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Square Matrix

Lecture 3

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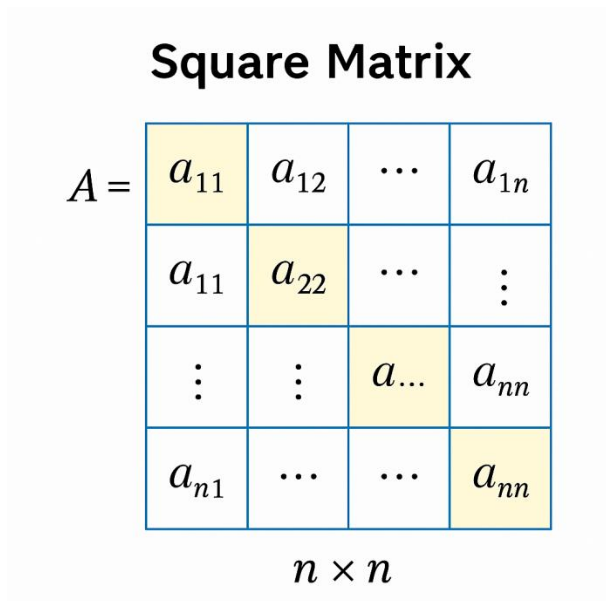
Square Matrix

- A **matrix** is a 2D array of numbers.
- **Square Matrix**: A matrix with the same number of rows and columns, i.e., n x n.
- **Real-world uses**: Graphics, cryptography, scientific computing, AI (especially in neural networks), etc.



Important Terms Related to Square Matrices

1. Main Diagonal (a.k.a. Primary Diagonal**)**

- Elements from **top-left** to **bottom-right**.
- For matrix A[i][j], the main diagonal has **i == j**.

1 2 3
4 **5** 6
7 8 **9**
→ Main Diagonal = 1, 5, 9

2. **Secondary Diagonal** (a.k.a. Anti-diagonal)

- From **top-right** to **bottom-left**.
- For A[i][j], this is where **i + j == n - 1**.

1 2 **3**
4 **5** 6
7 8 9
→ Secondary Diagonal = 3, 5, 7

Important Terms Related to Square Matrices

3. Upper Triangular

- For matrix A[i][j], this is where **i < j**.

3	**8**	**4**	**6**
4	2	**0**	**7**
4	5	2	**0**
3	6	7	1

→ Upper Triangular = 8, 4, 6, 0, 7, 0

4. Lower Triangular

- For matrix A[i][j], this is where **i > j**.

3	8	4	6
4	2	0	7
4	**5**	2	0
3	**6**	**7**	1

→ Lower Triangular = 4, 4, 5, 3, 6, 7

0,0	0,1	0,2	0,3	0,4
1,0	**1,1**	1,2	1,3	1,4
2,0	2,1	**2,2**	2,3	2,4
3,0	3,1	3,2	**3,3**	3,4
4,0	4,1	4,2	4,3	**4,4**

i==j

0,0	**0,1**	**0,2**	**0,3**	**0,4**
1,0	1,1	**1,2**	**1,3**	**1,4**
2,0	2,1	2,2	**2,3**	**2,4**
3,0	3,1	3,2	3,3	**3,4**
4,0	4,1	4,2	4,3	4,4

i<j

0,0	0,1	0,2	0,3	0,4
1,0	1,1	1,2	1,3	1,4
2,0	**2,1**	2,2	2,3	2,4
3,0	**3,1**	**3,2**	3,3	3,4
4,0	**4,1**	**4,2**	**4,3**	4,4

i>j

0,0	0,1	0,2	0,3	**0,4**
1,0	1,1	1,2	**1,3**	1,4
2,0	2,1	**2,2**	2,3	2,4
3,0	**3,1**	3,2	3,3	3,4
4,0	4,1	4,2	4,3	4,4

i + j == n - 1

Special types of Square Matrices

Identity Matrix

- Diagonal = 1, all other elements = 0

1	0	0	0
0	**1**	0	0
0	0	**1**	0
0	0	0	**1**

→ Identity Matrix

Diagonal Matrix

- Non-diagonal elements = 0; diagonal can be any value

5	0	0	0
0	**2**	0	0
0	0	**7**	0
0	0	0	**1**

→ Diagonal Matrix

Symmetric Matrix

- A[i][j] == A[j][i]

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

→ Symmetric Matrix