Introduction to Scilab
Use Scilab, not Matlab

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Outline

- **Open Source Software**
- **History of Scilab**
- **Usage of Scilab**
- **Comparing other open source software systems**

FOSS: Free and Open Source Software

- Commercial software is expensive
- Heavy penalties if unauthorised software is used by industry
  - Stories from Italy, HLL, WIPRO
- Our SME's don't use ANY software:
  - commercial software is expensive
  - they are not aware of open source software
- Makes small companies uncompetitive
- There is no alternative to open source software

Scilab

- **A good substitute for Matlab**
- **About 95% compatibility**

What is Scilab?

- **Free and open source**
- **Easy to use**
- **Excellent computational environment:**
  - **LINPACK, EISPACK, LAPACK: same as Matlab**
  - **Other software not available for Matlab: Dassl, ODEPACK, etc.**

Scilab is created for mathematicians

- **Matrices and vectors can be created easily - no typing, storage allocation, etc.**
- **Matrix-vector product, scalar-vector/matrix products are written without any fuss - like the mathematicians do**
- **Belongs to Matlab family - originally created by Prof. Cleve Moler, who had worked on Linpack and Eispack projects**

History of Scilab

- Prof. Cleve Moler created Matlab through NSF funding
- As Government funded, source code had to be made available
- Many companies started using this idea
  - Matrix$_x$
  - CTRL-C
  - Matlab
  - Scilab
- Used extensively for linear algebra, simulation, control system design
- Scilab - a recent story

Scilab - other features

- **Can call programs written in Fortran, C**
- **Good graphics capability**
- **Large installed base**
- **A lot of algorithms implemented in interpreted language as well**
- **Free**
- **Check out www.scilab.org or www.scilab.in**

How reliable is Scilab?

- **CNES - France's ISRO**
- **CNES Arianne rockets**
- **CNES relies on Scilab for many critical calculations:**
  trajectory, flight dynamics, orbit

CNES Talk

- **Use of Scilab for Space Mission Analysis and Flight Dynamics Activities**
- **by Thierry Martin**
- **Senior Manager, CNES**

Purchase of Matlab at IIT Bombay - A Story

Usage of Scilab

Simple Arithmetic - 1

```
4+6+12

 ans  =
     22.

a = 4, b = 6; c = 12

 a  =
     4.
 c  =
     12.

a+b+c
```

Useful Commands

- **demos**
  - **Gives demos on several different things**
- **apropos**
  - **Helps locate commands associated with a word**
- **help**
- **functional invocation with no arguments**
  - **Helps draw plots**
- **diary**
  - **Stores all commands and resulting outputs**

Simple Arithmetic & Display

```
a = 4; b = 6; c = 12;
d = a+b+c
```

```
 d  =
    22.
```

```
d = a+b+c;
```

```
d
```

```
 d  =

    22.
```

Simple Arithmetic

```
x = sqrt(2)/2, y = asin(x)

 x  =

    0.7071068
 y  =

    0.7853982
y_deg = y * 180 /%pi

 y_deg  =

    45.
```

Vector Operation - 2 I

```
-->a = 1:5, b = 1:2:9


 a  =
 !   1.    2.    3.    4.    5. !
 b  =
 !   1.    3.    5.    7.    9. !

-->c = [b a]


c  =
! 1.    3.    5.    7.    9.    1.    2.    3.
```

Vector Operation - 2 II

```
-->d = [b(1:2:5) 1 0 1]
```

```
 d  =
!   1.    5.    9.    1.    0.    1. !
```

Vector Operation - 3 I

```
-->a, b


 a  =
 !   1.    2.    3.    4.    5. !
 b  =
 !   1.    3.    5.    7.    9. !

-->a - 2
```

Vector Operation - 3 II

```
ans  =
 ! - 1.    0.    1.    2.    3. !

-->2*a-b


 ans  =
!   1.    1.    1.    1.    1. !
```

Logical Operators

==	**equal to**
<	**less than**
>	**greater than**
<=	**less than or equal to**
>=	**greater than or equal to**
<> or ~=	**not equal to**

Vector Operations Using Logical Operators I

```
-->A = 1:9, B = 9-A


A  =
!   1.    2.    3.    4.    5.    6.    7.
 B  =
!   8.    7.    6.    5.    4.    3.    2.

-->tf = A==B
```

Vector Operations Using Logical Operators II

```
tf  =
!  F  F  F  F  F  F  F  F  F  !

-->tf = A>B


tf  =
!  F  F  F  F  T  T  T  T  T  !
```

Transpose I

```
-->c = [1;2;3]


 c  =
!   1. !
!   2. !
!   3. !

-->a=1:3
```

Transpose II

```
a  =
!   1.    2.    3.   !

-->b = a'


b  =
!   1.  !
!   2.  !
!   3.  !
```

Submatrix I

```
-->A=[1 2 3;4 5 6;7 8 9]

 A  =

!   1.    2.    3. !
!   4.    5.    6. !
!   7.    8.    9. !

-->A(3,3)=0
```

Submatrix II

```
A  =

!   1.    2.    3. !
!   4.    5.    6. !
!   7.    8.    0. !
```

Submatrix I

```
A
```

```
 A   =

!   1.    2.    3. !
!   4.    5.    6. !
!   7.    8.    0. !
```

```
-->B=A(3:-1:1,1:3)
```

Submatrix II

```
B  =
!   7.    8.    0. !
!   4.    5.    6. !
!   1.    2.    3. !
```

Submatrix

```
-->A

A  =
!   1.    2.    3. !
!   1.    4.    7. !
!   7.    8.    0. !

-->B=A(:,2)

B  =
!   2. !
!   4. !
!   8. !
```

Submatrix I

```
-->b=[5 -3;2 -4]


 b  =
!   5.  - 3. !
!   2.  - 4. !

-->x=abs(b)>2
```

Submatrix II

```
x  =
!  T  T  !
!  F  T  !

-->y=b(abs(b)>2)


 y  =
!    5.  !
!  - 3.  !
!  - 4.  !
```

Special Matrices I

```
-->zeros(3,3)


 ans  =

!   0.    0.    0. !
!   0.    0.    0. !
!   0.    0.    0. !

-->ones(2,4)
```

Special Matrices II

```
ans  =
!   1.    1.    1.    1. !
!   1.    1.    1.    1. !

-->rand(2,1)


ans  =
!   0.2113249 !
!   0.7560439 !
```

Go for Vector Computation

Go for Vector Computation I

```
-->a = ones(10000,1);
-->timer()


ans  =
    0.02

-->for i = 1:10000, b(i)=a(i)+a(i); end
-->timer()
```

Go for Vector Computation II

```
ans  =
    0.31

-->c = a+a;
-->timer()


ans  =
    0.03
```

Plots

Go through the Demos!

Comparing Matlab and Scilab

- **Capability comparison - a correct question?**
- **Is Matlab required for class students?**
- **Matlab and versions**
- **Mathworks: 2,000 employees**
- **Scilab: 23 full time employees**

Hardware Interfacing through FOSS

- **Scilab**
  - **Xcos, HART, COMEDI**
- **GNURadio**

Scilab for Hardware Interfacing

- **COMEDI has device drivers for 150 A/D and Digital I/O cards**
- **We can call ALL of them from Scilab**
  - **Using Xcos ($\simeq$ Simulink), HART**
- **Devices not in COMEDI, but with C drivers**
- **Devices without device drivers**

GNURadio for Hardware Interfacing

- **Open source software**
- **Uses C++ and Python**
- **Can call OpenCV**
- **Has graphic front end**
  - **Has sliders, etc. - allows change of parameters in real time**
- **Calling Scilab functions from GNURadio**
- **Calling Xcos functions from GNURadio**
  - **LabView does not allow Simulink calls!**

Control of Single Board Heater System through Scilab and GNURadio

Thanks