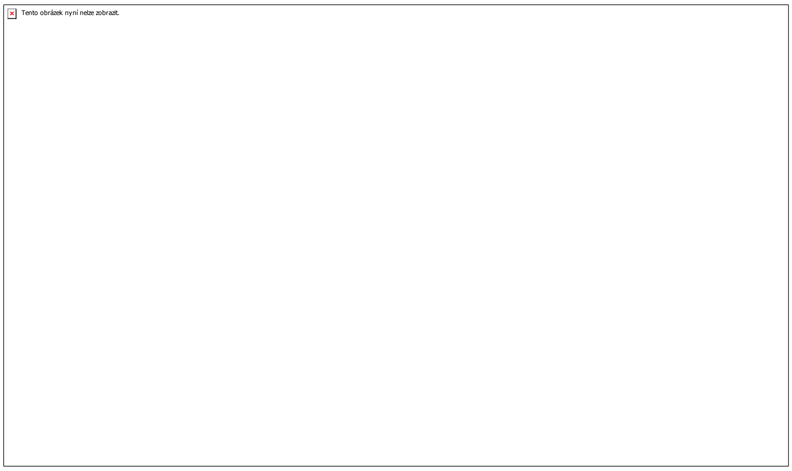
Unit 4 – Matrices in Mathematics

I Definition and Operations

1. a) Look at the matrix below and give names for the parts with arrows:



b) Read the text below and check/complete your answers:

In mathematics, matrices play a very important role. A matrix is defined as a rectangular array of elements. It is divided into rows and columns which contain numbers or expressions or variables, called elements. A particular row and column corresponds to a certain element. If the arrangement has m rows and n columns, then the matrix is said to be of order $m \times n$ (read as m by n), or we say that the matrix has the dimension $m \times n$. A matrix is enclosed by a pair of parentheses, i.e. ( ), or square brackets, i.e. [ ], and is denoted by a capital letter. The variables a_{ij}, where index $i = 1, \dots n, j = 1, \dots m$, denote the elements or members or entries of a matrix.

Based on: https://math.tutorvista.com/algebra/matrices.html

c) Write down your definition of matrix:

Basic properties and operations of matrices.

2. Read the properties of matrices below and complete the sentences using the word given in brackets to form a word that fits in the gap. Do not use –ing forms. (EXAM PRACTICE)

a) Addition and __________________ of two matrices is possible only if they have the same order. (SUBTRACT)
b) The __________________ of two matrices A and B is possible if the number of columns of A is equal to the number of rows B. (MULTIPLY)
c) Two matrices are said to be __________________ if they have the same order. (COMPARE)
d) The __________________ inverse of a matrix A is -A. (ADDITION)
e) A square $A = [a_{ij}]$ is said to be __________________ if $a_{ij} = a_{ji}$. (SYMMETRY)

3. Speaking. Choose one operation with matrices, e.g. addition, subtraction, … and explain how it is done.

4. There is an example of the matrix multiplication. Read the text and fill in the missing items.

multiply	dot product		product	last
height	row	width	coordinate	column

Ordinary matrix product

The ordinary matrix product is the most often used and the most important way to (1)……………………. matrices. It is defined between two matrices only if the width of the first matrix equals the (2)………………….. of the second matrix. Multiplying an $m \times n$ matrix with an $n \times p$ matrix results in an $m \times p$ matrix. If many matrices are multiplied together, and their dimensions are written in a list in order, e.g. $m \times n, n \times p, p \times q, q \times r$, the size of the result is given by the first and the (3)……………………. numbers ($m \times r$), and the values surrounding each comma must match for the result to be defined. The ordinary matrix product is not commutative.

$$\overset{3\times 4 \text{ matrix}}{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ 1 & 2 & 3 & 4 \end{bmatrix}} \overset{4\times 5 \text{ matrix}}{\begin{bmatrix} \cdot & \cdot & \cdot & a & \cdot \\ \cdot & \cdot & \cdot & b & \cdot \\ \cdot & \cdot & \cdot & c & \cdot \\ \cdot & \cdot & \cdot & d & \cdot \end{bmatrix}} = \overset{3\times 5 \text{ matrix}}{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & x_{3,4} & \cdot \end{bmatrix}}$$

The element $x_{3,4}$ of the above matrix (4) ……………………. is computed as follows

$$x_{3,4} = (1,2,3,4) \cdot (a,b,c,d) = 1 \times a + 2 \times b + 3 \times c + 4 \times d.$$

The first (5) **…………………….** in matrix notation denotes the (6) **…………………….** and the second the column; this order is used both in indexing and in giving the dimensions. The element $\boldsymbol{x_{ij}}$ at the intersection of row $\boldsymbol{i}$ and (7) **…………………….** $\boldsymbol{j}$ of the product matrix is the dot product (scalar product) of row $\boldsymbol{i}$ of the first matrix and column $\boldsymbol{j}$ of the second matrix. This explains why the (8)**…………………….** and the height of the matrices being multiplied must match: otherwise the (9)**…………………….** is not defined.

Text from https://www.scribd.com/document/36768703/About-Matrices

5. Matrices find many applications. Match the first half of sentences with the correct endings.

1. Physics makes use of matrices in various domains, for example	of distances between pairs of vertices in a graph.
2. Graph theory uses matrices to keep track	in geometrical optics and matrix mechanics.
3. Computer graphics uses matrices to project	that use a square mathematical matrix to determine the pattern of music intervals.
4. Serialism and dodecaphonism are musical movements of the 20th century	of functions or exponentials to matrices.
5. Matrix calculus generalizes classical analytical notions such as	in performing seismic surveys in geology.
6. Matrices are quite useful	3-dimensional space onto a 2-dimensional screen.
7. Matrices are used in statistics while	the calculation of production of goods effectively.
8. Matrices have a great importance in economics in	managing records, drawing graphs and in other calculations.

Exercise based on http://cs.wikipedia.org/wiki/Matrix
https://math.tutorvista.com/algebra/matrix-theory.html

6. Listening. Watch video about an example of matrix application and answer the questions below.
https://www.youtube.com/watch?v=3ysnWTtni_4

a) What does the matrix P describe?

b) What does the matrix Q describe?

c) What does the product PxQ tell us?

d) What helped the speaker to figure out what the product meant?

7. ***Work out the following problems.***

a) Mary found that her new car averaged 18.2 per miles per gallon the first week, 19.0 the second week, 17.6 the third week, and 18.5 the fourth week. Write this information as a row matrix and then as a column matrix.

b) Joan' s scores on the first three tests in her math class were 82, 77, and 85. Paula scored 91, 80, and 82 on the same three tests. Janet' s scores on the three tests were 90, 82, and 79. Write this information as a 3x3 square matrix in two different ways.

c) Richard Marcias bought 7 shares of Sears stock, 9 shares of IBM stock, and 8 shares of Chrysler stock. The following month, he bought 2 shares of Sears stock, no IBM, and 6 shares of Chrysler. Write this information first as a 3x2 matrix and then as a 2x3 matrix.

d) Margie Bezzone works in a computer store. The first week she sold 5 computers, 3 printers, 4 disc drives, and 6 monitors. The next week she sold 4 computers, 2 printers, 6 disc drives, and 5 monitors, Write this information first as a 2x4 matrix and then as a 4x2 matrix.

8. Language of mathematics:

a) Make the plurals:

matrix	
index	

b) Read this notation.

$$[\mathbf{AB}]_{i,j} = A_{i,1}B_{1,j} + A_{i,2}B_{2,j} + \cdots + A_{i,n}B_{n,j} = \sum_{r=1}^{n} A_{i,r}B_{r,j},$$