CHE/CEN138

COMPUTER PROGRAMMING

MATRIX OPERATIONS

References

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2.Hunt, B.R., Lipsman, L.R. and Rosemberg J. M. “A guide to MATLAB for Beginners and ExperiencedUsers"Cambridge University Press, 2001.

3.Kubat, C. “MATLAB Yapay Zeka ve Mühendislik Uygulamaları” İkinci Baskı, Pusula Yayıncılık, 2014McGraw Hill, International Edition 2012.

CONTENT

- Definitions and Terms
- Special Matrices
- Matrix Algebra
- Determinant and Inverse

Definitions and Terms

- Vector, matrix
- Element, subscript
- "Matrices of the same kind"

Vector

A *VECTOR* IS A COLUMN OF NUMBERS CONSISTING OF N NUMBERS

$$\mathbf{A} = \begin{bmatrix} \mathbf{a_1} \\ \mathbf{a_2} \\ \mathbf{a_3} \\ \cdots \\ \mathbf{a_n} \end{bmatrix}$$

The values shown by $\boldsymbol{a_i}$ are the **elements** of vector **a**.

Matrix (Pl.: Matrices)

MATRIX

is a rectangular array of numbers consisting of
m rows and
n columns.

$$\begin{bmatrix} \mathbf{a_{11}} & \mathbf{a_{12}} & \cdots & \mathbf{a_{1m}} \\ \mathbf{a_{21}} & \mathbf{a_{22}} & \cdots & \mathbf{a_{2m}} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{a_{n1}} & \cdots & \cdots & \mathbf{a_{nm}} \end{bmatrix}$$

The values shown by $\boldsymbol{a_{ij}}$ are the **elements** of vector **a**.

Matrix example

$$\begin{bmatrix} 2 & 5 & 7 & 8 \\ 5 & 6 & 8 & 3 \\ 1 & 6 & 4 & 0 \end{bmatrix}$$

This matrix has 3 rows rows and 4 columns.

We say it is a **3 x 4** (3 by 4) matrix.

We denote the element on the second row and fourth column with $\mathbf{a_{2,4}}$

• Special Matrices

- Row / column matrices
- Zero matrix
- Square matrix
- Diagonal matrix
- Unit matrix
- Symmetric matrix
- Transpose
- Orthogonal matrix

Row matrix / column matrix

A matrix with one row is called a **row matrix**.

$$\begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix}$$

A matrix with one column is called a **column matrix**.

$$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Also called: **row-vector** and **column-vector**.

Zero Matrix

A ZERO MATRIX

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Square Matrix

$$\begin{bmatrix} 2 & 5 & 7 \\ 5 & 6 & 8 \\ 1 & 6 & 4 \end{bmatrix}$$

A **SQUARE MATRIX**
HAS THE SAME
NUMBER OF ROWS
AND COLUMNS.

The elements $\mathbf{a_{i,i}}$, with i = 1,2,3,...
are called **diagonal** elements.

Diagonal matrix

$$\begin{bmatrix} 2 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$

A **DIAGONAL MATRIX** IS A SQUARE MATRIX WITH ALL NON-DIAGONAL ELEMENTS ARE **0**.

Unit matrix

A **unit matrix** is a diagonal matrix with all diagonal elements **1**.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Also called: **identity matrix** - **I**.

Symmetric matrix

A **SYMMETRİC MATRİX** IS A SQUARE MATRIX WHERE $A_{I,J} = A_{J,I}$ FOR ALL ELEMENTS.

$$\begin{bmatrix} 1 & -1 & 4 \\ -1 & 2 & 3 \\ 4 & 3 & 6 \end{bmatrix}$$

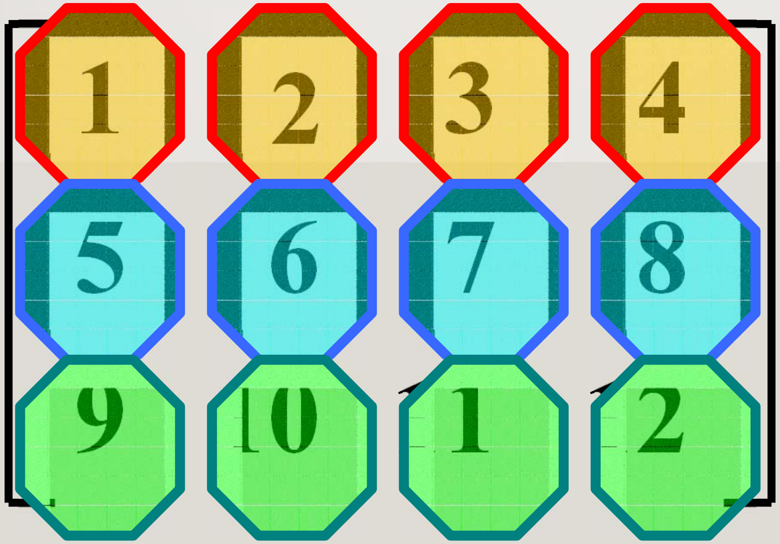
Transpose

THE TRANSPOSE OF THE M X N MATRIX A IS SHOWN BY A^T.

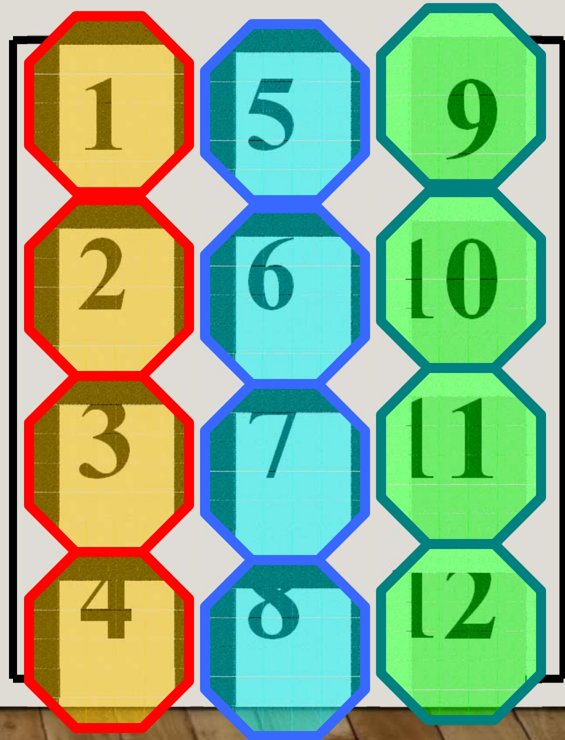
- A^T is an **n x m** matrix,
- row **i** of **A** = column **i** of A^T for (**i** = 1,2,3, .. **n**)

Transpose (2)

A =



A^{T} =



Orthogonal matrix

AN **ORTHOGONAL MATRIX** IS A SQUARE MATRIX WHICH PRODUCES A UNİT MATRİX İF İT İS MULTİPLİED BY İTS OWN TRANSPOSE:

$$\mathbf{A} \times \mathbf{A}^{T} = \mathbf{I}$$

Properties of special matrices

$$\mathbf{A} = (\mathbf{A}^{T})^{T} = (((\mathbf{A}^{T})^{T})^{T})^{T}$$

$$(\mathbf{A} + \mathbf{B})^{T} = (\mathbf{A}^{T} + \mathbf{B}^{T})$$

If $\mathbf{A}$ is a symmetric matrix, then

$$\mathbf{A} = \mathbf{A}^{T}$$

If $\mathbf{A}$ is an orthogonal matrix, then

$$\mathbf{A} \times \mathbf{A}^{T} = \mathbf{I}$$