ISBN - 978-93-91143-83-1

MULTIDISCIPLINARY RESEARCH IN RECENT TRENDS IN PHYSICAL SCIENCES

Proceeding of Conferences 2021-2022

1. International Conference on Emerging Trends in Material Science
Date 9th & 10th November 2022
2. National Conference on Recent Trends In Mathematics & Statistics
Date 9th November 2022

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Published By
BMP Publisher
www.bmppublisher.com

Matrix Operation in Scilab

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Abstract:

Scilab is a very powerful and open-source software package for scientific and technical computation, visualization and programming. It includes a large number of general purpose and specialized functions, using state of the art algorithms, for numerical computation.

More complex tasks of linear algebra, such as the resolution of systems of linear equations Ax = b, various decomposition, eigen values and eigen vectors computations, are also performed by compiled and optimized source codes. These operations are performed by common operators like the slash "/" or backslash "\" or with functions like spec, which computes eigenvalues and eigenvectors.

Scilab Software is also useful for create empty matrices, null matrices, identity matrices, transpose and inverse of matrices, rank and range of matrices, various algebraic operations, upper and lower triangular matrix, determinant.

Keywords: Scilab Software, Matrix, Matrix Operations, Transpose, Range, Rank

Introduction

Scilab is like a heaven for Linear Algebra related problems, as it recognizes matrices and their operations. Defining a matrix is easy and simple. There are a lot of in-built functions to perform various tasks like transposing a matrix, multiplying or adding matrices, element-wise operations, various types of matrix like Identity matrix and so more.

In Scilab, the basic data type is the matrix, which is defined by:

- The number of rows,
- The number of columns,
- The type of data.

The data type can be real, integer, boolean and polynomial. When two matrices have same number of rows and columns then this allows to perform algebraic operations. The vectors are a particular case of matrices, where the number of rows is equal to1. Simple scalar variables do not exist in Scilab. Scilab was created to be able to perform matrix operations as fast as possible. Most basic operations, such as addition, substraction, transpose and dot product are performed with the common operators "+", "-", "*" and the single quote (’),so the source code is both simple and fast.

Objectives

- Scilab is an open-sourcesoftware for numerical computations. It is free of cost so we can use it easily.
- We operate scilab on matrices just as easily as an ordinary calculator works with scalar data combined with the fact that all matrix operations are available.

- We can create matrices, such as zero matrices, identity matrices.
- To give working knowledge of Scilab.
- To learn how can use Scilab file to define document class.
- Use tabular and array environments within Scilab document.
- To give knowledge of how can write equation and matrix.
- To learn how to perform matrix operations as fast as possible. Most basic operations, such as addition, substraction, transpose and dot product are performed.
- Also,we learn it is useful for create empty matrices, null matrices, identity matrices and all types of matrices.
- To find transpose and inverse of matrices, rank and range of matrices, various algebraic operations, upper and lower triangular matrix, determinant.

Method

Vectors-Vectors are specified as a list of scalars, where the delimiters determine the layout of the vector. Elements in comma- or whitespace-separated lists form a row-vector:→**rowVector = [1,2,3] rowVector =**

1. 2. 3.

→sameRowVector = [1 2 3] whereas semicolons separate

elements of columnvectors.

→columnVector = [1.;2.;3.]
= 1.
2.
3.

Let define a vector in two ways – first one is using spaces
→p = [1 2 3]
p =
1. 2. 3.
Or using commas,
→q = [2, 3, 4]
q =
2. 3. 4.

Length of vector

We find length of vector as follows:
→length (p)
ans =
3.

Addition of vector

→p +q
ans =
3. 5. 7.

Matrix- The syntax to create a matrix is a straight forward extension of the vector syntax. The row vectors of the matrix are assigned to the elements of a column vector.
-->column Row Matrix = [[11,21,31]; [12,22,32]; [13,23,33]]
Column Row Matrix =
11. 21. 31.
12. 22. 32.

13. 23. 33.
which can be also written without the inner brackets and with whitespaces instead
of commas.
--> p = [1 2 3;4 5 6]
p =
1.2. 3.
4. 5. 6.

Size of matrix-The size of matrix can be obtained by using the size command
-->size (p)
ans =
2. 3.

Creating Identity Matrix- The frequently needed identity matrix is returned by eye(m,n) if the matrix dimensions m and n agree.
In the general case the matrix $[\delta_{ij}]_{i=1...m,j=1...n}$ is created. -->Identity Matrix = eye(3,3)
-->eye(4,4)
ans =
0. 0. 0. 0.
0. 1. 0. 0.
0. 0. 1. 0.
0. 0. 0. 1.

Creating matrices containing zeroes and ones – Other useful functions are zeros(m,n) andones(m,n) which create the matrices $[u_{ij} = 0]_{i=1...m,j=1...n}$ and $[uij = 1]i=1...m,j=1...n$ respectively.
Create a matrix of zeros with 2 rows and 2 columns using the command
-->zeros(2,2)
ans =
0. 0.
0. 0.
A matrix of all ones can be created with ones command as follows
-->ones(2,4)
ans =
1. 1. 1. 1.
1. 1. 1. 1.

The empty matrix-An empty matrix can be created by using empty square brackets, as in the following session, where we create 0 × 0 matrix.
-->A=[]
A =
[]

Determinant of matrix :-It is find by using syntax det.
-->c=[6 1 1;4 -2 5;2 8 7]
c = 6. 1. 1.
4. -2. 5.
2. 8. 7.
--> det(c)
ans =

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Matrix Algebra-The elementary operations in linear algebra +,−,×,/ and the power function are easily accessible in the scilab language.
Addition-The sum of two matrices is computed with the "+" operator.
-->A = [1 2 3;4 5 6]
A =
1. 2. 3.
4. 5. 6.

```
-->B = [7 8 9;0 -1 4]
B  =
       7.    8.    9.
       0.   -1.   4.
-->A+B
ans  =
       8.   10.   12.
       4.   4.    10.
```

Multiplication -Matrix multiplication is done with the "*" operator:

```
--> A =[1 0;1 0]
A=
    1 0
    1 0
-->B =[1 2;2 1]
B=
    1 2
    2 1
-->A*B
ans  =
       1.    2.
       1.    2.
```

Transpose-The transpose is returned if a "" follows the matrix expression.

```
-->A = [1 2;3 4] + % * [5 6;7 8]
A =
    1. +5i    2. +6i
    3. +7i    4. +8i
-->A'
ans =
       1. -5i    3. -7i
       2. -6i    4. -8i
```

Element-wise Operations-If a dot "." is written before an operator an operator, it is associated with an element wise operator

```
-->a = [0 1 ; 2 3]
       1.        2.
       3.        4.
-->a.* a
ans  =
       1.        4.
       9.        16.
```

Inverse of Matrix- The inverse is calculated with the inv([A]) function.

```
-->Ainv = inv(A);

-->x1 = Ainv*b x1 =

      1.0057916
    - 2.2502357
      0.8202812
```

Conclusion

- Various types of matrices and their operations provide rich source of problem.
- Due to good and free computational tools are available currently, the future lies in computational techniques.
- Scilab provide powerful tools.

- So we can easily solve large problems.

Reference

- Website: **https://help.scilab.org/doc/6.0.0/en_US/plot3d.html**
- Scilab for very beginners :-

https://www.scilab.org/sites/default/files/scilab_beginners_0.pdf