Workshop: Introduction to Scilab

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(The sequence of spoken tutorials to be listened/followed is same as that of exercise sets below.)

1. **Getting Started**

   (a) 04:17: Perform the following calculations on the scilab command line:

   $$\text{phi} = \frac{\sqrt{5}+1}{2} \qquad \text{psi} = \frac{\sqrt{5}-1}{2}$$

   Find 1/phi and 1/psi.

   (b) 6:06: Verify Euler's identity: Is $e^{\pi i}+1$ close to zero?
   Compare with $\cos(\pi) + i \cdot \sin(\pi)$.

2. **Matrix Operations**

   (a) 03:15: In Scilab, enter the following Matrices:

   $$A = \begin{bmatrix} 1 & 1/2 \\ 1/3 & 1/4 \\ 1/5 & 1/6 \end{bmatrix}$$

   $$B = \begin{bmatrix} 5 & -2 \end{bmatrix}, \quad C = \begin{bmatrix} 4 & 5/4 & 9/4 \\ 1 & 2 & 3 \end{bmatrix}$$

   Using Scilab commands, compute each of the following, if possible.

   i. $A * C$
   ii. $A * B$
   iii. $A + C'$
   iv. $B * A - C' * A$
   v. $(2 * C - 6 * A') * B'$
   vi. $A * C - C * A$
   vii. $A * A' + C' * C$

   Explain the errors, if any.

   (b) 04:15: From the video:

   i. Find E(:, :)
   ii. Extract the second column of E
   iii. Display just the first and last columns[1] of E.

   (c) 05:46: If A = $\begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 1 \\ 4 & 1 & 5 \end{bmatrix}$
   Use a suitable sequence of row operations on A to bring A to upper triangular form.[2]

   (d) 07:28: Represent the following linear system as a matrix equation. Solve the system using the inverse method:

   $$\begin{aligned} x + y + 2z - w &= 3 \\ 2x + 5y - z - 9w &= -3 \\ 2x + y - z + 3w &= -11 \\ x - 3y + 2z + 7w &= -5 \end{aligned}$$

   (e) 08:01: Try solving the above system using the backslash method.

   (f) 08:38: Verify the solution from the previous question.

   (g) 09:38: Try det(A), A^2, A^3 and Eigenvalues of A (from the previous question).
   Also multiply A by an identity matrix of the same size.

3. **Scripts and Functions**

   (a) 02:48:

   i. Create a scilab script file to display time on console window. (hint: clock())
   ii. Create a scilab script file to display product of a matrix A and inverse of A. $A = [1, 1; 1, -1]$
   iii. Create a scilab script file to plot 'x' vs 'sin(x)'. 'x' varies from -2p to 2p, where p is specified at the beginning of the script file.

   (b) 05:04:

   i. Create a function file to calculate sum and difference of any two numbers. The output should be the sum and the difference of numbers.
   ii. Create a function file to calculate the rowwise and columnwise mean and standard deviation of a user defined matrix. Display the matrix, its mean and standard deviation in output. (hint; mean(), stdev())

   (c) 09:05:

[1] Tip: from a given matrix E, desired columns can be specified by defining a vector v consisting of just the desired column indices and using $E(:, v)$. Similarly for rows also.

[2] Upper triangular matrix: all elements below the North-West to South-East diagonal of the matrix are zero.

i. Create an inline function to sort the elements of a random vector in descending order. (hint: gsort())
ii. Create an inline function to round off the elements of a vector [1.9, 2.3, -1.1, 50.5] to the nearest integer. (hint: round())

(d) 10:30:

i. Create a function file to calculate LU factorization of a matrix. (hint: lu()).
ii. Create a function file to that takes two matrices A and B as input. Calculate their trace.
   A. If trace of A is greater than trace of B, then display 1.
   B. If trace of B is greater than trace of A, then display -1.
   C. If both traces are equal, then display 0.

(e) Create a function file to evaluate and plot following function for x(x varies from -1 to 1 with step size of 0.1).

$$f(x) = x^2 - \sin(x), \qquad x \leqslant 0$$
$$x(x) = \cos(x), \qquad x > 0$$

(hint : if else)

(f) Create an inline scilab function file to 3-d plot of parametric curve (Given a=2).
t = varies form 0 to 2π (with 100 intermediate points).

$$x = a * \cos(t); \qquad y = a * \sin(t);$$

(hint : linspace(), param3d())

4. **Conditional Branching**
Note the importance of 'end' at the end of the 'if-then-else-end' construct.

(a) 1:20: Write a code to check if a given number n is less than or equal to 10, if yes, display its square.(for $n = 4, 13$ and 10)

(b) 2:04: Write a code to check if a number is less than 10, if yes, then display '> 10', if it is greater than 10, then display '> 10', else display the number. (for $n = 4, 13$ and 10)

(c) 2:26: Write the previous code in one line.

(d) 3:09: Write a code using select case conditional construct to check whether a given number is a multiple of 10 (take 5 values/multiples), and if so, display the number.

5. **Iteration**

(a) 0:42: Create a vector starting from 1 to 10

(b) 1:02: Create a vector from 2 to 20 with an increment of 3

(c) 1:55: Write a for loop to display all the even numbers between 1 to 50

(d) 2:55: Write a code that takes as input a vector x=1:10, displays the values of x one by one and comes out of loop when the value of x is 8.

(e) 3:31: Write a code that takes an input vector x=1:2:10 and displays only last two values of the vector.

(f) 4:44: Find summation of vector x = [1 2 6 4 2], using iterative procedure. Hint: Check length(), add each number using 'for' loop.

(g) 5:20: Write a code using while loop to display odd numbers in the range 1 to 25.

(h) 5:40: Write a code using while to which take input from 0 to 15 in increments of 1 and display number 10 and 15

6. **Plotting**

(a) 01:12: Create a linearly spaced vector from 0 to 1 with 10 points

(b) 01:12: Also create a linearly spaced vector from 0 to 1 with 11 points

(c) 01:35: plot sin(x) versus x.

(d) 02:50: Use plot2d and try changing the color to red. Also try style = -1

(e) 03:53: Put a title: "Sine", and labels, 'x axis' and 'y axis'

(f) 05:50: Plot sin(x) and cos(x) on the same window.

(g) 06:08: Create a legend for the above plots.

(h) 09:25: Now plot sin(x) and cos(x) as subplots within the same window.

(i) 10:10: Save your plot as a file.