Introduction to Scilab

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What is Scilab?

- Scilab is a mathematical software
- Similar software: Matlab, Mathematica, octave, Euler math Toolbox, Maxima, ...
- Speciality: Free, highly supported, powerful, many users, ...,
- Homepage: www.scilab.org
- Scilab language allows to dynamically compile and link other languages such as Fortran and C: this way, external libraries can be used as if they were a part of Scilab built-in features.
- Scilab also interfaces LabVIEW, a platform and development environment for a visual programming language

Scilab's Main Features

- A high-level programming language
- Scilab is an interpreted language
- Integrated object-oriented 2-D and 3-D graphics with animation
- A dedicated Editor
- An XML-based help system
- Interface with symbolic computing packages (Maple and MuPAD 3.0)
- An interface with Tcl/Tk
- Scilab works with most Unix systems including GNU/Linux and on Windows (9X/NT/2000/XP/Vista/7), and Mac operating

Scilab coded Toolboxes

- Linear algebra and Sparse matrices
- Polynomials and Rational functions
- 2-D and 3-D graphics with animation
- Interpolation and Approximations
- Linear, Quadratic and Nonlinear Optimization
- Differentiable and Non-differential Optimization
- Signal Processing
- Statistic
- Scicos: A hybrid dynamic system modeler and simulator
- Parallel Scialab using PVM (parallel virtual machine)
- Metanet: Graphs and Network

Typical uses & basic data Elements

- Educational Institutes, Research centers and companies
- Math and computation
- Algorithm development
- Modeling, simulation, and visualization
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- Scientific and engineering graphics, exported to various formats so that can be included into documents.
- Application development, including GUI building

Basic data element (Matrix):

- Array : not require dimensioning
- Allow to solve problem with matrix and vector formulations

Using Scilab as calculator

+, -, * (multiplication), / (division), ^ (power)

> (12.34 + 0.03) / (2.8 - 1.2 * 3)

> 2^ 3 or 2*2*2

> 2^ 2 - 3

> 2^ -3

> ans=2^ 100

>ans^ (1/100)

- Solving quadratic equation x^ 2 -x + 1 = 0;

> a=1, b=-1, c=1

> (-a + sqrt(b^ 2 - 4*a*c))/(2*a)

Vectors and Matrices in Scilab

- Data types:(real or complex) numbers, vectors, matrices, polynomials, strings, functions, ...
- vectors in Scilab:

  > x = [0 1 2 -3]

  > y = [2; 4; 6; 8]

  > z = [1 2 3 4]'
- ' is interpreted as transpose of a matrix

  > 3*x, y+z, y-z

  > x+y, x+1

  (x+y is inconsistent addition)

Vectors and Matrices in Scilab...

- Matrices in Scilab:

  > A = [0 1 0 1; 2 3 -4 0]

  > B = A'

  > A*y, x*B, A*B, B*A, (B*A)^ 2
- Special matrices and vectors:

  > ones(2, 3), zeros(1,2), eye(3,3)

  > rand, rand(3,2)
- Empty vector or matrix: > a =[]
- Building matrix by blocks:

  >C = [A 2*A], x = [9 x 7], a = [a 1]

Solving linear equations using Scilab...

- $3x_1 + 2x_2 - x_3 = 1$

  $x_1 \quad + x_3 = 2$

  $2x_1 - 2x_2 + x_3 = -1$
- To solve the above system of equations:

  > A = [3 2 -1; 1 0 1; 2 -2 1]

  > y = [1 2 -1]'

  > x = inv(A)*y (inv is inverse of matrix)

  > x = A\y
- see program: 5sim-leq.sce, 6simu-leq.sce
- Theoretically it does not make any sense to divide some thing by a matrix

Some workspace commands

- who :Lists the variables currently in the scilab workspace
- whos : Same a who but provides more information on size, type
- whos -name a: List all variables with name starting with the letter 'a'
- what : Lists the scilab primitives
- clear: Kills the variables which are not protected.
- clear xyz: Kills the variables specified in the command
- clc: Clears screen
- clf: Clears figure window
- diary: List of current session commands

The colon ":" operator

- > 1:10, 1:100, xx=1:100;
- using ":" to suppress answer output
- > sum(xx)
- > 1:2:10, -3:3:11, 4:-1:1, 2:1:0,
- > t=0:0.1:2*%pi;

  > y=sin(t);

  > plot(t,y); xgrid(1);

  > plot(t,y), plot(t, sin(t), t, cos(t));

  > xtitle('Trigonometric function', 'sin(t)');

  > legend('sin(x)', 'cos(x)');
- program 7bar-grf-disp.sce : bar graph

Elements of vectors and matrices

- Example:

  > v=rand(4, 1)

  > v(1), v(3), v([2 4]), v(4: -1: 1), v($)

- "$" means the last entry
- Examples:

  > A = [1 2 3 4 5; 6 7 8 9 10]

  > A(2, 3), A(1, :), A(:, 2), A(:, [4 2])

  > A=[1 2; 3 4]; B=[2 3; 5 6];

  > C = [A, B]

  > D=diag(C)

Programming in Scilab

- Click on menu bar to open Scipad; then write your scilab function file
- Format of a function:

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

  (body of function definition; many have many lines)

  endfunction
- One file may contain more than one function
- To use the functions, you must load the function file by choosing File->Execute the file from menu

Programming in Scilab...

- A simple function is to find the n-th term of the Fibonnaci sequence 0, 1, 1, 2, 3, 5, 8, ...
- function k = fib(n)

  if n ==1, k=0;

  elseif n==2, k=1;

  else k=fib(n-1)+fib(n-2);

  end

  endfunction
- Save the file as fibo.sci (.sci is default extension)
- Execute it from Scilab menu bar
- Try, say: fibo(5), fib(10), fib(100)

Some programs in Scilab. . .

- 0ex-func-calc.sci : Computes exp(x)
- 1matx-add.sce : matrix addition
- 2matx-mul.sce : matrix multiplication
- 2d-adv.sce : 2d data values graph and save it
- 8fun1-plot.sce: plotting a function
- 17ga-optmze.sce : real valued genetic algorithm for the minimization of the rastrigin function (with dynamic display for the case of 2 parameters)
- Demonstration programs

Simulation software available along with Scilab

- SVM: Support vector machine (for classification and machine learning)
- Clustering: C-means, Fuzzy c-means, self organizing Map
- ANN Tool box 0.4.2.5
- Random number generations: binomial, discrete, geometric, Poisson, Exponential
- Sound file handling
- TCL/TK
- Signal processing
- Optimization and simulation
- Graphics: 2D, 3D, basic funcs, Animations, Finite elements, Bezier, ...
- Simulation: n-pendulum, Wheel, flow, Levitron

Note: Reference for above content: www.scilab.org