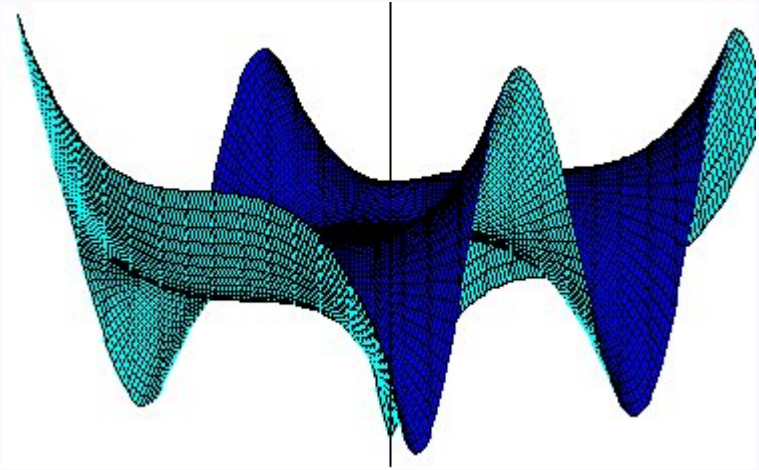

Scilab

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Introduction
Special Symbols in . . .
Rows and Columns

1. Introduction

- Scilab is an Open Source software.
- It can work on windows as well as linux as well as Mac.
- scilab understands many mathematical data types like vector, matrix, polynomial etc.
- scilab has inbuilt functions.
- It also allow us to do programming, in which we can use inbuilt commands e.g. rank, inv etc.
- scilab is case sensitive. So V and v are different in scilab.

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1. scilab has an editor called scipad.

2. scilab has graphics window.

3. scilab provides good help.

4. scilab has demos.

In scilab, vector and matrix are basic data types. A vector may also be considered as a matrix for computations.

```
-->V=[2,-4,5]

-->V
 V  =

    2.   - 4.    5.

-->V'
 ans  =

    2.
  - 4.
    5.
```

Define two vectors U and V and try $U + V$.
$U * V$
$U * V'$ What are your observations?
Try size(U).

Products of vectors:
Dot product (a scalar) and component-wise product (a vector):

```
-->u
 u   =
    1.    2.    3.
 v   =
    2.    3.    4.

-->u*v
    !--error 10
inconsistent multiplication

-->u.*v
 ans   =
    2.    6.    12.
```

```
-->u*v'
 ans  =
    20.

-->u'*v
 ans  =
    2.    3.    4.
    4.    6.    8.
    6.    9.    12.
```

Other interesting data type in scilab is Matrix.
Here is an example of writing a matrix in scilab.

```
B=[1,2;3,4]
 B   =

    1.    2.
    3.    4.
```

Now try to write a matrix A such that $A = \begin{bmatrix} 1 & -3 & 2.4 \\ .5 & 0 & 3 \end{bmatrix}$

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Try the following matrix operations for matrices of appropriate size :

- A+B
- 3*A
- A*B
- B*A
- A^{20}
- `A/B` $\frac{A}{B}$
- `A\B` Read it as A divides B $\frac{B}{A}$
- `A.^2`
- `A./B`
- `A.\B`

Using various commands for matrix operations and in built functions, it becomes easy to explain concepts in linear algebra at the college level.
For matrices there are in built commands to get elements, like

- A(2,1) (Gives the element in the second row and first column.)
- A(4) (Gives 4th element of the matrix, considering the matrix as a column-wise array)
- A(:,1) (All elements of the 1st column.)
- A(2,:) (All elements of the 2nd row.)
- size(A) (The number of rows and columns.)
- length(A) (The number of elements.)

- sum(A) (The sum of all elements.)
- sum(A, 'r') Row wise addition of elements
- prod(A)
- trace(A)
- det(A)
- inv(A)
- spec(A)
- max(A)
- min(A)

2. Special Symbols in scilab

```
-->%pi
 %pi  =

    3.1415927
-->%i
 %i  =

    i

-->%e
 %e  =
    2.7182818
-->%inf
 %inf  =

   Inf
-->%eps
 %eps  =

    0.0000000000000022
```

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```
-->format(5)

 -->%e
 %e  =

    2.72

-->format(20)

-->%e
 %e  =

    2.71828182845904509
```

```
 -->format('e', 10)


-->%pi
 %pi  =

    3.142D+00

-->format('e', 20)

-->%pi
 %pi  =

    3.1415926535898D+00

-->format('v',10)

-->%pi
 %pi  =

    3.1415927
```

Trignometric functions

```
-->cos(0)
 ans  =

    1.

-->sin(%pi/2)
 ans  =

    1.
```

You can find $\cos([\%pi : .1 : \%pi/4])$.

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Other types of matrices:

- eye(3,3)

```
-->eye(3,3)
 ans  =

    1.    0.    0.
    0.    1.    0.
    0.    0.    1.
```

- zeros(3,2)
- ones(3,2)
- clean(inv(A))
  Clean command rounds the number.
-

```
-->int(10*rand(3,3))
 ans  =

    8.    9.    3.
    6.    2.    2.
    3.    3.    5.
```

```
-->diag(eye(3,3))
 ans  =

    1.
    1.
    1.

-->A=int(10*rand(3,3))
 A  =

    2.    3.    8.
    7.    6.    6.
    0.    6.    8.
```

```
-->diag(A)
 ans  =

    2.
    6.
    8.
```

You can define matrix with the diagonal entries.

```
---> diag([2,-3,4,5])

--->diag([2,-3,4,5],1)


--->diag([2,-3,4,5],-2)
```

$ will give the last entry in the matrix. The entry can be row, column or the element of the matrix.

```
-->A($)

-->A($,1)

 -->A($,:)

--->A(:,$-1)
```

To find max element in the matrix `max(A)`
To find i, j th position of the $\max$ element as well as the value

```
-->[a,b]=max(A)
```

To find max from each column
.

```
--> max(A,'c')
```

To find max of each row

```
-->max(A,'r')
```

Similarly one can use `min(A)` command to find out $\min$

```
->A=int(10*rand(3,3))
 A  =

    2.    3.    8.
    7.    6.    6.
    0.    6.    8.

 -->Index=find(A<5)
Index  =

    1.    3.    4.

-->A(Index)
 ans  =

    2.
    0.
    3.
```

For symbolic computation

```
-->x=poly(0,'x')
 x   =

    x

-->A=[x,2*x;x^2,x+3]
 A   =

    x      2x

     2
    x      3 + x

-->det(A)
 ans   =

            2     3
    3x + x - 2x
```

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It is also possible to find inverse of symbolic matrix.

```
-->inv(A)
 ans  =
 
 
    3 + x           - 2
 -----------    ---------
        2    3              2
 3x + x - 2x    3 + x - 2x
 
 
   - x             1
 ---------      ---------
            2               2
 3 + x - 2x     3 + x - 2x
```

```
-->roots(x^2-3*x+4)
 ans  =

    1.5 + 1.3228757i
    1.5 - 1.3228757i
```

Complex roots apears in pairs of conjugates in case of ‘real’ coefficients.

Another way to define polynomial

```
-->V= [2 -4 5]

ans =
    2 -4 5

-->poly(V,'x','coeff')
 ans  =

                  2
    2 - 4x + 5x

-->poly([1,-2,3],'y','coeff')
 ans  =

                  2
    1 - 2y + 3y
```

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2.1. Quiz

1. To get help in scilab what you have to enter?
2. To see the demo of plot command what should you enter?
3. How to get transpose of the vector?
4. What is the difference between `u*v` and `u.*v`

Diary command is useful to record your work.

```
 --->  diary filename

--->  2+2

       4


--->  diary off
```

your file will record between diary filename command and diary off.
The file will be stored in the present working directory.
You can open the stored file with editor.

3. Rows and Columns

Consider matrix A

```
A   =

    2.    3.    4.
    4.    6.    8.
    6.    9.    12.
```

Now to obtain 1st row:

```
-->A(1,:)
 ans   =

    2.    3.    4.
```

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To obtain a submatrix or minor from a Matrix

```
--->A(1:2,3:4)
```

This will produce first 2 rows and column no 3 and 4.

To change $R_1 \longrightarrow 2R_1$

```
-->A(1,:)=2*A(1,:)
 A   =

    4.    6.    8.
    4.    6.    8.
    6.    9.    12.
```

To change $C_1 \longrightarrow 5C_1$

```
-->A(:,1)=5*A(:,1)
 A   =
    20.    6.    8.
    20.    6.    8.
    30.    9.    12.
```

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To perform operation as $R_1 \longrightarrow R_1 - R_2$

```
-->A(1,:)=A(1,:)-A(2,:)
 A   =

    0.      0.      0.
    20.     6.      8.
    30.     9.      12.
```

To perform operation as $R_2 \longrightarrow R_2 - \frac{2}{3}R_3$

```
-->A(2,:)=A(2,:)-(2/3)*A(3,:)
 A   =

    0.      0.      0.
    0.      0.      0.
    30.     9.      12.

-->
```

Logical comparisons

Use of scilab by various ways:

- Solve Linear System of Equations
- Find roots of higher degree polynomials
- Find eigen values
- Evaluate matrix and polynomials with complex numbers
- Draw 2D and 3D figures

Thanks!