

Introduction to MATLAB

001511.03

PB17000047 范毅敏

fym0503@mail.ustc.edu.cn

Why MATLAB???

Why not C/C++?

Pros

- have learned it for a semester
- FREE

Cons

- TOO hard to write/debug
- TOO long

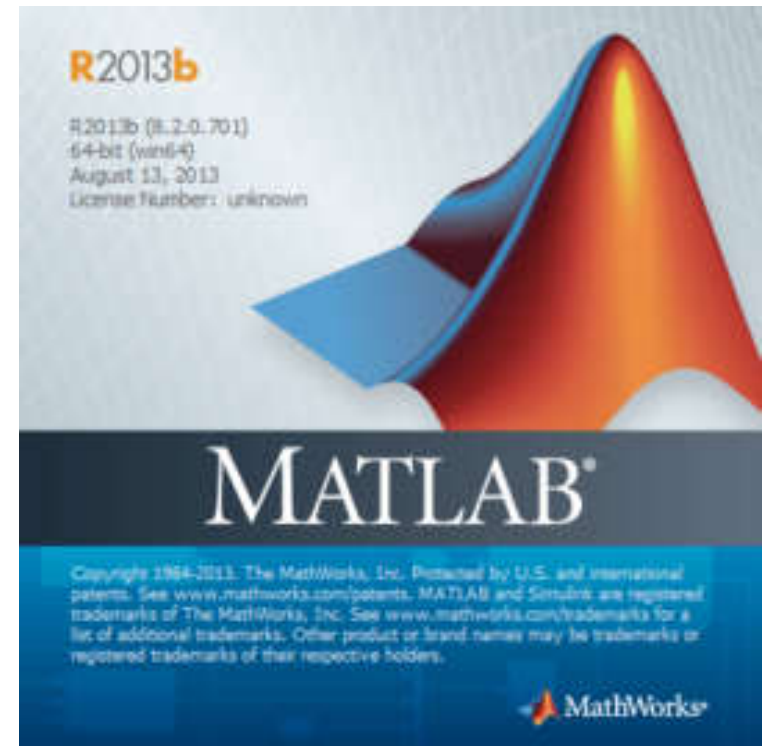
Why MATLAB(Octave)?

Pros

- easy to learn and use
- very effective

Cons

- NOT FREE(zbh.ustc.edu.cn with ustcnet)
- You have not learned it !



Other programming languages:
Julia, Python ...

Part I: Basics

- Getting Help
- Variables
- Number and String
- Flow Control / Loops
- Time
- Input
- Output
- Function

Getting Help

- type one of following commands in the command window:
 - **help** – lists all the help topic
 - **help command** – provides help for the specified command
 - **help help** – provides information on use of the help command
 - ***Baidu/Bing/CSDN/Google... of course***
 - ***whos show all variables on the screen!***

Variables

- Variable names:
 - Must start with a letter
 - May contain only letters, digits, and the underscore “_”
 - Matlab is case sensitive, i.e. one & OnE are different variables.
- Assignment statement:
 - *Variable = number;*
 - *Variable = expression;*
- Example:

```
>> tutorial = 1234;  
>> tutorial = 1234  
tutorial =  
    1234
```

NOTE: when a semi-colon “;” is placed at the end of each command, the result is not displayed.

Variables (con't...)

- Special variables:
 - ans : default variable name for the result
 - pi: $\pi = 3.1415926\dots$
 - eps: $\epsilon = 2.2204e-016$, smallest amount by which 2 numbers can differ.
 - Inf or inf : ∞ , infinity
 - NaN or nan: not-a-number

Solutions to Systems of Linear Equations

- Example: a system of 3 linear equations with 3 unknowns (x_1, x_2, x_3):

$$3x_1 + 2x_2 - x_3 = 10$$

$$-x_1 + 3x_2 + 2x_3 = 5$$

$$x_1 - x_2 - x_3 = -1$$

Let :

$$A = \begin{bmatrix} 3 & 2 & 1 \\ -1 & 3 & 2 \\ 1 & -1 & -1 \end{bmatrix} \quad x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \quad b = \begin{bmatrix} 10 \\ 5 \\ -1 \end{bmatrix}$$

Then, the system can be described as:

$$Ax = b$$

Solutions to Systems of Linear Equations (con't...)

- Solution by Matrix Inverse:

$$Ax = b$$

$$A^{-1}Ax = A^{-1}b$$

$$x = A^{-1}b$$

- MATLAB:

```
>> A = [ 3 2 -1; -1 3 2; 1 -1 -1];
```

```
>> b = [ 10; 5; -1];
```

```
>> x = inv(A)*b
```

```
x =
```

```
-2.0000
```

```
5.0000
```

```
-6.0000
```

Answer:

$$x_1 = -2, x_2 = 5, x_3 = -6$$

- Solution by Matrix Division:

The solution to the equation

$$Ax = b$$

can be computed using **left division**.

- MATLAB:

```
>> A = [ 3 2 -1; -1 3 2; 1 -1 -1];
```

```
>> b = [ 10; 5; -1];
```

```
>> x = A\b
```

```
x =
```

```
-2.0000
```

```
5.0000
```

```
-6.0000
```

Answer:

$$x_1 = -2, x_2 = 5, x_3 = -6$$

NOTE:

left division: $A \backslash b \rightarrow b \div A$

right division: $x / y \rightarrow x \div y$

Number and String

a='numercial';
b='analysis';
c=strcat(a,b)
d=char(a,b)
length(a)
size(d)
strcmp(a,b)
isletter(a)
blanks(10)
upper(b)
sort(b)
num2str()
str2num()
mat2str()

```
num2str(123)  
num2str([1,2,3])
```

```
a = 1;  
y1 = num2str(a,'%02d');%'01'  
y2 =  
num2str(a,'%03d');%'001'
```

```
str2num('222');  
str2num(char({'222','233'}))  
str2num('a')
```

```
“” = “
```

`()`, `{ }` and `[]` in MATLAB

→ `[]`

for matrix and vector

```
a=[1 2 3]
```

```
a=[1 2 3;4 5 6]
```

→ `{ }`

cell

```
A(2,1) = {[1 2 3; 4 5 6]}
```

```
c={'hhh',123,[1 2 3]}
```

→ `()`

find/change the elements

```
a(3)=1
```

Think about that:

`{ }` and `[]` in MATLAB:

```
a = {1 2 3};
```

```
b = [1 2 3];
```

```
c = {[1 2 3],[4 5 6]};
```

```
d = {[1 2 3],[4 5 6]};
```

```
e = [[1 2 3],[4 5 6]];
```

```
f = {[1 2 3],[4 5 6]};
```

```
c{1},c(1),c{1}(1),c{1}{1}
```

```
d{1},d(1)
```

```
f{1},f(1)
```

Flow Control: If...Else

Example: (**if...else** and **elseif** clauses)

```
if temperature > 100
    disp ('Too hot – equipment malfunctioning.')
elseif temperature > 90
    disp ('Normal operating range.');
```

else

```
    disp ('Too cold – turn off equipment.')
end
```

Flow Control: Loops

- **for** loop
 for *variable = expression*
 commands
 end
- **while** loop
 while *expression*
 commands
 end

- **Example (for loop):**

```
for t = 1:5000  
    y(t) = sin (2*pi*t/10);  
end
```

- **Example (while loop):**

```
EPS = 1;  
while ( 1+EPS) >1  
    EPS = EPS/2;  
end  
EPS = 2*EPS
```

- the **break** statement
 break – is used to terminate the execution of the loop.

Time

tic & toc

```
tic  
d=zeros(1,10000);  
for i=1:10000  
    d(i)=i;  
end  
T=toc
```

clock

```
t1=clock;  
t2=clock;  
T=t2-t1;
```

cputime

```
t1=cputime;  
t2=cputime;  
T=t2-t1;
```

clock

```
t1=clock;  
t2=clock;  
T=etime(t1,t2);
```

Input

Interact:

```
>>x=input('please input a number:')  
please input a number:22  
x = 22
```

```
>>x=input('please input a string:', 's')  
please input a string:this is a string  
x = this is a string
```

From file

```
importdata  
data.txt
```

```
    a1 a2 a3
```

```
    b1 b2 b3
```

```
    1 2 3
```

```
    4 4 4
```

```
    6 5 6
```

```
A=importdata('data.txt',' ',2)
```

```
xlsread
```

```
A = xlsread('data.xlsx','Sheet1');
```

```
csvread
```

```
A=csvread('data.csv',row,col);
```

Output

disp

```
→x=10;  
    disp(x)  
→x='hello';  
    disp(x)  
→disp([num2str(2),'a'])  
→disp([1 2 3])
```

fprintf

```
→x=10;  
    fprintf(x)  
→x='hello';  
    fprintf(x)  
→fprintf(fid,format,data)  
    fid=fopen('d:\char1.txt','w');  
    format:  
    %d 整数  
    %e 实数: 科学计算法形式  
    %f 实数: 小数形式  
    %g 由系统自动选取上述两种格式之一  
    %s 输出字符串
```

Function

→inline

```
f=inline('x^2+y','x','y');  
z=f(2,3);
```

→syms+subs

```
syms f x  
f=2*x+x^2;  
subs(f,'x',5)
```

→file

```
myfile.m  
clear;  
clc;  
for t=1:10  
    y=mylfg(t);  
    fprintf('M^(1/3)=%6.4f\n',t,y);
```

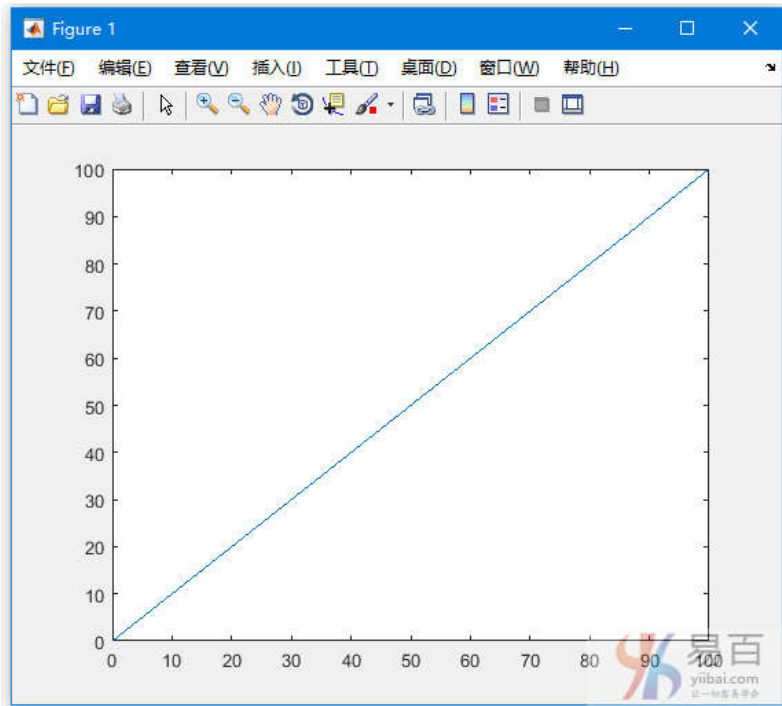
```
mylfg.m  
  
function y=mylfg(x)  
    y=x^3;
```

```
funtry2.m  
function []=funtry2()  
for t=1:10  
    y=lfg2(t)  
    fprintf('M^(1/3)=%6.4f\n');  
End  
function y=lfg2(x)  
    y = x^(1/3);
```

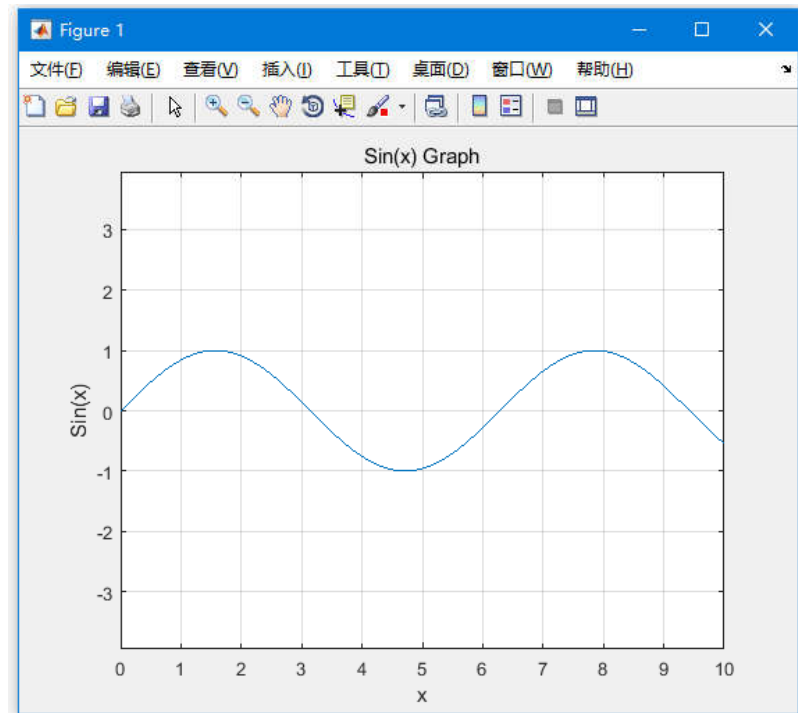

Part II: Visualization

Visualization: Basics

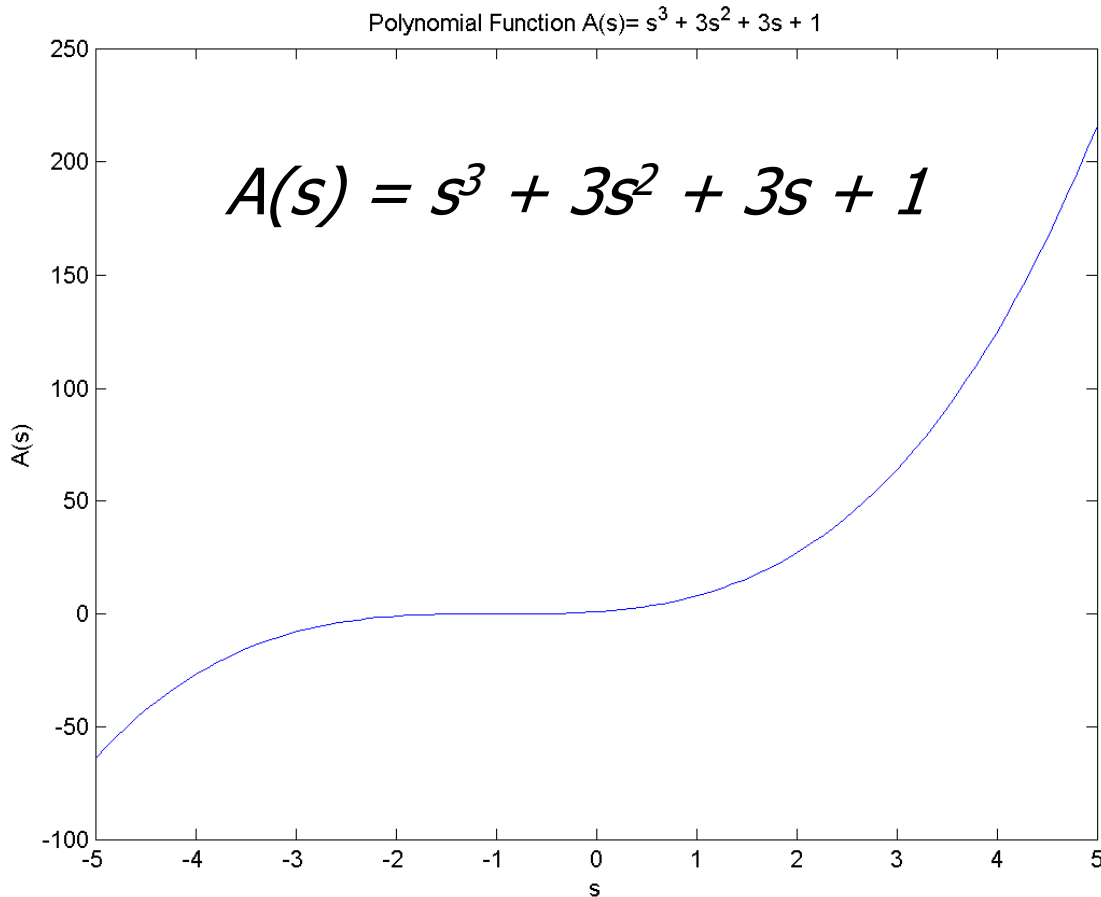
```
x = [0:5:100];  
y = x;  
plot(x, y)
```



```
x = [0:0.01:10];  
y = sin(x);  
plot(x, y), xlabel('x'), ylabel('Sin(x)'), title('Sin(x)  
Graph')
```



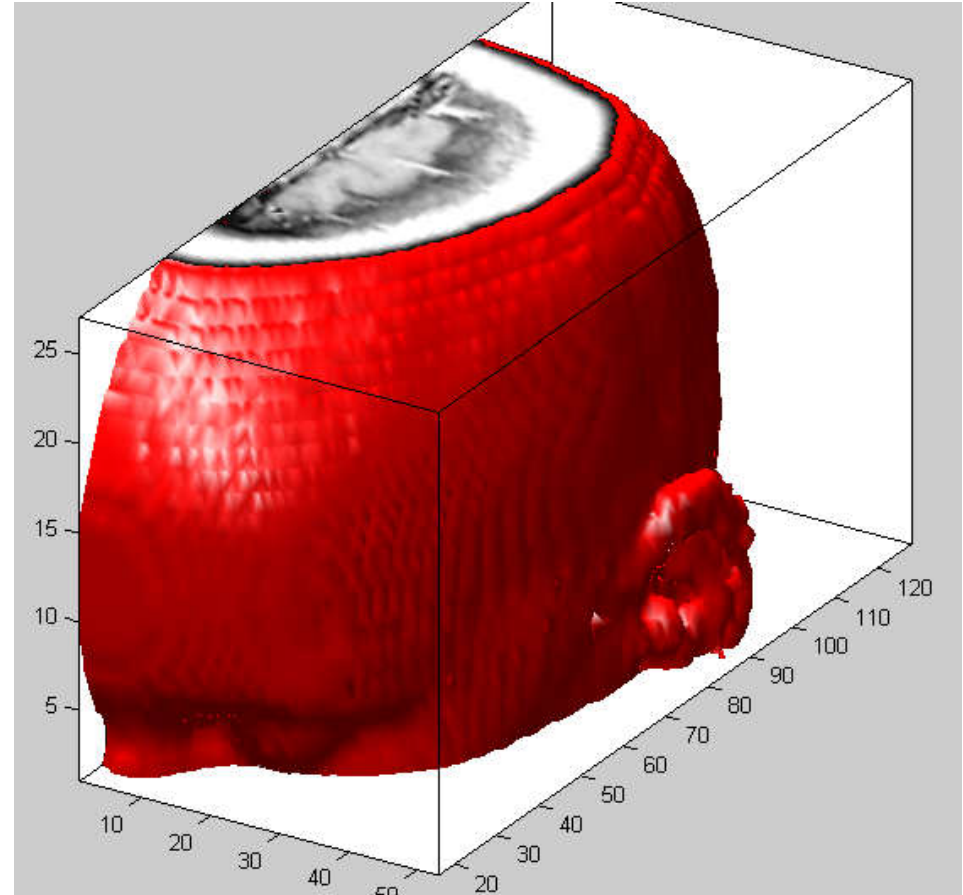
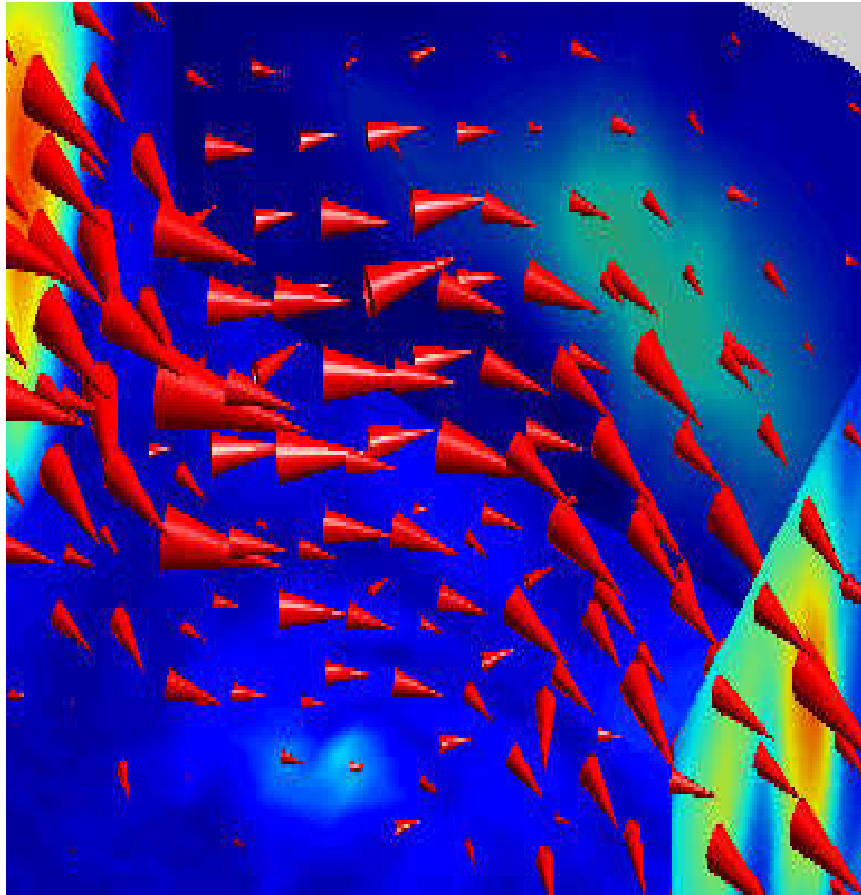
Visualization: Plotting



- Example:

```
>> s = linspace (-5, 5, 100);  
>> coeff = [ 1 3 3 1];  
>> A = polyval (coeff, s);  
>> plot (s, A),  
>> xlabel ('s')  
>> ylabel ('A(s)')
```

Advanced Visualization



THANKS!

节日快乐!



中华人民共和国成立70周年

The 70th Anniversary of the Founding of
The People's Republic of China