MATLAB Tutorial

June 5, 2008
Matrix and Operations
  Matrix and Operations
  Some Basic Matrices

Plot & Graphics
  Plot
  Labeling

Complex Numbers
  Basic Operations

FOR loop
  For loop

Help
  Help in MATLAB
Matrix and Variables

To enter a matrix

\[ A = \begin{bmatrix} 3 & 1 \\ 6 & 4 \end{bmatrix} \]

\[
\begin{align*}
\gg & \ A = [3 \ 1; \ 6 \ 4] \\
\gg & \ A = [3,1; \ 6,4] \\
\gg & \ B = [3 \ 5; \ 1 \ 2]
\end{align*}
\]
Matrix and Variables

- To enter a matrix $A = \begin{bmatrix} 3 & 1 \\ 6 & 4 \end{bmatrix}$

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

- To check dimension of a matrix, use `size`

  >> size(A) = 2 2
Matrix and Variables

- To enter a matrix \( A = \begin{bmatrix} 3 & 1 \\ 6 & 4 \end{bmatrix} \)
  
  \[
  \begin{align*}
  &\text{>> } A = [3 \ 1; \ 6 \ 4] \\
  &\text{>> } A = [3,1; \ 6,4] \\
  &\text{>> } B = [3 \ 5; \ 1 \ 2]
  \end{align*}
  \]

- To check dimension of a matrix, use `size`
  
  \[
  \begin{align*}
  &\text{>> } \text{size}(A) = 2 \ 2
  \end{align*}
  \]

- Determinant and inverse
  
  \[
  \begin{align*}
  &\text{>> } \text{det}(A) \\
  &\text{ans = } 6 \\
  &\text{>> } \text{inv}(A) \\
  &\text{ans = } 0.6667 \ -0.1667 \\
  &\ -1.0000 \ 0.5000
  \end{align*}
  \]
Basic Operations

- Addition
  
  ```
  >> C = A + B
  
  C = 
  6  6
  7  6
  ```
Basic Operations

▶ Addition

```
>> C = A + B
C =
6 6
7 6
```

▶ Subtraction

```
>> D = A - B
D =
0  -4
5   2
```
Basic Operations

▶ Multiplication
Basic Operations

- **Multiplication**
  - **Matrix Multiplication**
    
    >>> E = A*B
    
    E =
    
    10  17
    22  38
Basic Operations

- **Multiplication**
  - **Matrix Multiplication**
    >>> \( E = A \times B \)
    
    \[
    E = \\
    10 \quad 17 \\
    22 \quad 38
    \]
  - **Element-wise Multiplication**
    >>> \( E = A \cdot \times B \)
    
    \[
    E = \\
    9 \quad 5 \\
    6 \quad 8
    \]
Basic Operations

▶ Division
Basic Operations

- Division
  - Element-wise Division
    ```
    >> F = A ./ B
    F =
    1.0000  0.2000
    6.0000  2.0000
    ```
Basic Operations

Division

Element-wise Division

\[
\begin{align*}
\text{\textgreater\textgreater} & \quad \text{F} = \text{A} ./ \text{B} \\
\end{align*}
\]

\[
\begin{align*}
\text{F} &= \\
1.0000 & 0.2000 \\
6.0000 & 2.0000 \\
\end{align*}
\]

\[
\begin{align*}
AB^{-1} \\
\end{align*}
\]

\[
\begin{align*}
\text{\textgreater\textgreater} & \quad \text{F} = \text{A} / \text{B} \\
\end{align*}
\]

\[
\begin{align*}
\text{F} &= \\
5.0000 & -12.0000 \\
8.0000 & -18.0000 \\
\end{align*}
\]

\[
\begin{align*}
\text{\textgreater\textgreater} & \quad \text{F} = \text{A} * \text{inv(B)} \\
\end{align*}
\]

\[
\begin{align*}
\text{F} &= \\
5.0000 & -12.0000 \\
8.0000 & -18.0000 \\
\end{align*}
\]
Basic Operations

\[ A^{-1}B \]

\[
\begin{align*}
\gg & \quad F = A \backslash B \\
F &= \\
& 1.8333 \quad 3.0000 \\
& -2.5000 \quad -4.0000
\end{align*}
\]

\[
\gg & \quad F = \text{inv}(A) \ast B \\
F &= \\
& 1.8333 \quad 3.0000 \\
& -2.5000 \quad -4.0000
\]
Generating a Vector of Arithmetic Sequence

\[ v = \text{start}:\text{increment}:\text{end} \]

\[
\begin{align*}
\text{v} & = 0:2:10 \\
& = 0\ 2\ 4\ 6\ 8\ 10 \\
\text{v} & = 0:10 \\
& = 0\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10
\end{align*}
\]
Generating Basic Matrices

- Matrix with zeros
  >>> z = zeros(2,3)
  z =
  0 0 0
  0 0 0
Generating Basic Matrices

- **Matrix with zeros**
  ```matlab
  >> z = zeros(2,3)
  z =
  0 0 0
  0 0 0
  ```

- **Matrix with ones**
  ```matlab
  >> w = ones(2,3)
  w =
  1 1 1
  1 1 1
  ```
Generating Basic Matrices

- **Matrix with zeros**
  ```
  >> z = zeros(2,3)
  z = 
  0 0 0
  0 0 0
  ```

- **Matrix with ones**
  ```
  >> w = ones(2,3)
  w = 
  1 1 1
  1 1 1
  ```

- **Identity matrix**
  ```
  >> I = eye(3)
  I = 1 0 0
  0 1 0
  0 0 1
  ```
Plot

Plot

\[ x = [x(1), ..., x(N)] \]
\[ y = [y(1), ..., y(N)] \]
Plot

Plot

$x = [x(1), \ldots, x(N)]$

$y = [y(1), \ldots, y(N)]$

plot(x,y) gives the plot with straight line connecting between the data points \{(x(1), y(1)), \ldots, (x(N), y(N))\}
Plot

- Plot
  \[ x = [x(1), \ldots, x(N)] \]
  \[ y = [y(1), \ldots, y(N)] \]

- \texttt{plot(x,y)} gives the plot with straight line connecting between the data points \{ (x(1), y(1)), \ldots, (x(N), y(N)) \}

- \texttt{x = [0:5]}
  \[ y = [1 7 5 3 2 1] \]
  \texttt{plot(x,y)}

\[ x = [0:5] \]
\[ y = [1 7 5 3 2 1] \]
Plot

Plot

- $x = [x(1), ..., x(N)]$
- $y = [y(1), ..., y(N)]$

- `plot(x,y)` gives the plot with straight line connecting between the data points \{$(x(1), y(1)), ...(x(N), y(N))$\}\}

- $x = [0:5]$
  - $y = [1 7 5 3 2 1]$
  - `plot(x,y)`

- `stem(x,y)` suitable if consider a discrete signal
Subplot

▶ subplot(r,c,p)
Subplot

- subplot(r,c,p)
  - r is number of rows
Subplot

- `subplot(r,c,p)`
  - `r` is number of rows
  - `c` is number of columns
Subplot

- `subplot(r,c,p)`
  - `r` is number of rows
  - `c` is number of columns
  - `p` is the position of that plot
Subplot

- `subplot(r,c,p)`
  - `r` is number of rows
  - `c` is number of columns
  - `p` is the position of that plot

- `>> subplot(2,2,1)`
  - `>> plot(x,y)`
  - `>> subplot(2,2,2)`
  - `>> stem(x,y)`
  - `>> subplot(2,2,3)`
  - `>> plot(x,y)`
  - `>> subplot(2,2,4)`
  - `>> stem(x,y)`
Label the Plot

- Title `title('.......')`
Label the Plot

- Title `title('.......')`
- X axis `xlabel('.......')`
Label the Plot

- Title: `title('........')`
- X axis: `xlabel('........')`
- Y axis: `ylabel('........')`
Basic Operations

- Real part and imaginary part of $z = 1 + j2$

- $\text{real}(z) = 1$
- $\text{imag}(z) = 2$

- $|z| = 2.2361$
- $\angle(z) = 1.1071$
Basic Operations

- Real part and imaginary part of $z = 1 + j2$
  - $\text{real}(z)$
    - ans = 1
  - $\text{imag}(z)$
    - ans = 2
Basic Operations

- Real part and imaginary part of $z = 1 + j2$
  
  ```
  >> real(z)
  ans =
  1
  >> imag(z)
  ans =
  2
  ```

- Find the magnitude and the phase (in radian)
Basic Operations

- Real part and imaginary part of $z = 1 + j2$
  - $\gg\ \text{real}(z)$
    - ans = 1
  - $\gg\ \text{imag}(z)$
    - ans = 2

- Find the magnitude and the phase(in radian)
  - $\gg\ \text{abs}(z)$
    - ans = 2.2361
  - $\gg\ \text{angle}(z)$
    - ans = 1.1071
Basic Operations

- Conjugate of $z = 1 + j2$
Basic Operations

- Conjugate of $z = 1 + j2$
  
  ```matlab
  >> conj(z)
  ans =
  1.0000 - 2.0000i
  ```
FOR Loop

- FOR loop
  for i = start:increment:end
  <do P(i)>
  end

Example: Find the summation 1+2+...+10

```matlab
summ = 0;
for i = 1:10
    summ = summ + i;
end

summ
```

summ = 55
FOR Loop

- FOR loop
  for i = start:increment:end
  <do P(i)>
  end

- Example: Find the summation 1+2+...+10
  >> summ=0;
  >> for i =1:10
  summ = summ+i;
  end
  >> summ
  summ =
  55
Need Help?

▷ Help - help name
Need Help?

- **Help** - `help name`
- **Search** - `lookfor name`