MATLAB
函式建立與應用

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請先下載本週上課資料

- http://www.ym.edu.tw/~cflu
- 點選左欄 [課程資料] → [MATLAB圖形使用者介面]
- 下載第3週 [上課資料] materials_L3.zip，檔案大小約3KB

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本週內容: FUNCTION

- 函式的建立與特性
- 函式的應用技巧

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We Are Able to do This...

- X=[3 1 8 6 5 4 3 5 4 1 6 8 7 9 6]
- 計算sample mean $\mu_x = \frac{\sum_{k=1}^{N} x_k}{N}$ *(where N=15)*
- 計算sample variance $S_x^2 = \frac{\sum_{k=1}^{N} (x_k - \mu_x)^2}{N-1}$
- 計算每一個x的z score $z_x = \frac{x_k - \mu_x}{S_x}$

請執行materials_L3\exercise01.m

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We Deserve Something Better…

- Simplify massive codes
  - mean(X) ⇔ sum(X)/length(X)
  - var(X) ⇔ sum((X-mean(X)).^2)/(length(X)-1)
  - zscore(X) ⇔ (X-mean(X))/sqrt(sum((X-mean(X)).^2)/(length(X)-1))
  - [mean_X,var_X,zscore_X]=**givemeall**(X)
- Repetitive processing
- Integrate different modules into one function (GUI)

試試看在command window中鍵入
[mu,S,Z]=givemeall(X)

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函式的建立與特性

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Basic Format

- Start with **function**
- Function name = file name
- <Optional> **Input**: right-hand side, within parenthesis
- <Optional> **Output**: left-hand side, within bracket

corr.m

```
1  function [coef, pval] = corr(x, varargin)
2  %CORR Linear or rank correlation.
3    %   RHO = CORR(X) returns a P-by-P matrix c
4    %   correlation coefficient between each pair
5    %   matrix X.
```

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Common Errors

- Correct

test.m

```
1  function test
```

test.m

```
1  function [c,d]=test(a,b)
2
```

- **Errors…**

test.m

```
1  functoin test
2
```

test.m

```
1  function (c,d)=test(a,b)
2
```

test.m

```
1  function tests
2
```

test.m

```
1  function [c,d]=test[a,b]
2
```

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Basic Format

- **Function declaration**
  - Function name
  - Input and output variables
- **Function instruction**
  - Brief description
  - Introduction of variables
  - Examples
  - Author
- **Function content**
  - Remember to call all inputs
  - Remember to set all outputs

testfun.m

```
1   function [c,d]=testfun(a,b)
2   % This is a test function.
3   %  Lu, Chia-Feng 2014.10.2
4
5   c=a+b;
6   d=a-b;
```

Try to create a test function!

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Error in Calling a Function

- Change "current directory"
- Set path to include the folder of function

Command Window

```
>> [c,d]=testfun(1,2)
Undefined function 'testfun'
for input arguments of type
'double'.
```

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Function vs. Workspace

- Variables created in functions cannot be called outside the function.

testfun.m

```
1   function [c,d]=testfun(a,b)
2   % This is a test function.
3   %  Lu, Chia-Feng 2014.10.2
4
5   c=a+b;
6   d=a-b;
7   e=a*b;
8   f=a/b;
9
```

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Transport Variables

- Call by address always deal with one variable~
  - Sent the memory address
- Call by value deal with several identical variables~
  - Copy value

... clone

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Function vs. Workspace

- When calling a function, the variable names can be different from the function declaration.
- Inputs, outputs → **call by value**

testfun.m

```
function [c,d]=testfun(a,b)
% This is a test function.
%   Lu, Chia-Feng 2014.10.2

c=a+b;
d=a-b;
```

Command Window

```
>> [sum_ab,minus_ab]=testfun(1,2)

sum_ab =

     3


minus_ab =

    -1
```

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Global Variables

- MATLAB also allows call-by-address approach.

Command Window

```
>> global a b
>> a=1; b=3;
>> [c,d]=testfun

c =

     4


d =

    -2
```

testfun.m

```
function [c,d]=testfun
% This is a test function.
%   Lu, Chia-Feng 2014.10.2

global a b
c=a+b;
d=a-b;
```

Declare global variables before using them!

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Comparison

Input & output variables

testfun.m

```
function [c,d]=testfun(a,b)
% This is a test function.
%   Lu, Chia-Feng 2014.10.2

c=a+b;
d=a-b;
```

global variables

testfun.m

```
function [c,d]=testfun
% This is a test function.
%   Lu, Chia-Feng 2014.10.2

global a b
c=a+b;
d=a-b;
```

請開啟materials_L3\givemeall.m，確認是否了解此function的架構~

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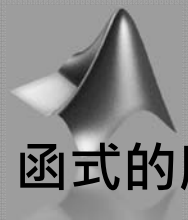

函式的應用技巧

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Calling a Function

- Incorrect usage…

testfun.m

```
1   function [c,d]=testfun(a,b)
2   % This is a test function.
3   %  Lu, Chia-Feng 2014.10.2
4
5   c=a+b;
6   d=a-b;
```

Forget to set input variables first!

```
>> [c,d]=testfun(a,b)
Undefined function or variable
'a'.
```

Forget to set path first!

```
>> [c,d]=testfun(1,2)
Undefined function 'testfun'
for input arguments of type
'double'.
```

```
>> [c,d]=testfun(1)
Error using testfun (line 5)
Not enough input arguments.
```

```
>> [c,d,e]=testfun(1,2)
Error using testfun
Too many output arguments.
```

```
>> [c,d]=testfun(1,2,3)
Error using testfun
Too many input arguments.
```

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Flexibility in Using Functions

- Various numbers of inputs
- Setup default values of variables
- Print out the customized error message

mean(X)
mean(X,DIM)

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Input/output Flexibility

- **nargin**
  - Number of function input arguments.
- **nargout**
  - Number of function output arguments.
- **varargin**
  - Variable length input argument list.
- **varargout**
  - Variable length output argument list.

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If-else flow control

- if condition1
    statement1
  else
    statement2
  end

```
1   a=99;
2   b=81;
3
4   if a>=b
5     winnerScore=a;
6   else
7     winnerScore=b;
8   end
```

Equal	==
Not equal	~=
Less than	<
Greater than	>
Less than or equal	<=
Greater than or equal	>=

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MATLAB function: mean

- open mean → open a function named "mean"

```
function y = mean(x,dim)
%MEAN   Average or mean value.
if nargin==1,
 % Determine which dimension SUM will use
 dim = find(size(x)~=1, 1 );
 if isempty(dim), dim = 1; end

 y = sum(x)/size(x,dim);
else
 y = sum(x,dim)/size(x,dim);
end
```

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Instruction of Functions

- **help**
  - Display help text in Command Window.

```
function [c,d]=testfun(a,b)
% This is a test function.
%  Lu, Chia-Feng 2014.10.2

c=a+b;
d=a-b;
```

consecutive notation lines

- **open**
  - Open files by extension.
  - .m file open program file in MATLAB Editor.

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End Function on Purpose

- **return**
  - Return to invoking function.

```
function [c,d]=testfun_mod(a,b)
% This is a test function with input check.
%  Lu, Chia-Feng 2014.10.2

if nargin < 2
   c=nan;
   d=nan;
   return
end

c=a+b;
d=a-b;
```

請開啟並傳呼materials_L3\testfun_mod.m

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Demo: send email function

- address='alvin4016@ym.edu.tw'; ← **請先換成自己的email !! 關閉防毒軟體~**
- title='MATLAB send email test';
- message='This is a test email';
- attachfile='Sendmail_CFLu.m';

- success=Sendmail_CFLu(address,title,message,attachfile)

請開啟並傳呼materials_L3\Sendmail_CFLu.m

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THE END

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