



# MATLAB基本介紹

助教 倪聖評

2017.09.19

# 大綱

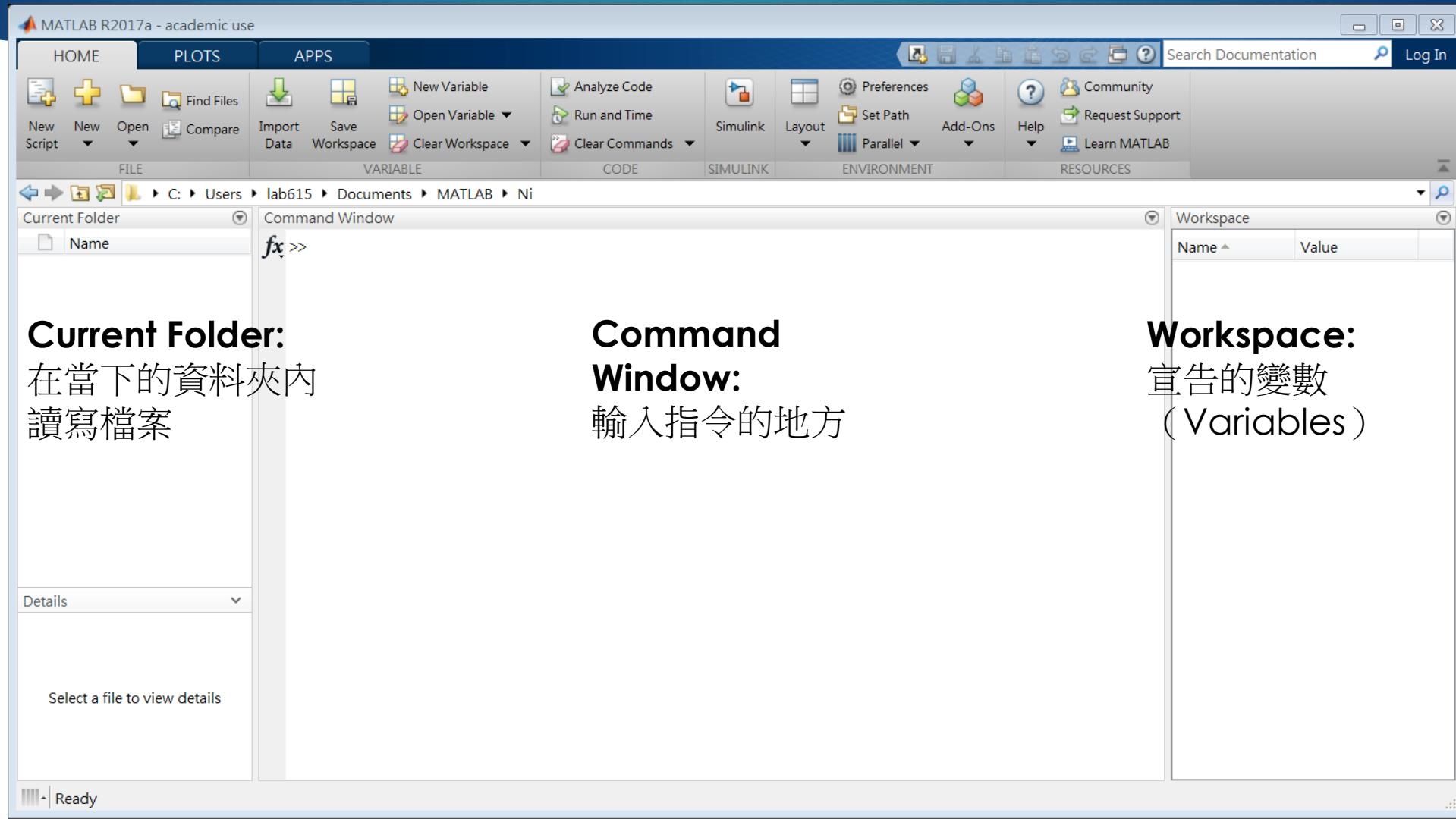
- ▶ 什麼是MATLAB?
- ▶ 外觀介紹
- ▶ 一般變數宣告與運算
- ▶ 矩陣宣告與運算
- ▶ 符號變數宣告
- ▶ 範例
- ▶ 儲存程式
- ▶ 函數查詢
- ▶ 參考資料

# 什麼是MATLAB?

- ▶ Matrix Laboratroy。
- ▶ 高階程式語言，有許多工具（toolboxes）和內建函數（built-in functions）可以使用。
- ▶ 擅長矩陣運算與圖形繪製。

# 外觀介紹

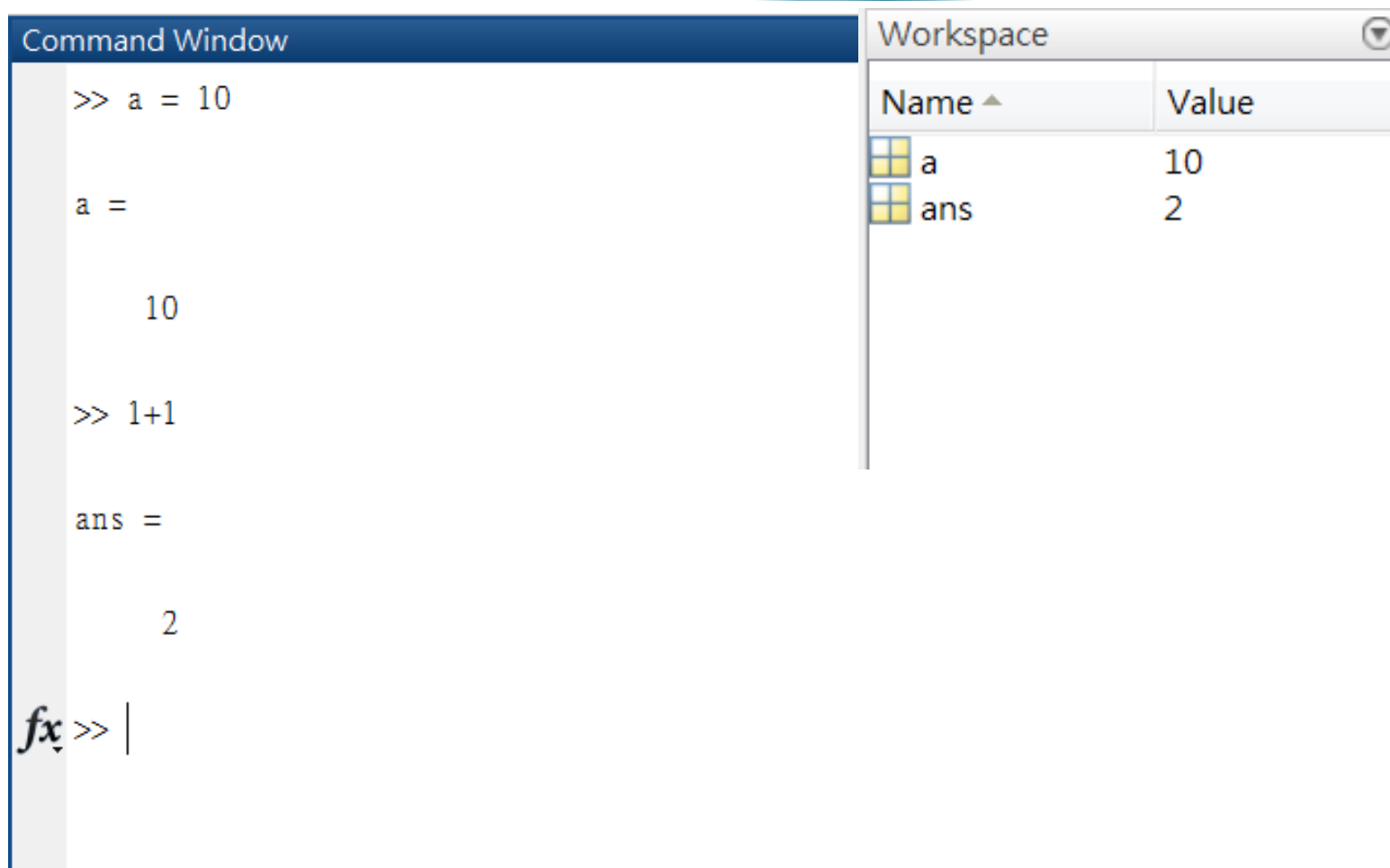
以下用學校授權的MATLAB R2017a版本做說明



# 一般變數宣告與運算

- ▶ 在Command Window中輸入： $a = 10$ ，可以在右邊Workspace中看到目前變數出現 $a$ 。
- ▶ 若是在Command Window中直接輸入算式，答案會存在名為 $ans$ 的變數中。
- ▶ 加(+)減(-)乘(\*)除(/)次方(^)

# 一般變數宣告與運算（舉例）



The image shows a screenshot of the MATLAB Command Window and Workspace. The Command Window on the left displays the execution of two commands: `>> a = 10` and `>> 1+1`. The first command assigns the value 10 to the variable `a`, and the second command calculates the sum of 1 and 1, with the result 2 stored in the default variable `ans`. The Workspace window on the right shows the current state of the workspace, listing the variables `a` and `ans` with their respective values, 10 and 2.

Name	Value
a	10
ans	2

# 矩陣宣告與運算

- ▶ Row vector:

>> A = [1 2 3]  $\leftrightarrow$  [1 2 3]

- ▶ Column vector:

>> B = [1;2;3]  $\leftrightarrow$   $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

- ▶ 3\*2 Matrix:

>> M = [1 4;2 5;3 6]  $\leftrightarrow$   $\begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}$

# 矩陣宣告與運算（舉例）

Command Window

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

A =

1	2	3
---	---	---

```
>> B = [1;2;3]
```

B =

1
2
3

```
>> C = A*B
```

C =

14

```
>> D = B*A
```

D =

1	2	3
2	4	6
3	6	9



# 矩陣宣告與運算

- ▶ 快速宣告矩陣：  
    >> A = [1 2 3 4 5]可寫成：>> A = [1:1:5]或是[1:5]  
    >> B = [1 3 5 7 9]可寫成：>> A = [1:2:9]
- ▶ 矩陣運算：  
    加(+)減(-)乘(\*)除(/)（須注意矩陣的dimension）
- ▶ 個別運算矩陣內的每個element：加(.+)減(-)乘(\*)除(/)次方(.^)
- ▶ A的轉置矩陣：transpose(A)或是A.'

# 矩陣宣告與運算（舉例）

Command Window

```
>> A = [1:5]
```

```
A =
```

```
    1    2    3    4    5
```

```
>> A.^2
```

```
ans =
```

```
    1    4    9   16   25
```

```
>> A.'
```

```
ans =
```

```
    1
```

```
    2
```

```
    3
```

```
    4
```

```
    5
```

*fx* >> |

# 符號變數 (Symbolic Variable) 宣告

- ▶ 若是我們要運算符號變數，要使用syms進行宣告。

例如：

```
>> syms s tau 或是
```

```
>> s = sym('s'); tau = sym('tau')
```

- ▶ 使用方式請看以下範例。

## 範例（一）使用符號變數求解方程式

Command Window

```
>> syms x  
>> y = x*sin(x)-x;  
>> solve(y,x)
```

ans =

0

pi/2

*fx* >> |

宣告  $x$  為符號變數  
宣告  $y$  為  $x$  的函數  
當  $y = 0$  時的函數解

若在算式後面加上";"  
則不會列印出答案，可以節省command  
window的版面。

## 範例（二） 使用符號變數求反拉式轉換(inverse Laplace)

- （課本例題）已知拉式轉換函式： $Y(s) = \frac{1}{s} \cdot \frac{1}{\tau s + 1}$ ，求反拉式轉換。

Command Window

```
>> syms s tau;  
>> ilaplace(1/(tau*s^2+s))
```

ans =

```
1 - exp(-t/tau)
```

*fx* >> |

可以得到答案：

$$y(t) = 1 - e^{-t/\tau}$$

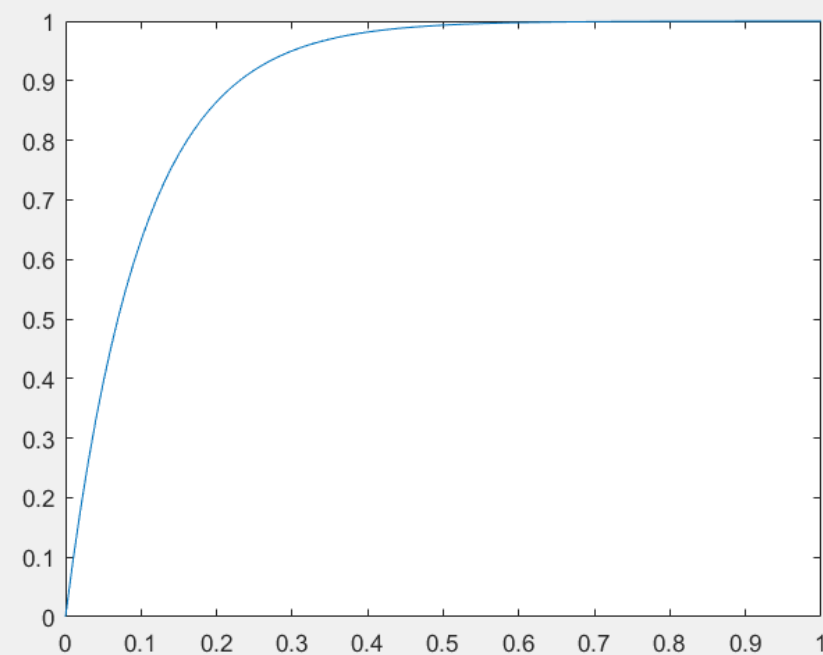
## 範例（三）繪製已知函數的圖形

- （延續上題）假設  $\tau = 0.1$ ，繪製  $y(t) = 1 - e^{-t/\tau}$  的圖形。

### Command Window

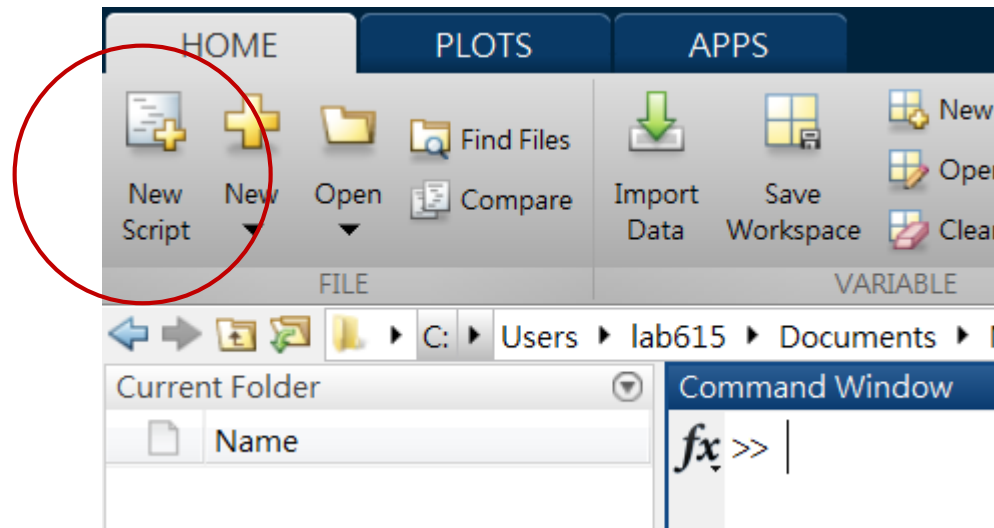
```
>> t = 0:0.01:1;      設定時間 t 為 0~1 秒，  
>> tau = 0.1;         取樣間隔 0.01 秒  
>> y = 1-exp(-t/tau);  
>> plot(t,y)  
fx >> |
```

輸出圖形：



# 儲存程式

- ▶ 除了在command window直接輸入指令以外，也可以使用Script撰寫程式，並且儲存成 .m 檔案，方便下次使用。
- ▶ 第一步：開啟New Script：



# 儲存程式

- ▶ 第二步：在editor中鍵入程式。
- ▶ 第三步：儲存檔案，格式為 .m 檔案。
- ▶ 注意！下次執行程式時必須將 current folder 移置存放 .m 檔案的資料夾。

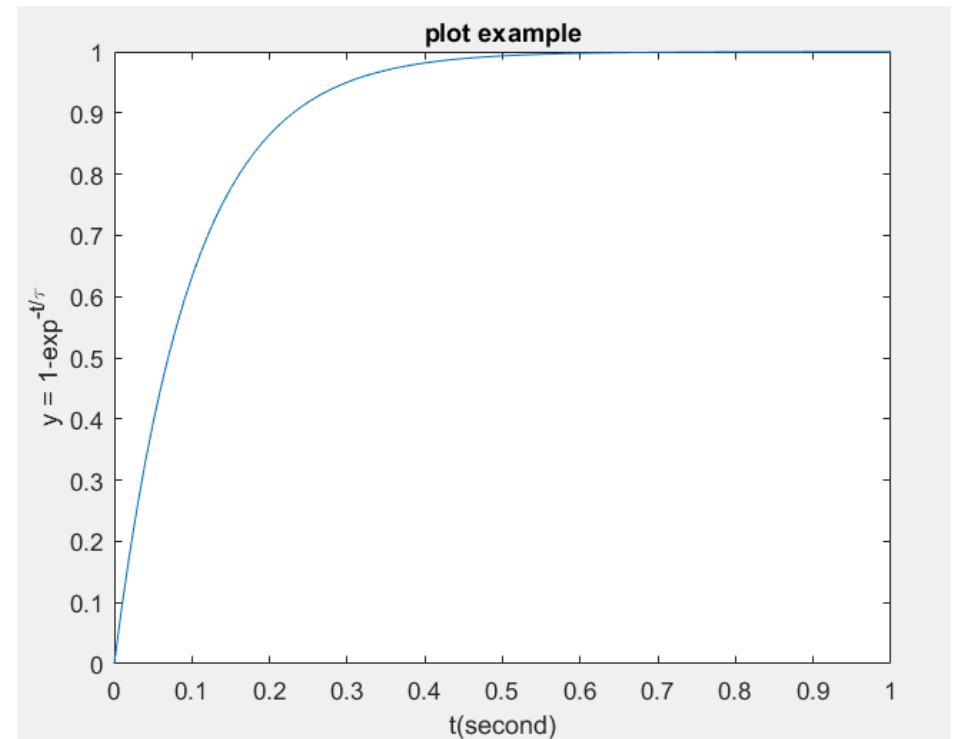


# 儲存程式（舉例）

```
Editor - C:\Users\lab615\Documents\MATLAB\Ni\plot_example.m
plot_example.m
1 - close all; % delete current figure
2 - clear; % delete current variables
3 - t = 0:0.01:1; % t = 0~1 with 0.01 sample period
4 - tau = 0.1;
5 - y = 1-exp(-t/tau); % y is a function of t
6 - plot(t,y) % y-t plot
7 - title('plot example'); % add title to current figure
8 - xlabel('t(second)'); % add label to current figure
9 - ylabel('y = 1-exp^{-t/\tau}');
```

在editor中鍵入程式，並且儲存為.m檔案  
%後面文字為註解，不會被執行

開啟.m檔案，按下執行後的程式輸出結果：



# 函數查詢

因為MATLAB函數眾多，建議大家學習如何自己查找需要的function。

- ▶ 可以在MATLAB官網中查詢各種function用法，或是在command window中輸入help function查詢使用方法。（以下用示範查詢diff的使用方法）

The screenshot displays the MATLAB Documentation website. At the top, the MathWorks logo is on the left, and navigation links for Products, Solutions, Academia, Support, Community, and Events are in the center. On the right, there are links for Contact Us and How to. Below the navigation bar is a blue header with the word 'Documentation' on the left and a search bar containing 'diff' on the right. A left sidebar menu shows a tree structure of documentation topics, with 'MATLAB' and 'Functions' expanded. The main content area shows the 'diff' function page. It includes the title 'diff' in yellow, a subtitle 'Differences and Approximate Derivatives', and a 'Syntax' section with three lines of code: `Y = diff(X)`, `Y = diff(X,n)`, and `Y = diff(X,n,dim)`. Below this is a 'Description' section with a paragraph and a bulleted list of usage rules. The first bullet point states that if X is a vector of length m, then Y = diff(X) returns a vector of length m-1. The second bullet point states that if X is a nonempty, nonvector p-by-m matrix, then Y = diff(X) returns a matrix of size (p-1)-by-m. The third bullet point states that if X is a 0-by-0 empty matrix, then Y = diff(X) returns a 0-by-0 empty matrix.

在MATLAB官網上查詢

# 函數查詢

因為MATLAB函數眾多，建議大家學習如何自己查找需要的function。

Command Window

```
>> help diff
```

**diff** Difference and approximate derivative.

**diff(X)**, for a vector X, is [X(2)-X(1) X(3)-X(2) ... X(n)-X(n-1)].

**diff(X)**, for a matrix X, is the matrix of row differences,

[X(2:n,:) - X(1:n-1,:)].

**diff(X)**, for an N-D array X, is the difference along the first non-singleton dimension of X.

**diff(X,N)** is the N-th order difference along the first non-singleton dimension (denote it by DIM). If  $N \geq \text{size}(X, \text{DIM})$ , **diff** takes successive differences along the next non-singleton dimension.

**diff(X,N,DIM)** is the Nth difference function along dimension DIM.

If  $N \geq \text{size}(X, \text{DIM})$ , **diff** returns an empty array.

Examples:

```
h = .001; x = 0:h:pi;
```

```
diff(sin(x.^2))/h is an approximation to 2*cos(x.^2).*x
```

```
diff((1:10).^2) is 3:2:19
```

```
If X = [3 7 5
```

```
0 9 2]
```

```
then diff(X,1,1) is [-3 2 -3], diff(X,1,2) is [4 -2
```

```
9 -7],
```

```
diff(X,2,2) is the 2nd order difference along the dimension 2, and
```

```
diff(X,3,2) is the empty matrix.
```

See also [gradient](#), [sum](#), [prod](#).

在command window中輸入help查詢



# 祝大家學習順利~

## 參考資料

- <https://www.mathworks.com/>
- <https://www.youtube.com/watch?v=4ocHER25osU&list=PLVHBjRDK0kALcQMwAFbR5q2driYZCHNlx&index=2>
- Automatic Control System/ Golnaraghi Kuo
- MATLAB軟體安裝請參考「交大授權軟體服務網」  
<https://ca.nctu.edu.tw/>