MATLAB基礎學習與應用

教學投影片

Part 2

【Q】迴圈

NOTE: for loop 迴圈數固定

格式 for i=array

commands

end

Ex: for i=1:3

y(i)=cos(i)

end

執行結果

```
y =
    0.5403
y =
    0.5403   -0.4161
y =
    0.5403   -0.4161   -0.9900
```

Ex: 1+2+3+4+5...+10=?

```
sum=0;
for  i=1:10;
   sum=sum+i;
end
sprintf('\n 1+2+...+10= %5.0f',sum)
```

執行結果

```
 1+2+...+10=    55
```

【Q】while loop的格式如何?

格式 while expression %判斷式成立
commands
end

Ex: 1+2+3...+n>50 最小之n值?

程式

```
sum=0;
n=0;
while sum<=50
    n=n+1;
    sum=sum+n;
end
sprintf('\n 1+2+...+n >50 最小之n值= %3.0f, 其和=%5.0f',n,sum)
```

執行結果

```
 1+2+...+n >50 最小之n值=  10, 其和=   55
```

EX. n! ≥10^{100}最小的n=?

程式

```
n=1;
while  prod(1:n)<1e100
       n=n+1;
end
sprintf('\n 最小之n值= %3.0f, n!=%5.3e',n,prod(1:n))
```

執行結果

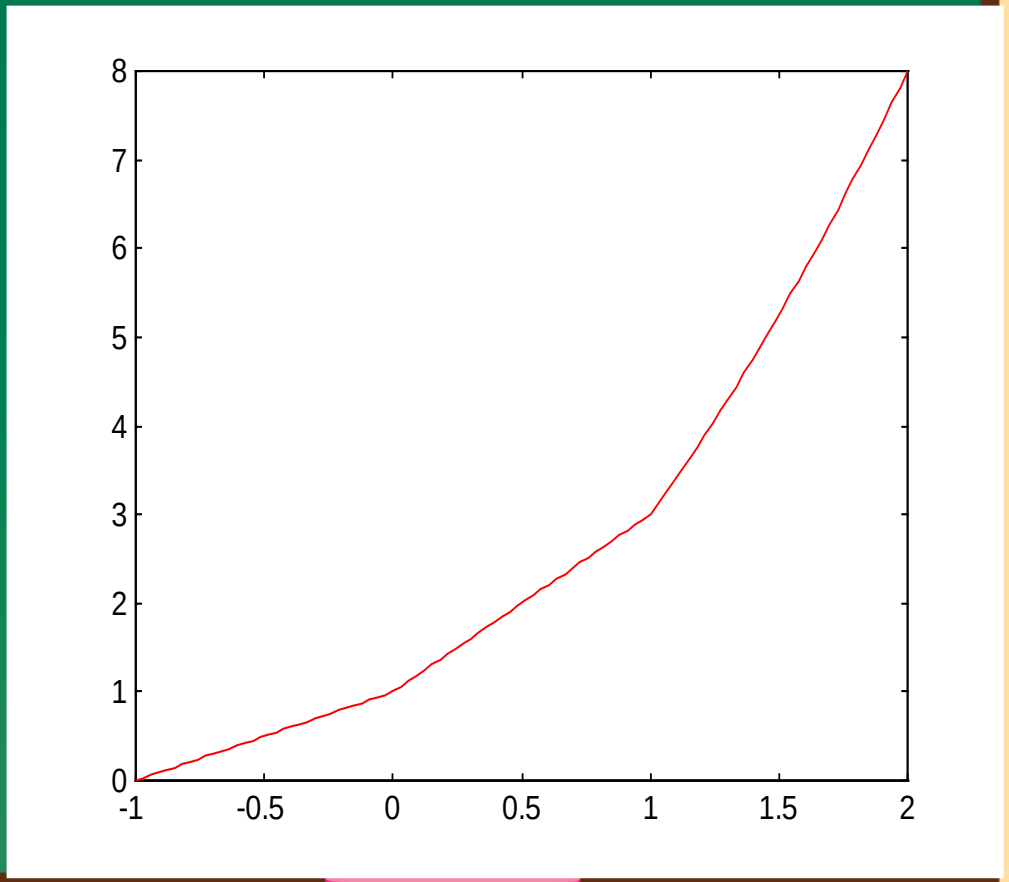
最小之n值= 70, n!=1.198e+100

【Q】If-else-end structure的格式

```
if  expressions1;
        commands1;
    elseif expressions2;
        commands2;
    elseif  expressions3;
        commands3;
    else  commands4;
end
```

Ex: $f(x)=\begin{cases} x+1 & ,x\le 0 \\ 2x+1 & ,0<x\le 1 \\ x^2+2x & ,1<x\le 2 \end{cases}$, plot f(x) v.s. x

```
x=linspace(-1,2,100);
for  i=1:length(x)
    if  x(i)<=0
       y(i)=x(i)+1;
    elseif  x(i)<=1
       y(i)=2*x(i)+1;
    else
       y(i)=x(i)^2+2*x(i);
    end
end
plot(x,y)
```



【Q】script file 與 function files

script file : operate globally on the data in workspace

以.M為副檔名，鍵入檔名就可直接執行

步驟：

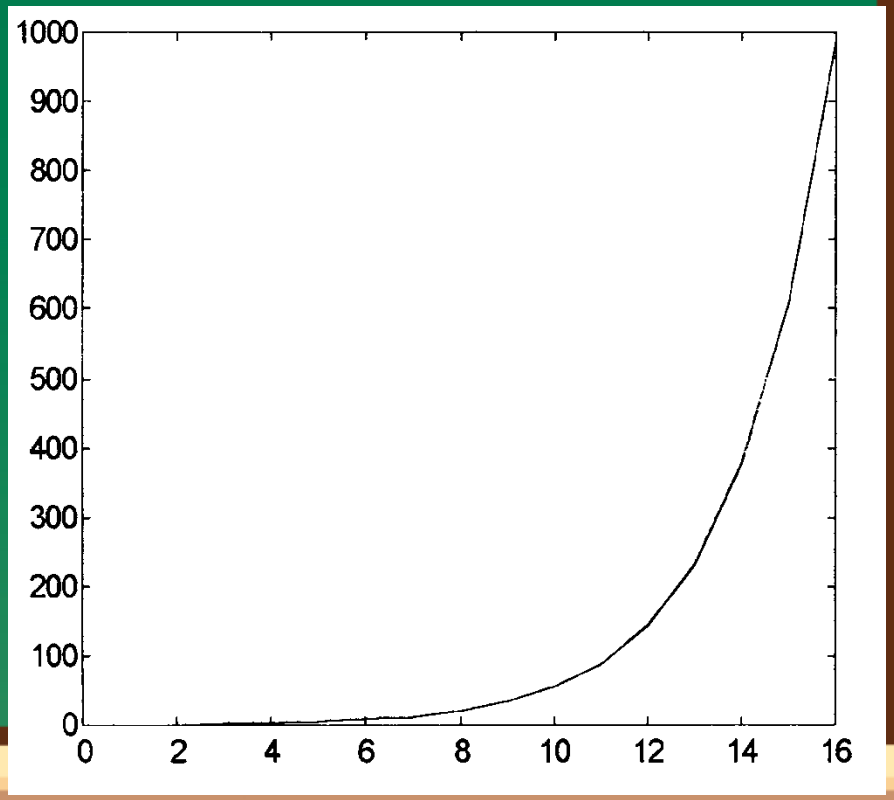
Step1:file =>new=>M-file

Step2:在筆記本內編輯一 .M檔

Step3:執行在命令視窗鍵入檔名或 file=>run M-file

Ex: fibno.m

```
% M-file
f=[1  1];
I=1;
while  f(I)+f(I+1)<1000
    f(I+2)=f(I)+f(I+1);
    I=I+1;
end
plot(f)
```



function file ·allow parameter passing by values
·using local variables

新指令即新函數，以.M為副檔名，執行時須代入引數之值，或配合Script file 方可執行。

Ex: mean.m

```
function   y=mean(x)  % 程式開始
%  remark or comments
[m,n]=size(x);
if m= =1
    m=n;
end
y=sum(x)/m; % 程式結束
```

Usage : z=1:99;
y=mean(z)
y=50

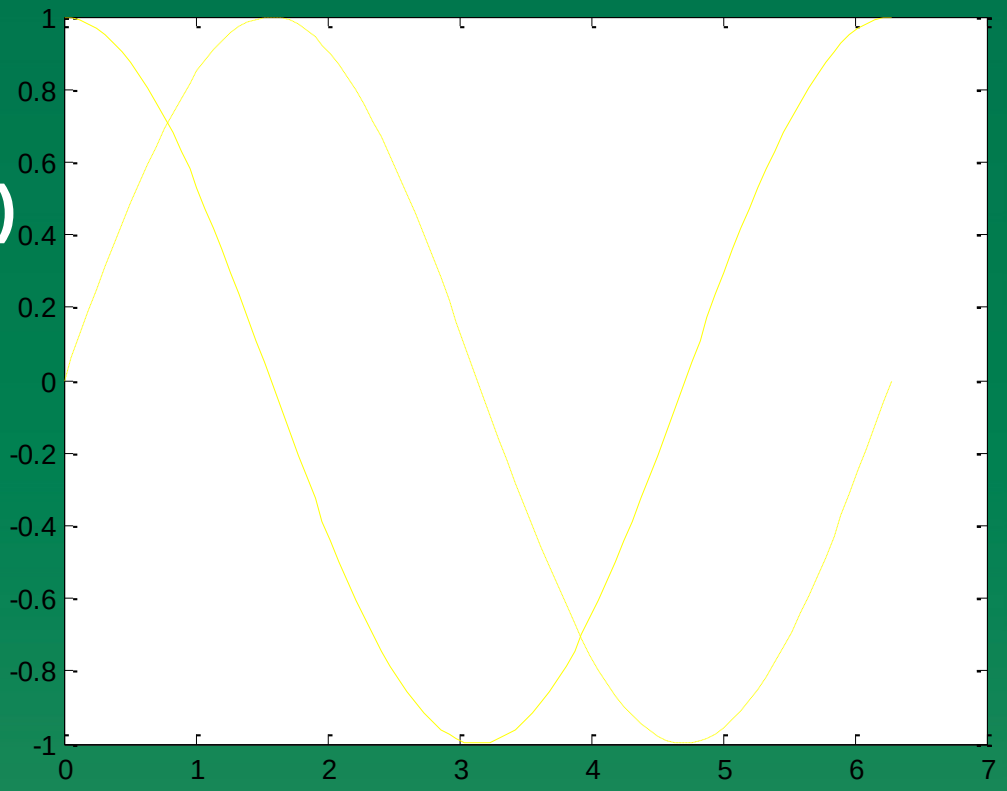
【Q】如何畫圖

- 格式 **plot(x1,y1,'+r',x2,y2,'--g',...)**
  x1,y1,'+r' 第一組圖資料
  x2,y2,‘--g’ 第二組圖資料

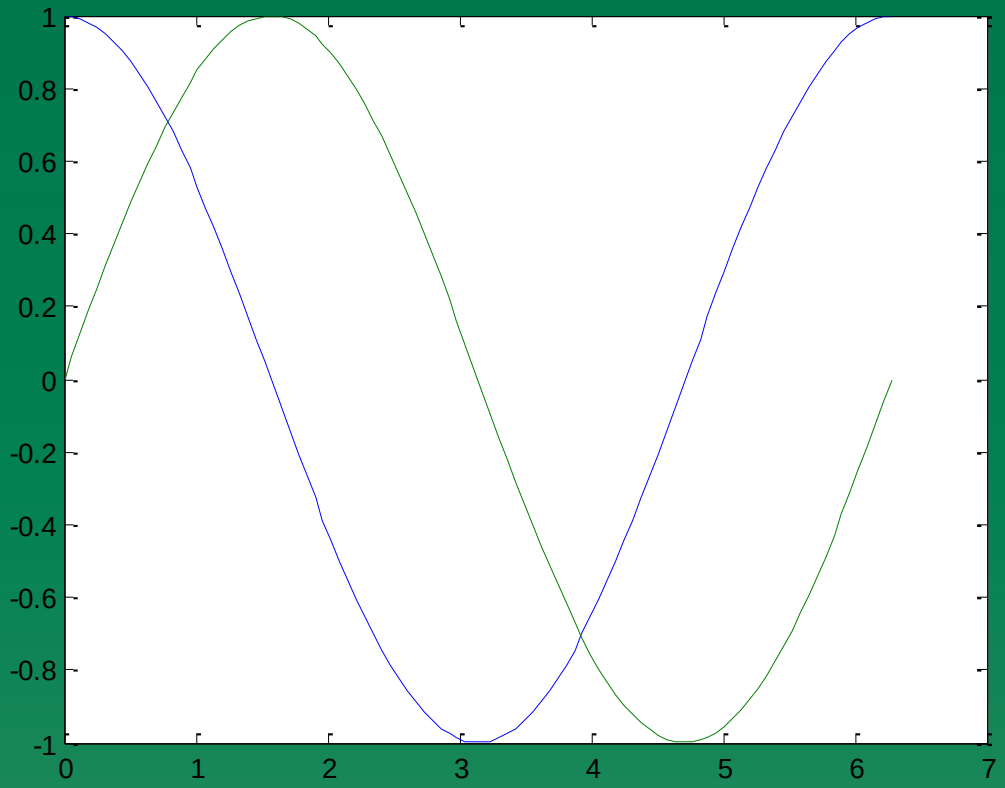
顏色代號		線條代號	
y	黃色	.	實點
m	紫色	o	圓圈
c	淺藍色	x	x符號
r	紅色	+	正號
g	綠色	*	星號
b	藍色	-	實線
w	白色	:	點線
k	黑色	-.	點虛線
		--	虛線

Ex:繪cos(x)圖與sin(x)圖於同一圖中

```
>>x=linspace(0,2*pi,100);
>>y1=cos(x);
>>y2=sin(x);
>>plot(x,y1,'-y',x,y2,'--y')
```



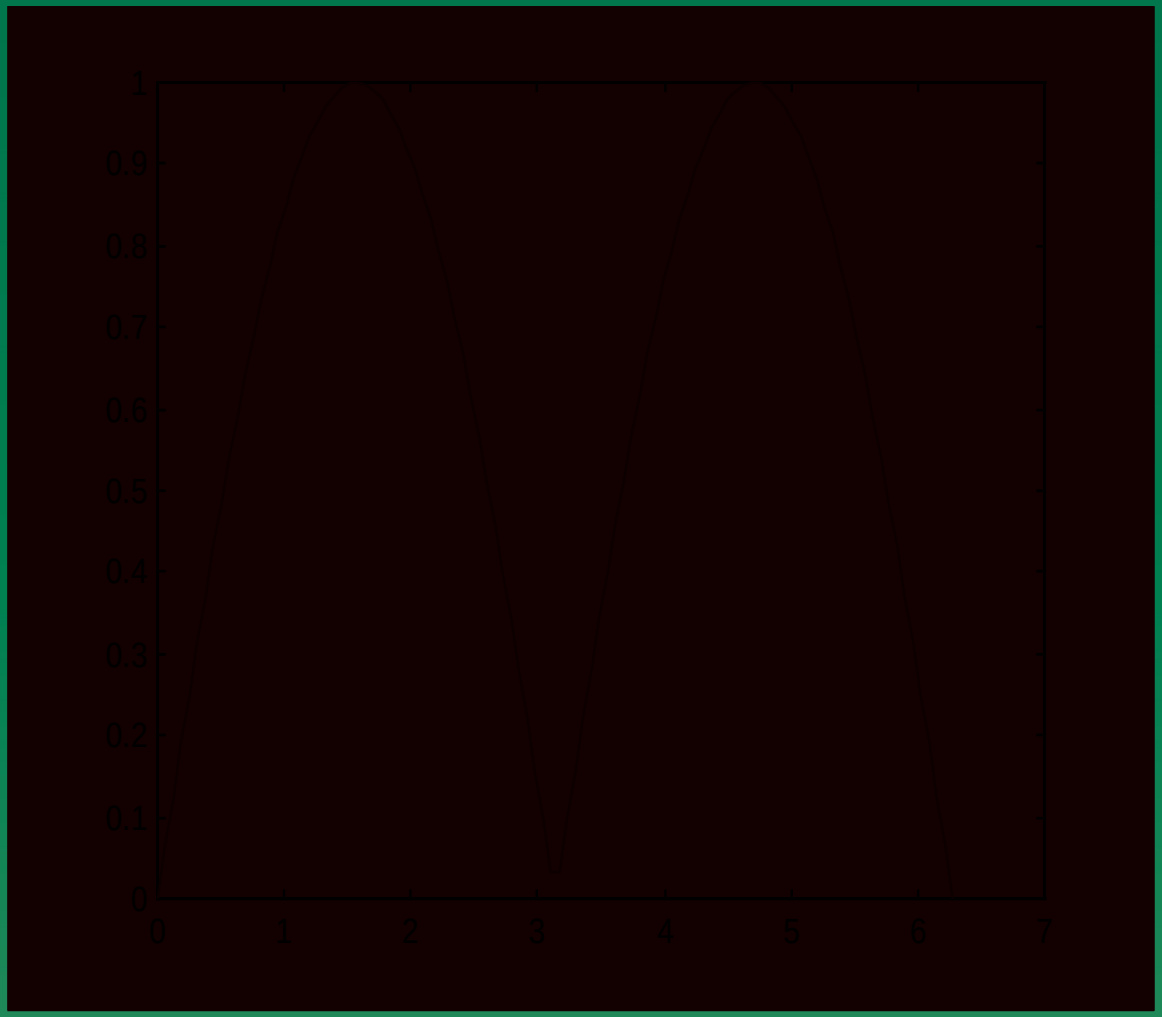
>>plot(x,y1,x,y2)



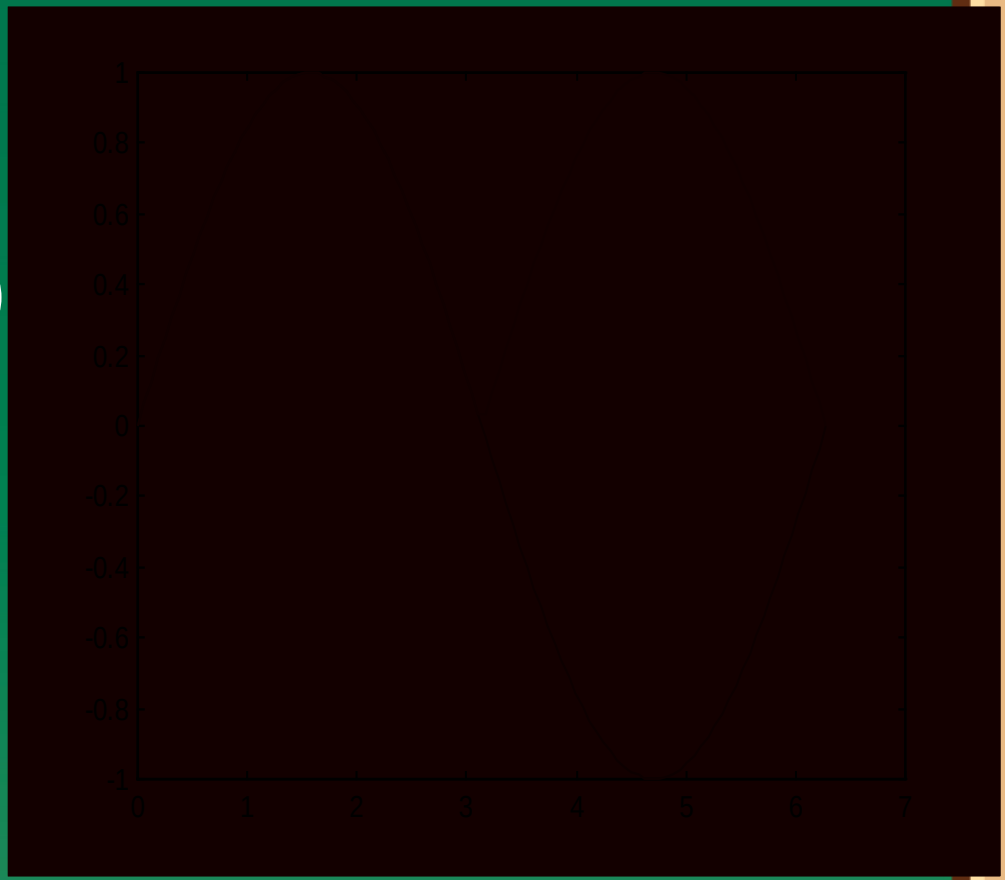
【Q】如何給圖示資料

- xlabel('　') %x軸名
- ylabel('　') %y軸名
- title('　') %圖名
- grid %格線
- gtext(' * ') %用滑鼠移至欲標示的位置

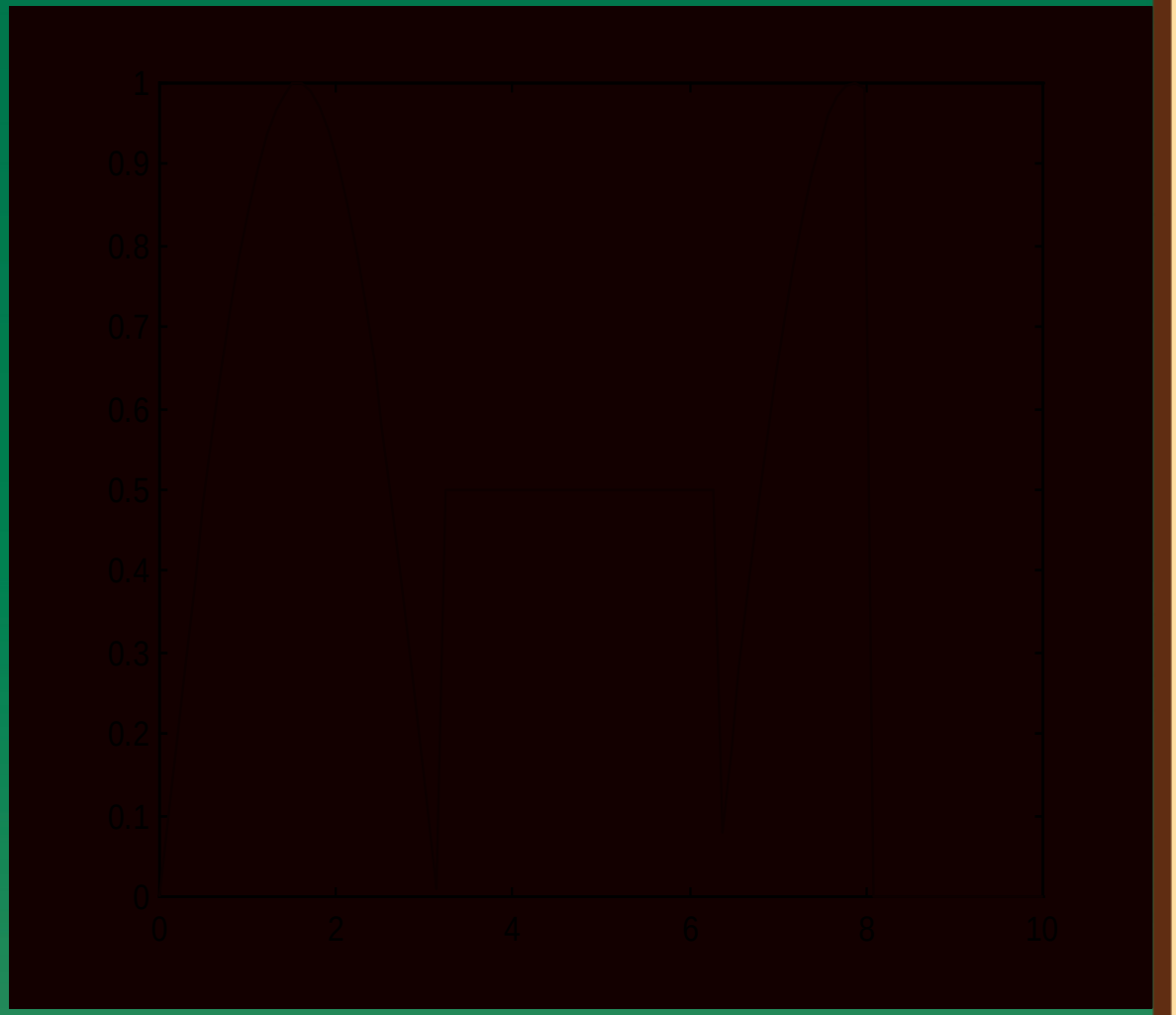
```
>>x=linspace(0,2*pi,100);
>>y=sin(x);
>>y=abs(y);
>>plot(x,y)
```



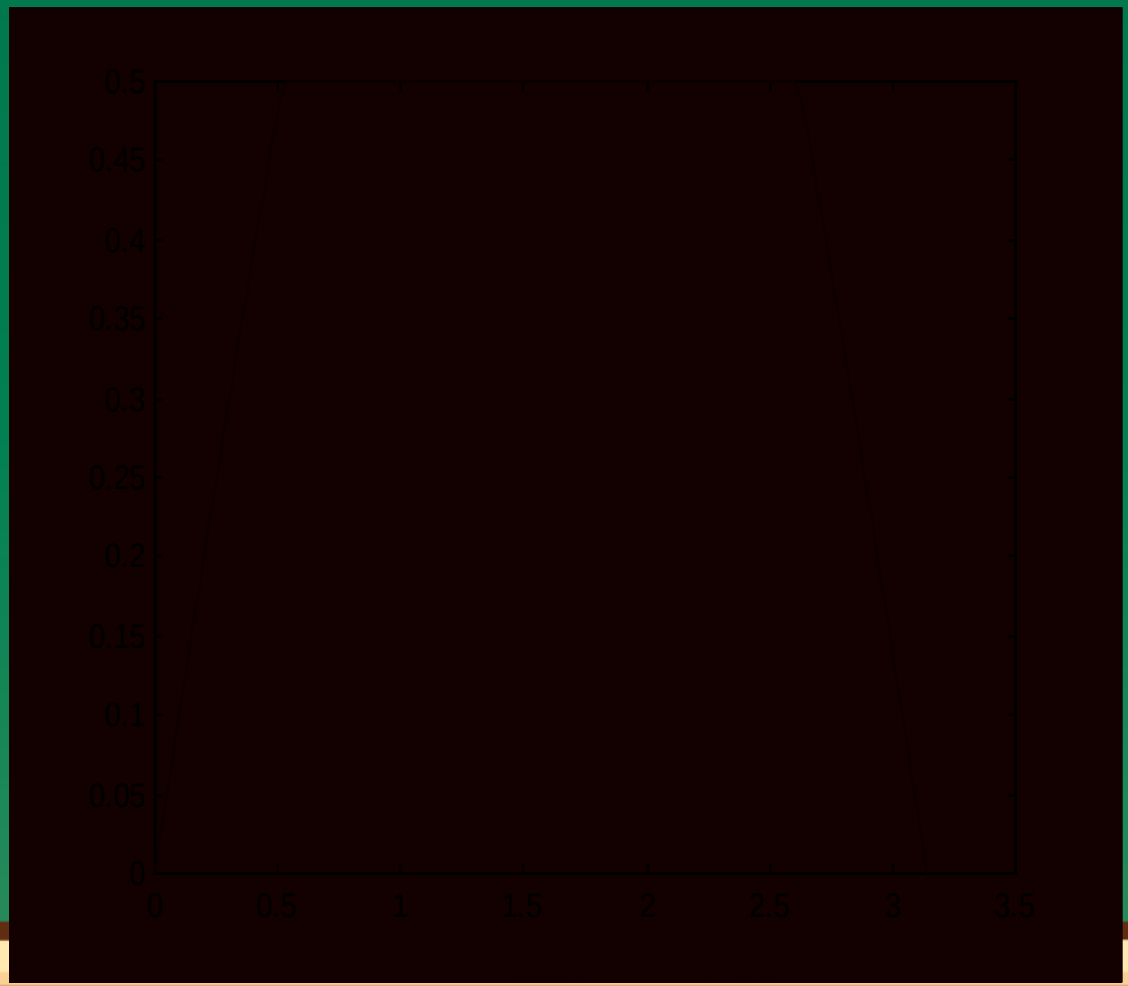
```
>>x=linspace(0,2*pi,100);
>>y=sin(x);
>>y1=(y>=0).*y;
>>plot(x,y,x,y1,'r')
>>y2=(y<0).*y;
>>plot(x,y,x,y1,'r',x,y2,'w')
>>z=y1-y2;
>>plot(x,y,x,z,'m')
```



```
>>x=linspace(0,10,100);
>>y=sin(x);
>>z=(y>=0).*y;
>>z=z+0.5*(y<0);
>>z=(x<=8).*z;
>>plot(x,z)
```



```
>>x=linspace(0,pi,100);
>>y=sin(x);
>>z=(y<0.5).*y+0.5*(y>=0.5);
>>plot(x,z)
```



【Q】如何繪特殊圖形

axis([0 10 0 15])

axis([x軸上限 x軸下限 y軸上限 y軸下限])

axis('square')

調整圖形由長方形變成正方形

polar **%極座標圖**

bar **%柱狀圖**

pie **%pie圖**

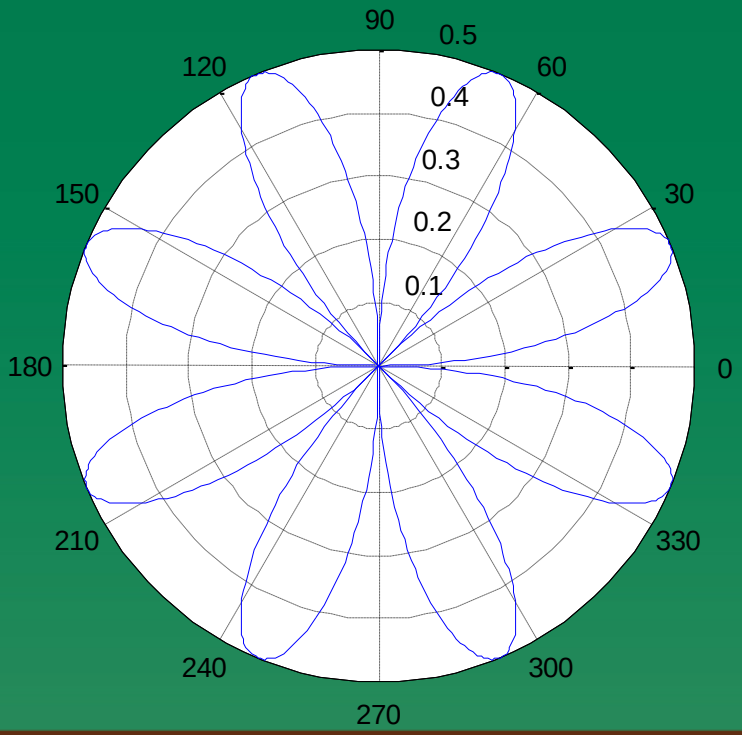
stairs **%梯圖**

errorbar **%誤差圖**

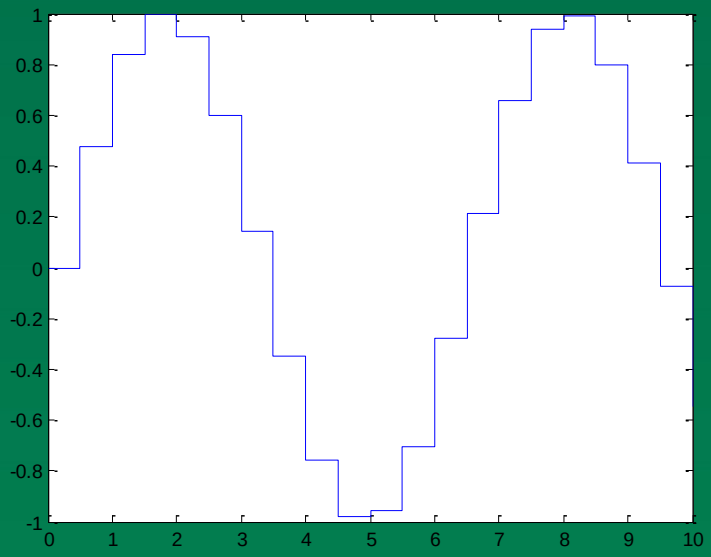
errorbar(x,y,e) **%e誤差**

Ex:

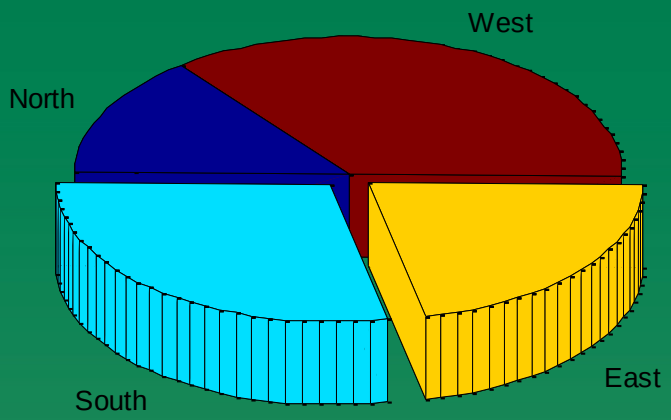
```
>>t=0:0.01:2*pi;
>>r=sin(2*t).*cos(2*t);
>>polar(t,r)  % t--角度 ,r--長度
```



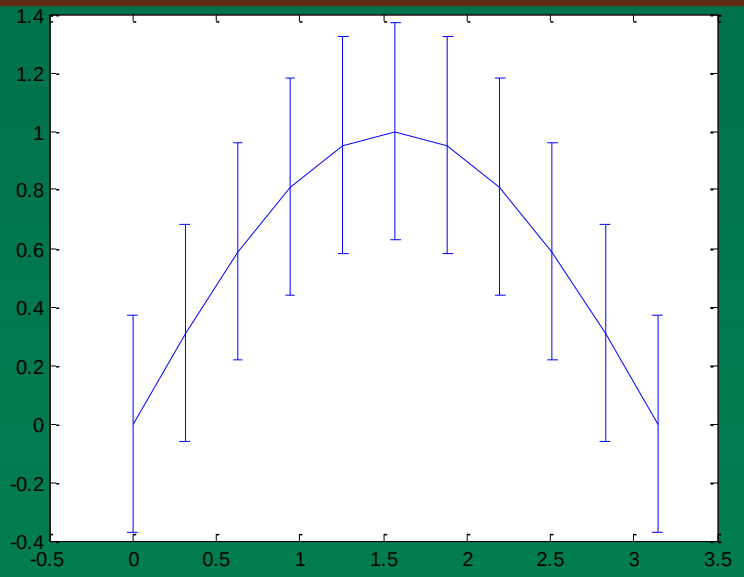
```
%
% stairs plot
%
>>x=0:0.5:10
>>stairs(x,sin(x))
```



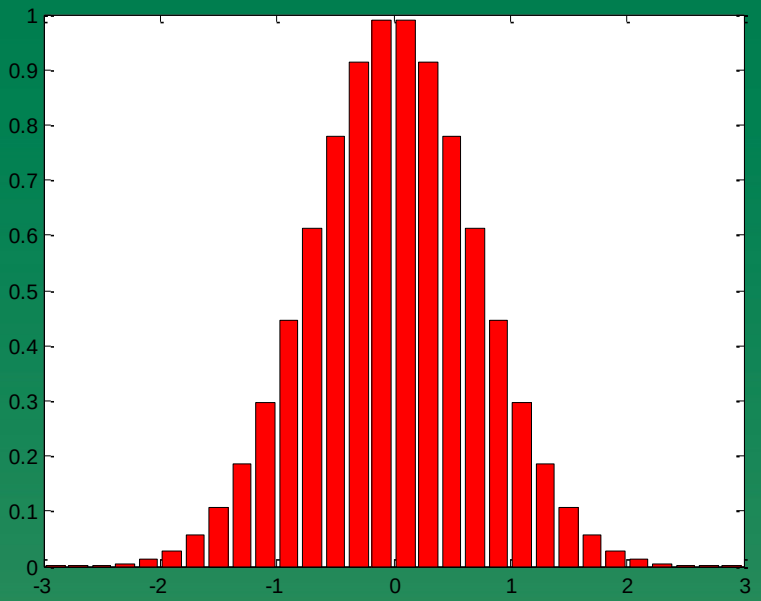

```
%
% pie plot
%
x=[1 3 0.5 2.5 2]
explode=[0 1 0 0 0]
pie(x,explode)
%
pie3(x,explode) % 3D pie plot
pie3([2 4 3 5],[0 1 1 0],{'North','South','East','West'})
```



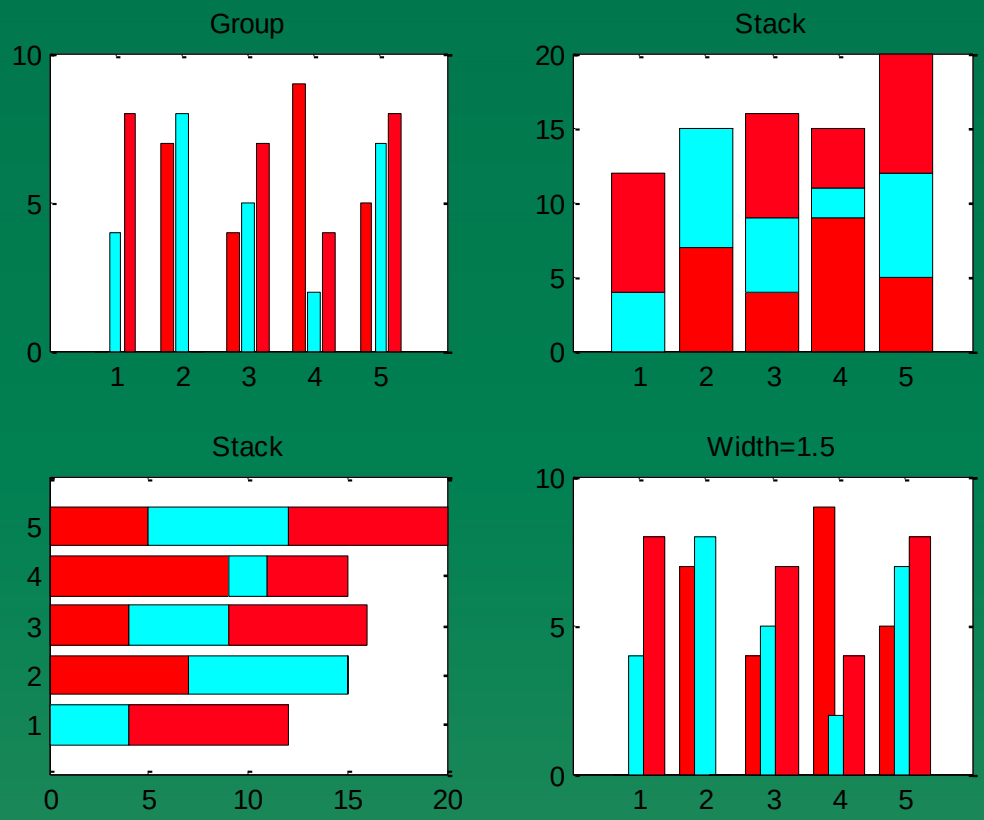
```
%
% errorbar plot
%
x=0:pi/10:pi;
y=sin(x);
e=std(y)*ones(size(x));
errorbar(x,y,e)
```




```
%
% bar plot
%
% example 1
%
x=-2.9:0.2:2.9;
bar(x,exp(-x.*x))
colormap hsv
```



```
% example 2
Y=round(rand(5,3)*10);
subplot(2,2,1)
bar(Y,'group')
title('Group')
%
subplot(2,2,2)
bar(Y,'stack')
title('Stack')
%
subplot(2,2,3)
barh(Y,'stack')
title('Stack')
%
subplot(2,2,4)
bar(Y,1.5)
title('Width=1.5')
```

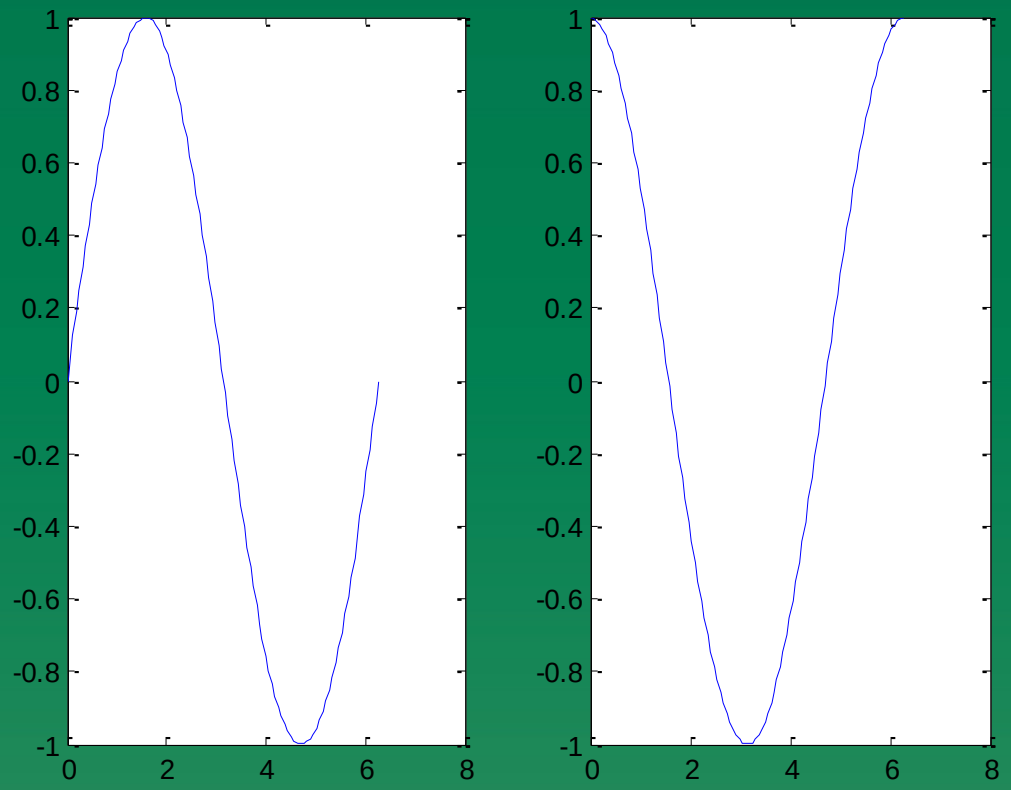


【Q】如何在同一視窗中繪多個圖

subplot(m,n,p) % p--第n個圖,陣列排法,m--橫排數,n--直排數

Ex:繪n乘m圖

```
t=linspace(0,2*pi,100);
y1=sin(t);
y2=cos(t);
subplot(1,2,1)
plot(t,y1)  % sin
subplot(1,2,2)
plot(t,y2)  % cos
```



【Q】繪多曲線於同一圖

- 方法1.plot(x1,y1,’w’,x2,y2,’y’…..)
- 方法2.疊圖

```
plot(x1,y1,’w’)
hold on
plot(x2,y2,’y’)
hold off   %hold off
```

【Q】如何繪3D圖

相關指令

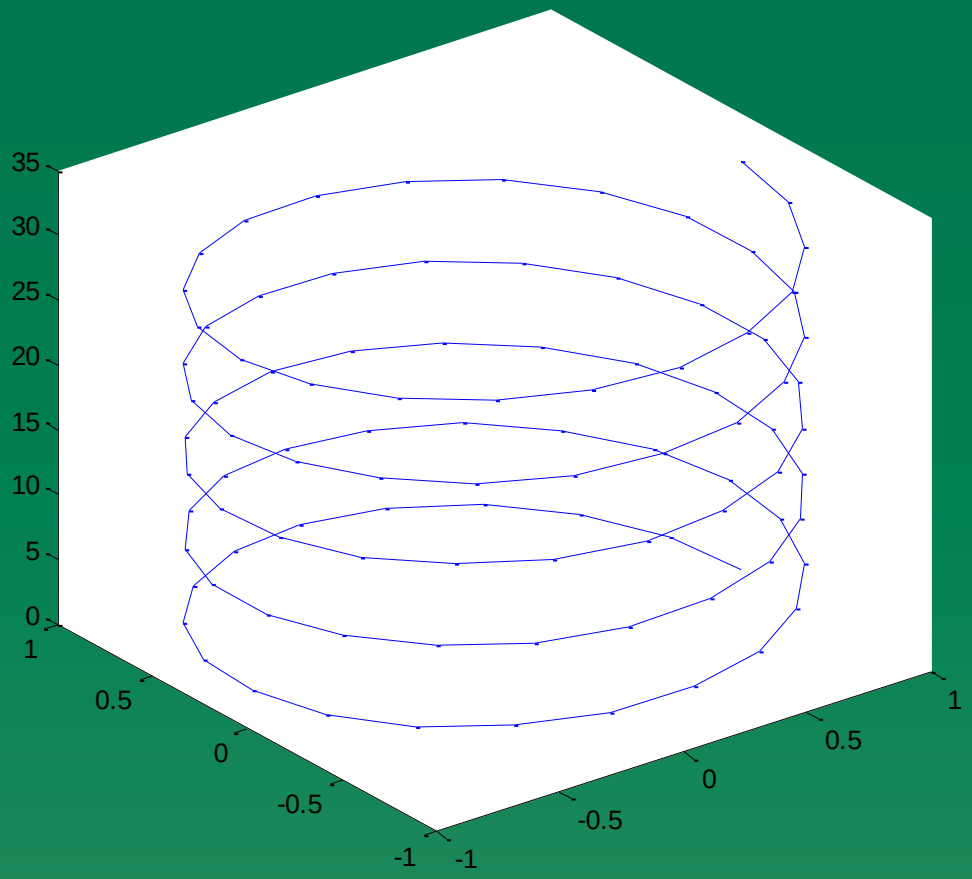
plot3	%plot lines and points in 3D
contour,contour3	%creat contnour plot
mesh,meshc,meshz	%3D mesh surface plot
surf,surfc,surfl	%3D shaded surface
view	%3D graph viewpoint specification

Ex:

$$\begin{cases} x = \cos(t) \\ y = \sin(t) \\ z = t \end{cases}$$

, **0≦t≦10π**

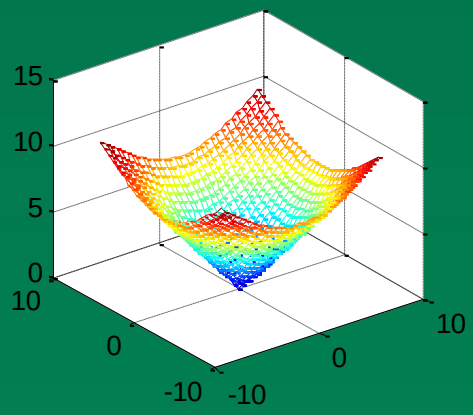
```
t=linspace(0,10*pi,100);
x=cos(t);
y=sin(t);
z=t;
plot3(x,y,z)
```

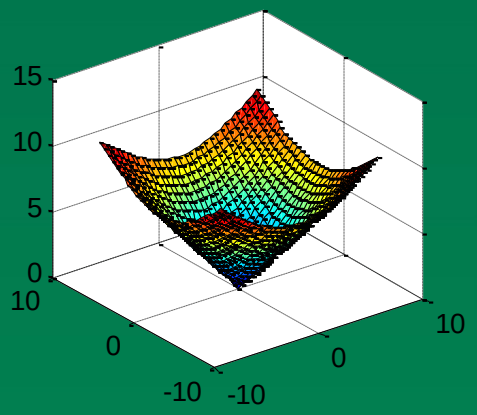


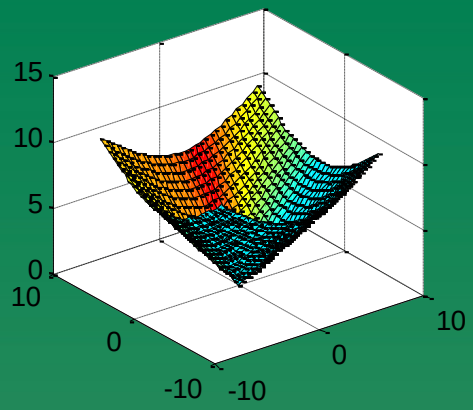
Ex: 用mesh繪圖

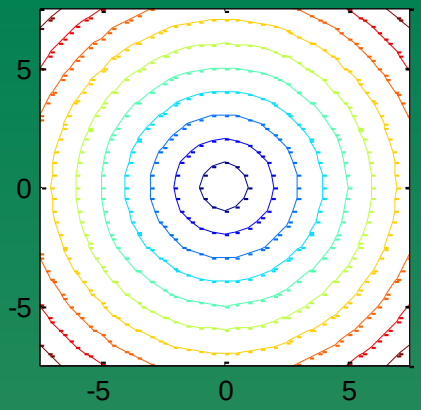
$$\begin{cases} z = \sqrt{x^2 + y^2} \\ -7.5 \le x, y \le 7.5 \end{cases}$$

```
x=-7.5:0.5:7.5;  %取值
y=x;
[x,y]=meshgrid(x,y);
z=sqrt(x.^2+y.^2);  %算值
subplot(2,2,1);
mesh(x,y,z)  %繪圖
subplot(2,2,2)
surf(x,y,z)  %表面加顏色
subplot(2,2,3)
surfl(x,y,z)  %顏色光照
subplot(2,2,4)
contour(x,y,z)  %輪廓線
```





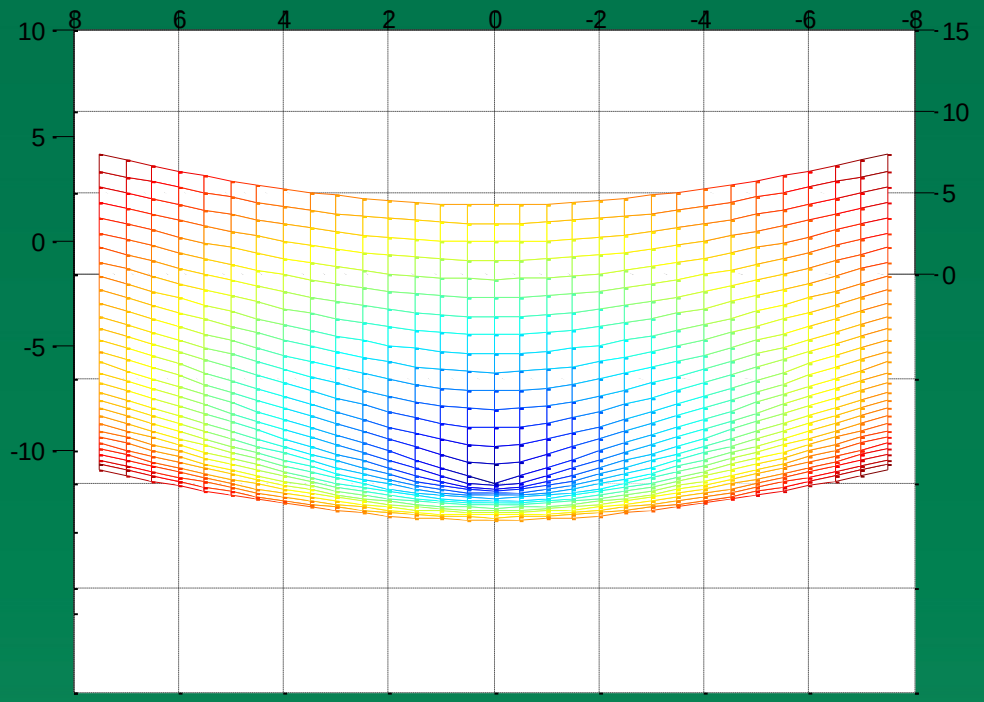




Ex: 圖形旋轉

view(水平角,仰角)

```
view(37.5,90)       %內定值
x=-7.5:0.5:7.5;
y=x;
[x,y]=meshgrid(x,y);
z=sqrt(x.^2+y.^2);   %算值
mesh(x,y,z)         %繪圖
view(90,120)
```



【Q】如何處理多項式

- **Ex:** $p(x) = 5x^3 + x + 2 = 0$ 求根?

```
>>P=[5  0  1  2]
>>r=roots(P)
```

- **Ex:** 知 r=[1 2 3] %根, 求P(x)

```
>>r=[1  2  3]   %根
>>P=poly(r)
```

【Q】多項式加減polyadd

- **Ex:** $a(x) = x^3 + 2x + 1$, $b(x) = x^5 + x + 1$

```
>>a=[1  0  2  1];
>>b=[1  0  0  0  1  2];
>>c=polyadd(a,b)          %c=a+b
>>d=polyadd(a,-b)         %d=a-b
>>e=polyadd(2*a,3*b)      %e=2a+3b
```

NOTE: *polyadd.m*是一個自行建立的function file

```
function p=polyadd(a,b)
%
% This function is designed for adding two given
% polynominals, a and b.
%
% p(x)=a(x)+b(x)
%
na=length(a);
nb=length(b);
if na>nb
   p=a+[zeros(1,na-nb) b];
elseif na<nb
   p=[zeros(1,nb-na) a]+b;
else
   p=a+b
end
```

【Q】多項式微分

```
>>p=[1 2 3 4]
>>g=polyder(p)

g =

     3     4     3
```

【Q】多項式的乘法

- **Ex: c(x)=a(x)*b(x)**

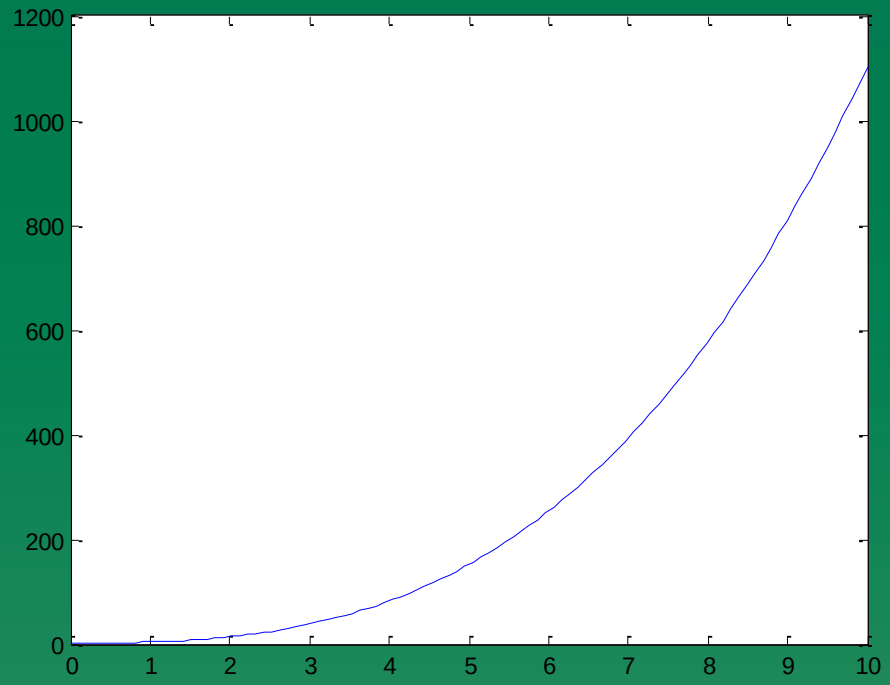
```
>>a=[1  0  2  1];
>>b=[1  0  0  0  1  2];
>>c=conv(a,b)
>>b=deconv(c,a)        %b=c÷a
>>[q,r]=deconv(c,a)    %q商數，r餘數

c =
    1    0    2    1    1    2    2    5    2
b =
    1    0    0    0    1    2
q =
    1    0    0    0    1    2
r =
    0    0    0    0    0    0    0    0    0
```

【Q】計算多項式函數值

Ex: $p(x) = x^3 + x^2 + 2$ 求 $p(1.9) = ?$

```
>>p=[ 1  1  0  2];
>>v=polyval(p,1.9);
>>x=linspace(0,10,100);
>>y=polyval(p,x);
>>plot(x,y)
```



Summary

roots(p)
poly(r)
polyadd(a,b)
conv(a,b)
polyval(p,x)
[q,r]=deconv(a,b)
[r,p,k]=residue(a,b)
polyder(p)

【Q】curve fitting and interpolation 曲線湊合及內差

- **step1.given deta**

```
t=[20  30  40  50];
c=[0.5  0.7  0.8  0.9];
```

- **step2.fitting a polynomial of order n**

```
p=polyfit(t,c,2)    %2為多項式階數
p =
   -0.0003    0.0305   -0.0050
```

【Q】簡便的內差指令

- 一維內差

```
t=[20 30 40 50]; c=[2.5 0.7 0.8 0.9];
y=interp1(t,c,35)
z=interp1(t,c,[25 33 45]) %多點內差
y =
    0.7500
z =
    1.6000
    0.7300
    0.8500
NOTE: y=interp1(t,c,t1,'spline')
      指定用cubic spline法作內差 (better solution)
y=interp1(t,c,35,'spline')
y =
    0.6313
```

【Q】簡便的內差指令

- 二維內差
- step1.如何給二維數據

```
x=1:5;
y=1:3;
r=[82 81 80 82 84;79 63 61 65 81;84 84 82 85 86];
```

- step2. 內差

```
zi=interp2(x,y,r,x1,y1)   %x,y,r數據 x1 & y1欲內差之座標
zi=interp2(x,y,r,1.5,1.5)
```

執行結果

```
zi =

   76.2500
```

%內定linar法,%內差x座標1.5,內差y座標1.5

zi=interp2(x,y,r,1.5,1.5,‘cubic’) %指定cubic方法

執行結果

```
zi =
   71.9688
```

%

zi=interp2(x,y,r,[1.5 2.5 3.5 4.5],2.5)

執行結果

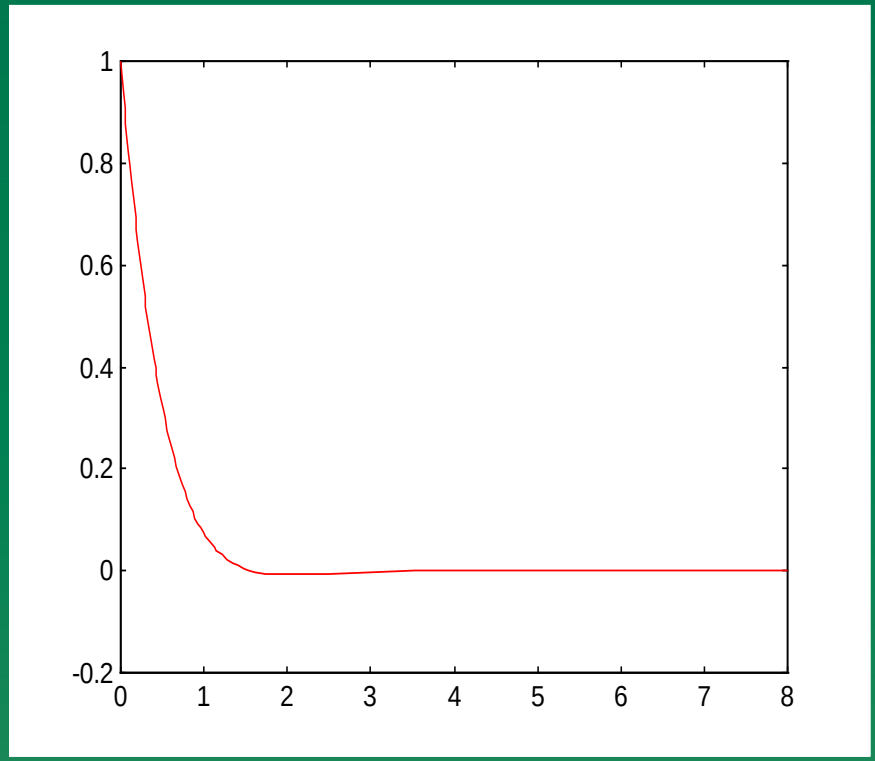
```
zi =
   77.5000   72.5000   73.2500   79.2500
```

%x多數據時用向量

【Q】函數的運算

- **A.函數的繪圖**

Ex: $f(x)=\cos(x)\cdot e^{-2x}$



方法1.

```
>>x=linspace(0,8,100);
>>y=cos(x).*exp(-2*x);
>>plot(x,y)
```

方法2. 用fplot

```
>>f='cos(x).*exp(-2*x)';
>>fplot(f,[0  8])    % f 函數,[0  8]x值上下限
```

方法3. 用ezplot

```
>>ezplot('cos(x)*exp(-2*x)',[0 8])
% for two functions
>>ezplot('x+y-2','2*x-y^2+1')
```

方法4. 先將函數建檔 fun.m

```
>>function y=fun(x)
>>y=cos(x).*exp(-2*x);
```

回到*Matlab Command Window*再用fplot繪圖

```
>>fplot('fun',[0 8])  %fun為檔名
```

- **B.求函數之最小值**

方法1.

```
>>x=linspace(0,8,100);
>>y=cos(x).*exp(-2*x);
>>[ymin  index]=min(y)
>>xmin=x(index)
ymin =
   -0.0076
index =
    26
xmin =
    2.0202
```

方法2.fminbnd

```
>>f='cos(x).*exp(-2*x)';
>>xmin=fminbnd(f,0,8);
   %算y最小值
>>x=xmin
>>ymin=eval(f)
x =
    2.0344
ymin =
   -0.0076
```

【Q】如何解 *f(x)=0, x=?*

- **A. 單變數 *f(x)=0, x=?***

Ex: $f(x) = e^{-x} + x^2 - \cos(x) = 0$

*step 1. edit fun.m

```
function y=fun(x)
y=exp(-x)+x^2-cos(x);
```

*step 2. 求解(回到*Matlab Command Window*)

```
>>xzero=fzero('fun',0.5)  %xzeor解 ,0.5 起始猜測值
```

*step 3. 驗算答案

```
>>yzero=fun(xzero)
```

B. 多變數

Ex:

$$\begin{cases} f_1(x,y) = x^2 + ye^{-x} = 0 \\ f_2(x,y) = x + y + y^3 = 0 \end{cases}, x = ? \, y = ?$$

1. edit fun.m

```
function y=fun(x)
y(1)=x(1)^2+x(2)*exp(-x(1));
y(2)=x(1)+x(2)+x(2)^3;
```

2. 求解(回到*Matlab Command Window*)

```
xzero=fsolve('fun',[0 1]) % [0 1]分別為x 與y 之起始猜測值
```