Introduction to MATLAB

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1 Introduction

MATLAB, which stands for "matrix laboratory," is a programming language and application for scientific computing. MATLAB is typically used for Linear Algebra, data analysis, and graphing. Matrices are used as the fundamental data type, which makes up a large part of MATLAB's usefulness. Octave is the free version of MATLAB and has a lot of the same capabilities.

2 Getting Started

Basic Commands:

- Addition
  $2 + 2$
- Multiplication
  $3 * 6$
- Division
  $32/4$

Vectors:

- Vector
  x=[1 2 3 4 5]
- Squaring
  $x.^2$

Matrix Operations:

- 2x2 Matrix
  A=[2 4; 6 8]
- Entry
  A(2,1)
- Row
  A(1,:)
- Multiplication
  $A * 4$

3 Helpful Tips

- **lowercase** Unlike Mathematica, MATLAB uses only lowercase letters when typing commands. For example: If you're finding of the determinate of a matrix, you would type det(A), NOT Det(A).
- **Error Message** If you would happen to make a mistake, MATLAB will show an error message telling you the mistake you made. Also, if you click the error message, it will take you to a help menu.
- **Semicolon** Using a semicolon after a line of code will hide the output.

4 Linear Algebra

- **Zero Matrix** Creates a matrix containing all zeros of designated size.
  Command: zeros(3,2)
- **Identity Matrix** Creates Identity Matrix of designated size.
  Command: eye(4)
- **Matrix Manipulation**
  Switching rows of a matrix. Command: A([1,2],:)= A([2,1],:)
  Switching columns of a matrix. Command: A([1,2],[2,1])
- **Determinant** Finds the determinant of a matrix. Command: det(A)
- **Rank** Finds the rank of a matrix. Command: rank(A)

5 Linear Systems of Equations

Given the system of linear equations:

$$\begin{cases} x - 3y + 3z = -4 \\ 2x + 3y - z = 15 \\ 4x - 3y - z = 19 \end{cases} \Rightarrow \begin{bmatrix} 1 & -3 & 3 \\ 2 & 3 & -1 \\ 4 & -3 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -4 \\ 15 \\ 19 \end{bmatrix}$$

To solve in MATLAB enter the code:

```
B=[ 1 -3 3; 2 3 -1; 4 -3 -1]
v= [-4; 15; 19]
u= B\v
To check solution: B*u
```

Row Reduced Echelon Form

$$C = \begin{bmatrix} 1 & -3 & 3 & -4 \\ 2 & 3 & -1 & 15 \\ 4 & -3 & -1 & 19 \end{bmatrix}$$

```
Code: C=[ 1 -3 3 -4; 2 3 -1 15; 4 -3 -1 19]
      rref(C)
```

6 Graphing

6.1 Plot Curves in 2D

Method 1
Set domain window, enter function, then plot.

```
Code: x=[ -2*Pi: 0.01 : 2*Pi];
      y=cos(x);
      plot (x,y)
```

Method 2
Include code for domain in the same line as function.

```
 Code: x = [-2*Pi: 0.01: 2*Pi]; plot(x,cos(x))
```

6.2 Labels

After entering code from above, add the following to add a title and axis labels.

```
Code: title('Cosine Function')
      xlabel('x-axis')
      ylabel('y-axis')
```

6.3 Combining Plots

Plotting more than one function on the same plane.

```
Code: x = [0: 1: 10];
plot(x, x.^2, x, x.^3)
```