MNESTRIS
NETWORK FOR EMPOWERING PEOPLE IN ADDED-VALUE MANUFACTURING SYSTEMS AND TECHNOLOGIES / REGIONAL INNOVATION SCHEME

Manufacturing process Digital-Twin-oriented introduction to Octave

Authors:

Panos Stavropoulos, Assistant Professor

Alexios Papacharalampopoulos, Dr.

eit Manufacturing

This activity has received funding from European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

Info

Purpose

- The purpose of the current presentation is to introduce Octave tool to the ones interested in the concept of digital twin and/or cognitive automation.
- This presentation has been created under the framework EIT Manufacturing Project M-NEST-RIS.
- It is considered as an educational product and its price is equal to 0 Euros.
- Material herein can be reproduced given that the source is mentioned.

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LMS Laboratory for Manufacturing Systems & Automation

Info

Preparation

- Download Octave
- https://www.gnu.org/software/octave/download

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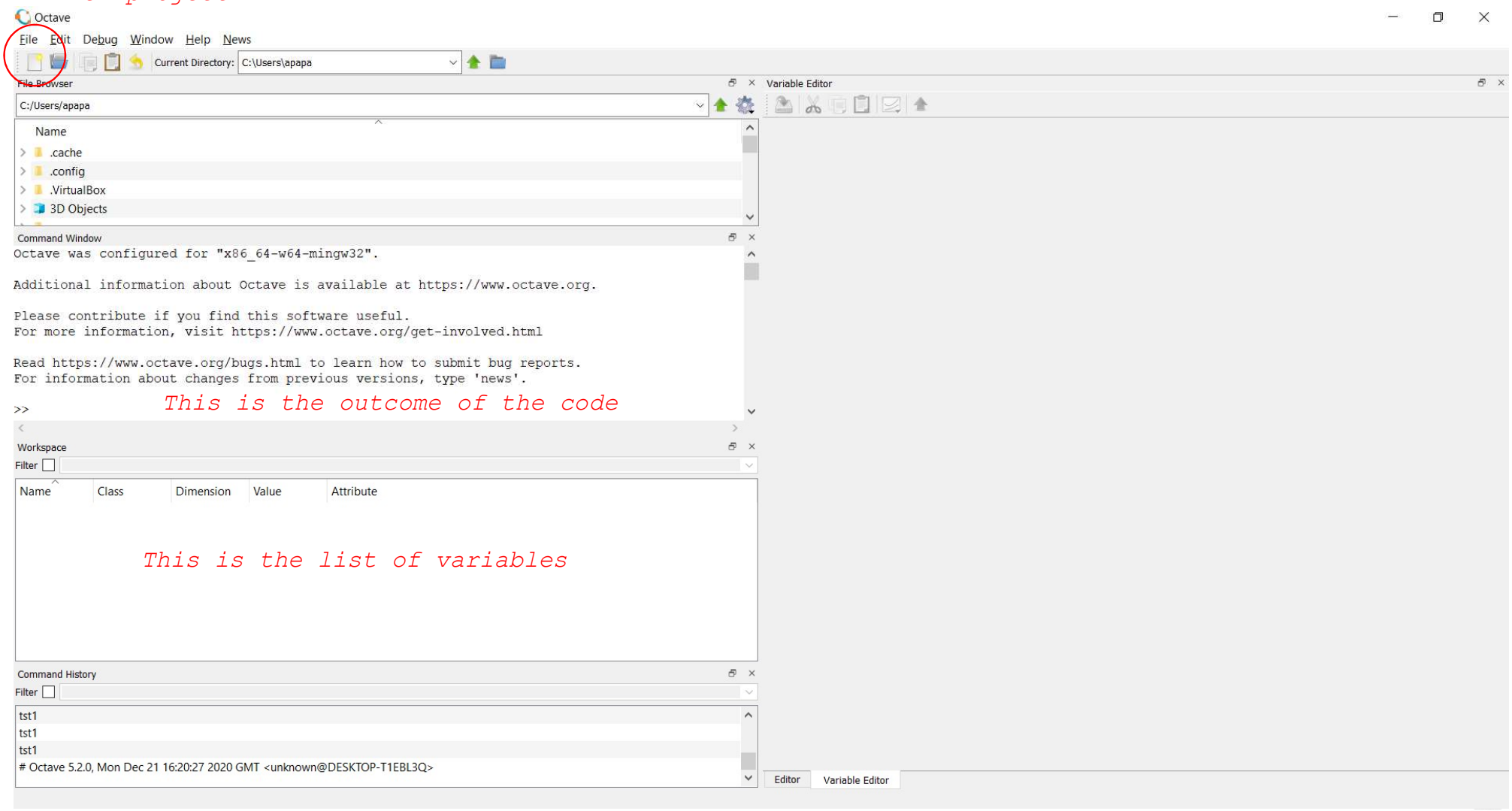
Task

New project



Info

Writing and executing code

- Procedural coding – one line runs after the other
- First Run requires saving the code file as text

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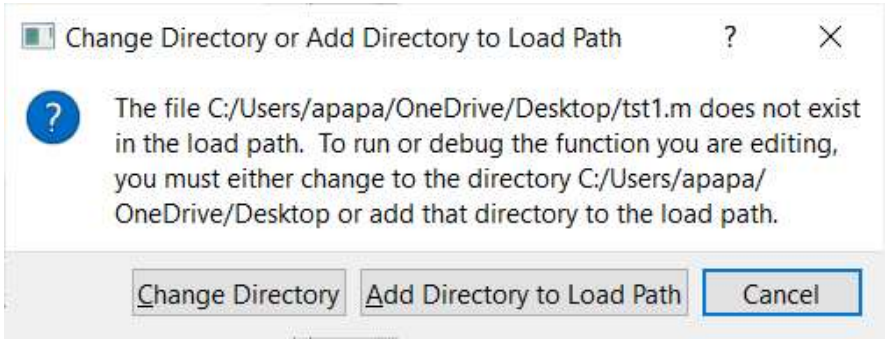
Task



The path folder refers to a folder in the PC where all the related codes that are required for our code to run exist.
One can change this path folder temporarily, or include the folder where they saved their code in the load path, an ensemble of such folders.

Info

Types of Variables

- All variables can be considered to be complex matrices

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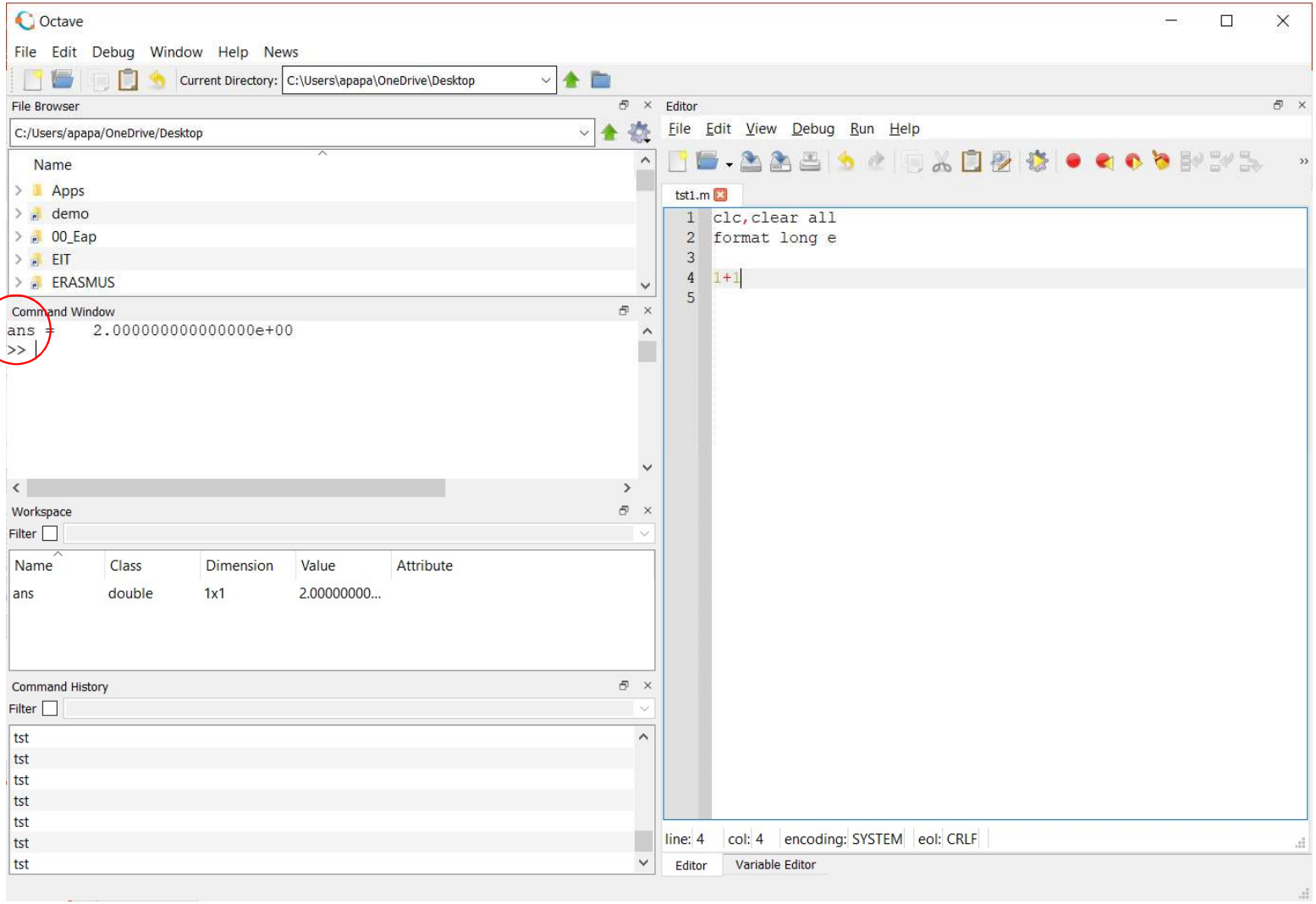
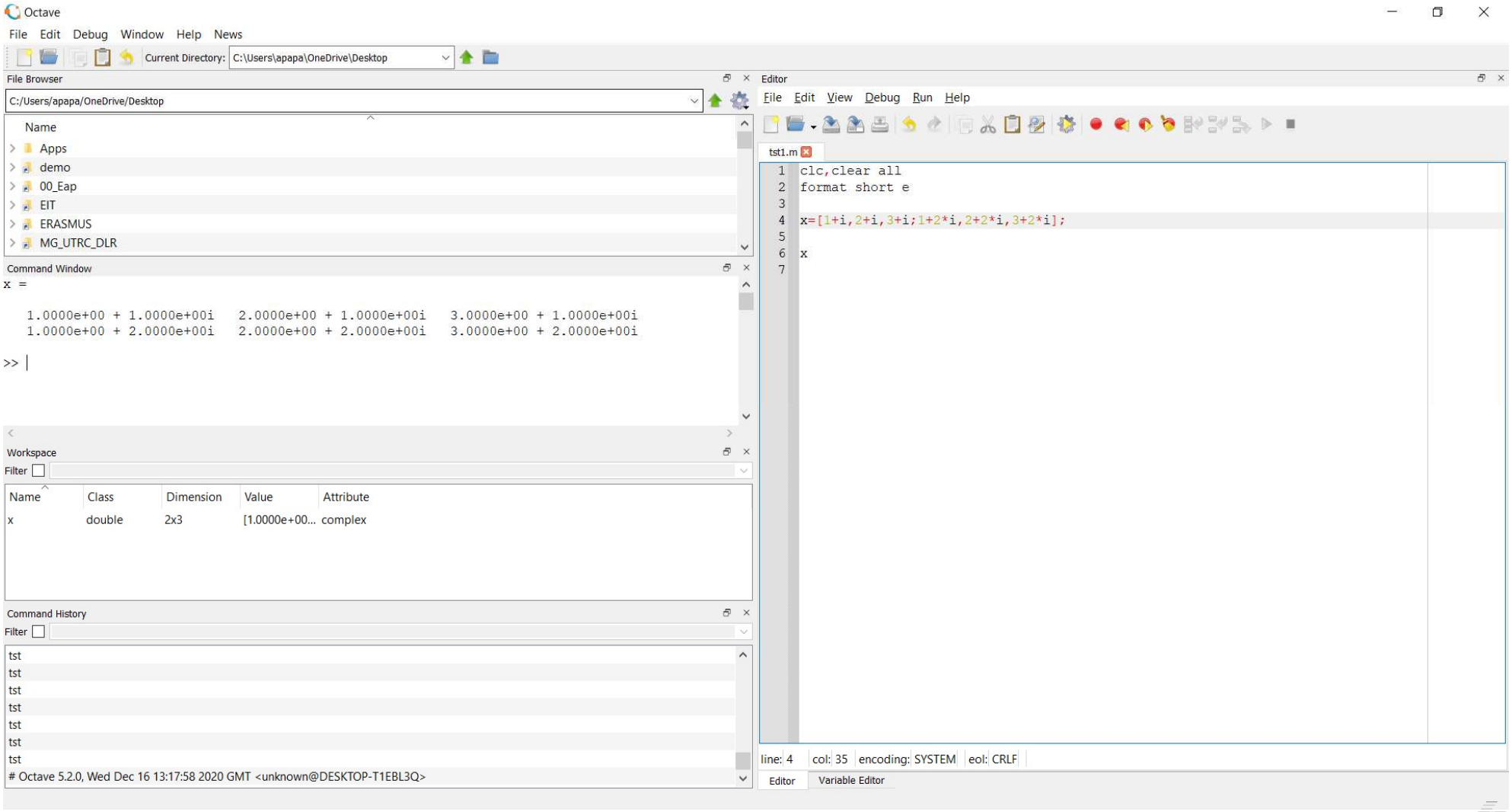
Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
Command Window
ans = 2.0000000000000000e+00
>>
Workspace
Filter
Name Class Dimension Value Attribute
ans double 1x1 2.00000000...
Command History
Filter
tst
tst
tst
tst
tst
tst
tst
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format long e
3
4 1+1
5
line: 4 col: 4 encoding: SYSTEM eol: CRLF
Editor
Variable Editor

Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
MG_UTRC_DLR
Command Window
x =
1.0000e+00 + 1.0000e+00i 2.0000e+00 + 1.0000e+00i 3.0000e+00 + 1.0000e+00i
1.0000e+00 + 2.0000e+00i 2.0000e+00 + 2.0000e+00i 3.0000e+00 + 2.0000e+00i
>>
Workspace
Filter
Name Class Dimension Value Attribute
x double 2x3 [1.0000e+00... complex
Command History
Filter
tst
tst
tst
tst
tst
tst
tst
Octave 5.2.0, Wed Dec 16 13:17:58 2020 GMT <unknown@DESKTOP-T1EBL3Q>
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format short e
3
4 x=[1+i,2+i,3+i;1+2*i,2+2*i,3+2*i];
5
6 x
7
line: 4 col: 35 encoding: SYSTEM eol: CRLF
Editor
Variable Editor

Info

Types of Operations

- All kinds of operations are supported
- For matrices, check operator .* against operator * and .^ against ^

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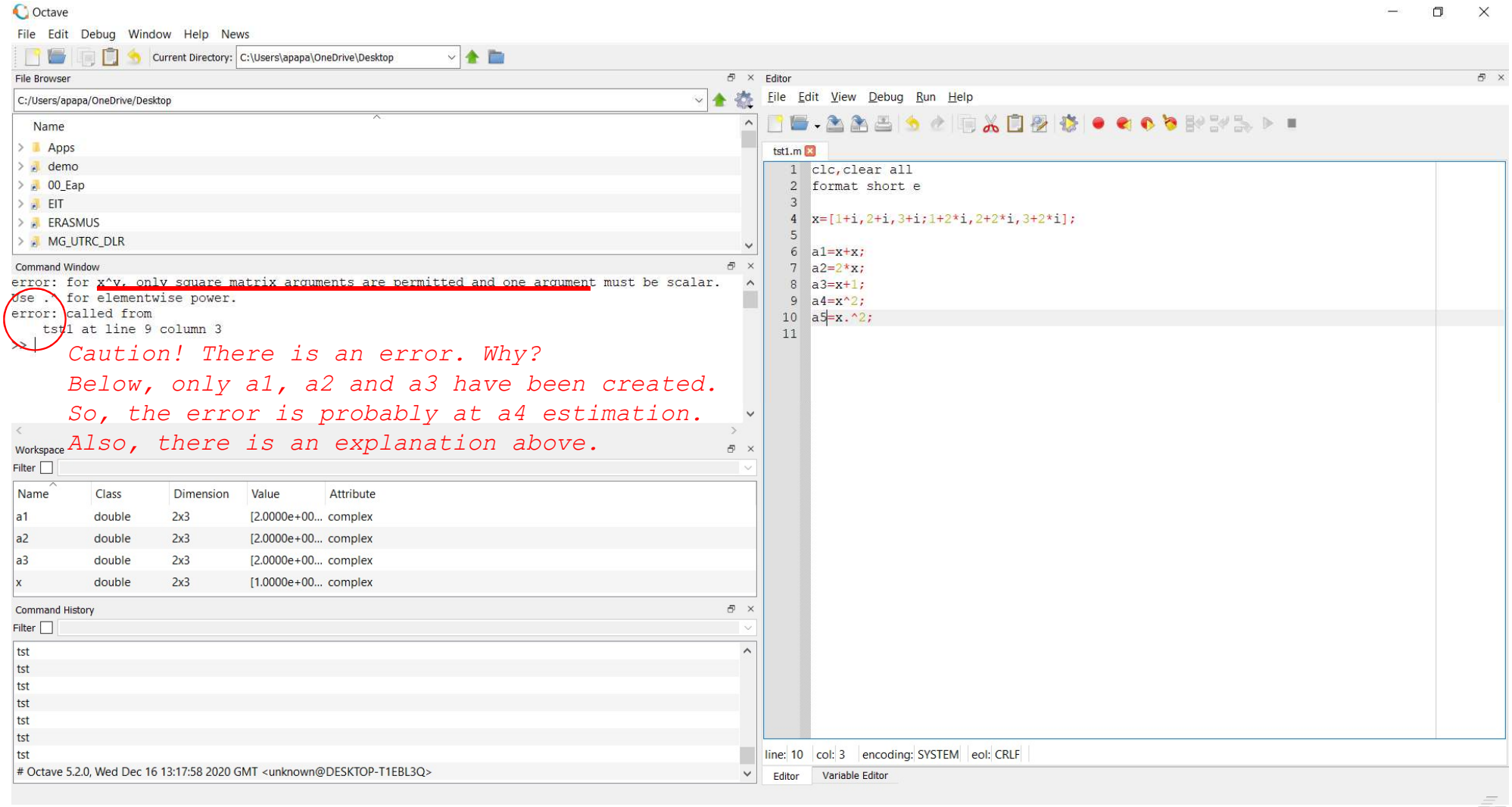
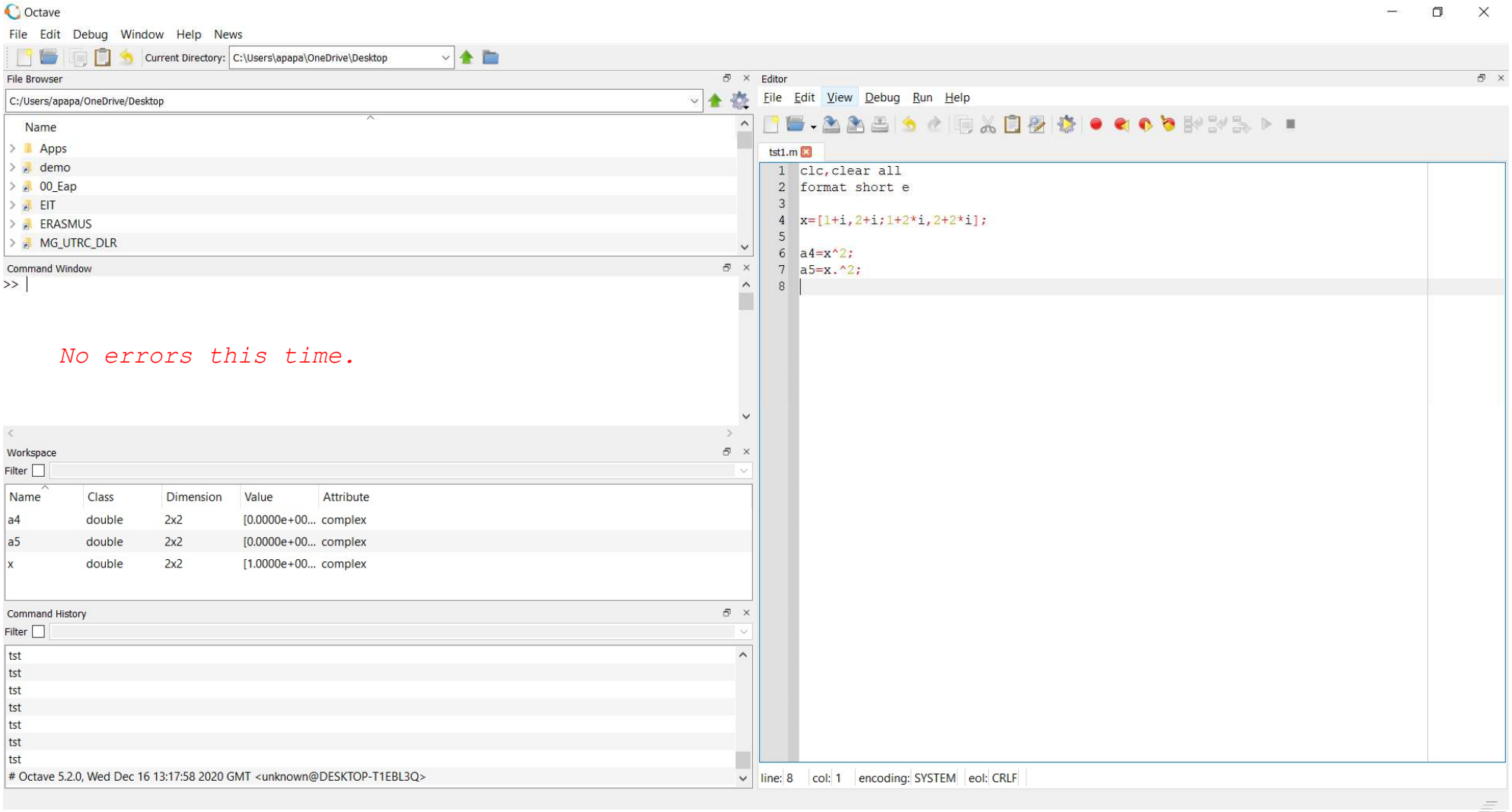
Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
MG_UTRC_DLR
Command Window
error: for x^y, only square matrix arguments are permitted and one argument must be scalar.
Use .^ for elementwise power.
error: called from
tst1 at line 9 column 3
>>
Caution! There is an error. Why?
Below, only a1, a2 and a3 have been created.
So, the error is probably at a4 estimation.
Also, there is an explanation above.
Workspace
Filter
Name Class Dimension Value Attribute
a1 double 2x3 [2.0000e+00... complex
a2 double 2x3 [2.0000e+00... complex
a3 double 2x3 [2.0000e+00... complex
x double 2x3 [1.0000e+00... complex
Command History
Filter
tst
tst
tst
tst
tst
tst
tst
Octave 5.2.0, Wed Dec 16 13:17:58 2020 GMT <unknown@DESKTOP-T1EBL3Q>
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format short e
3
4 x=[1+i,2+i,3+i;1+2*i,2+2*i,3+2*i];
5
6 a1=x+x;
7 a2=2*x;
8 a3=x+1;
9 a4=x^2;
10 a5=x.^2;
11
line: 10 col: 3 encoding: SYSTEM eol: CRLF
Editor Variable Editor

Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
MG_UTRC_DLR
Command Window
>>
No errors this time.
Workspace
Filter
Name Class Dimension Value Attribute
a4 double 2x2 [0.0000e+00... complex
a5 double 2x2 [0.0000e+00... complex
x double 2x2 [1.0000e+00... complex
Command History
Filter
tst
tst
tst
tst
tst
tst
tst
Octave 5.2.0, Wed Dec 16 13:17:58 2020 GMT <unknown@DESKTOP-T1EBL3Q>
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format short e
3
4 x=[1+i,2+i;1+2*i,2+2*i];
5
6 a4=x^2;
7 a5=x.^2;
8
line: 8 col: 1 encoding: SYSTEM eol: CRLF

Info

Elementary Loops

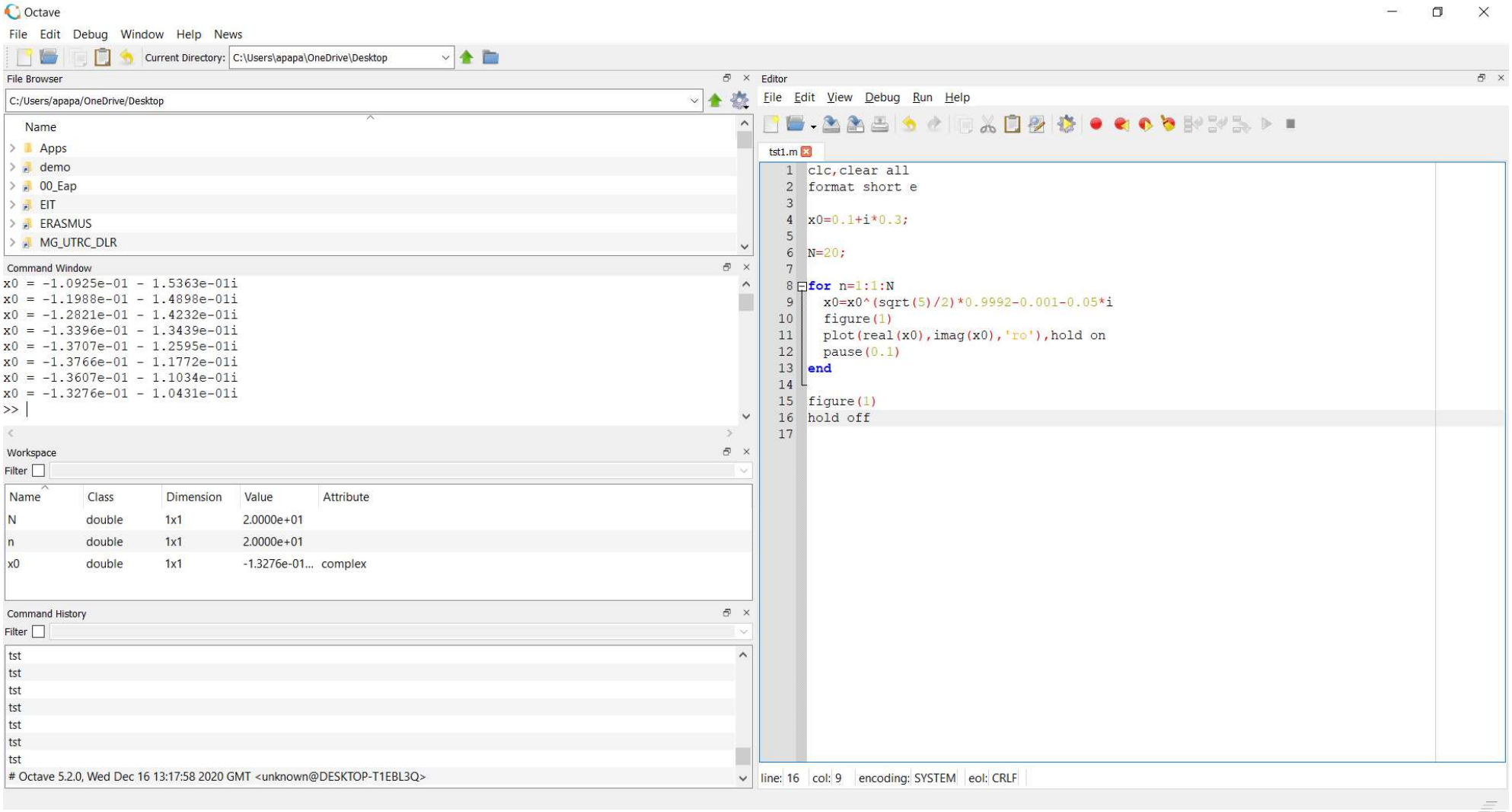
- The for loop is supported as per below

For start:step:end

- Plotting diagrams is also supported

- Example hereafter refers to plotting a sequence in the complex plane

Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
MG_UTRC_DLR
Command Window
x0 = -1.0925e-01 - 1.5363e-01i
x0 = -1.1988e-01 - 1.4898e-01i
x0 = -1.2821e-01 - 1.4232e-01i
x0 = -1.3396e-01 - 1.3439e-01i
x0 = -1.3707e-01 - 1.2595e-01i
x0 = -1.3766e-01 - 1.1772e-01i
x0 = -1.3607e-01 - 1.1034e-01i
x0 = -1.3276e-01 - 1.0431e-01i
>>
Workspace
Filter
Name Class Dimension Value Attribute
N double 1x1 2.0000e+01
n double 1x1 2.0000e+01
x0 double 1x1 -1.3276e-01... complex
Command History
Filter
tst
tst
tst
tst
tst
tst
tst
Octave 5.2.0, Wed Dec 16 13:17:58 2020 GMT <unknown@DESKTOP-T1EBL3Q>
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format short e
3
4 x0=0.1+i*0.3;
5
6 N=20;
7
8 for n=1:1:N
9 x0=x0^(sqrt(5)/2)*0.9992-0.001-0.05*i
10 figure(1)
11 plot(real(x0),imag(x0),'ro'),hold on
12 pause(0.1)
13 end
14
15 figure(1)
16 hold off
17
line: 16 col: 9 encoding: SYSTEM eol: CRLF

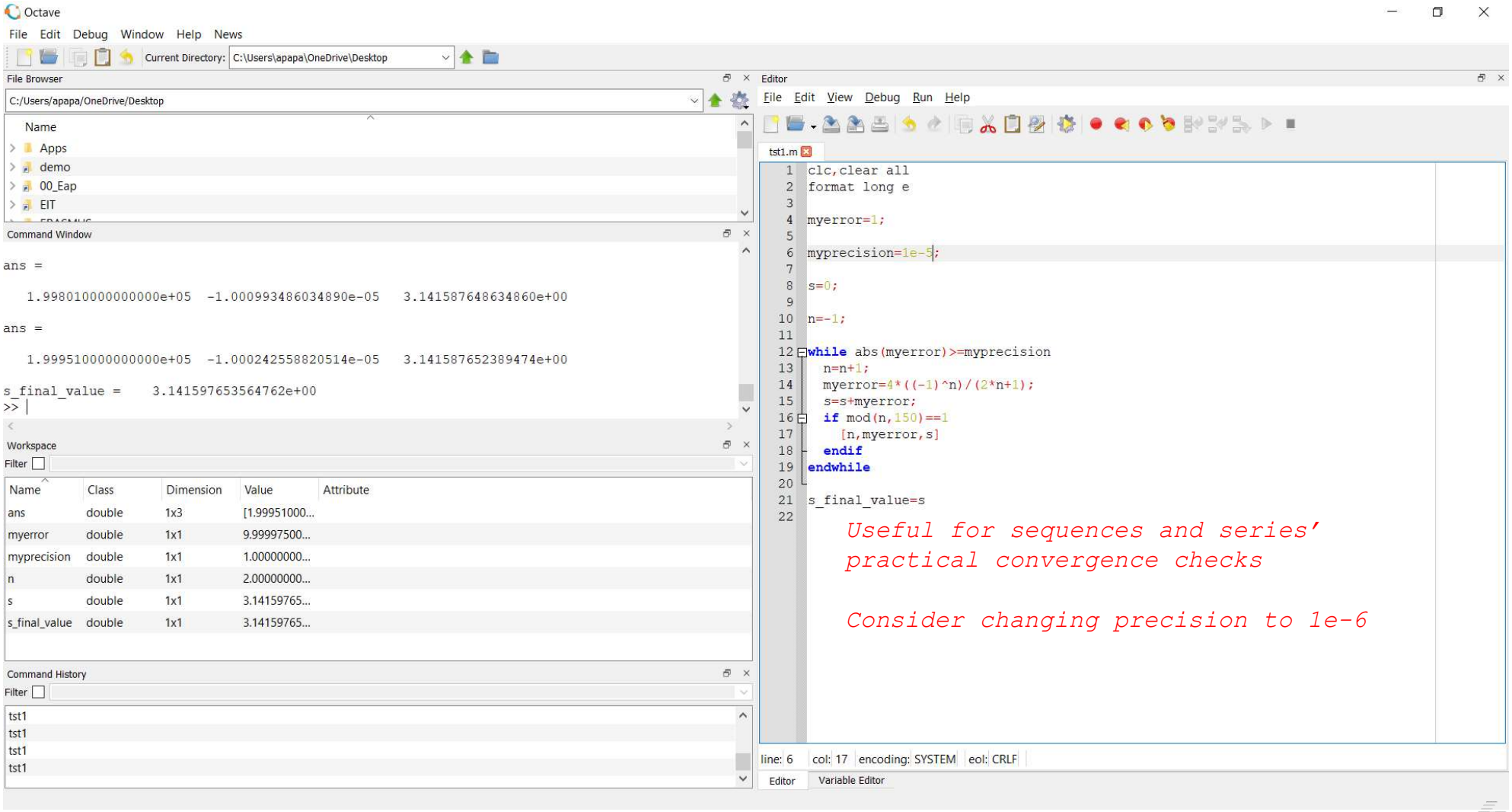
Info

Conditions & Conditional Loops

- While a statement is true, something is performed continuously
- If – then – else statement as per usual

- Example hereafter refers to estimating pi value up to a desired accuracy

Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
Command Window
ans =
1.998010000000000e+05 -1.000993486034890e-05 3.141587648634860e+00
ans =
1.999510000000000e+05 -1.000242558820514e-05 3.141587652389474e+00
s_final_value = 3.141597653564762e+00
>>
Workspace
Filter
Name Class Dimension Value Attribute
ans double 1x3 [1.99951000...
myerror double 1x1 9.99997500...
myprecision double 1x1 1.00000000...
n double 1x1 2.00000000...
s double 1x1 3.14159765...
s_final_value double 1x1 3.14159765...
Command History
Filter
tst1
tst1
tst1
tst1
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format long e
3
4 myerror=1;
5
6 myprecision=1e-5;
7
8 s=0;
9
10 n=-1;
11
12 while abs(myerror)>=myprecision
13 n=n+1;
14 myerror=4*((-1)^n)/(2*n+1);
15 s=s+myerror;
16 if mod(n,150)==1
17 [n,myerror,s]
18 endif
19 endwhile
20
21 s_final_value=s
22
Useful for sequences and series' practical convergence checks
Consider changing precision to 1e-6
line: 6 col: 17 encoding: SYSTEM eol: CRLF
Editor
Variable Editor

Info

Systemic Approaches

- Transfer functions' definition is supported
- As well as their step responses
- An external package is required to be loaded

- Example hereafter refers to plotting the step response of a first order continuous time system

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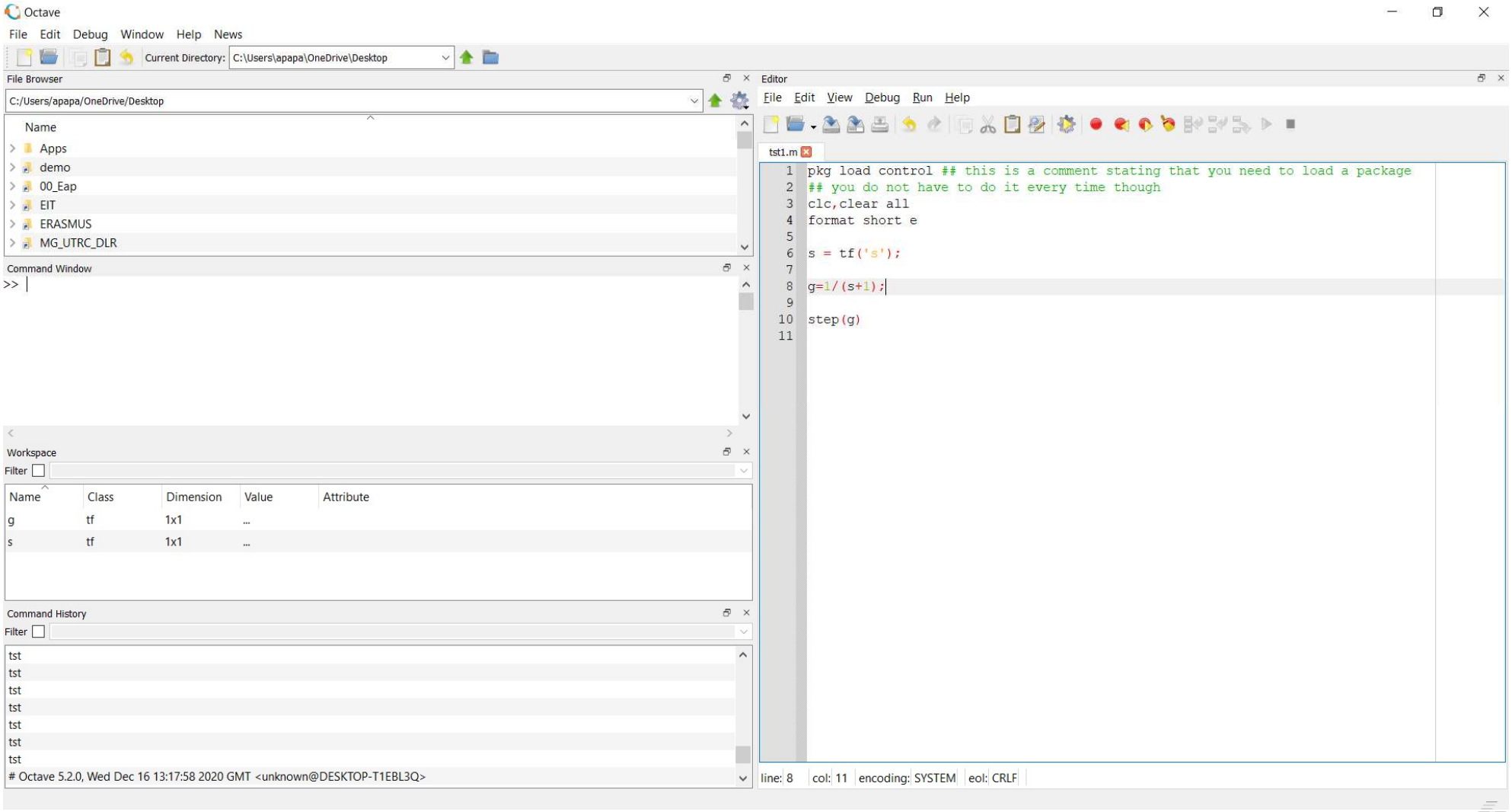
Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
MG_UTRC_DLR
Command Window
>>
Workspace
Filter
Name Class Dimension Value Attribute
g tf 1x1 ...
s tf 1x1 ...
Command History
Filter
tst
tst
tst
tst
tst
tst
tst
Octave 5.2.0, Wed Dec 16 13:17:58 2020 GMT <unknown@DESKTOP-T1EBL3Q>
Editor
File Edit View Debug Run Help
tst1.m
1 pkg load control ## this is a comment stating that you need to load a package
2 ## you do not have to do it every time though
3 clc,clear all
4 format short e
5
6 s = tf('s');
7
8 g=1/(s+1);
9
10 step(g)
11
line: 8 col: 11 encoding: SYSTEM eol: CRLF

Info

Theoretical modelling

- Numerical solutions for ODEs (and PDEs) can be approximated

- Example hereafter refers to utilizing Runge-Kutta 4-5 method to solve a system of linear differential equations written in its first-order form

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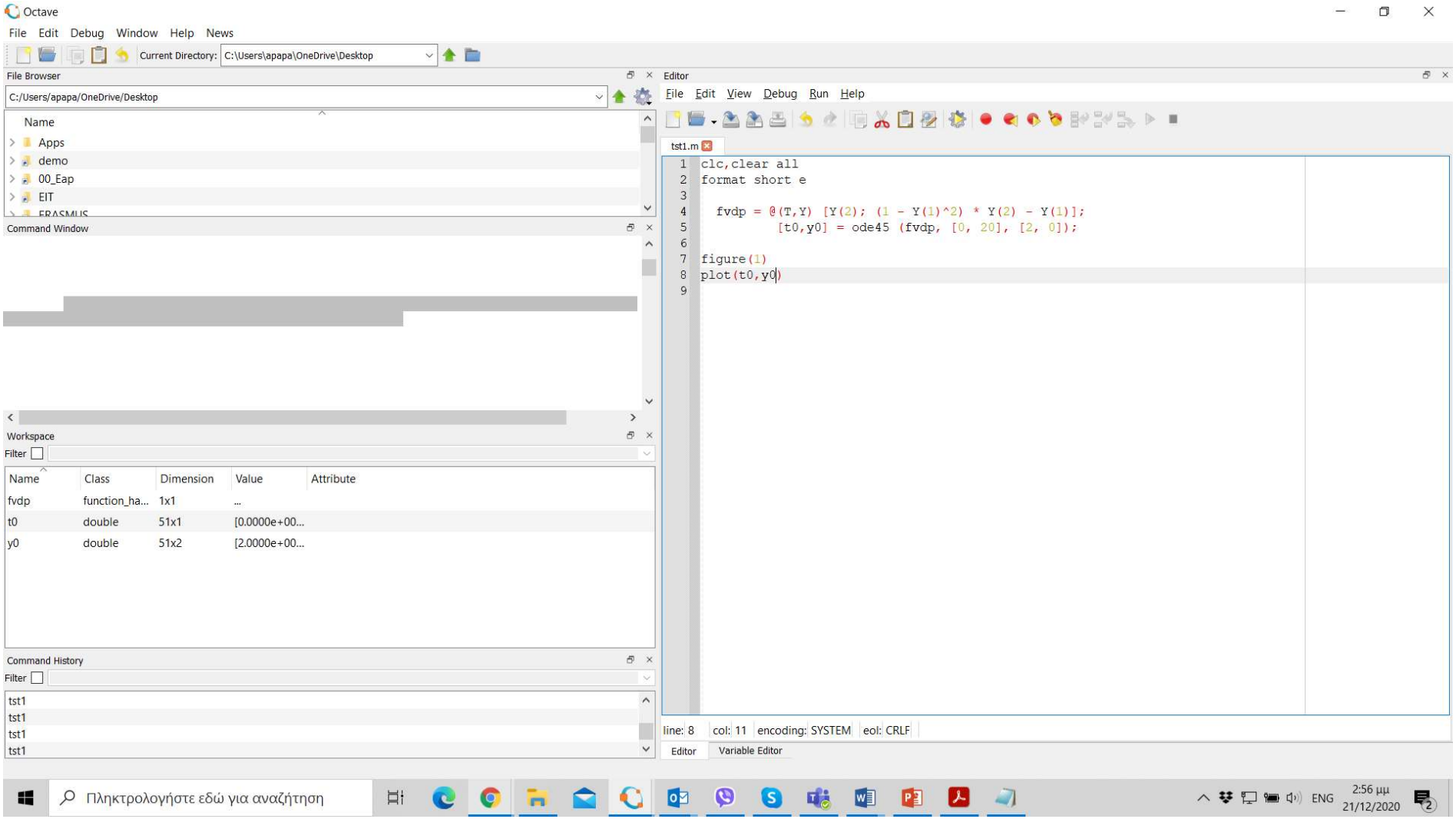
Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
Command Window
Workspace
Filter
Name Class Dimension Value Attribute
fvdp function_ha... 1x1 ...
t0 double 51x1 [0.0000e+00...
y0 double 51x2 [2.0000e+00...
Command History
Filter
tst1
tst1
tst1
tst1
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format short e
3
4 fvdp = @(T,Y) [Y(2); (1 - Y(1)^2) * Y(2) - Y(1)];
5 [t0,y0] = ode45 (fvdp, [0, 20], [2, 0]);
6
7 figure(1)
8 plot(t0,y0)
9
line: 8 col: 11 encoding: SYSTEM eol: CRLF
Editor Variable Editor
Πληκτρολογήστε εδώ για αναζήτηση
ENG
2:56 μμ
21/12/2020

Info

Uncertainty management

- Statistics' tools are supported

- Example hereafter refers to K-S test for uniform probability density function

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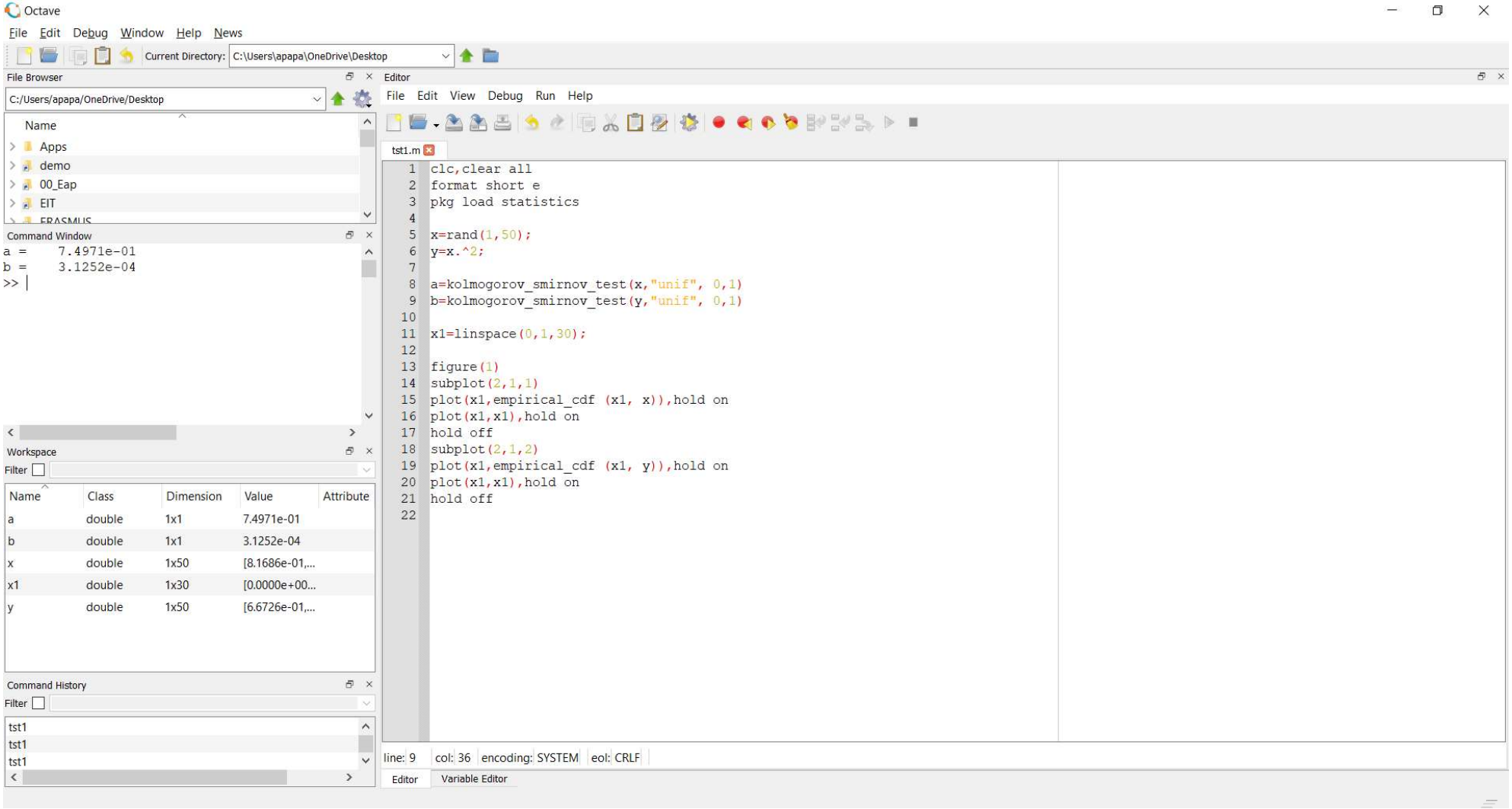
Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
Command Window
a = 7.4971e-01
b = 3.1252e-04
>>
Workspace
Filter
Name Class Dimension Value Attribute
a double 1x1 7.4971e-01
b double 1x1 3.1252e-04
x double 1x50 [8.1686e-01,...
x1 double 1x30 [0.0000e+00...
y double 1x50 [6.6726e-01,...
Command History
Filter
tst1
tst1
tst1
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format short e
3 pkg load statistics
4
5 x=rand(1,50);
6 y=x.^2;
7
8 a=kolmogorov_smirnov_test(x,"unif", 0,1)
9 b=kolmogorov_smirnov_test(y,"unif", 0,1)
10
11 x1=linspace(0,1,30);
12
13 figure(1)
14 subplot(2,1,1)
15 plot(x1,empirical_cdf (x1, x)),hold on
16 plot(x1,x1),hold on
17 hold off
18 subplot(2,1,2)
19 plot(x1,empirical_cdf (x1, y)),hold on
20 plot(x1,x1),hold on
21 hold off
22
line: 9 col: 36 encoding: SYSTEM eol: CRLF
Editor
Variable Editor

Info

IoT, metrology and control

- I/O control is supported

- Example hereafter refers to retrieving data (=signal) from microphone, playing them through the speakers and at the same time visualizing a their spectrogram

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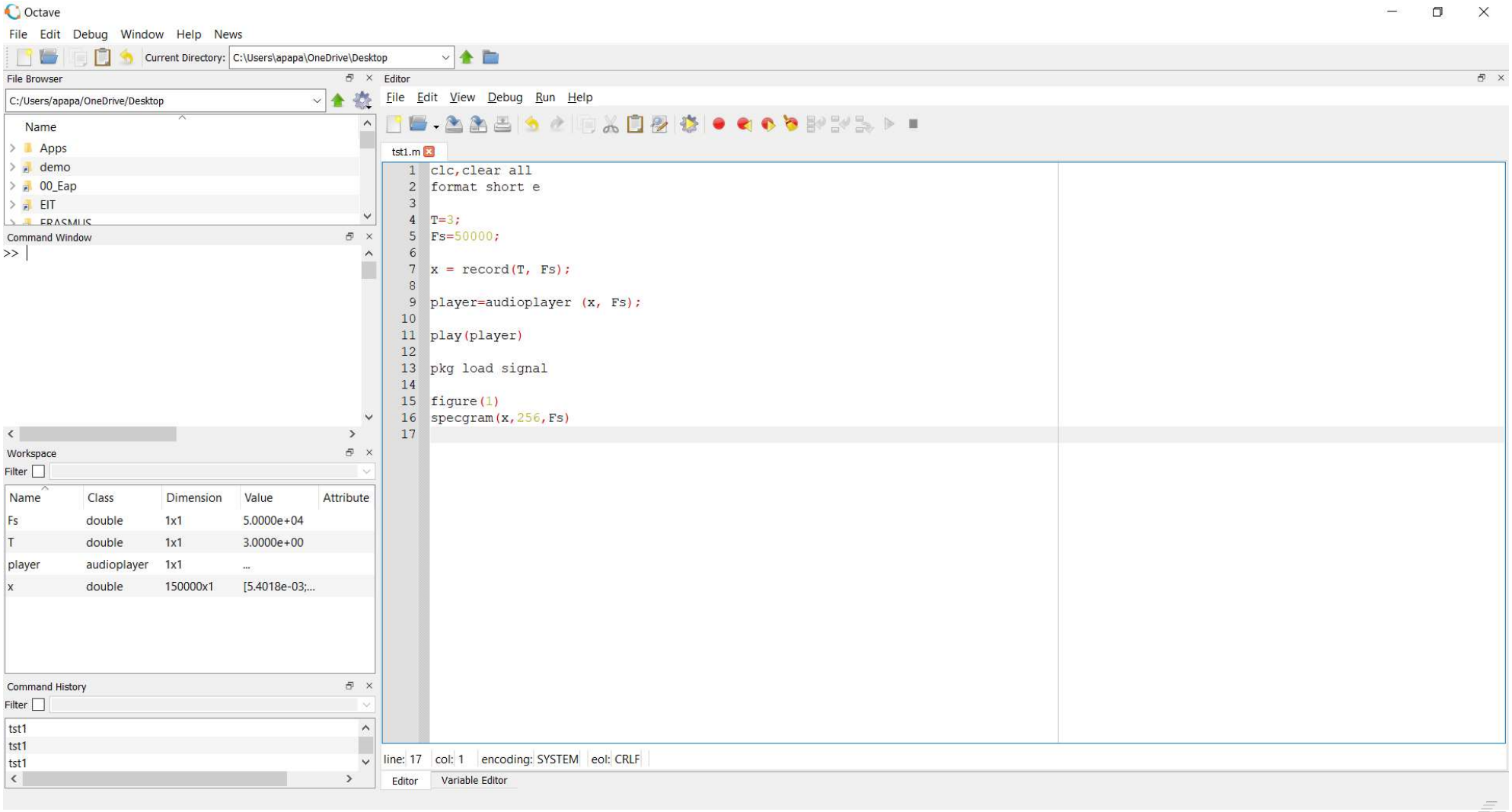
Task


Octave
File Edit Debug Window Help News
Current Directory: C:\Users\apapa\OneDrive\Desktop
File Browser
C:/Users/apapa/OneDrive/Desktop
Name
Apps
demo
00_Eap
EIT
ERASMUS
Command Window
>>
Workspace
Filter
Name Class Dimension Value Attribute
Fs double 1x1 5.0000e+04
T double 1x1 3.0000e+00
player audioplayer 1x1 ...
x double 150000x1 [5.4018e-03;...
Command History
Filter
tst1
tst1
tst1
Editor
File Edit View Debug Run Help
tst1.m
1 clc,clear all
2 format short e
3
4 T=3;
5 Fs=50000;
6
7 x = record(T, Fs);
8
9 player=audioplayer (x, Fs);
10
11 play(player)
12
13 pkg load signal
14
15 figure(1)
16 specgram(x,256,Fs)
17
line: 17 col: 1 encoding: SYSTEM eol: CRLF
Editor
Variable Editor

Info

Extra information

- For further information about the current presentation, the concepts in it, or the project, please contact
  - Dr. Panos Stavropoulos, pstavr@lms.mech.upatras.gr

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