符号函数

简单符号变量

```
syms a b c
syms x
```

符号方程

```
syms a x;
y = a*x + x^2;
```

符号矩阵

```
syms alpha;
M = [cos(alpha) -sin(alpha); sin(alpha) cos(alpha)]
```

M =

$$\begin{pmatrix} \cos(\alpha) & -\sin(\alpha) \\ \sin(\alpha) & \cos(\alpha) \end{pmatrix}$$

简单计算

```
syms a b;
y = exp(sqrt(a + b));
y
```

y = $e^{\sqrt{a+b}}$

符号表达式化简

```
syms a;
y = (cot(a/2)-tan(a/2)) *(1+tan(a)*tan(a/2));
simplify(y)
```

ans =

$$\frac{2}{\sin(a)}$$

因式分解

```
factor(12)
```

```
ans = 1×3
     2     2     3
```

```
syms m n x
y = -24*m^2 *x-16*n^2*x
```

y = $-24\,x\,m^2 - 16\,x\,n^2$

```
factor(y)
```

ans = $\left(-8 \quad x \quad 3\,m^2+2\,n^2\right)$

```
y1 = m^3 - n^3
```

y1 = m^3-n^3

```
factor(y1)
```

ans = $\left(m-n \quad m^2+m\,n+n^2\right)$

多项式展开

```
syms a x
y = a*(x^2-a)^2+(x-2)
```

y = $x+a\,\left(a-x^2\right)^2-2$

```
expand(y)
```

ans = $a^3-2\,a^2\,x^2+a\,x^4+x-2$

多项式合并

```
syms x y
z = (x+y)^2*y+5*y*x-2*x^3
```

z = $5\,x\,y+y\,\left(x+y\right)^2-2\,x^3$

```
collect(z, x)
```

ans = $-2\,x^3+y\,x^2+\left(2\,y^2+5\,y\right)\,x+y^3$

```
collect(z, y)
```

ans = $y^3+\left(2\,x\right)\,y^2+\left(x^2+5\,x\right)\,y-2\,x^3$

```
collect(z,(x+y))
```

ans = $y\,\left(x+y\right)^2+5\,x\,y-2\,x^3$

计算分子与分母

```
[z1, z2] = numden(sym(2.5))
```

z1 = 5

z2 = 2

```
syms x y
z = 1/x*y+x/(x^2-2*y)
```

z =

$$\frac{y}{x} - \frac{x}{2\,y - x^2}$$

```
[z1, z2] = numden(z)
```

z1 = $-x^2\,y - x^2 + 2\,y^2$

z2 = $x\,(2\,y - x^2)$

符号函数求导

```
syms x
y = x^4-5*x^2+6
```

y = $x^4 - 5\,x^2 + 6$

```
diff(y) % 一阶导数
```

ans = $4\,x^3 - 10\,x$

```
yg = diff(y,2) % 二阶导数
```

yg = $12\,x^2 - 10$

```
if yg == diff(diff(y))
   disp('True')
end
```

True

```
y = cos(x)*tan(x);
df_10 = diff(y,10)
```

df_10 =

$$240\sin(x)\,{\sigma_1}^2 - \cos(x)\tan(x) - 4032\sin(x)\,{\sigma_1}^3 + 32640\sin(x)\,{\sigma_1}^4 - 79360\sin(x)\,{\sigma_1}^5 - 10\sin(x)\,\sigma_1 - 33\ldots$$

where

$$\sigma_1 = \tan(x)^2 + 1$$

```
simplify(df_10)
```

ans = $-\sin(x)$

多元函数的导数

```
syms x1 x2 x3
y1 = x1^5 * x2 +x2*x3 -x1^2*x3
```

y1 = $x_2\,{x_1}^5 - x_3\,{x_1}^2 + x_2\,x_3$

```
py1 = diff(y1, x1, 1) % 对 x1 求一阶偏导
```

py1 = $5\,{x_1}^4\,x_2 - 2\,x_1\,x_3$

```
py2 = diff(y1, x1, 2) % 对 x1 求二阶偏导
```

py2 = $20\,{x_1}^3\,x_2 - 2\,x_3$

```
py3 = diff(y1,x1,x2) % 先对 x1 求偏导, 再对 x2 求偏导
```

py3 = $5\,{x_1}^4$

```
py4 = diff(y1,x2,x1) % 先对 x2 求偏导, 再对 x1 求偏导(由高数可知, 结果与 Py3 相同)
```

py4 = $5\,{x_1}^4$

对矩阵求差分

```
A = [4 5 6 3 2 1];
diff(A)
```

```
ans = 1×5
     1     1    -3    -1    -1
```

```
diff(A,2)
```

```
ans = 1×4
     0    -4     2     0
```

```
A = [4 5 6;7 4 2;5 6 2]
```

```
A = 3×3
     4     5     6
     7     4     2
     5     6     2
```

```
A1 = diff(A)
```

```
A1 = 2×3
     3    -1    -4
    -2     2     0
```

```
A2 = diff(A, 2)
```

```
A2 = 1×3
    -5     3     4
```

```
A3 = diff(A,2,1) % 行间差分
```

```
A3 = 1×3
    -5     3     4
```

```
A4 = diff(A,2,2) % 列间差分
```

```
A4 = 3×1
     0
     1
```