

# **Introduction to SciLab**

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# Session 1

# Topics

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1. Basics of SCILAB
2. Matrices and arrays
3. Exponential, logarithmic, trigonometric functions
4. Rounding of functions



# Introduction to SCILAB

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- ▶ **SCientific LABoratory**
- ▶ High level programming language
- ▶ Open Source Software
- ▶ Scilab homepage : <http://www.scilab.org>



# Tutorial 1

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- ▶ Print 'Welcome To SCILAB'
- ▶ Find sum of two numbers
- ▶ Escape Characters: \n, \t
- ▶ Specifiers : %c , %s, %d, %f
- ▶ Input radius and find area of circle.



# **Creating File : Applications → SciNotes**

## **Creating Script File**

File → New **or** Ctrl + N

## **Saving a script file**

File → Save **or** Ctrl + S

## **Executing a script file**

Execute → Save and execute **or** F5



# General SCILAB Commands

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help	Opens HELP browser
clc	Clear command window.
clear	Removes all variables
clf	Clear or reset the current graphic figure (window) to default values
close	Close a figure or a window
exit	Exit from SCILAB.



# Matrix

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- ▶ **Row Matrix**

```
>> x=[1 2 3]
```

```
>> z=[2, 1, 0]
```

- ▶ **Column Matrix**

```
>> y=[1 ; 2 ; 3]
```

- ▶ **Continuation :**

- ▶ Ellipsis (...)





► **Create matrix  $G$**

$$G = \begin{bmatrix} 2 & 6 & 0 & 0 & 0 & 0 \\ 3 & 9 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 2 & 0 & 0 \\ 0 & 0 & 3 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & -5 & 5 \\ 0 & 0 & 0 & 0 & 5 & 3 \end{bmatrix}$$

# Tutorial 2

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- ▶ **Perform following operation on matrix  $G$ .**
  - ▶ Delete last row and last column of matrix
  - ▶ Extract first  $4 \times 4$  sub matrix from  $G$
  - ▶ Replace  $G(5, 5)$  with 4



# Operators

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## ▶ Arithmetic Operators

▶ +, -, \*, /, \, ^

## ▶ Relational Operators

▶ <, >, <=, >=, ==, ~=

## ▶ Logical Operators

▶ &, |, ~

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# Arithmetic Operators

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## Array Operators

<b>+</b>	Addition
<b>-</b>	Subtraction
<b>.*</b>	Multiplication
<b>./</b>	Division
<b>.^</b>	Exponentiation

## Matrix Operators

<b>+</b>	Addition
<b>-</b>	Subtraction
<b>*</b>	Multiplication
<b>/</b>	Division
<b>^</b>	Exponentiation

# \ Left Division

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- ▶ Used to solve matrix equation
- ▶  $x = A \backslash b$
- ▶ Same as  $x = \text{inverse}(A) \cdot b$
- ▶ To solve  $Ax = b$



# Tutorial 3

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- ▶ **Array** addition, multiplication, division, subtraction
- ▶ **Matrix** addition, multiplication, division, subtraction,



# Tutorial 4

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- ▶ Perform following:
    - ▶  $A(\text{row, column})$
    - ▶ Size
    - ▶ Length
    - ▶ Sub-matrix
    - ▶ Transpose
    - ▶ Inverse
    - ▶ Append row or column
- 



# Utility Matrices

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- ▶ **zeros** = creates zeros matrix
- ▶ **ones** = creates ones matrix
- ▶ **eye** = creates identity matrix
- ▶ **rand** = creates random matrix





# Exponential, Logarithms, Trigonometric Functions

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- ▶ **Exponential Function:**

- ▶  $\exp(x)$

- ▶ **Logarithm Functions:**

- ▶  $\log(x)$ ,  $\log_{10}(x)$

- ▶ **Trigonometric Functions:**

- ▶  $\sin$ ,  $\cos$ ,  $\tan$ ,  $\sec$ ,  $\csc$ ,  $\cot$

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# Example

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$e^3$

$\log_{10}(e^3)$

$\sin(90^\circ)$

`exp(3)`

`log10(exp(3))`

`pi=22/7;  
sin(pi/2);`

# Round -off functions

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- ▶ **Floor** = round towards nearest lower int
  - ▶ **Ceil** = round towards nearest higher int
  - ▶ **Round** = round towards nearest int
  - ▶ **Sign** = sign
  - ▶ **Fix** = round towards zero
- 



# **Session 2**

**(15 minutes break)**

# Topics

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1. Conditional statements
2. Loop statements
3. Plotting statements
4. Creating and executing functions



# To learn conditional statements

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## Tutorial 5

- ▶ Input salary to calculate bonus:

if  $s > 50000 = 25\%$  if  $25000 < s < 50000 = 40\%$

and if  $s < 25000 = 50\%$  using if else



# if statement

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```
if expr1 then  
  statements  
elseif expr1 then  
  statements  
....  
else  
  statements  
end
```



# select statement

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```
select variable  
case value1 then  
instructions 1  
case value2 then  
instructions 2  
...  
case valuen then  
instructions n  
[else instructions]  
end
```

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# To learn loop statements

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## Tutorial 6

- ▶ Input a number and find factorial of that number.



# FOR statement

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```
for variable = Initialization : Uppdate statement : Condition  
statement,  
...,  
...,  
statement  
end
```



# While statement

---

```
while expression  
  instructions  
  ...  
  instructions  
end
```



# Linearly Spaced Values

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```
>> linspace(0,10,5)
```

```
ans =
```

```
0    2.5000    5.0000    7.5000   10.0000
```



# To study plotting

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## Tutorial 7

- ▶ Equation of st line:  $y=mx+c$
- ▶ Where, m and c are constants given as  $m=0.5$  ;  
 $c=-2$
- ▶ And x co-ordinates are given as follows  $x= 0,$   
 $1.5, 3, 4, 5, 7, 9, 10$



# Plot : Linear plot

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<code>plot( X,Y)</code>	plots vector Y versus vector X
<code>plot(Y)</code>	plots the columns of Y versus their index
<code>plot(X,Y,S)</code>	where S is a character string made
<code>plot(x, y, '+:r')</code>	plots a cyan dotted line with a plus at each data point
<code>plot(x, y, '-y',x, y, 'og')</code>	plots the data twice, with a solid yellow line interpolating green circles at the data points



# Tutorial 8

## To study 3D plot & overlay plots

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### ► Plot3 function

for  $0 \leq t \leq 20$  plot 3D figure where

$$x(t)=\sin(t); \quad y(t)=\cos(t); \quad z(t)=t;$$

### ► Overlay plots

for  $0 \leq x \leq \Pi$   $y = \cos(x)$  and

$$z = 1 - \frac{x^2}{2} + \frac{x^4}{24}$$



# Tutorial 9

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- ▶ Plot  $Y = \sin(X)$ ,  $0 \leq X \leq 2\pi$   
taking 100 linearly spaced points in given interval.

Label axes & put “plot created by your name” in title.





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# **Creating & Executing Function File**



# Tutorial 10

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- ▶ Input a number and find factorial of that number.



# Function

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## ► Syntax for creating function:

```
function [out1, out2, ...] = myfun(in1, in2, ...)
```

```
....
```

```
end
```

## ► Syntax for executing function:

```
exec('myfun.sci',-1);
```

```
f=factr(5)
```

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# **Session 3**

**(30 minutes - break)**

# **Industrial Robotics**

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# Topics

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1. Rotation & Translation Transformation
2. Screw Transformation
3. Composite Transformation
4. Reach & Stroke of Robot In Given Workspace With the Help of Yaw Pitch Roll



# Robotics tool

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- ▶ **Download :** [RTSX1.0.zip](#)
  - ▶ **Link:** <http://controlsystemslab.com/rtsx/download/>
  - ▶ Unzip the file. Change Scilab current directory to the parent of unzipped dir, and type
  - ▶ `exec('startup_rtsx.sce',-1);` *// load all functions to Scilab workspace*
  - ▶ `rprdemo;` *// see if things work okay*
- 

