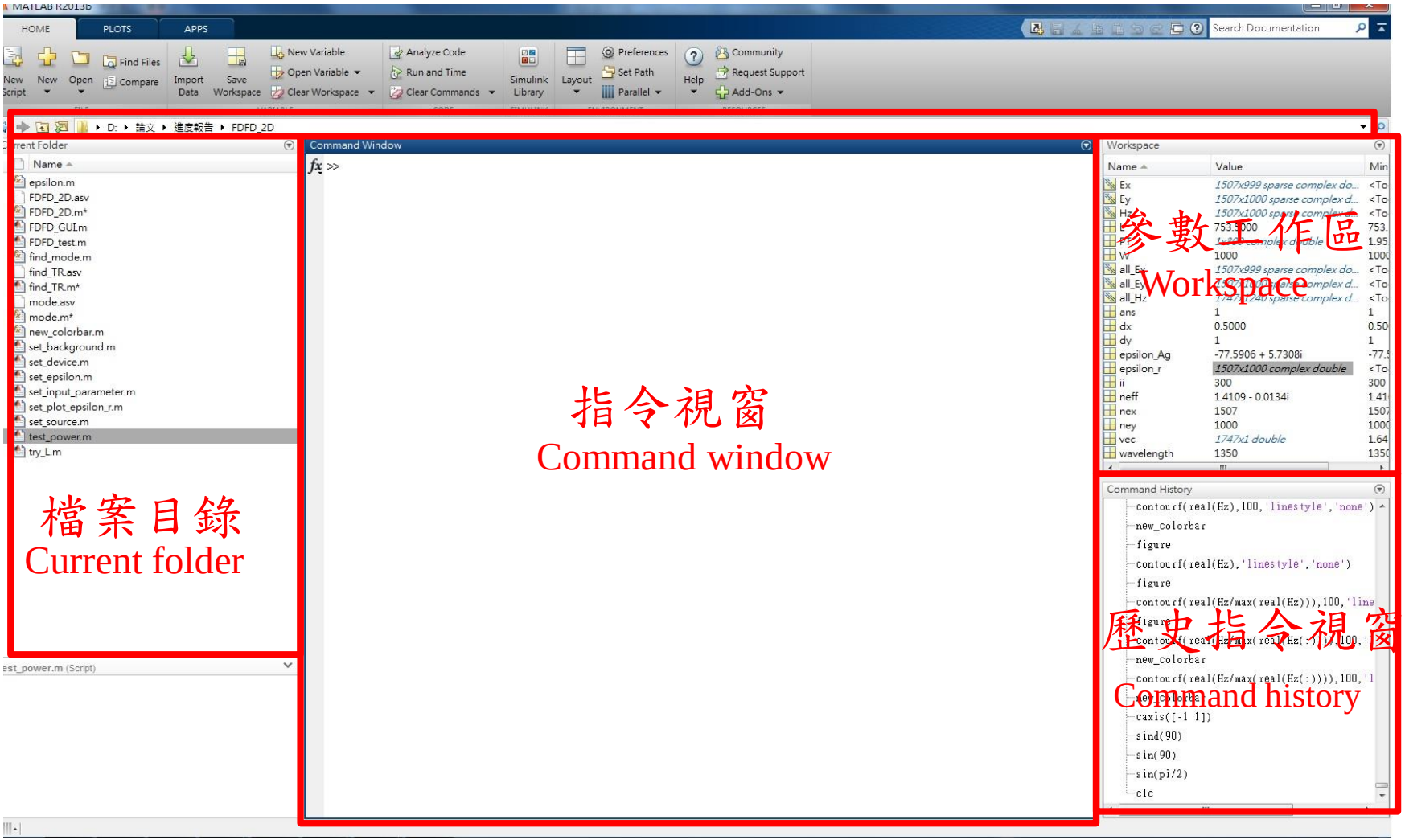
The Language of Technical Computing by Matlab

Class 1 : Scalar calculation

Outline

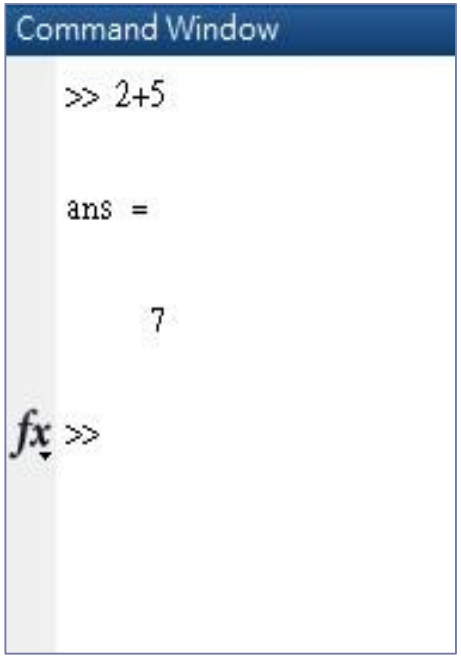
1. Basics of MATLAB
2. Script (底稿)
3. Some functions
4. for loop
5. 習題

Basics of MATLAB

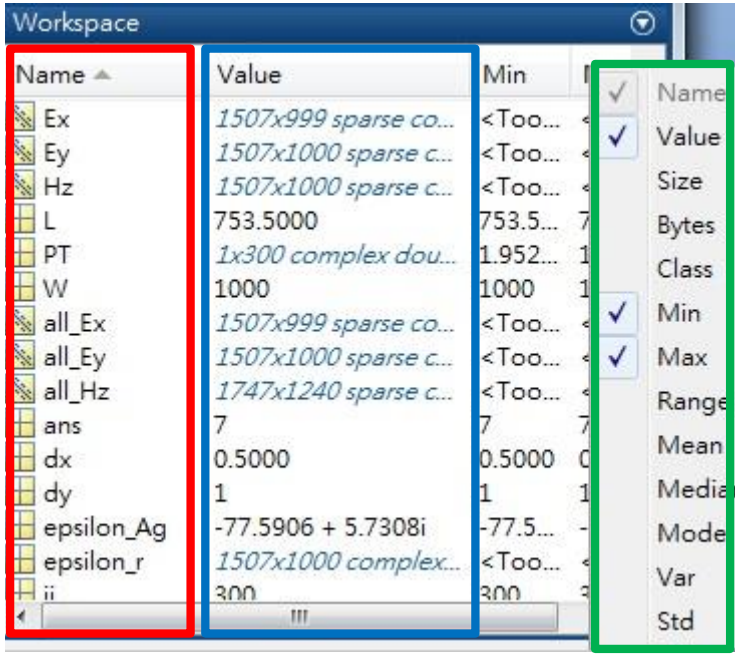


Basics of MATLAB

- Input and output



- Workspace (variable explorer)



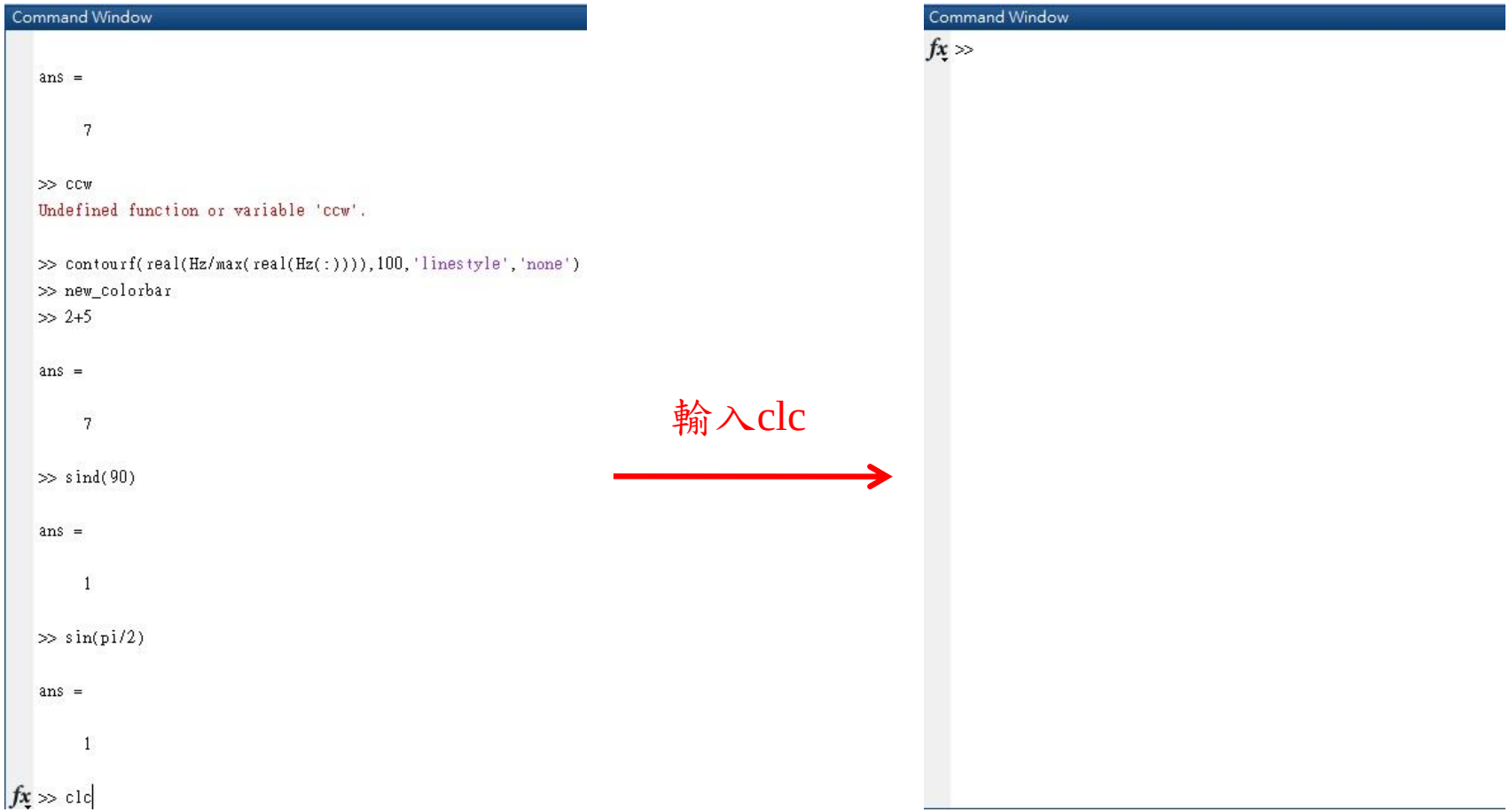
變數名稱　變數值　按下滑鼠右鍵，可以選擇視窗裡要呈現的內容。

Basics of MATLAB

- help +查詢指令名稱

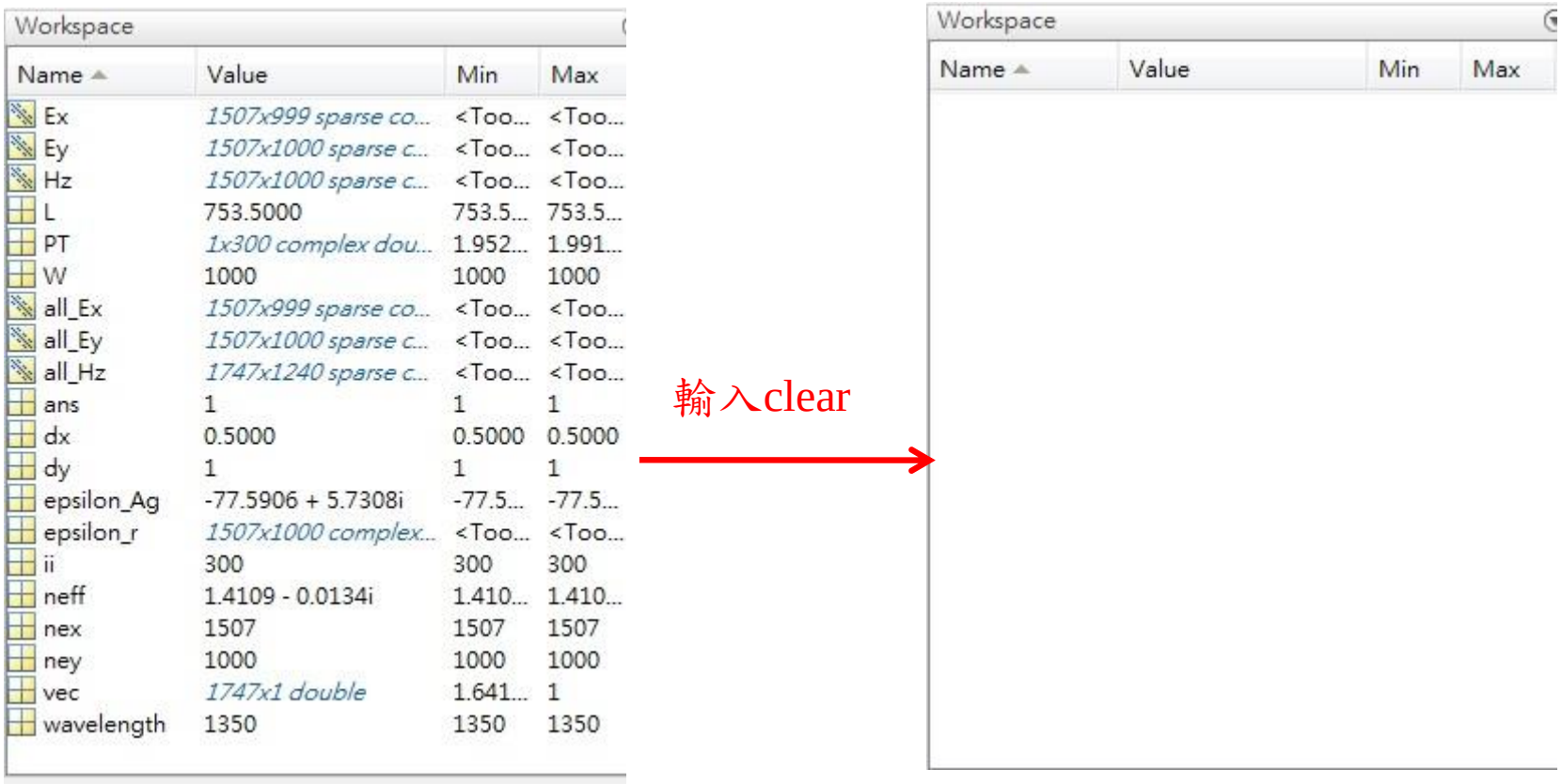
Basics of MATLAB

- clc：Clear command window



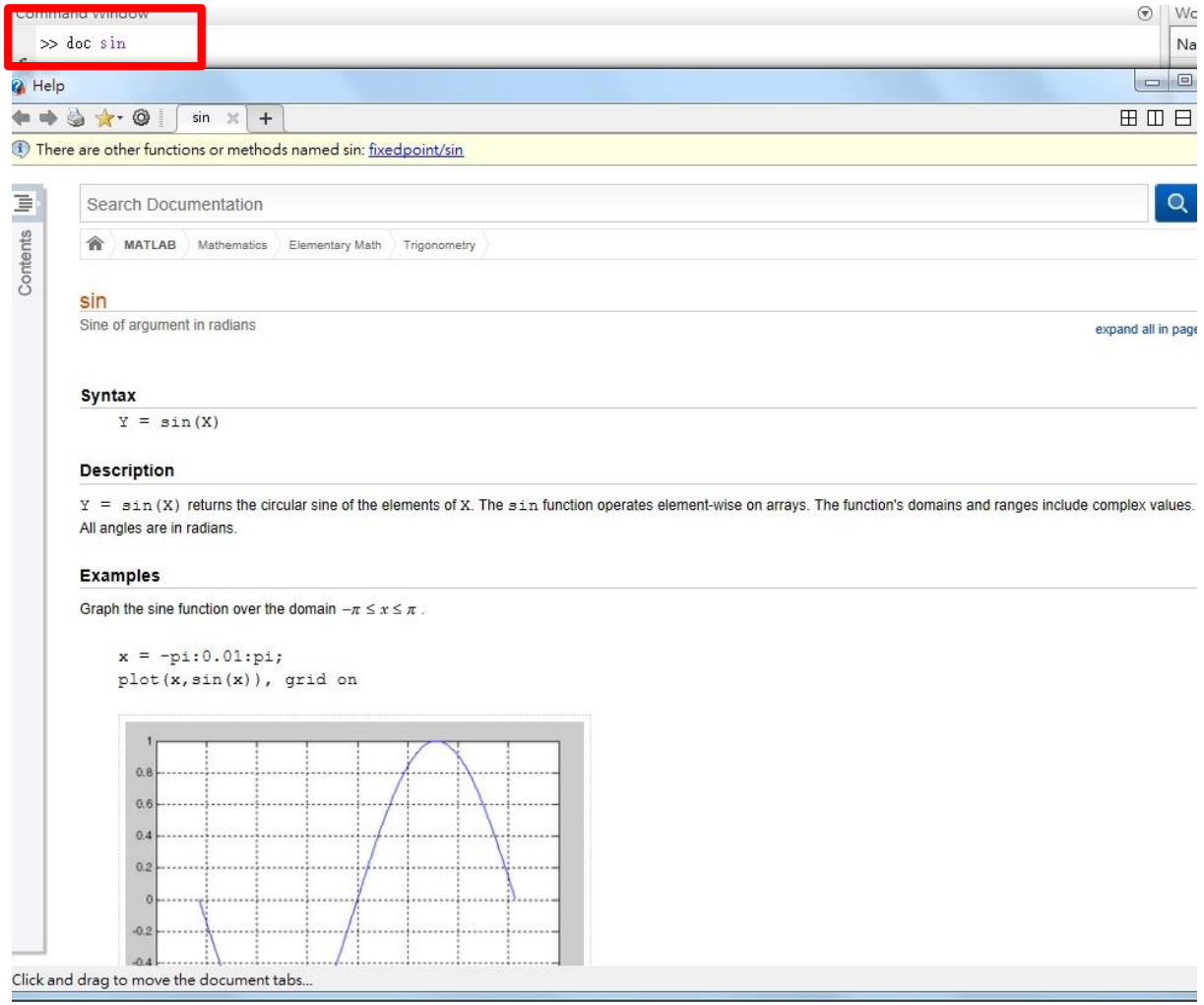
Basics of MATLAB

- clear：Clear variables and functions from memory.



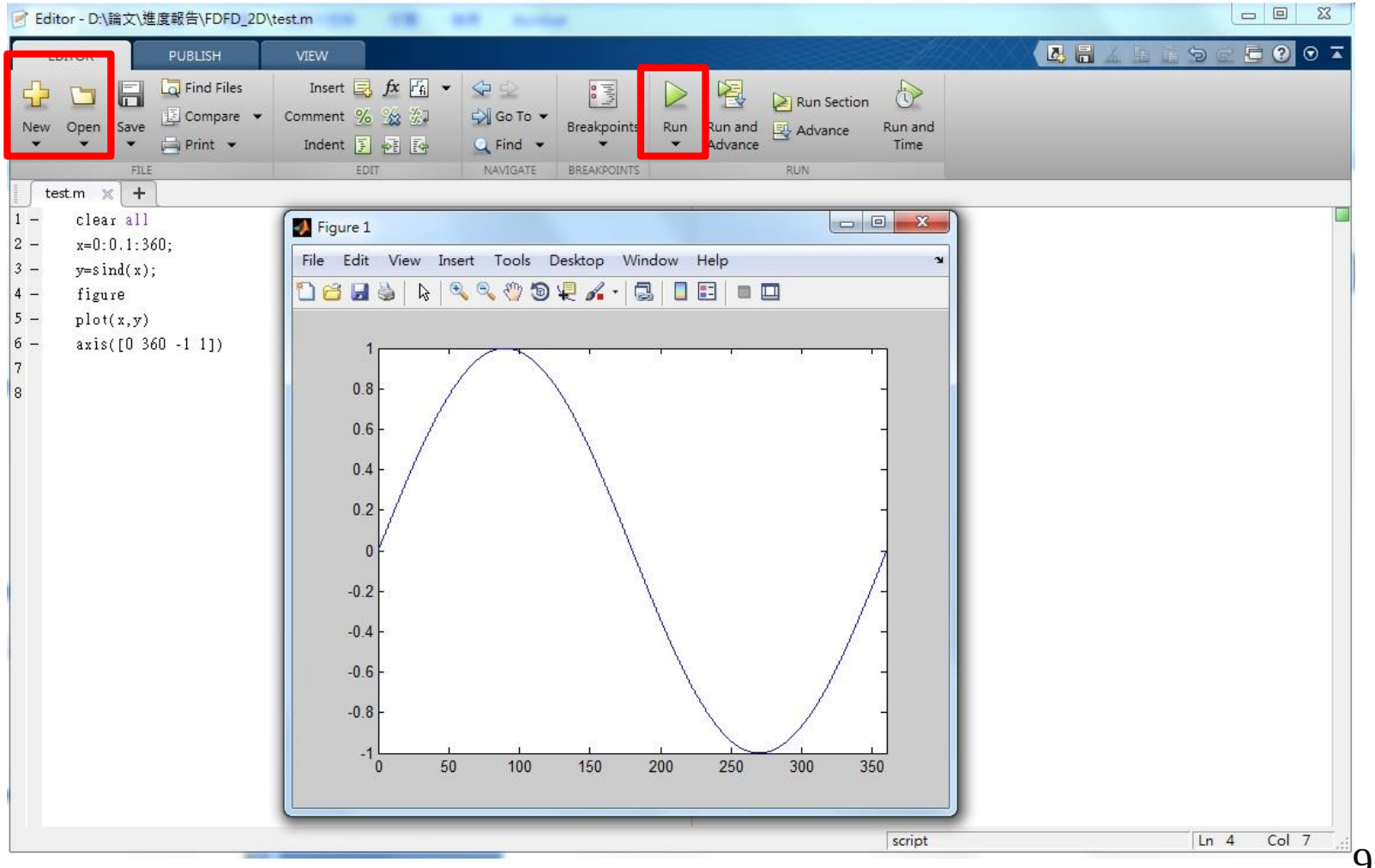
Basics of MATLAB

- doc+查詢指令名稱



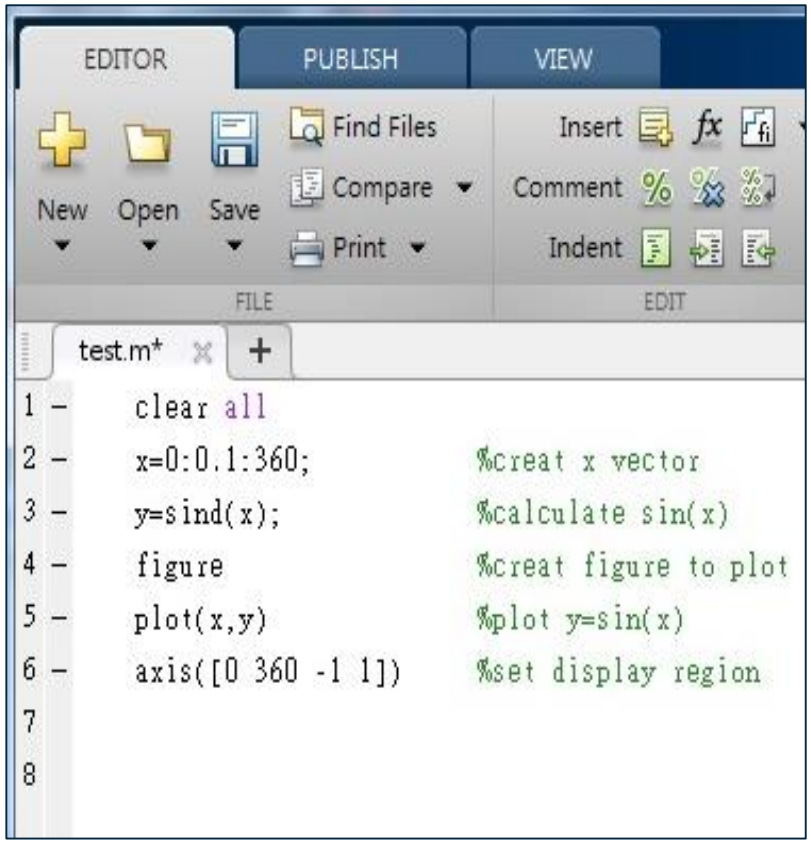
Script (可存檔底稿)

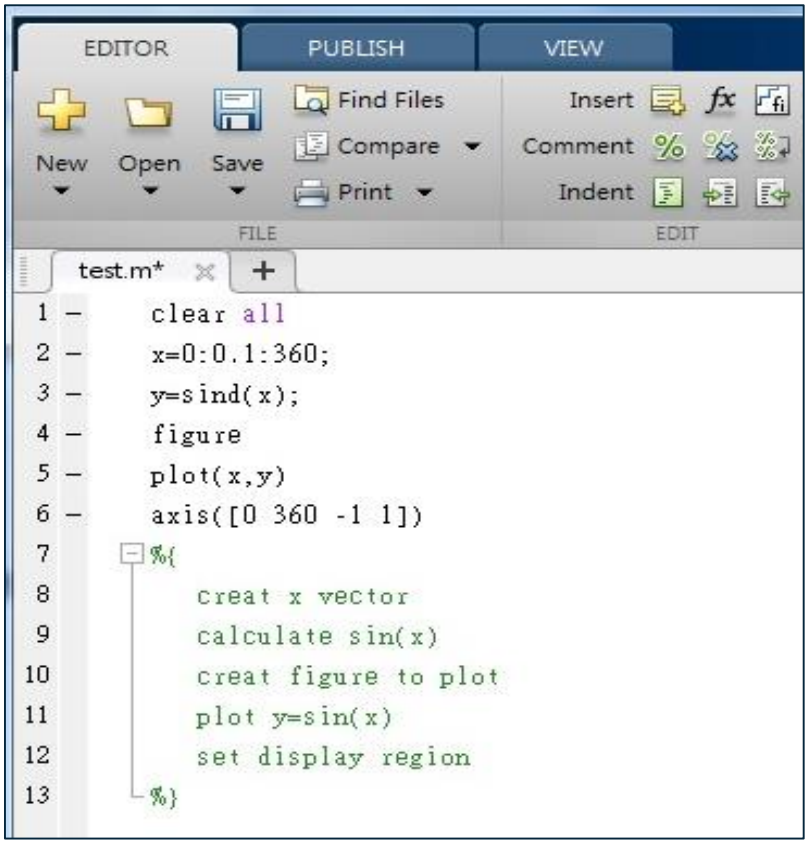
- Coding in the script instead of command window



Script

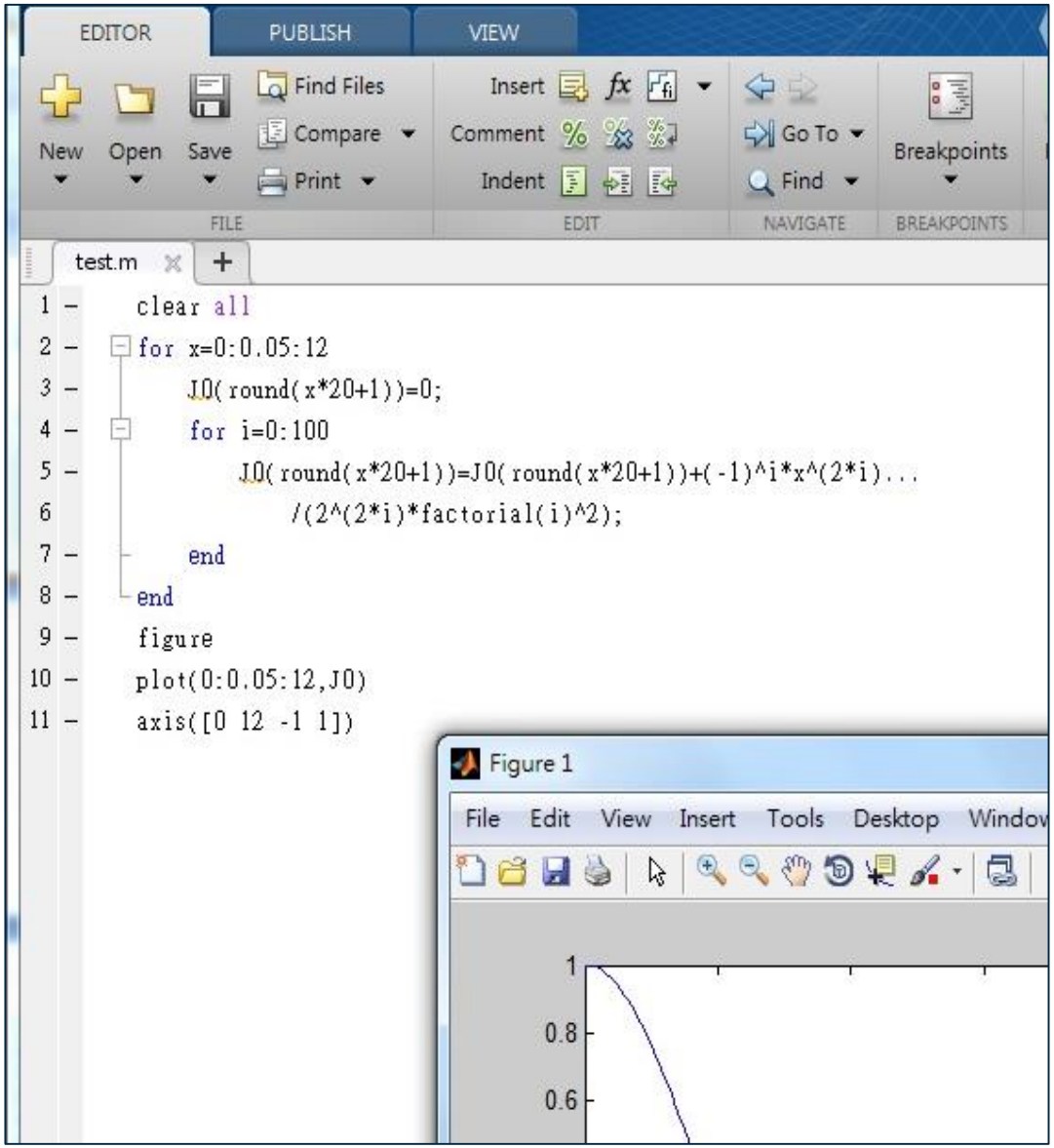
- Comment % 標註





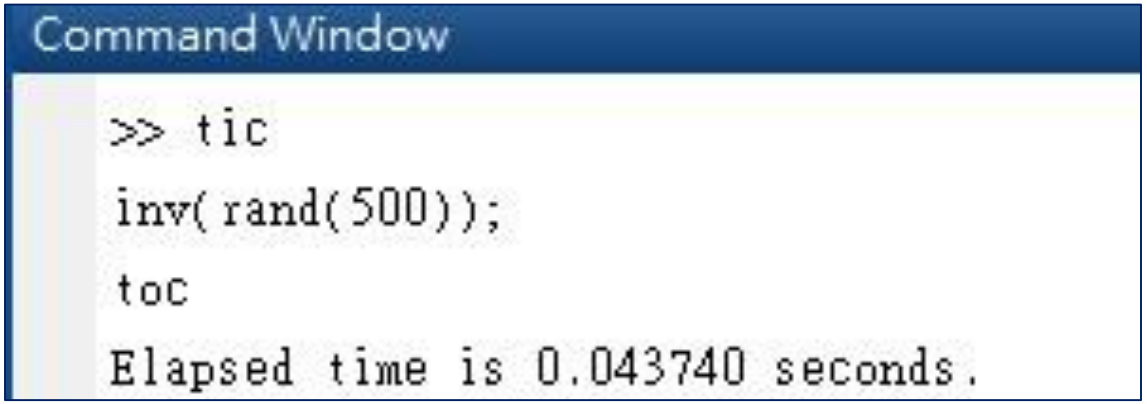
Script

- If there's too …
  much stuff in a line



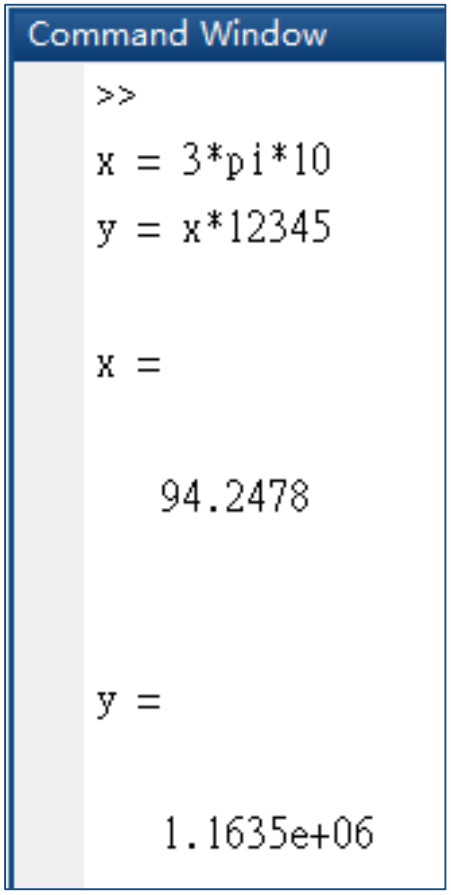
Script

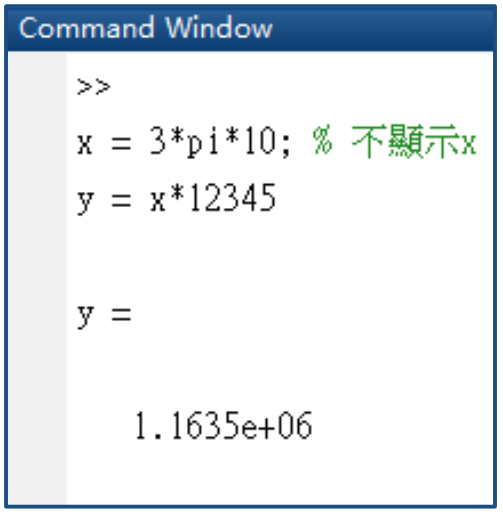
- Variable names
  - Always start with a letter.
  - Spacings are not allowed.
    - **O** answer_1, pig123, TAisFat
    - **X** 9487cat, cat 9487
- tic toc
  - timer



Script

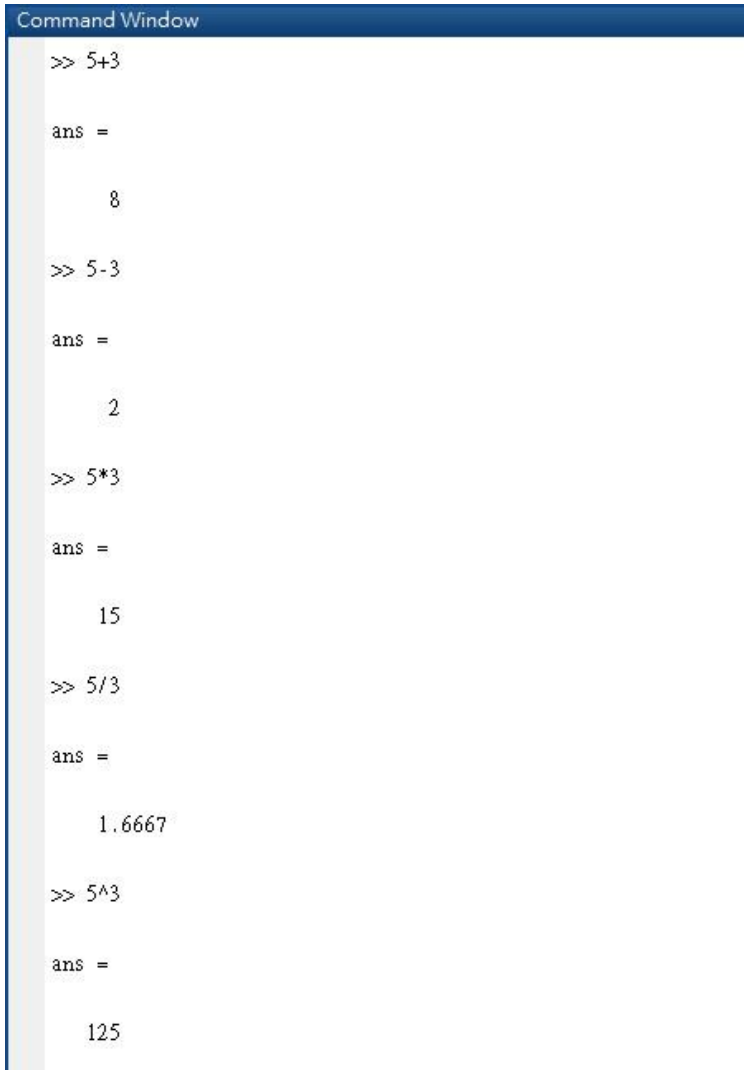
- When semicolon is at the end;
  - Suppress the output display.





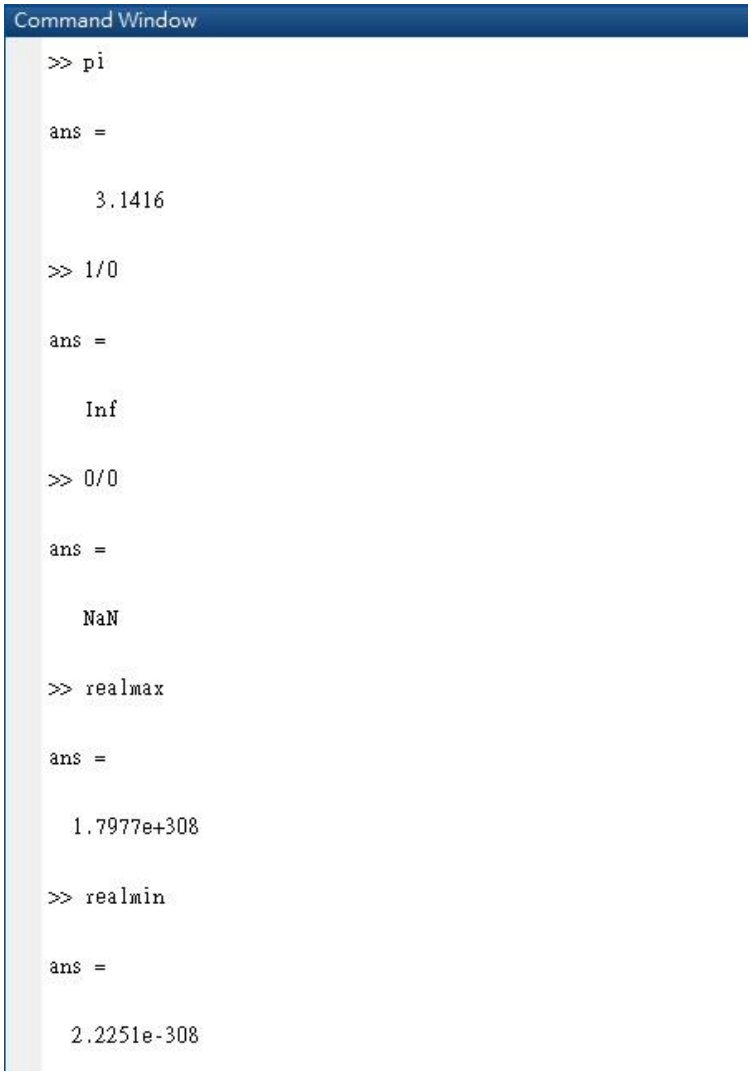
加減乘除

運算符號	代表意義	範例
+	加法	5+3
-	減法	5-3
*	乘法	5*3
/ or \	除法	5/3
^	次方	5^3



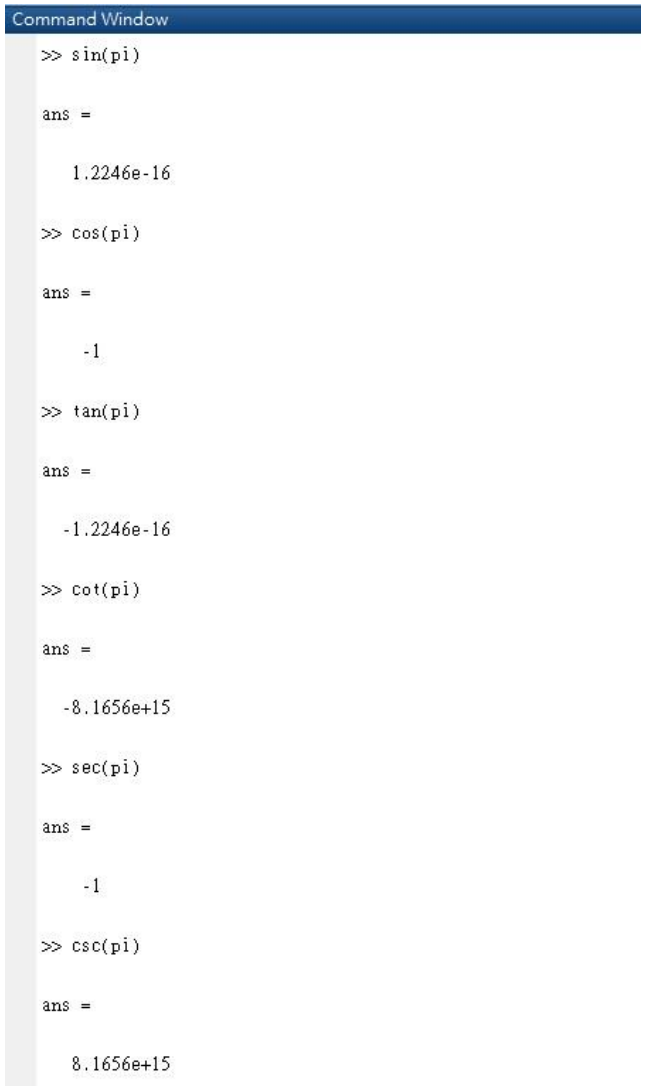
永久常數

永久常數	說明
pi	圓周率
inf	無限大
i,j	虛數(complex)
nan	不存在
realmax	系統的最大數值
realmin	系統的最小數值



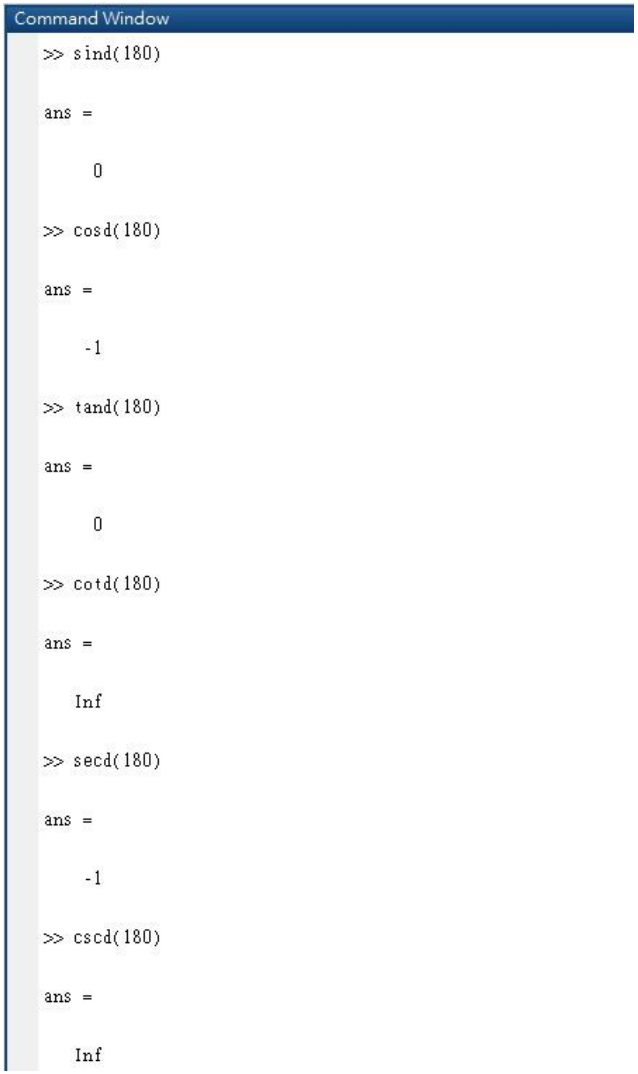
三角函數(徑度)

三角函數(徑度)	範例
sin(x)	sin(pi)
cos(x)	cos(pi)
tan(x)	tan(pi)
cot(x)	cot(pi)
sec(x)	sec(pi)
csc(x)	csc(pi)



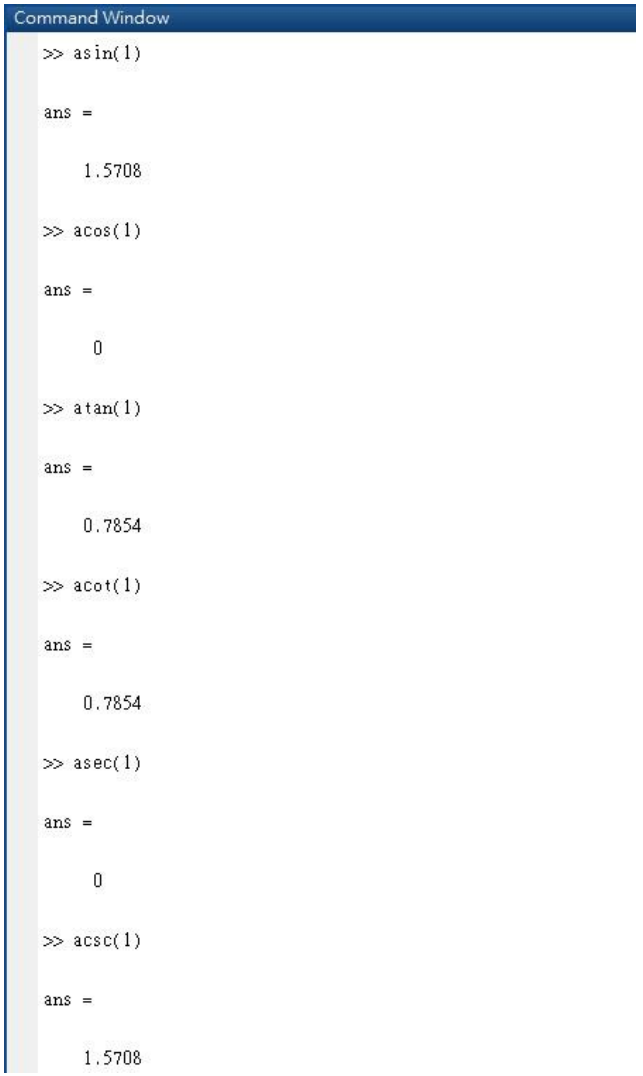
三角函數(度)

三角函數(度)	範例
sind(x)	sind(180)
cosd(x)	cosd(180)
tand(x)	tand(180)
cotd(x)	cotd(180)
secd(x)	secd(180)
cscd(x)	cscd(180)



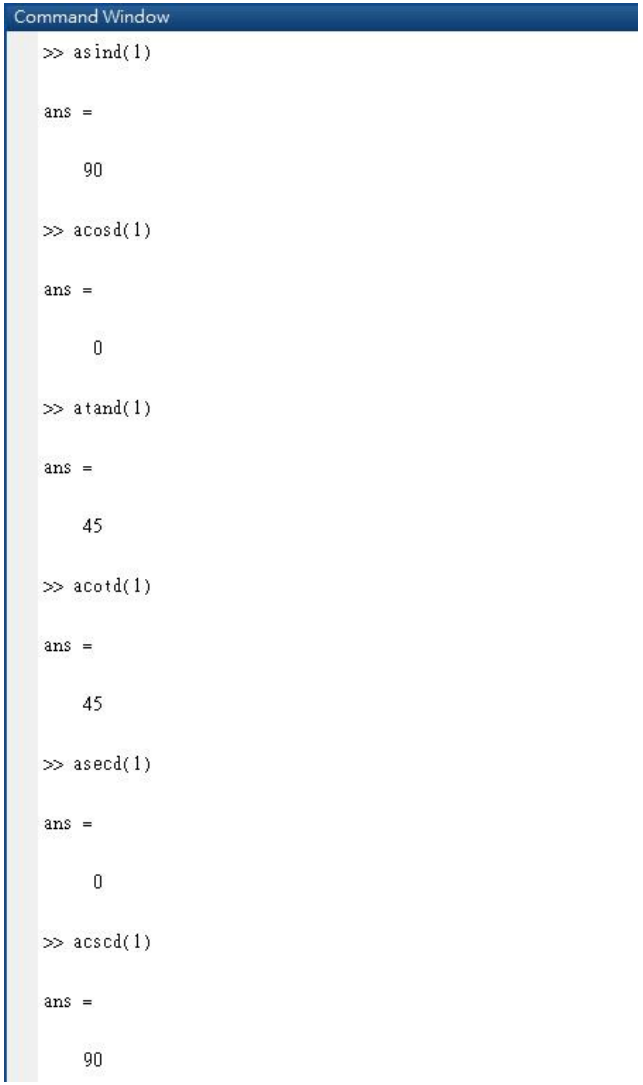
反三角函數(徑度)

反三角函數(徑度)	範例
asin(x)	asin(1)
acos(x)	acos(1)
atan(x)	atan(1)
acot(x)	acot(1)
asec(x)	asec(1)
acsc(x)	acsc(1)



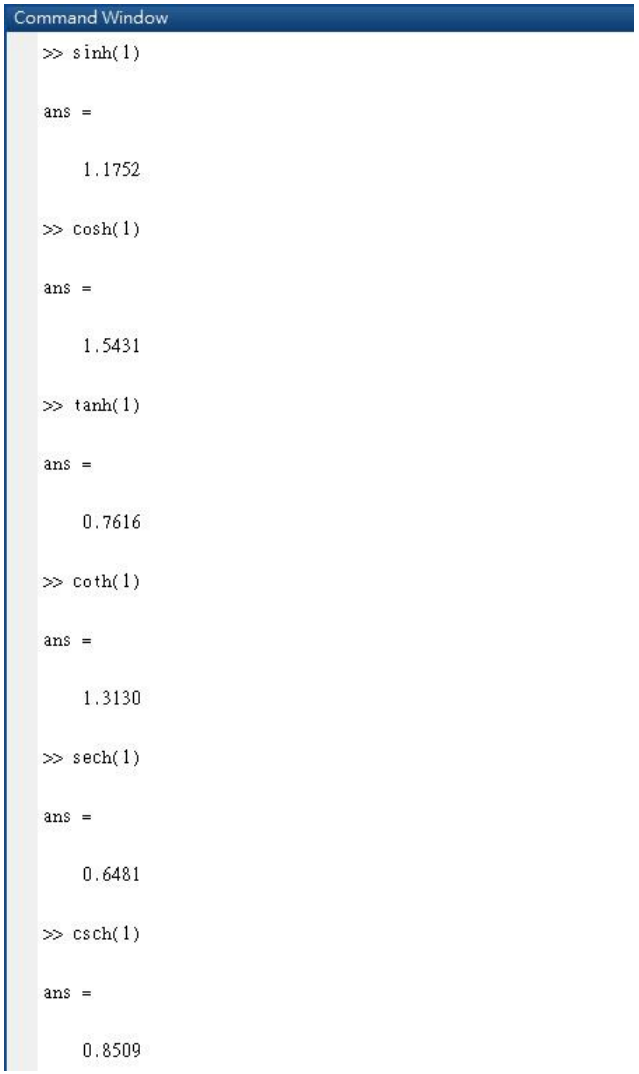
反三角函數(度)

反三角函數(度)	範例
asind(x)	asind(1)
acosd(x)	acosd(1)
atand(x)	atand(1)
acotd(x)	acotd(1)
asecd(x)	asecd(1)
acscd(x)	acscd(1)



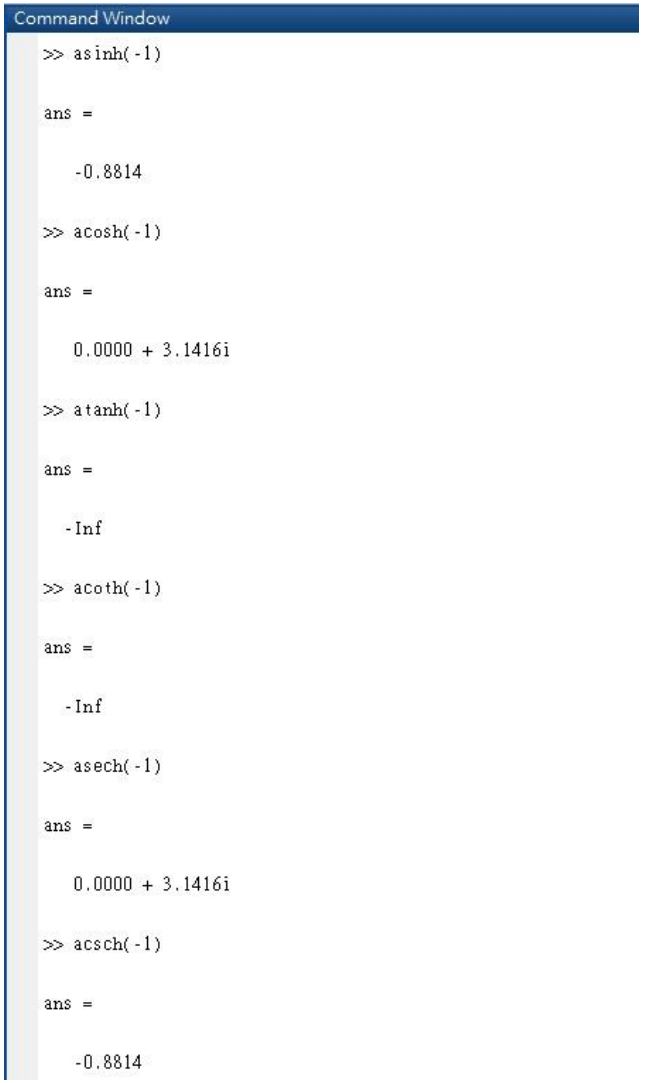
雙曲函數

雙曲函數	範例
sinh(x)	sinh(1)
cosh(x)	cosh(1)
tanh(x)	tanh(1)
coth(x)	coth(1)
sech(x)	sech(1)
csch(x)	csch(1)



反雙曲函數

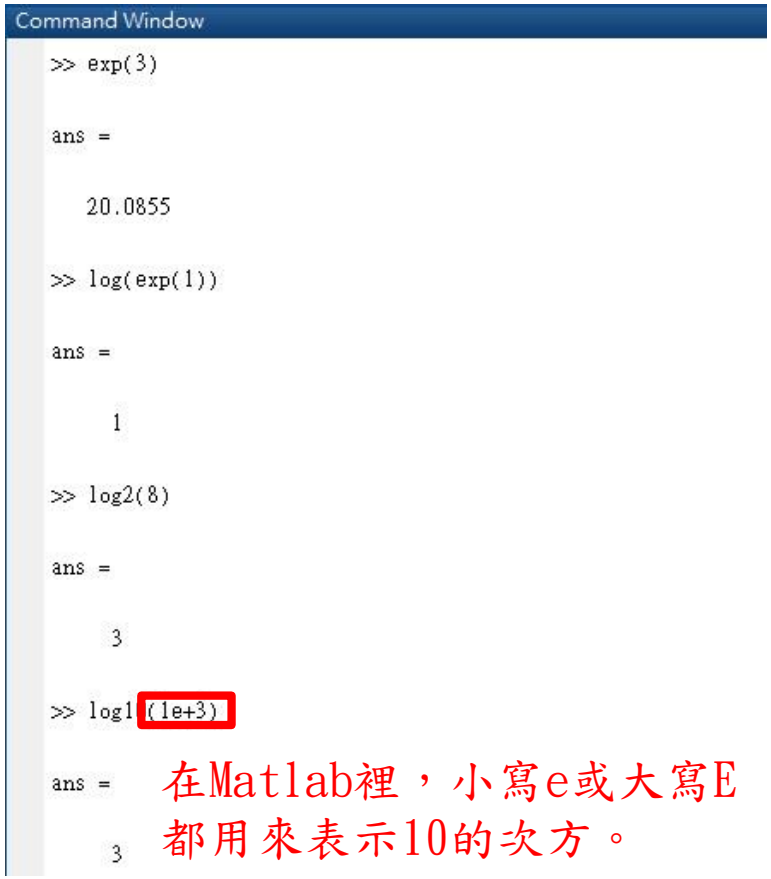
反雙曲函數	範例
asinh(x)	asinh(-1)
acosh(x)	acosh(-1)
atanh(x)	atanh(-1)
acoth(x)	acoth(-1)
asech(x)	asech(-1)
acsch(x)	acsch(-1)



指數對數

指數	說明	範例
exp(x)	自然指數函數	exp(3)

對數	說明	範例
log(x)	以自然數為底	log(exp(1))
log2(x)	以2為底	log2(8)
log10(x)	以10為底	log10(1e+3)



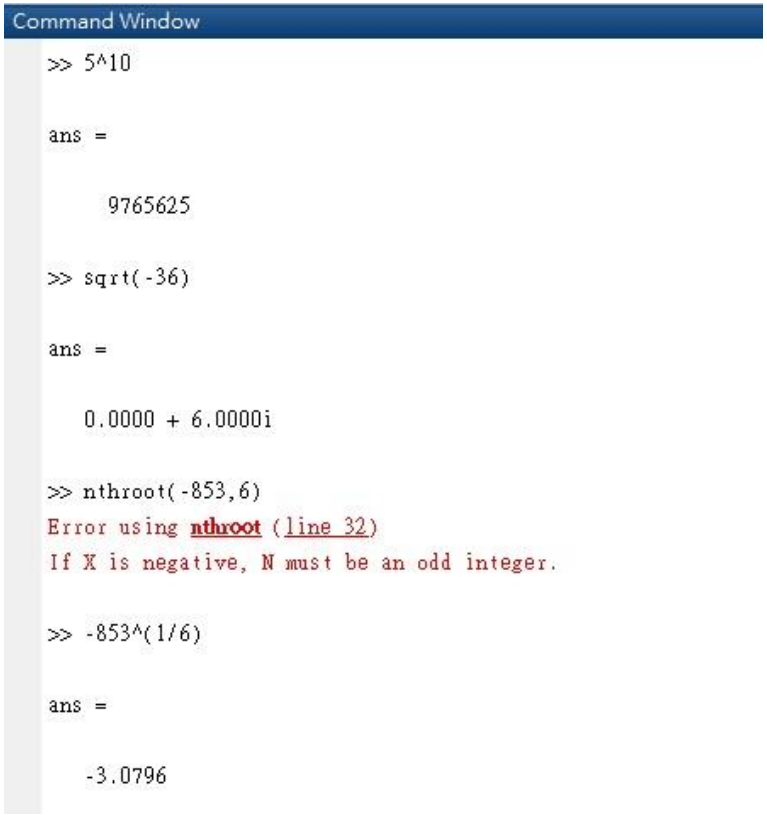
在Matlab裡，小寫e或大寫E都用來表示10的次方。

PS ：任意底數$\log_b x = \log(x)/\log(b)$

平方、根號

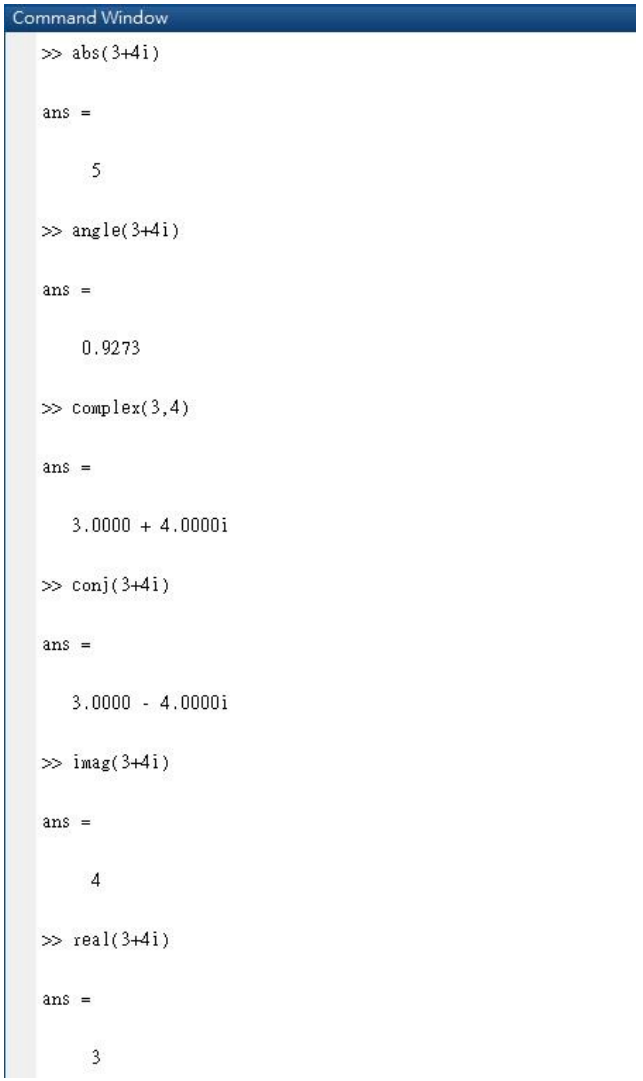
次方	說明	範例
x^n	x的n次方	5^10

根號	說明	範例
sqrt(x)	x開根號	sqrt(-36)
nthroot(x,n)	x開n次根	nthroot(-853,6)



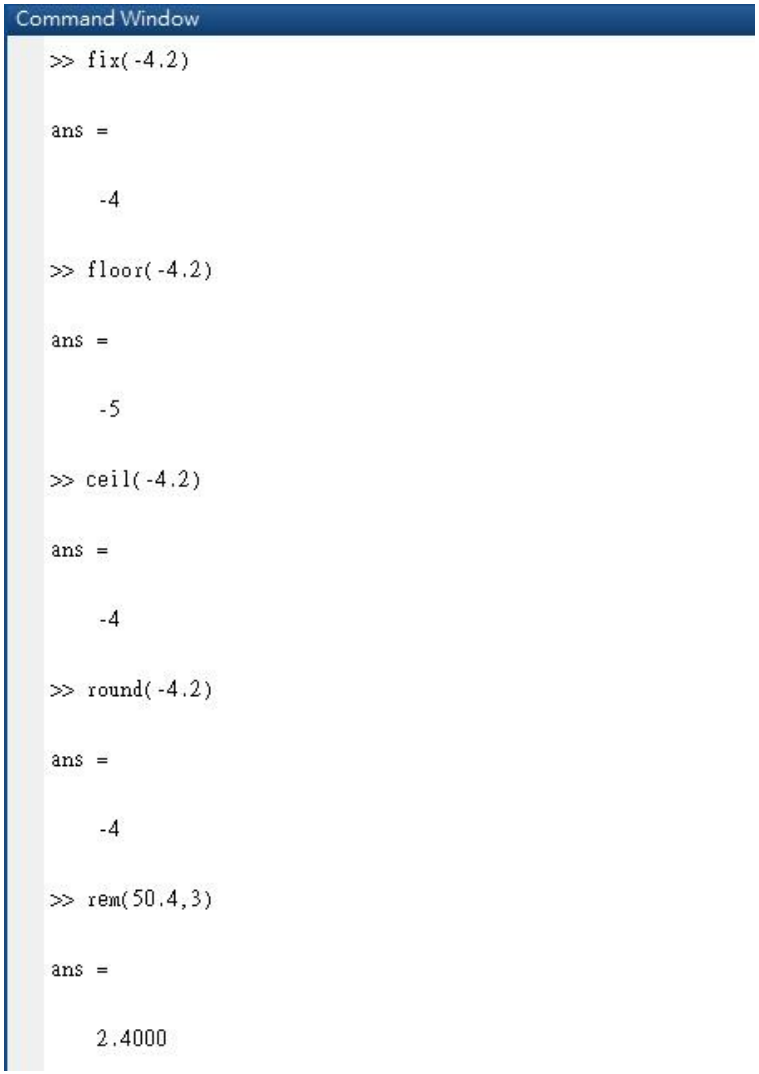
複數運算

函數	說明	範例
abs(z)	z的絕對值	abs(3+4i)
angle(z)	z的主幅角(徑度) $(-\pi \sim \pi)$	angle(3+4i)
complex(a,b)	建立複數， 實部a虛部b	complex(3,4)
conj(z) or z'	複數z的共軛複數	conj(3+4i)
imag(z)	取出複數z的虛部	imag(3+4i)
real(z)	取出複數z的實部	real(3+4i)



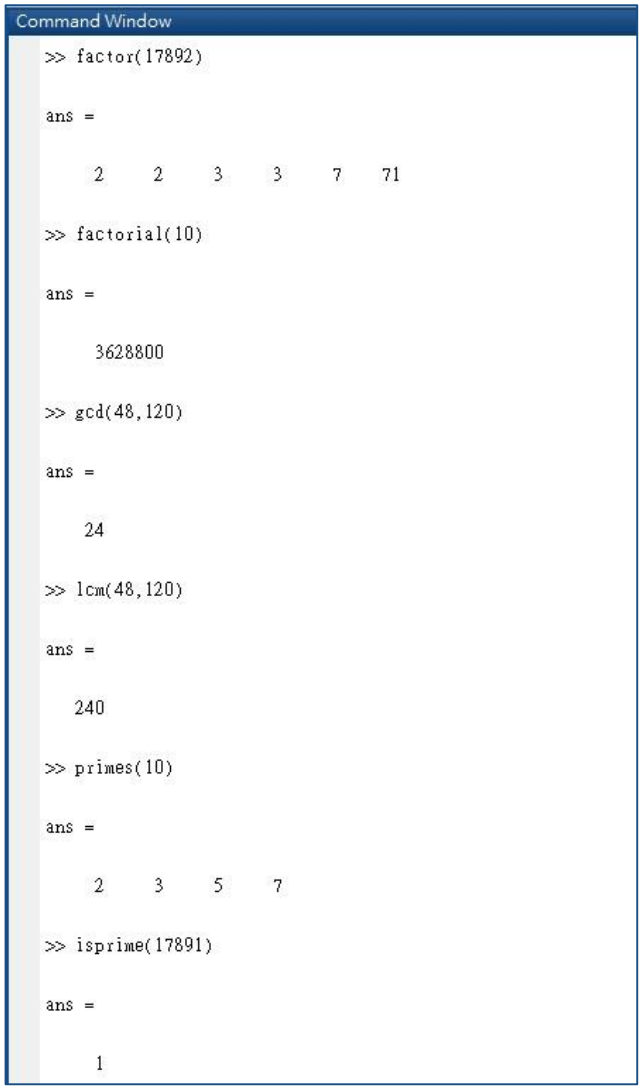
捨取、餘數函數

函數	說明	範例
fix(x)	捨棄x的小數	fix(-4.2)
floor(x)	小於等於x的最大整數	floor(-4.2)
ceil(x)	大於等於x的最小整數	ceil(-4.2)
round(x)	最靠近x的整數	round(-4.2)
rem(x,y)	x/y的餘數	rem(50.4,3)



其它函數

函數	說明	範例
factor(x)	求出整數x的質因數	factor(17892)
factorial(x)	x!(階)	factorial(10)
gcd(a,b)	a,b的最大公因數	gcd(48,120)
lcm(a,b)	a,b的最小公倍數	lcm(48,120)
primes(x)	小於等於x的所有質數	primes(10)
isprime(x)	判斷x是否為質數，1(是)0(否)	isprime(17891)



for

- for loop to repeat specified number of times

迴圈變數　某個值

```
for index = values
        statement1;
        statement2
end
```

Hint:

Matlab裡1:100代表一個從1到100的向量。

a = 1:3 等同於 a = [1,2,3]

test.m*

```
1 -     clear all
2 -     sum=0;
3 -     for i=1:100
4 -         sum=sum+i;
5 -     end
6 -     sum
7
```

迴圈變數:i

敘述主體

（此行會被執行100次）

>> sum 5050

Ref: https://www.mathworks.com/help/matlab/ref/for.html

for

- Ex: $\sum_{n=0}^{100} \frac{(-1)^n x^{2n}}{2^{2n}(n!)^2}$

迴圈變數：x

向量：0:0.05:12

test.m*

```
1 -   clear all
2 -   for x=0:0.05:12
3 -       J0(round(x*20+1))=0;
4 -       for i=0:100
5 -           J0(round(x*20+1))=J0(round(x*20+1))+(-1)^i*x^(2*i)/(2^(2*i)*factorial(i)^2);
6 -       end
7 -   end
8 -   figure
9 -   plot(0:0.05:12,J0)
10 -  axis([0 12 -1 1])
11
```

敘述主體1(執行了$\frac{12-0}{0.05}=240$次)

敘述主體2(執行了240＊101次)

Hint:

round(): 四捨五入至整數

習題

1. 已知sin(x) 、 cos(x)的Taylor級數展開為：

$$\sin(x) = \sum_0^{\infty} (-1)^n \frac{x^{(2n+1)}}{(2n+1)!}$$

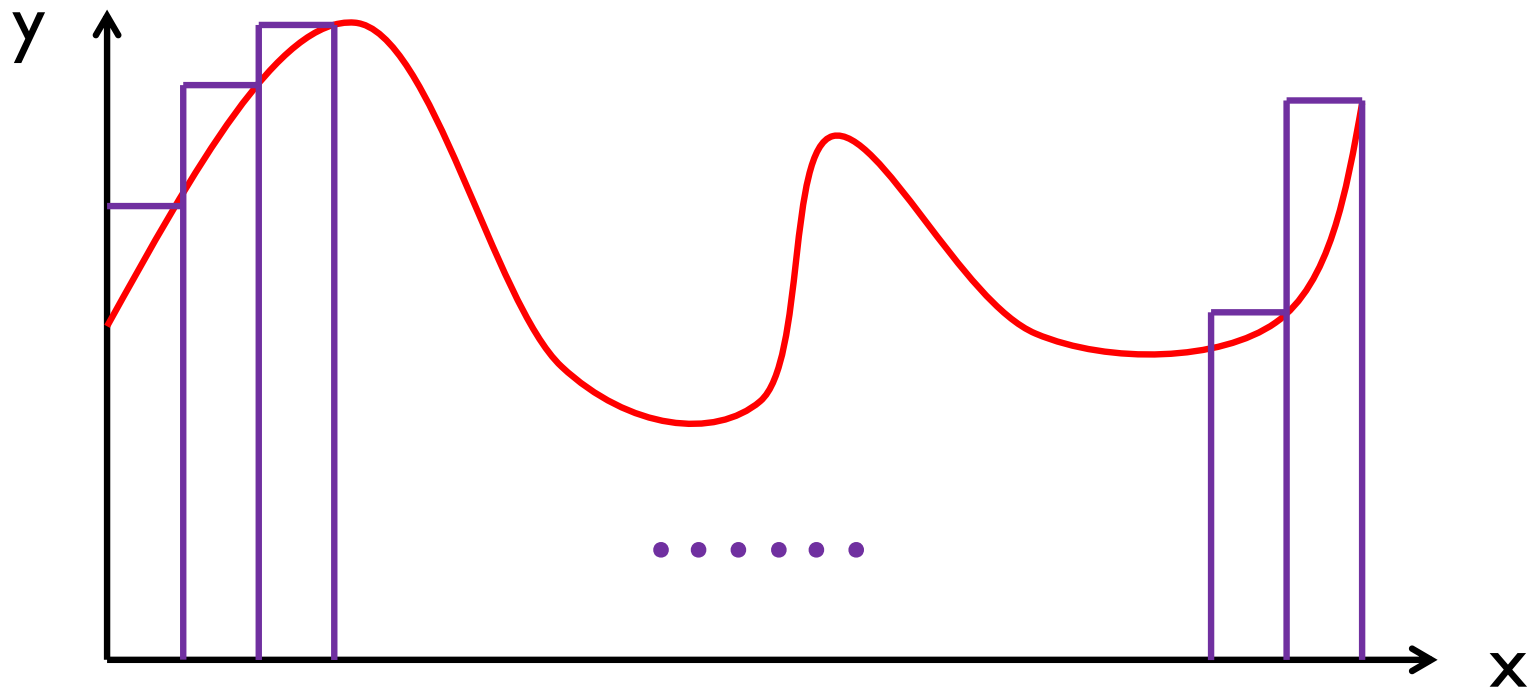
$$\cos(x) = \sum_0^{\infty} (-1)^n \frac{x^{2n}}{(2n)!}$$

請利用此方程式去計算sin(π)和cos(π)的值，並且計算其誤差。

(加分題) n = ? 誤差<0.00001

習題

2. 利用微積分中積分的定義，請計算 $\int_0^{10} e^x dx$ 的數值，並計算其誤差。



Hint:將此積分圖切成小等分的長方形，分割越精細誤差越小。