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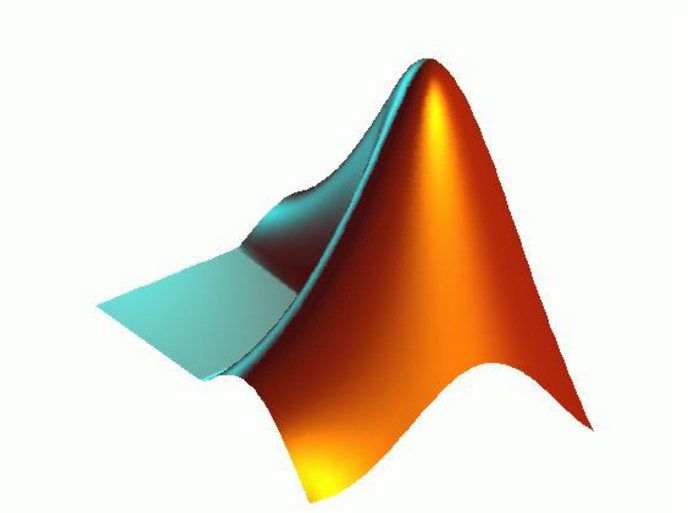
INTRODUCTION TO MATLAB



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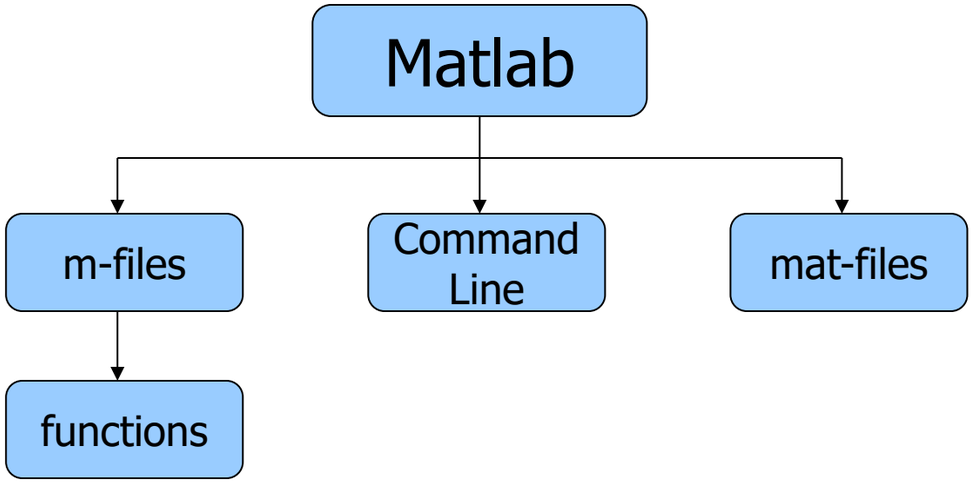
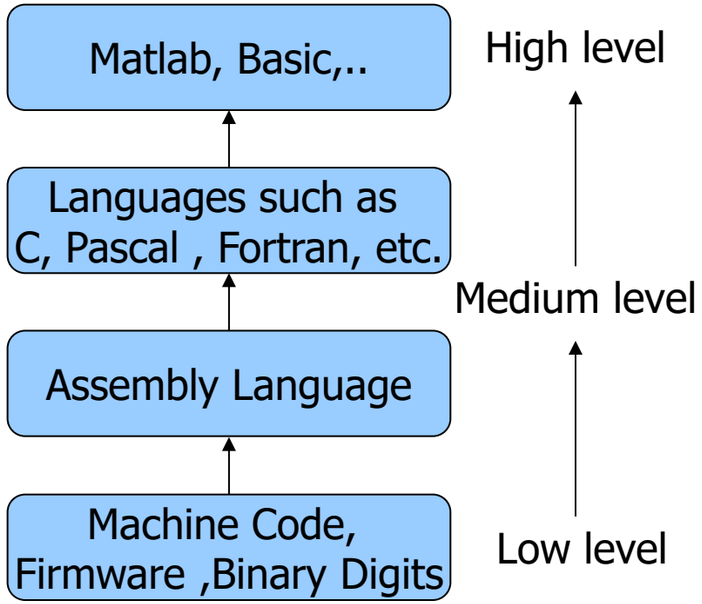
Introduction

❖MATLAB (MATrix LABoratory)

- ✓ MATLAB is a product of The MathWorks™ Inc.
- ✓ MATLAB enables us to solve many advanced numerical problems rapidly and efficiently.





Commands

```
>>help
>>clc
>>clear
>>clear all
>>save
>>load
```

Matrix

```
[1,1   1,2   .   1,n
 2,1   2,2   .   2,n
 3,1   3,2   .   3,n
  .     .     .
 m,1   m,2   .   m,n]
```

```
>> N = 5:10:35
N =
    5   15  25  35
>> P = [1:3; 30:-10:10]
P =
    1   2   3
    30  20  10
```

```
>> x=[1 2 3]
x =
     1     2     3

>> x=[1,2,3]
x =
     1     2     3

>> x=[1
      2
      3
      4];
>> x=[1;2;3;4]

x =
     1
     2
     3
     4
```

Matrix

```
>> a=[1 2];
  >> b=[3
       4];

 >> a*b
  ans =
       11

 >> b*a
  ans =
     3     6
     4     8
```

```
>> A = [1:3;4:6;7:9]
A =
     1     2     3
     4     5     6
     7     8     9

>> mean(A)
ans =
     4     5     6

>> sum(A)
ans =
     12    15    18
```

```
x = zeros(1,3)
x =
     0     0     0

x = ones(1,3)
x =
     1     1     1

x = rand(1,3)
x =
 0.9501   0.2311 0.6068
```

Linear equation system

$$\begin{bmatrix} 1 & 2 & 3 \\ 5 & 1 & 4 \\ 3 & 2 & 1 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \end{Bmatrix} = \begin{Bmatrix} -5 \\ -1 \\ 5 \end{Bmatrix}$$

```
A = [1 2 3; 5 1 4; 3 2 1]
    A =
      1    2    3
      5    1    4
      3    2    1
```

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

```
x =inv(A)*b

      x =

           2
           1
          -3
```

Polynomial: roots

❖Find the roots of the polynomial

$$p_1(x) = x^4 - 10x^3 + 35x^2 - 50x + 24$$

```
p1=[1 –10  35  –50  24]      %  Specify and display the coefficients of p1(x)

p1 =
     1    -10     35    -50     24

roots_ p1=roots(p1)          %  Find the roots of p1(x)

roots_p1 =

   4.0000
   3.0000
   2.0000
   1.0000
```

Polynomial: poly

- It is known that the roots of a polynomial are -1, -2, -3, -4+5j and -4-5j. Compute the coefficients of this polynomial.

```
r4=[ -1   -2   -3 -4+5j -4-5j ]

r4 =
  Columns 1 through 4
  -1.0000   -2.0000   -3.0000   -4.0000+ 5.0000i
  Column 5
  -4.0000- 5.0000i

poly_r4=poly(r4)

poly_r4 =
     1    14   100   340   499   246
```

Therefore, the polynomial is

$$p_4(x) = x^5 + 14x^4 + 100x^3 + 340x^2 + 499x + 246$$

Polynomial: polyval

- Evaluate the polynomial at x = -3

$$p_5(x) = x^6 - 3x^5 + 5x^3 - 4x^2 + 3x + 2$$

```
p5=[1  –3   0   5  –4   3   2];   % These are the coefficients of the given polynomial
                                  % The semicolon (;) after the right bracket suppresses the
                                  %  display of the row vector that contains the coefficients of p5.
%
val_minus3=polyval(p5, –3)        % Evaluate p5 at x=–3; no semicolon is used here
                                  % because we want the answer to be displayed

val_minus3 =
         1280
```

Polynomial: conv

Let

$$p_1 = x^5 - 3x^4 + 5x^2 + 7x + 9$$

and

$$p_2 = 2x^6 - 8x^4 + 4x^2 + 10x + 12$$

Compute the product $p_1 \cdot p_2$ using the **conv(a,b)** function.

```
p1=[1  –3   0  5  7  9];          % The coefficients of p1
p2=[2   0  –8  0  4  10  12];     % The coefficients of p2
p1p2=conv(p1,p2)                  % Multiply p1 by p2 to compute coefficients of the product p1p2
```

```
p1p2 =
  2   -6   -8   34   18   -24   -74   -88   78   166   174   108
```

Therefore,

$$p_1 \cdot p_2 = 2x^{11} - 6x^{10} - 8x^9 + 34x^8 + 18x^7 - 24x^6$$
$$-74x^5 - 88x^4 + 78x^3 + 166x^2 + 174x + 108$$

Polynomial: polyder

Let

$$p_5 = 2x^6 - 8x^4 + 4x^2 + 10x + 12$$

Compute the derivative $\frac{d}{dx}p_5$ using the **polyder(p)** function.

```
p5=[2  0  –8  0  4  10  12];     % The coefficients of p5
der_p5=polyder(p5)               % Compute the coefficients of the derivative of p5
```

```
der_p5 =
    12     0   -32     0     8    10
```

Therefore,

$$\frac{d}{dx}p_5 = 12x^5 - 32x^3 + 4x^2 + 8x + 10$$

Script file

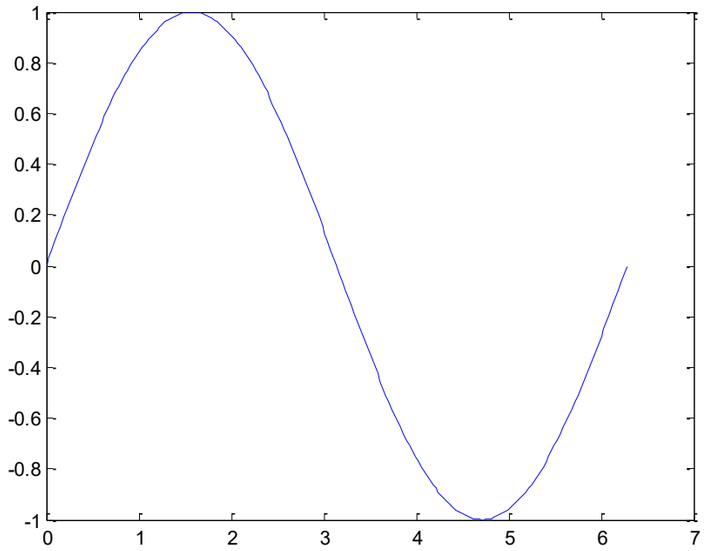
- MATLAB recognizes two types of files: script files and function files. Both types are referred to as m−files since both require the .m extension.
- A script file consists of two or more functions.

Function file

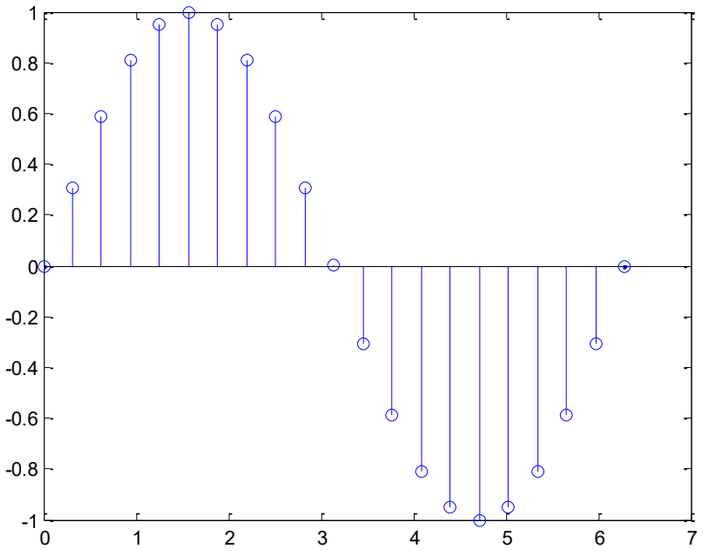
```
%File name: pwr2.m
function y=pwr2(x)
y=x^2
end
```

Visualization

```
x = 0:pi/100:2*pi;
y = sin(x);
plot(x,y)
```

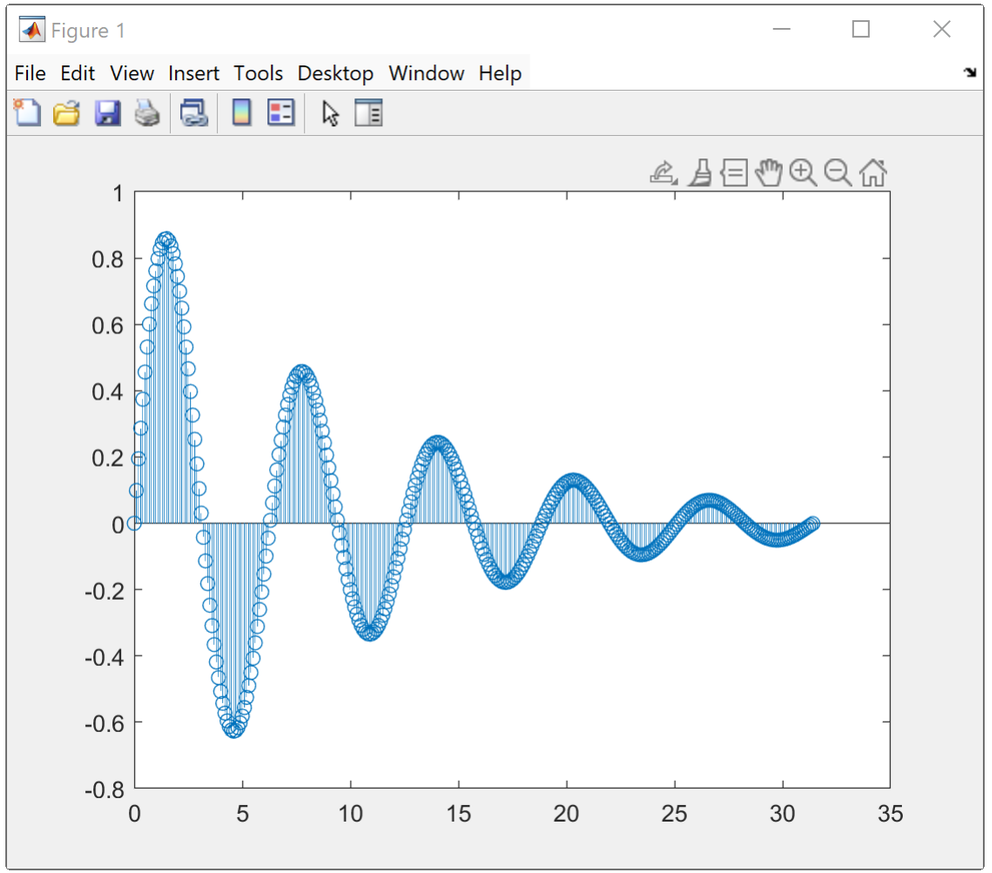



```
x = 0:pi/100:2*pi;
y = sin(x);
stem(x,y)
```



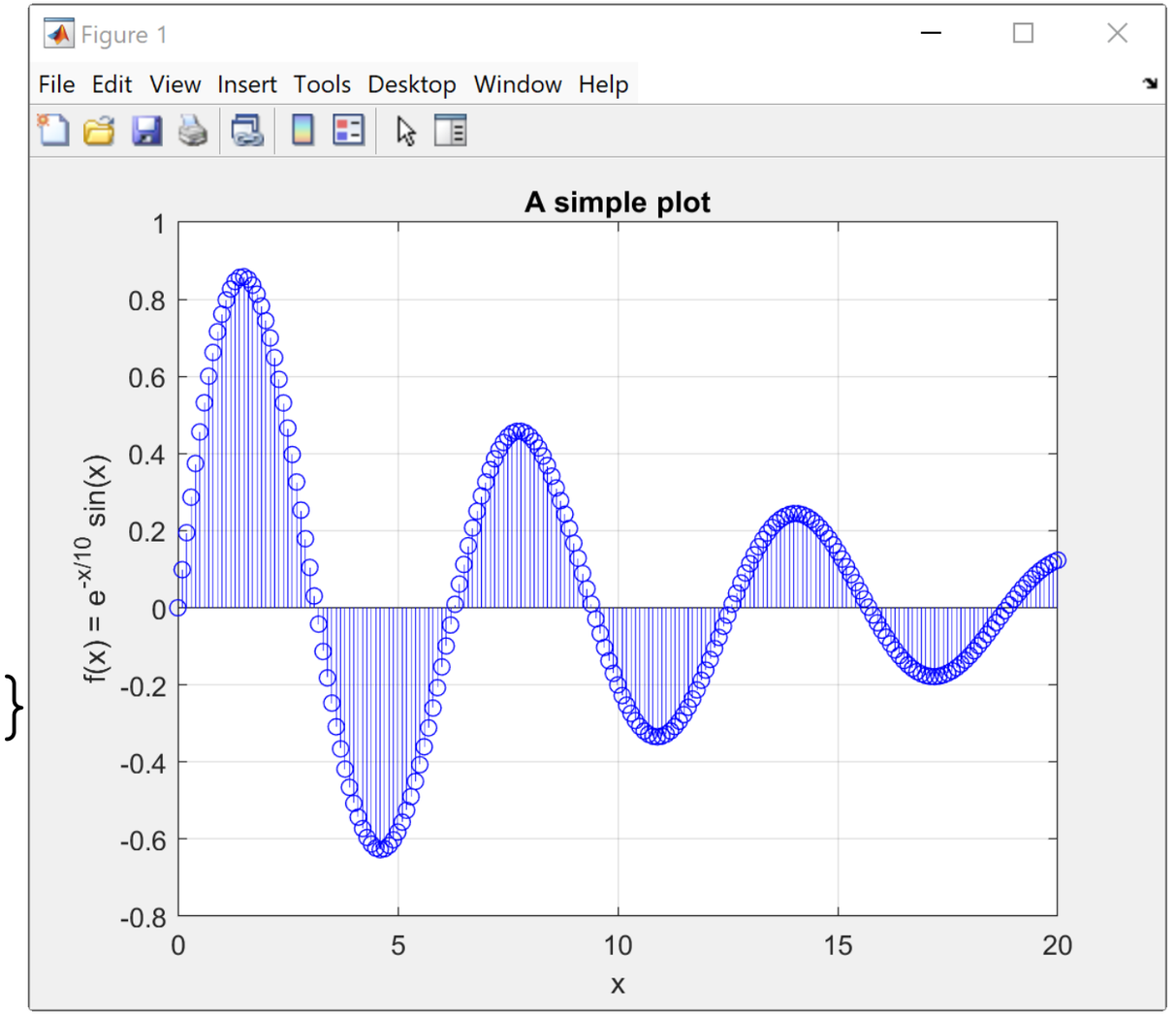
Visualization using stem

```
x=0:0.1:10*pi;
stem(x,sin(x).*exp(-0.1*x))
```



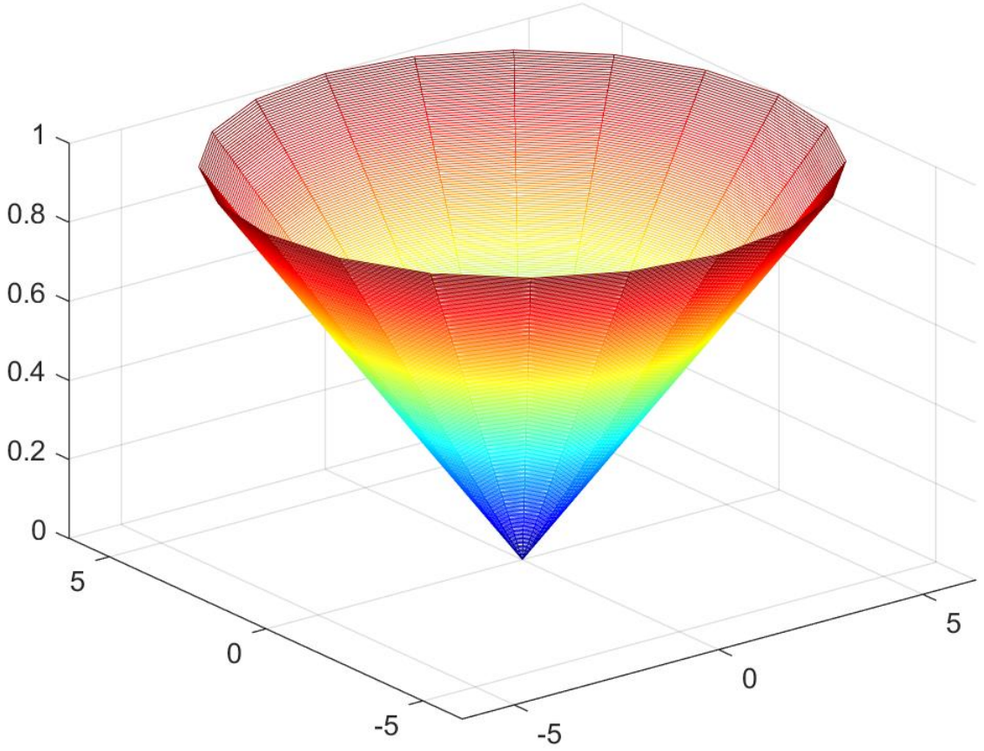
Visualization using stem

```
x = 0:0.1:20;
y = exp(-x/10).*sin(x);
stem(x,y,'Color','b')
grid on
xlabel('x')
ylabel('f(x) = e^{-x/10} sin(x)')
title('A simple plot')
```



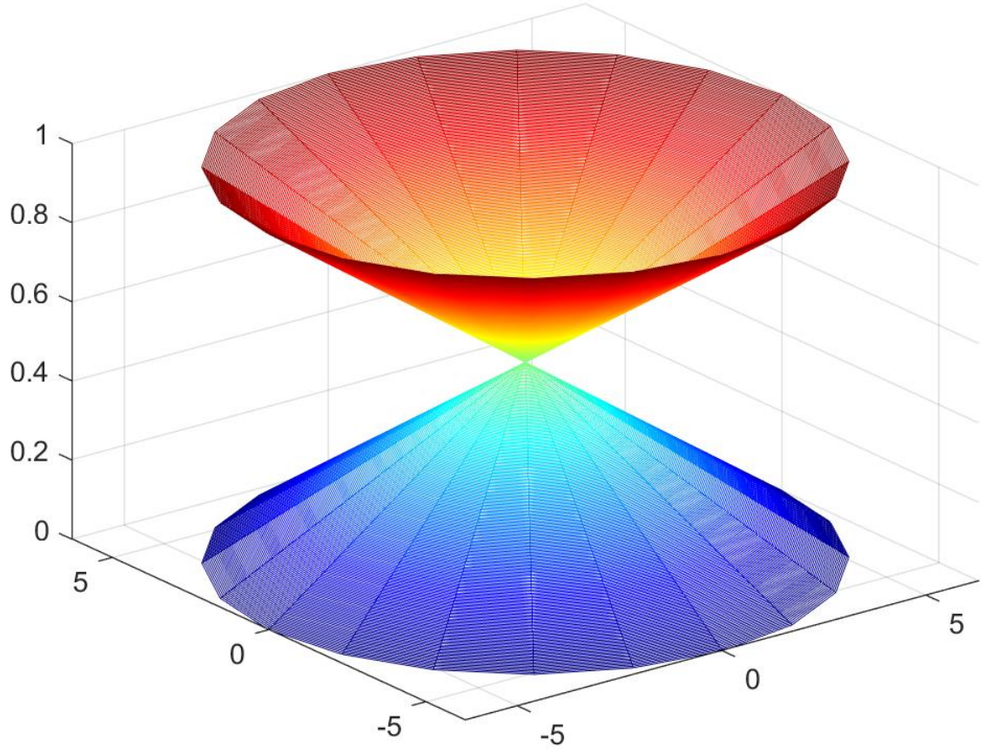
mesh

```
colormap jet
t=0:pi/100:2*pi;
[X Y Z]=cylinder(t);
mesh(X,Y,Z)
```



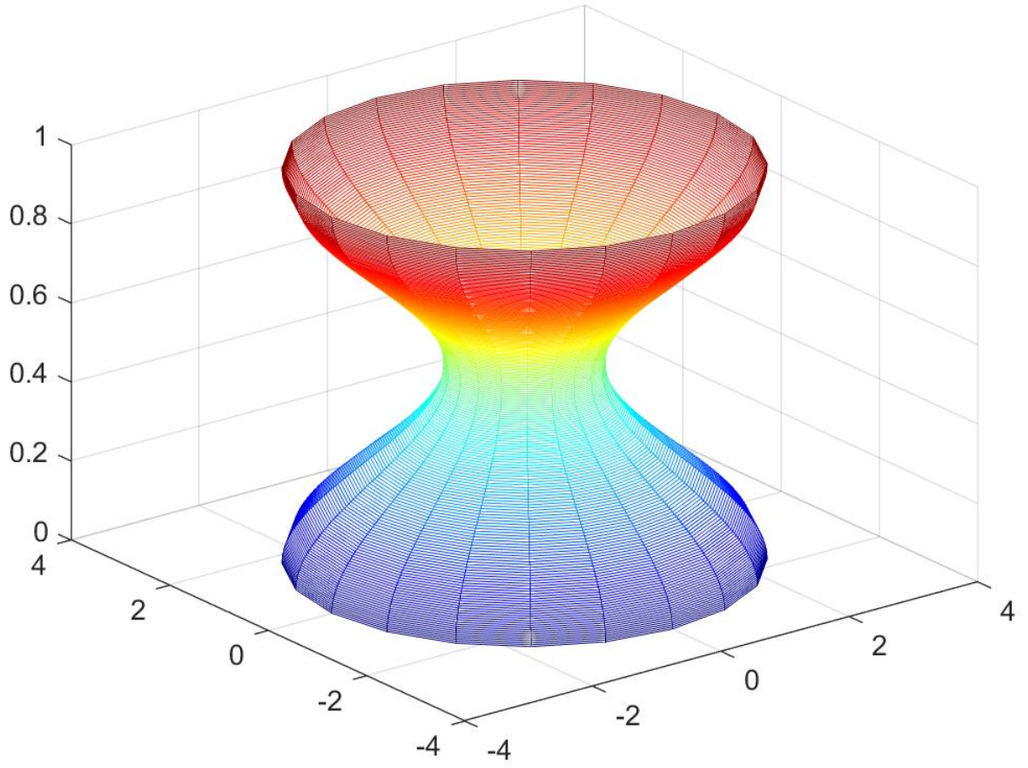
mesh

```
colormap jet
t=-2*pi:pi/100:2*pi;
[X Y Z]=cylinder(t);
mesh(X,Y,Z)
```



mesh

```
colormap jet
t=0:pi/100:2*pi;
[X Y Z]=cylinder(2+cos(t));
mesh(X,Y,Z)
```



mesh

```
colormap jet
x=-50:50;
y=-50:50;
for a=1:101
for b=1:101
z(a,b)=sqrt(x(a)^2+y(b)^2);
end
end
meshc(x,y,z)
```