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Linked List - Part I

Course on Data Structure

Pankaj Sharma • Lesson 7 • July 15, 2024

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CS & IT Engineering

Data Structure

Arrays- VI

Lecture Number- 07

By- Pankaj Sir

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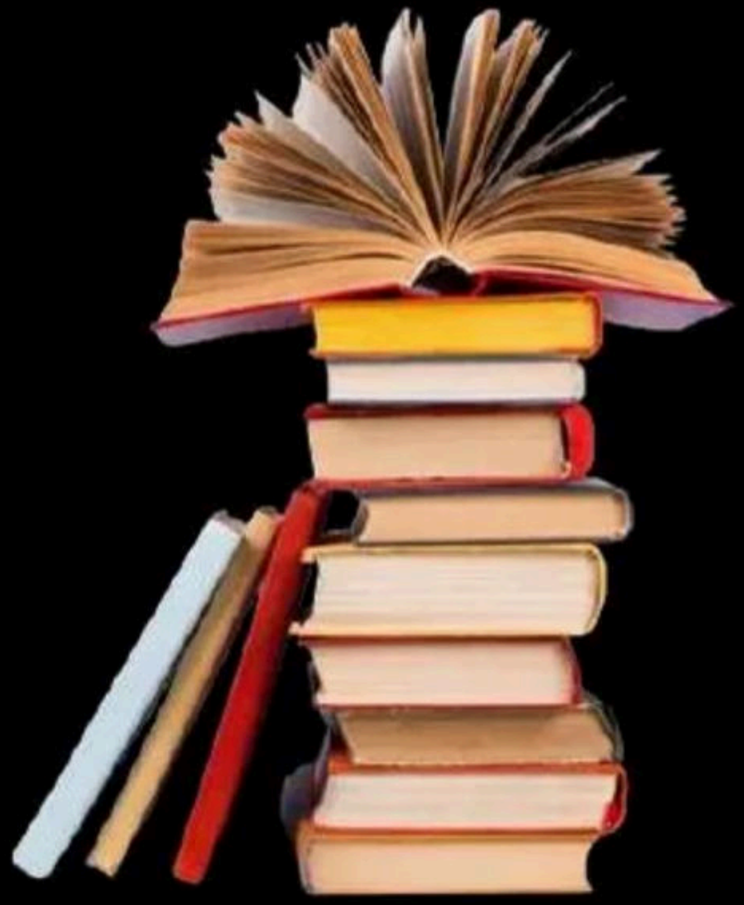
Topics

to be covered



1. Arrays

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Upper Triangular Matrix

add(A_{ij})

rows already filled

1, 2, 3, ... $(i-1)$

1st → N ⇒ $N-(1-1)$

2nd → N-1 ⇒ $N-(2-1)$

3rd → N-2 ⇒ $N-(3-1)$

$(i-1)^{th}$ → $N-(i-1-1)$

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ \vdots \\ i-1 \\ i \\ \vdots \\ N \end{array}
\begin{array}{c}
\begin{array}{cccccccc} 1 & 2 & \cdots & j-1 & j & \cdots & & N \end{array} \\
\begin{bmatrix}
a_{11} & a_{12} & & a_{1,j-1} & a_{ij} & \cdots & & a_{1N} \\
0 & a_{22} & \cdots & a_{2,j-1} & a_{2j} & \cdots & & a_{2N} \\
0 & 0 & a_{33} & \cdots & \cdots & & & \\
 & & & & & & & \\
 & & & & & & & \\
 & & & & & & & \\
 & & & & & & & \\
 & & & & & & &
\end{bmatrix}
\end{array}$$

A_{ij}

$$N + (N-1) + (N-2) + \cdots + (N-i+2)$$

$$\frac{(i-1)}{2}\left[N + (N-i+2)\right] = \frac{(i-1)}{2}\left[2N - (i-2)\right]$$

$$= (i-1)\cdot N - \frac{(i-1)(i-2)}{2}$$

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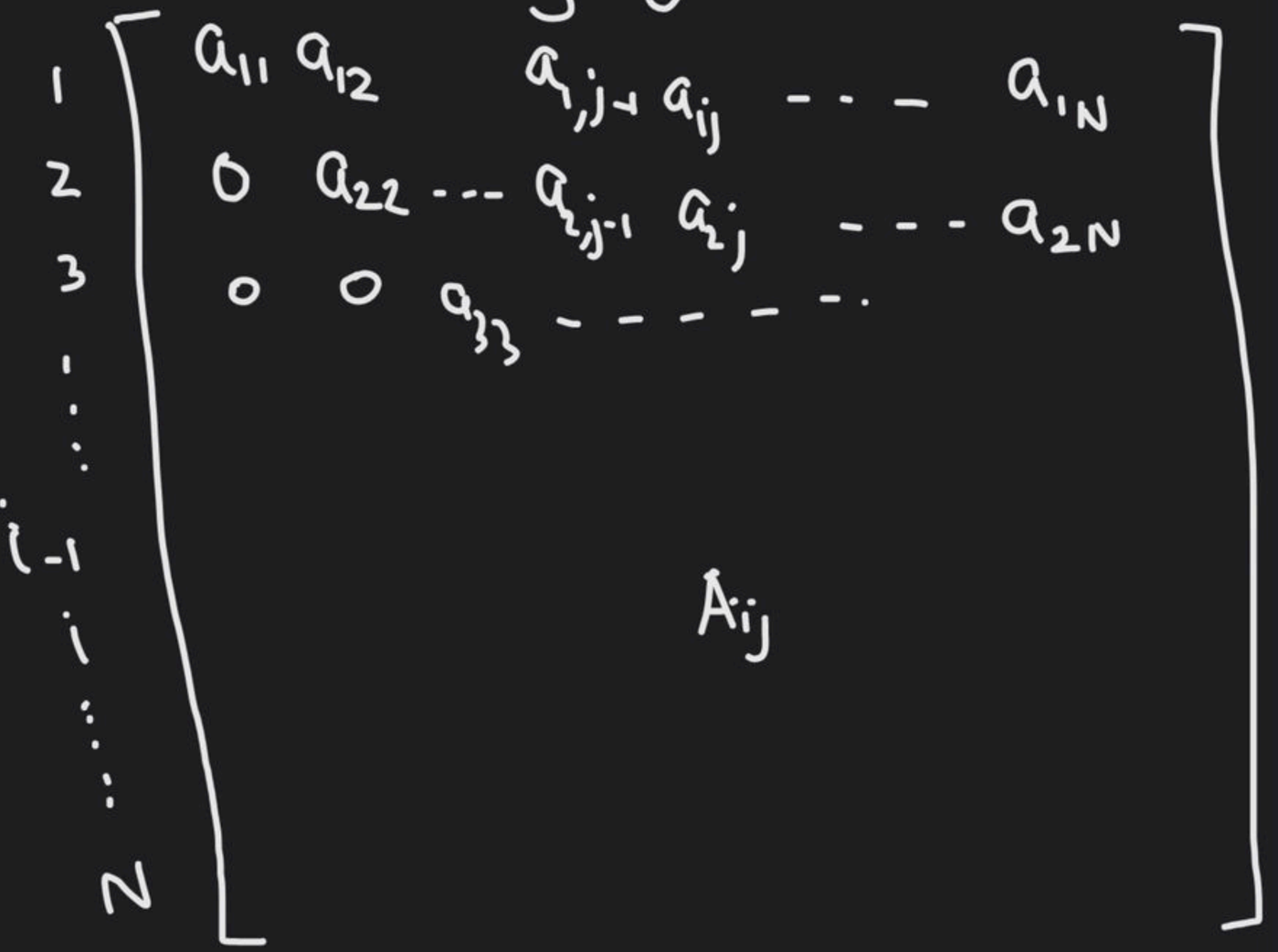
Upper Triangular Matrix

add(A_{ij})

Within ith row ele before A_{ij} = (j-i)



Total ele already filled before a_{ij}

$$= (j-1) + \left[\frac{(i-1)N - (i-1)(i-2)}{2} \right]$$

$$\text{addr}(A_{ij}) = \beta A + \left\{ (j-1) + \left[\frac{(i-1) \cdot N - (i-1)(i-2)}{2} \right] \right\} w$$

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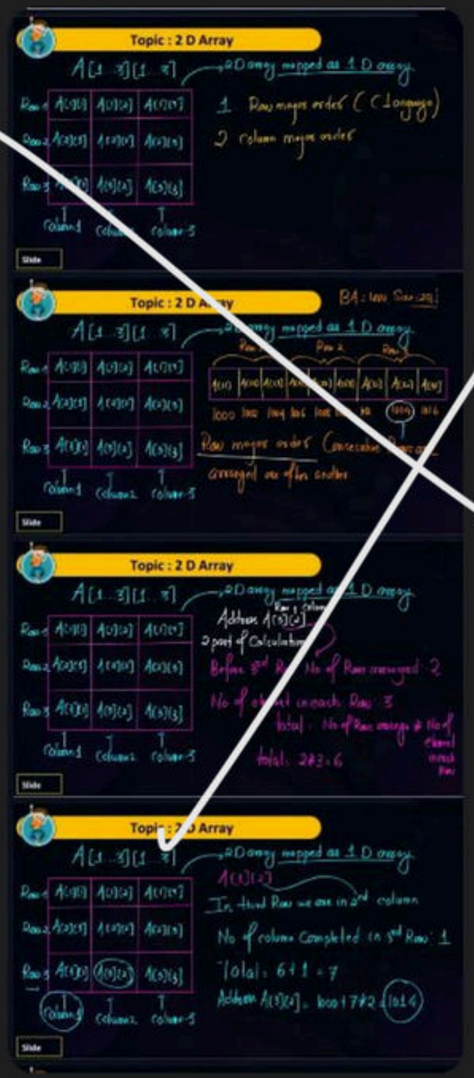
▲ 1 • Asked by Parshuram

Please help me with this doubt



Copy Paste

Q/ UTM $A[-12..12][-12..12]$ $12-(-12)+1=25 \times 25$

RMO

$w = 2$ bytes, $BA = 1000$

addr $(A_{0,3})$

rows already filled

$= -12$ to -1

$= -1-(-12)+1 = 12$ rows

ist, 2nd, 3rd, ... 12th

25 24 ... 14

$(25+24+\dots+14)$

$\frac{12}{2}[25+14] = 6 \times 39 = 234$

within row index 0, i.e. already filled before A_{03}

$= (3-0) = 3$

Total clc already filled = 237

Memory already filled = 237 × 2 = 474 Byte

1600 + 474 = 1474

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CM16

Upper triangular Matrix

addr(a_{34})

→ cols already filled

col1, col2, col3

(1 + 2 + 3)

= 6 elc

	1	2	3	4
1	a_{11}	a_{12}	a_{13}	a_{14}
2	0	a_{22}	a_{23}	a_{24}
3	0	0	a_{33}	a_{34}
4	0	0	0	a_{44}

a_{11}	a_{12}	a_{22}	a_{13}	a_{23}	a_{33}	a_{14}	a_{24}	a_{34}	a_{44}

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CM16

Upper triangular Matrix

(1 to 2)

ele (a_{34})

within 4th col, ele before a_{34}

(1, 2) = 2 ele

cols already filled

col1, col2, col3

(1 + 2 + 3)

= 6 ele

	1	2	3	4
1	a_{11}	a_{12}	a_{13}	a_{14}
2	0	a_{22}	a_{23}	a_{24}
3	0	0	a_{33}	a_{34}
4	0	0	0	a_{44}

a_{11}	a_{12}	a_{22}	a_{13}	a_{23}	a_{33}	a_{14}	a_{24}	a_{34}	a_{44}

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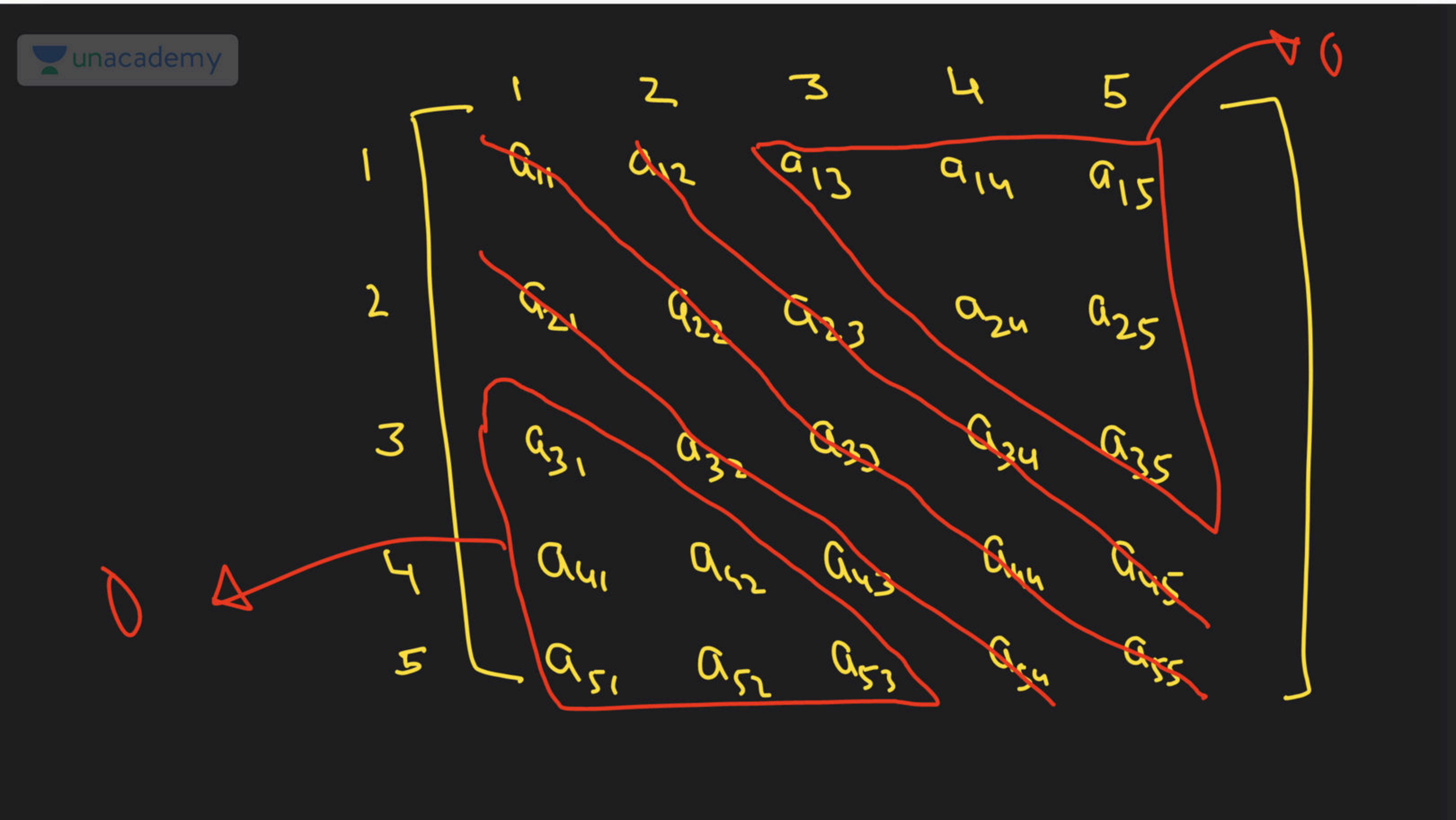
Tri-diagonal Matrix

1. Square matrix
2. Main diagonal ↖↘
   - diagonal - just above main diagonal
   - diagonal - just before main diagonal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1 2 3 4 5
1 2 3 4 5
a_{11} a_{12} a_{13} a_{14} a_{15}
a_{21} a_{22} a_{23} a_{24} a_{25}
a_{31} a_{32} a_{33} a_{34} a_{35}
a_{41} a_{42} a_{43} a_{44} a_{45}
a_{51} a_{52} a_{53} a_{54} a_{55}
0
0

# of elem in 1st row = 2

" " " last " = 2

" " " other rows = 3

$n \times n$ Tridiagonal matrix

Total no. of elements (non-zero)

= 1st + last + rem. (n-2) rows

= 2 + 2 + 3(n-2)

	1	2	3	4	5
1	a_{11}	a_{12}	0	0	0
2	a_{21}	a_{22}	a_{23}	0	0
3	0	a_{32}	a_{33}	a_{34}	0
4	0	0	a_{43}	a_{44}	a_{45}
5	0	0	0	a_{54}	a_{55}

RMO

addr(a45)

3 rows already filled

1st row → 2
2nd → 3
3rd → 3
} 8 ele

	1	2	3	4	5
1	a_{11}	a_{12}	0	0	0
2	a_{21}	a_{22}	a_{23}	0	0
3	0	a_{32}	a_{33}	a_{34}	0
4	0	0	a_{43}	a_{44}	a_{45}
5	0	0	0	a_{54}	a_{55}

a_{11}	a_{12}	a_{21}	a_{22}	a_{23}	a_{32}	a_{33}	a_{34}	a_{43}	a_{44}	a_{45}	a_{54}	a_{55}

RMO

addr(a_{45})

3 rows already filled

1st row → 2
2nd → 3
3rd → 3
} 8 ele

within 4th row ele before a_{45}

= (5 − 4th)

= 2

	1	2	3	4	5
1	a_{11}	a_{12}	0	0	0
2	a_{21}	a_{22}	a_{23}	0	0
3	0	a_{32}	a_{33}	a_{34}	0
4	0	0	a_{43}	a_{44}	a_{45}
5	0	0	0	a_{54}	a_{55}

a_{11}	a_{12}	a_{21}	a_{22}	a_{23}	a_{32}	a_{33}	a_{34}	a_{43}	a_{44}	a_{45}	a_{54}	a_{55}

RM10

Tridiagonal Matrix

add(a_{ij})

rows already filled

1, 2, 3, -- (i-1)

If → 2

(i-2) rows → 3 in each

$2 + 3(i-2) = 2 + 3i - 6$

within ith row

i.e. already filled

before a_{ij}

$= (j - i + 1)$

Total ele. already filled

$$= (3i - 4) + (j - i + 1)$$

$$= 2i + j - 3$$

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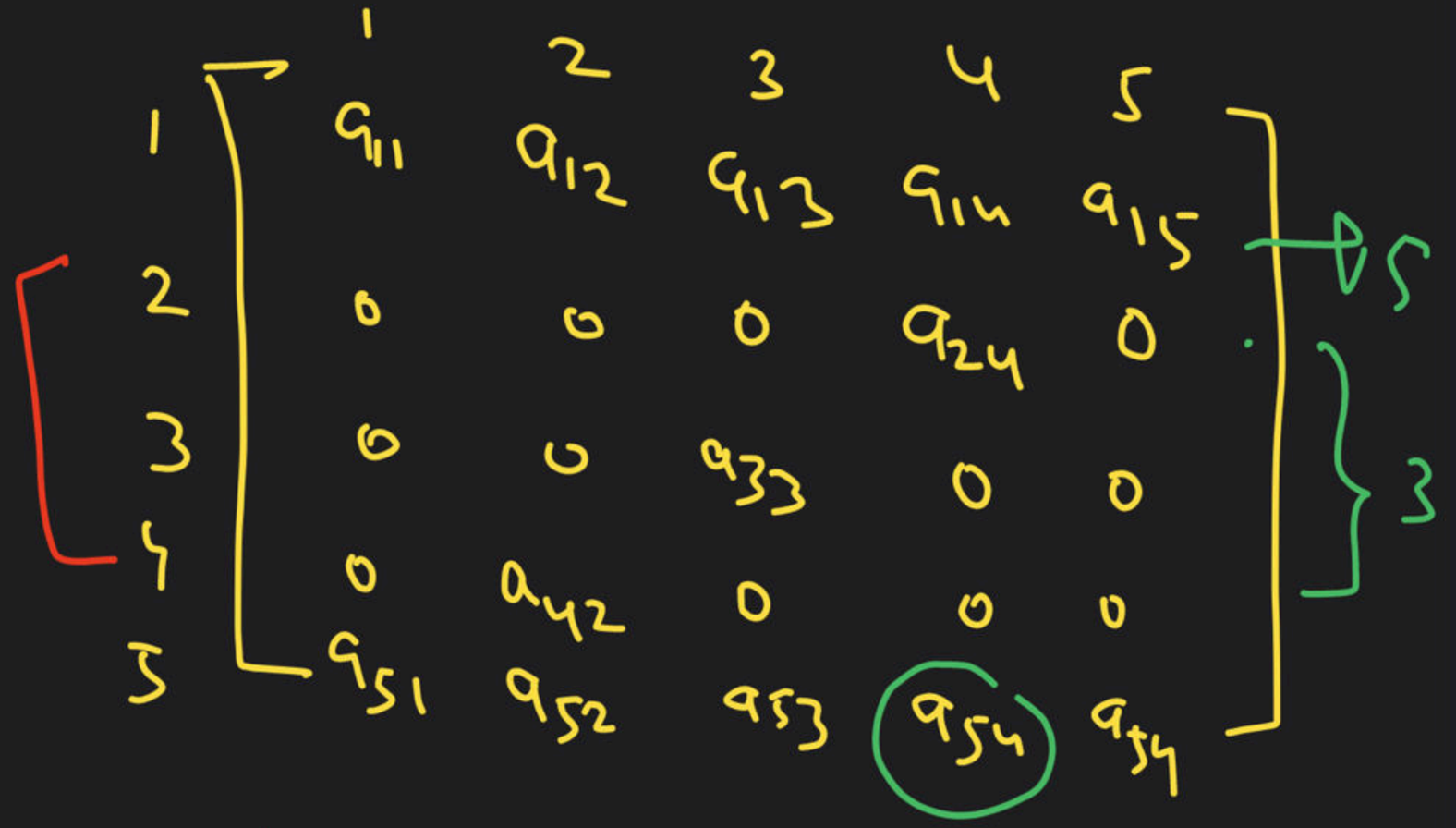
Z



RMO

4 rows → N

(n−2) → 1 rows

last row → N

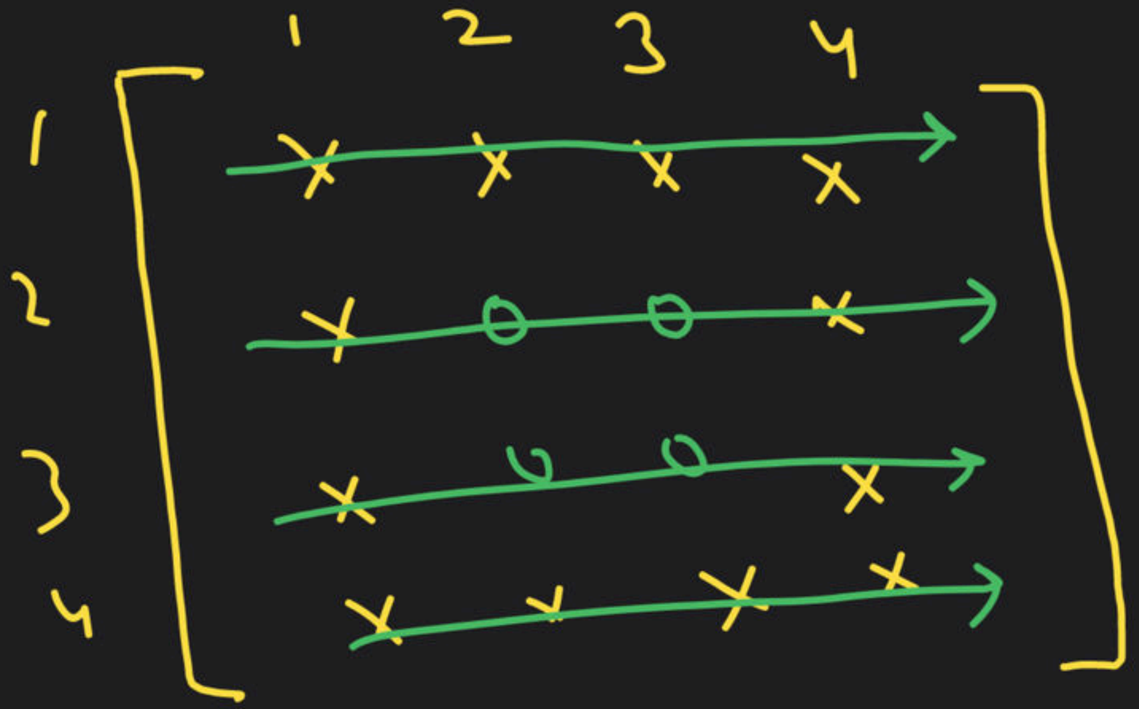
add(q_{54})

4 rows

within 5th row, ele filled = col1, col2, col3 (3)

1st row → 5 = 5 + 3(4)

rem 3 rows = (0)



Q1.

A[1..8, -5..5, -10..5] be a 3D array?

Total no. of elements?

$8 \times 11 \times 16 = 88 \times 16 = 1408$

Q2. A → 1D array A[1..75]

ω = 3 bytes

BA → 1120

addr(A[49])

48 elem x 3 = 144 Bytes

1120
144
1264

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Q3. $A[-5..5, -10..10)$ — 21

$w = 4$ Byte — RMO

$BA = 1000$

Addr($A_{0,0}$)

5 rows

$5 \times 21 = 105$

-10 to -1

10

Total $= 115$

Memory $= 115 \times 4 = 460$ Byte

$1000 + 460 = 1460$

Q Let A be a 2D array declared as follows

A: array[1..10][1..15] of integers

w= 1 byte, RMO, first elt. of the array is stored at location 100, what is the address of a[i][j].

A) 15i+j+84

B) 15j+i+84

C) 10i+j+89

D) 10j+i+89

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RMO

$A[1..10][1..15]$

$A_{i,j}$

$15(i+j-48)$

Rows already

$= 1$ to $(i-1)$

$= (i-1)$

$15(i-1)$

1 to $j-1$

$(j-1)$

Total

$= 15(i-1)+(j-1)$

Memory

$= 15(i-1)+(j-1)$

$loc(A_{i,j}) = 100 + 15(i-1)+(j-1)$

$= 100 + 15i - 15 + j - 1$

Q Consider the following declaration of a 2D array in C:

char a[100][100];

w = 1 Byte & array is stored starting from memory address 0, the address of a[40][20] is

a) 4040
b) 4120
c) 5040
d) 5020

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C

marks already filled

a[40][50]

0 to 39

= 39-0+1

= 40 X 100

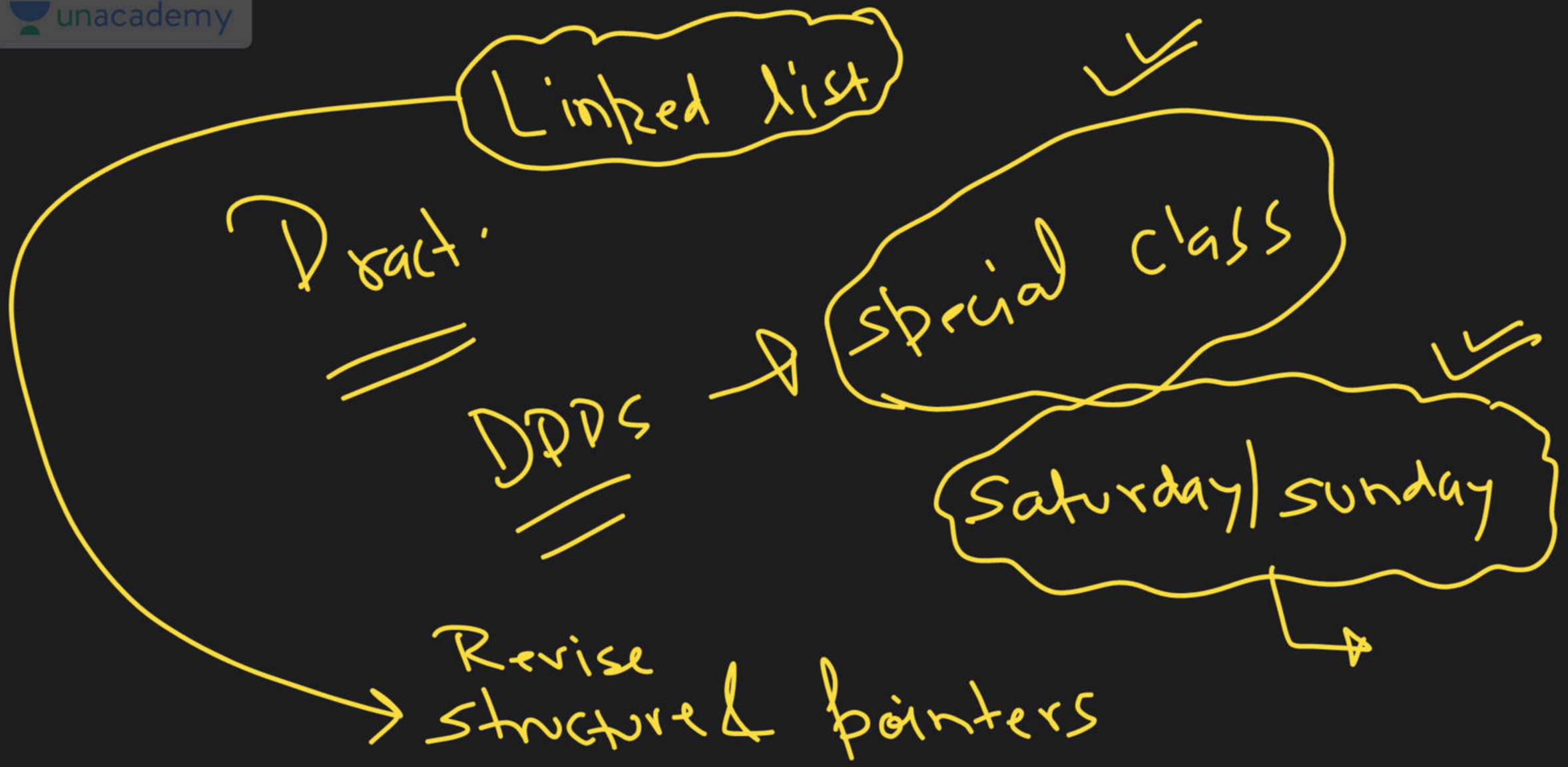
= 4000

0 to 49

= 50

Memory = 4000 cle X 1Byte

= 4000 Byte


Linked list
Pract:
DPDS
special class
Saturday/ sunday
Revise
structure & pointers

$$\#\text{ele} = 2 + 2 + 3(n-2)$$

$$= 4 + 3n - 6$$

$$\boxed{\#\text{of ele} = 3n - 2}$$

$n = 5$

$3 \times 5 - 2$

$= 13$

Total ele = 8

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THANK YOU!

Here's to a cracking journey ahead!