Software Workshop for Engineers: $M_{atl_{ab}}$

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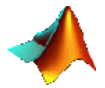
Automatic Control and System Design Engineering

Institut Supérieur des Études Technologiques de Bizerte

Outlines



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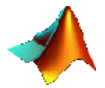

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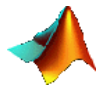
Purposes

Student has to be able to:

- process a signal;
- write scripts & functions;
- solve ordinary differential equations.



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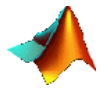

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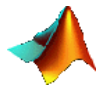

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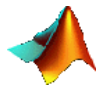

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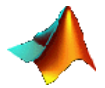

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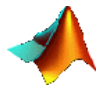
(THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL: Department of Physics and Astronomy[a])

[a] See: http://physics.unc.edu/undergraduate-program/labs/general-info/

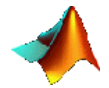
During this course, you will be working with one or more partners with whom you may discuss any points concerning laboratory work. However, you must write your lab report, in your own words.
Lab reports that contain identical language are not acceptable, so do not copy your lab partner's writing.
If there is a problem with your data, include an explanation in your report. Recognition of a mistake and a well-reasoned explanation is more important than having high-quality data, and will be rewarded accordingly by your instructor. A lab report containing data that is inconsistent with the original data sheet will be considered a violation of the Honor Code.



Falsification of data or plagiarism of a report will result in prosecution of the offender(s) under the University Honor Code.
On your first lab report you must write out the entire honor pledge:

"The work presented in this report is my own, and the data was obtained by my lab partner and me during the lab period."

On future reports, you may simply write *"Laboratory Honor Pledge"* and sign your name.



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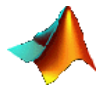


Matlab (Matrix Laboratory), developed by Mathworks, is a numerical computing environment. It allows data manipulations, implementation of algorithms, plotting functions and creating GUI.
It is an easy to use environment, a fourth-generation programming language (4GL).

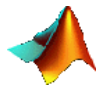
Key Features

- Interfacing capabilities with programs written in other languages (C, C^{++}, Java & Fortran)
- Third-party products (LabVIEW, XILINX, PSIM, etc.)
- Dozens of toolboxes: image acquisition, signal processing...
- Matlab users come from various domains of engineering, economics and science

Matlab is widely used in industry, academic institutions as well as research structures, click here to see a full list of Matlab's users stories.

Working at MathWorks

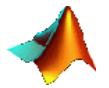
Outlines



Exercice 1

Create two matrices A and B: $A = \begin{pmatrix} 1 & 2 \\ 4 & -1 \end{pmatrix}$, $B = \begin{pmatrix} 4 & -2 \\ -6 & 3 \end{pmatrix}$.

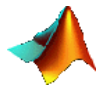
1. Compute $C_1 = A + B$ and $C_2 = A - B$.
2. Compute the matrix products $D_1 = AB$ and $D_2 = BA$.
3. Using element by element operations, compute the matrix F whose elements are obtained as follows: $f_{ij} = b_{ij} + a_{ij} b_{ij}^{\frac{1}{3}}$.
4. Are A and B singular? If no, compute their inverse.
5. Compute the eigenvalues of B.
6. In A, substract to the second row, the first row multiplied by 3.



Exercice 2

Given $X = [4, 1, 6]$ and $Y = [6, 2, 7]$, compute the following arrays:

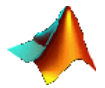
1. The matrix A whose elements are $a_{ij} = x_i y_j$.
2. The matrix B whose elements are $b_{ij} = \frac{x_i}{y_j}$.
3. The vector C whose elements are $c_i = x_i y_{4-i}$.



Exercice 3

Given $X = \begin{pmatrix} 5 & 0.35 & -3.5 & 5.47 & -2 \end{pmatrix}$, what are the commands that will execute the following operations:

1. Set the negative values of X to zero.
2. Extract the values of X greater than 3 in a vector Y.
3. Add 3 to the values of X that are even.
4. Set the values of X that are less than the mean to zero.
5. Set the values of X that are greater than the mean to their difference with the mean.



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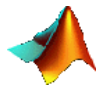


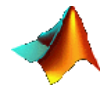
Exerice 1

What does this code do ?

```
Num = 0; Myeps = 1;
while (1+Myeps) > 1
      Myeps = Myeps/2;
      Num = Num + 1;
end
Num
Myeps = 2*Myeps
eps
```

Exerice 2

Develop in Matlab a script that generates a 4-bit Fibonacci LFSR.

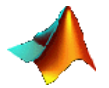


Exerice 1

The Legendre polynomials, P_n, are defined by the following recurrence relation:

$$(n+1)P_{n+1}(x) - (2n+1)P_n(x) + nP_{n-1}(x) = 0,$$

with $P_0(x) = 1$, $P_1(x) = x$ and $P_2(x) = \frac{3x^2-1}{2}$. Compute the next three Legendre polynomials and plot all 6 over the interval $[-1, 1]$ on the same figure.



Exerice 2

The Fibonacci numbers are computed according to the following equation:

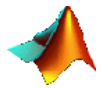
$$F_n = F_{n-1} + F_{n-2},$$

with $F_0 = F_1 = 1$.

1. Compute the first 10 Fibonacci numbers.
2. For the first 50 Fibonacci numbers, compute the ratio:

$$\frac{F_n}{F_{n-1}}.$$

3. Compare this ratio to the golden mean $\frac{1+\sqrt{5}}{2}$.



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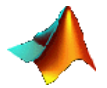
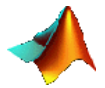


Exercice 1

1. Solve the differential equation using the Forward Euler Approximation, given by:

$$\dot{y}(t) = \frac{cos(t)}{2y - 2}.$$

2. Answer the previous question using Backward Euler Approximation, then Modified Euler Approximation.



Exercice 1

Solve the differential equation using the Runge Kutta Integration Method, given by:

$$\dot{y}(t) = \frac{cos(t)}{2y - 2}.$$

Exercice 2

Consider the following matrix representation:

$$\dot{X}(t) = \begin{bmatrix} 0 & 1 \\ -3 & -0.5 \end{bmatrix} X(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t).$$

Determine the trajectory of the vector X for an initial condition $\begin{pmatrix} 0.3 \\ 0 \end{pmatrix}$ and subject to the input e^{-t} over the interval $[0, 5]$.