UDC 378

LINEAR ALGEBRA TEACHING USING MATHEMATICS SOFTWARE PACKAGES

Kotova Olha
Candidate of Physical and Mathematical Sciences
Hryhorieva Valentyna
Candidate of Pedagogical Sciences
Hniedkova Olha
Candidate of Pedagogical Sciences
Kherson State University
Kherson, Ukraine

Annotation. Mathematics software packages using is one of the indicators of professional learning level of university graduates in information computer technologies (ICT). The problems of linear algebra are easy to algorithmize. To increase the efficiency of students' professional competencies formation, it is necessary to talk about algorithms in the form they would be performed by a computer. Mathematics software packages Mathematica, Maple, MathCAD, Matlab are used at practical classes. Mathematics software packages will automate arithmetic calculations and enable students to focus on the essence of method. The experience of Matlab package using in the linear algebra for students of "Software Engineering" specialty is presented in the article. Practical realization of main topics of linear algebra is developed in this package. The methodical features of the package application in solving the most algorithmic problems of the course are revealed.

Keywords: study of linear algebra, software packages in mathematics

Introduction. The priority directions of modern society development is educational process improvement on the basis of new information computer technologies (ICT) introduction. The ICT use in the educational process involves not

only the learning of the ways of ICT mastering and developing, but ICT use in a specific subject area, in particular, for training of solving tasks through various packages of applications (Mathematica, Maple, MathCAD, Matlab) (Stormy Attaway, 2009). Matlab environment use in diploma theses and dissertations will increase the complexity and importance of research. It will significantly redistribute the workload of teachers – from homework tasks assessment to network project management in Matlab environment. For example, Eindhoven Technical University in the Netherlands (Technische Universiteit Eindhoven), the most parts of scientific and teaching equipment are designed by students and produced within the educational process. So, it saves funds for the purchase of laboratory equipment.

The main purpose of the article is to consider the experience of using the Matlab package in linear algebra for students majoring in "Software Engineering".

Matlab package use in linear algebra learning. Students of computer specialties who have completed the linear algebra course should:

- understand the basic ideas of linear algebra, the role of the methods in applications of other sciences, their practical introduction and capabilities.
- possess theoretical knowledge in solving of linear equations, the theory of arithmetic linear spaces and the theory of linear operators on arithmetic linear spaces, theory of polynomials in one and several variables.
- orient in the linear algebra information flown.
- acquire skills in solving typical tasks of linear algebra.

For example, typical tasks are: finding a solution of linear equation systems, calculating the values of determinants and the matrix rank, finding a linear operator matrix, studying the roots of polynomials in one variable. Since linear algebra tasks are easy to algorithmize, their implementation in the mathematical package Matlab is possible.

Example. Let's consider the example. Matrices are given

$$A = \begin{pmatrix} -3 & 5 & 13 \\ 11 & -5 & 7 \\ 2 & -1 & -6 \end{pmatrix}, B = \begin{pmatrix} 2 & 9 & -8 \\ 1 & -15 & 14 \\ 4 & -12 & 3 \end{pmatrix} \quad (1)$$

Let's calculate A+B, A-B, A·B, B·A, |A|, |B|, A^{-1}, B^{-1}.

Set the matrix in the command window of the program

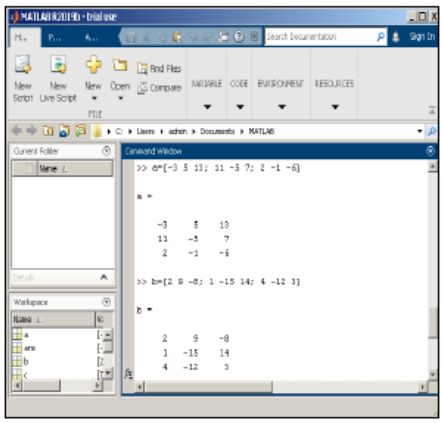

Fig.1. Initial data

$$A + B = \begin{pmatrix} -3 & 5 & 13 \\ 11 & -5 & 7 \\ 2 & -1 & -6 \end{pmatrix} + \begin{pmatrix} 2 & 9 & -8 \\ 1 & -15 & 14 \\ 4 & -12 & 3 \end{pmatrix} =$$

$$= \begin{pmatrix} -3+2 & 5+9 & 13-8 \\ 11+1 & -5-15 & 7+14 \\ 2+4 & -1-12 & -6+3 \end{pmatrix} = \qquad \begin{pmatrix} -1 & 14 & 5 \\ 12 & -20 & 21 \\ 6 & -13 & -3 \end{pmatrix}. \quad (2)$$

$$A - B = \begin{pmatrix} -3 & 5 & 13 \\ 11 & -5 & 7 \\ 2 & -1 & -6 \end{pmatrix} - \begin{pmatrix} 2 & 9 & -8 \\ 1 & -15 & 14 \\ 4 & -12 & 3 \end{pmatrix} =$$

$$= \begin{pmatrix} -3-2 & 5-9 & 13+8 \\ 11-1 & -5+15 & 7-14 \\ 2-4 & -1+12 & -6-3 \end{pmatrix} =$$

$$\begin{pmatrix} -5 & -4 & 21 \\ 10 & 10 & -7 \\ -2 & 11 & -9 \end{pmatrix}. \qquad (3)$$

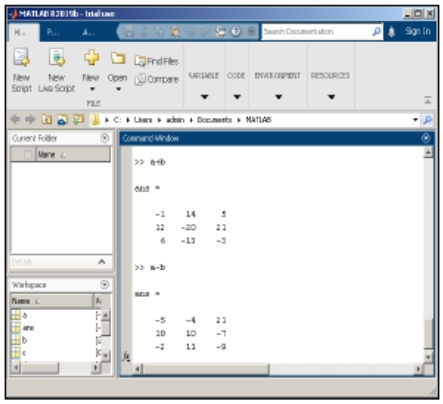

Fig. 2. Sum and disparity result

$$c_{11}=-3\cdot 2+5\cdot 1+\ c_{12}=-3\cdot 9+5\cdot(-15)+c_{13}=-3\cdot(-8)+5\cdot 14+13\cdot 4=$$

$$51,+13\cdot(-12)=-258,+13\cdot 3=133, \qquad (4)$$

$$c_{21}=11\cdot 2+(-5)\cdot 1+c22=11\cdot 9+(-5)\cdot(-15)+$$

$$c_{23}=11\cdot(-8)+\ +7\cdot 4=45+7\cdot(-12)=90,+(-5)\cdot 14+7\cdot 3=-137,$$

$$c31=2\cdot 2+(-1)\cdot 1+c32=2\cdot 9+(-1)\cdot(-15)+\ c33=-8\cdot 2+(-1)\cdot 14+$$

$$+(-6)\cdot 4=-21,+(-6)\cdot(-12)=105,+(-6)\cdot 3=-48. \qquad (5)$$

$$C=A\cdot B=\begin{pmatrix}-3 & 5 & 13\\ 11 & -5 & 7\\ 2 & -1 & -6\end{pmatrix}\cdot\begin{pmatrix}2 & 9 & -8\\ 1 & -15 & 14\\ 4 & -12 & 3\end{pmatrix}=$$

$$C=\begin{pmatrix}51 & -258 & 133\\ 45 & 90 & -137\\ -21 & 105 & -48\end{pmatrix} \qquad (6)$$

Similarly, we find

$$B\cdot A=\begin{pmatrix}2 & 9 & -8\\ 1 & -15 & 14\\ 4 & -12 & 3\end{pmatrix}\cdot\begin{pmatrix}-3 & 5 & 13\\ 11 & -5 & 7\\ 2 & -1 & -6\end{pmatrix}=\begin{pmatrix}77 & -27 & 137\\ -140 & 66 & -176\\ -138 & 77 & -50\end{pmatrix} \qquad (7)$$

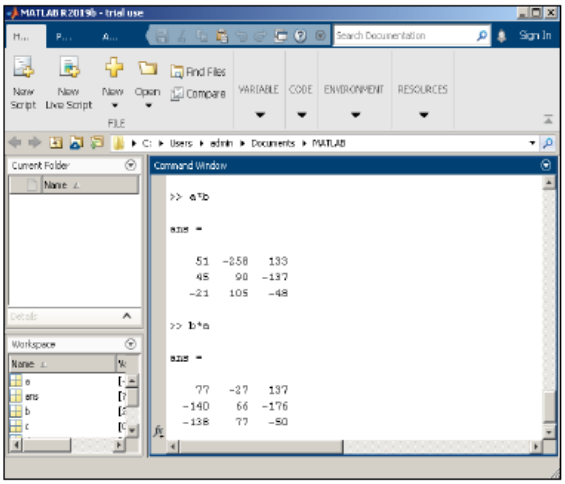

Fig. 3. Multiplication result

$$|A|=\begin{vmatrix}-3 & 5 & 13\\ 11 & -5 & 7\\ 2 & -1 & -6\end{vmatrix}=-3\cdot(-5)\cdot(-6)+11\cdot(-1)\cdot 13+5\cdot 7\cdot 2-\ -(2\cdot$$

$$(-5)\cdot 13+11\cdot 5\cdot(-6)+7\cdot(-1)\cdot(-3))=276. \qquad (8)$$

Similarly, we find

$$|B|=\begin{vmatrix}2 & 9 & -8\\ 1 & -15 & 14\\ 4 & -12 & 3\end{vmatrix}=339. \qquad (9)$$

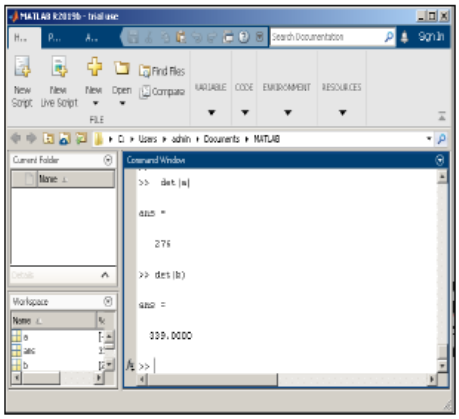

Fig. 4. Result of determinant finding

Similarly, we find

$$B^{-1} = \begin{pmatrix} 123 & 69 & 6 \\ 53 & 38 & -36 \\ 48 & 60 & -39 \end{pmatrix} \quad \mathbf{10}$$

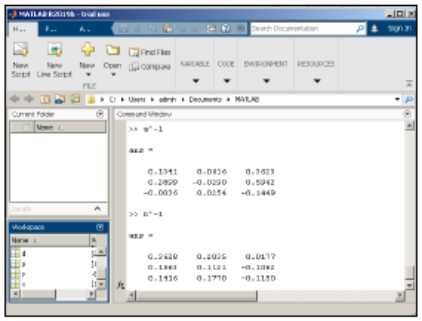

Fig. 5. The result of inverse matrix finding

Matlab supports working with complex numbers, which have significant applied value in Physics and Economics.

Conclusion and prospective. One of the significant advantages of Matlab system is its integration into all areas of modern science and technology. Matlab is a global standard in higher education and research. The linear algebra teaching is based on the traditional presentation of the material. Matlab package application allows to increase the educational process efficiency and to form competencies necessary in future professional activities (Thomas S. Shores, 2000).

Students are open to all kinds of technologies in Mathematics. The openness and availability of high-tech tools, is changing the approach to linear algebra

teaching.

Currently, in many educational institutions the organizing forms of educational process are being reformed and distance learning is being intensively introduced. It requires the development of electronic textbooks and practical works. So, the task of increasing of the laboratory works efficiency by working only with Web browser is actual. Tools for remote development have appeared in some mathematical packages, including Matlab. Web application development is a special feature of Matlab to use remote computing for increasing of solving tasks efficiency. It greatly facilitates teachers' work and plays an important role in improving the effectiveness of educational organization tools and the distance learning introduction.

In the following papers, approaches to linear algebra study with the use of mathematical packages will be described.

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