}{2} + j$

6 → $6 - 3 + 0$

$= 3 + 0$

3 → 2 4 5

	0	1	2	3	4
0	x	x	x	x	A
1	x	x	x	B	C
2	x	x	D	E	F
3	x	G	H	I	J
4	K	L	M	N	O

if (——)

04

13, 14

22, 23, 24

31, 32, 33, 34

40, 41, 42, 43

A B C D E F G

0 1 2 3 4 5 6

0 → cols - 1
1 → cols - 2
2 →

$\frac{j(j-1)}{2}$

0 → 3
1 → 2
2 → 1
3 → 0

3 (28)
30 (28)

(a)

	0	1	2	3
0	.	.	.	A
1	.	.	B	C
2	.	D	E	F
3	G	H	I	J

non-zer

~~03, 12, 13, 21, 22, 23~~
~~30, 31, 32, 33~~

(3)(3)

0 → 0
1 → 1
2 → 3
3 → 3

$\frac{j(j+i)}{2} + i$

0+3 = 3
2+1 = 3
1+2 = 3
0+3 = 3 [illegible]

cols - j - 1 → zero values

i+j >= 30
i+j >= cols - 1

cols - 1
3 - i

if (i+j >= cols - 1)

cols - j - 1
4 - 0 - 1
= 3
4 - 2 - 1 = 2

A	C	F	J	B	E	I	D	H	G
0	1	2	3	4	5	6	7	8	9

4 - 3 - 0

i =
i - cols - j - 1

j [illegible], or 2 - j
(non-zero)

3 × [illegible] S_2

zero

[illegible] j [illegible] (i) (3) →

i = total -

0
[3][0] , [2][1] , (4)

(cols - j) ~~nonzero~~

[2][3]
(i) (3)

~~G H~~ I

~~G D H~~ ~~B E I~~ ~~A C F J~~
0 1 2 3 4 5 6 7 8 9

↑
(0)(0) (2)(1)

rows × j

a) colums → j
b) elements total → j×rows ✓
c) Total - zero = nonzero → j×rows - (cols - j)
= j×rows - cols+j

✓ → start of column

$\frac{j(j+1)}{2} + j$

6 + 3 = 9

3×4 - 4 + 3
12 - 4
8 + 3 = (11)
(3)(0)

if (i+j >= cols - 1)
{ $\frac{j(j+1)}{2}$ + i - cols - j - 1

0 + 3 - 4 + 0 + 1 = 0

~~else~~

$i-(cols-j-1$

$i-cols+j+1$

2,1

$j\frac{(j+1)}{2}+i-(cols+j+1)$ 3,1

$1+2-4+1+1 = +1$

$i-cols-j-1$ 1,3

3,3

$1+3-4+1+1 = 2$

$6+1-4+3+1$

$7 \quad 3+3+1 > 7$

$6+3-4+3+1$ (a)

column major formula : if $(i+j >= cols-1)$

$\{ j\frac{(j+1)}{2} + i - cols + j + 1 \}$

to the start

else 0

(b)

cols + j + i

(b)

	0	1	2	3	4
0	A	B	C	D	E
1	F	G	H	I	
2	J	K	L		
3	M	N			
4	O				

i = non-zero in any column

0	1	2	3	4	5	6	7	8
A	F	J	M	O	B	G	K	N
C	H	L	D	I	E			
9	10	11	12	13	14			

j	nonzer
0	→ 0
1	→ 4
2	→ 7
3	→ 9
4	→ 10

if (i + j < cols)

{ j( ) i( )

2

}

else 0

Total = rows × j

Stant = rows × j − { zeros }

$\frac{j(j-1)}{2}$

nous × j − $\frac{j(j+1)}{2}$ + i

C[1][2]

= 5 × 2 − $\frac{2(2-1)}{2}$ + 1

= 10 − 1 + 1

10

[0][4] → (E) rows with col

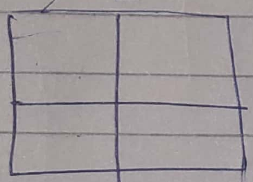
$= rows \times j - \frac{j(j-1)}{2} + i$

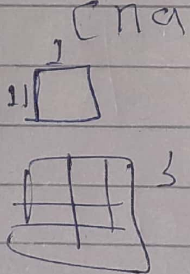
total — zero — non-zero in current.

$= 5 \times 4 - \frac{2(4(4-1))}{2} + 0$

$= 20 - 6 + 0 = 14$

2D { 2

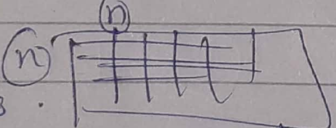




rows × cols

0 1 2 (3)

i+1 % rows cols.



row (i × cols + j)

0 (i × D2 + j) →

D1 i1 × D2 + i2

4×4

Index = i × cols + j

64 24 1 −98

2 → (3)

r c	0	1	2
0	6	4	24
1	1	(−9)	8

3×2

	0	1
0	6	4
1	4	−9
2	24	(8)

64 24 1 −98

3×2

(2,i)

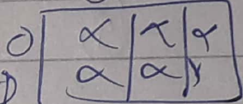
0 1 2 — 2, 3

i × cols + j

1 × 3 + 1

3 + 1 = 4

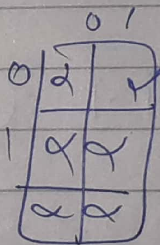
00 11 22



i × cols + j

1 × 2 + 1

2 + 1 = (3)



0 1 2

0 1 2

2 × 2 + 1

(5)

00 11 22

= j × rows + i