

MATLAB

Symbolic

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MATLAB command : syms & symfun

- Declare symbols(variables) & declare the formula

MATLAB command "syms" is used to declare symbols.

If one want to make a function and evaluate the function value at some points, then it can be used to take a task.

For example, I want to compute $f(x, y) = \cos(x) \log(y)$ at $x = e, y = \pi$.

1. Declare the symbols. (variables)

```
syms x y
```

2. Declare the formula. (function)

```
f = symfun(cos(x)*log(y), [x, y]) % [x ,y] is input variables.
```

3. Compute the function value

```
f(exp(1), pi)
```

One can see the answer as 'cos(3060513257434037/1125899906842624)*log(pi)'.

If want to see answer as a decimal point, use "eval" command.

i.e. Use the code like "eval(f(exp(1), pi))"

Check the value eval(pi) and eval(exp(1)).

MATLAB command : syms & symfun

- Declare symbols(variables) & declare the formula

If want compute 2 functions like $f_1(x, y) = x^3 - y$ and $f_2(x, y) = \frac{\sqrt{x}}{y}$ at $(1, 1), (0.2, 4), (3, -1)$.

1. Declare the symbols. (variables)

```
syms x y
```

2. Declare the formula. (function)

```
f = symfun([x^3-y, sqrt(x)/y], [x, y]) % f will give the 1*2 vector values
```

3. Compute the function value

```
f(1, 1), f(0.2, 4), f(3, -1)
```

Here x, y are not a vector, they are the symbols(variables).

So you do not need to use elementwise operations($.^+ .^- .^* ./ .^$).

Just use (+ - * / ^) operations.

MATLAB command : fplot

- Draw the function defined by symbol.

MATLAB command "fplot" draw the function defined by symbol.

For example, draw the function $y = x * \cos(x)$ on $-\pi \leq x \leq \pi$.

1. Declare the symbol. (variable)

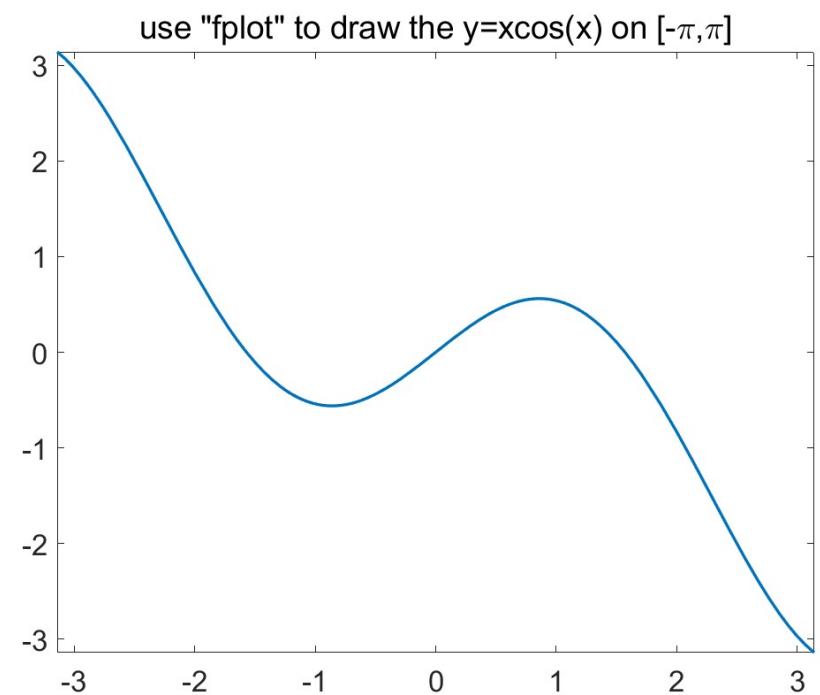
```
syms x
```

2. Declare the formula. (function)

```
y = x*cos(x)
```

3. Draw the function

```
figure(1), fplot(y, [-pi, pi])
```



MATLAB command : fplot

- Draw the function defined by symbol.

Using "fplot", you can draw the graph at once without using "hold on" and "hold off".

For example, draw the functions $\begin{cases} y = \cos(x) \\ y = \cos(2x) \\ y = \cos(x) + \sin(x) \end{cases}$ on $-\pi \leq x \leq \pi$.

1. Declare the symbol. (variable)

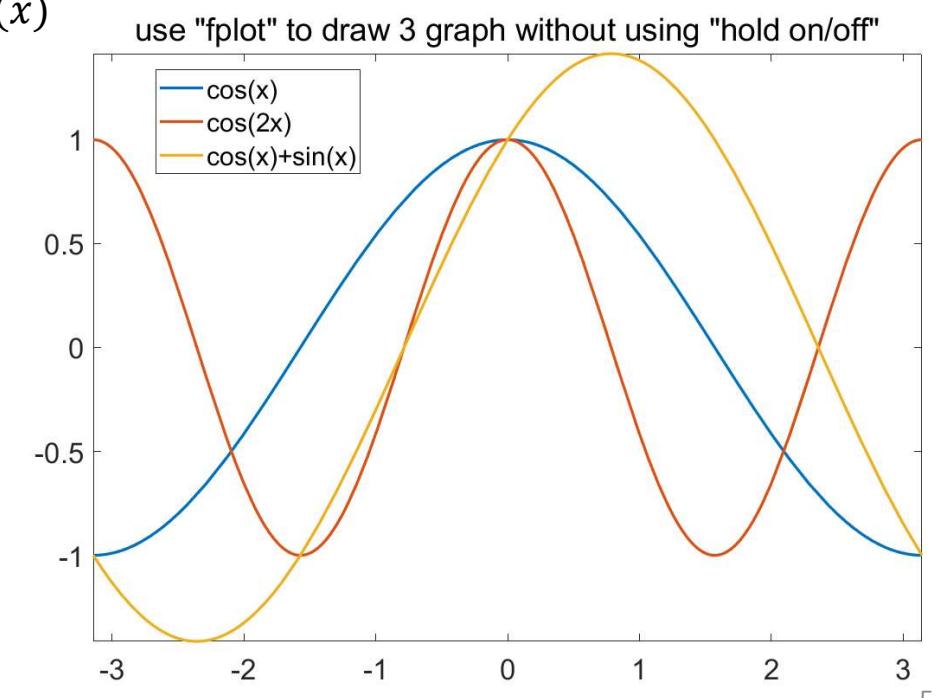
```
syms x
```

2. Declare the formula. (function)

```
y = [cos(x), cos(2*x), cos(x)+sin(x)]
```

3. Draw the function

```
figure(1), fplot(y, [-pi, pi])
```



MATLAB command : expand & factor

- Declare symbols(variables) & declare the formula

MATLAB command "expand" gives the expanded and simplified equation of input.

MATLAB command "factor" gives the factorization form of input equation or input number.

Examples

MATLAB codes	output
<code>syms x y</code>	
<code>p=(x-2)*(x+4)</code> <code>expand(p)</code>	$x^2+2*x-8$
<code>expand(cos(x+y))</code>	$\cos(x)*\cos(y)-\sin(x)*\sin(y)$
<code>factor(x^2-4)</code>	$[x-2, x+2]$
<code>factor(x^2-y^2)</code>	$[x+y, x-y]$

Type "help expand" to see more details of command "expand".

Type "help factor" to see more details of command "factor".

In general "**help ####**" gives more details about MATLAB command "####".

MATLAB command : solve & subs

- Find the roots of the equation & substitute the variables

MATLAB command "solve" gives the roots of the equation.

MATLAB command "subs" can verify the roots.

For example, find the roots of $x^4 - 2x^3 - 13x^2 + 14x + 24 = 0$ and verify the roots.

1. Declare the symbol. (variable)

```
syms x
```

2. Declare the equation.

```
y = x^4-2*x^3-13*x^2+14*x+24
```

3. Find the roots of the equation.

```
roots = solve(y == 0, x) % solve the equation y=0 for variable x.
```

4. Verify the roots.

```
subs(y, x, roots) % calculate y value by substituting roots for variable x.
```

Please study and practice yourself by using "**help ###**"