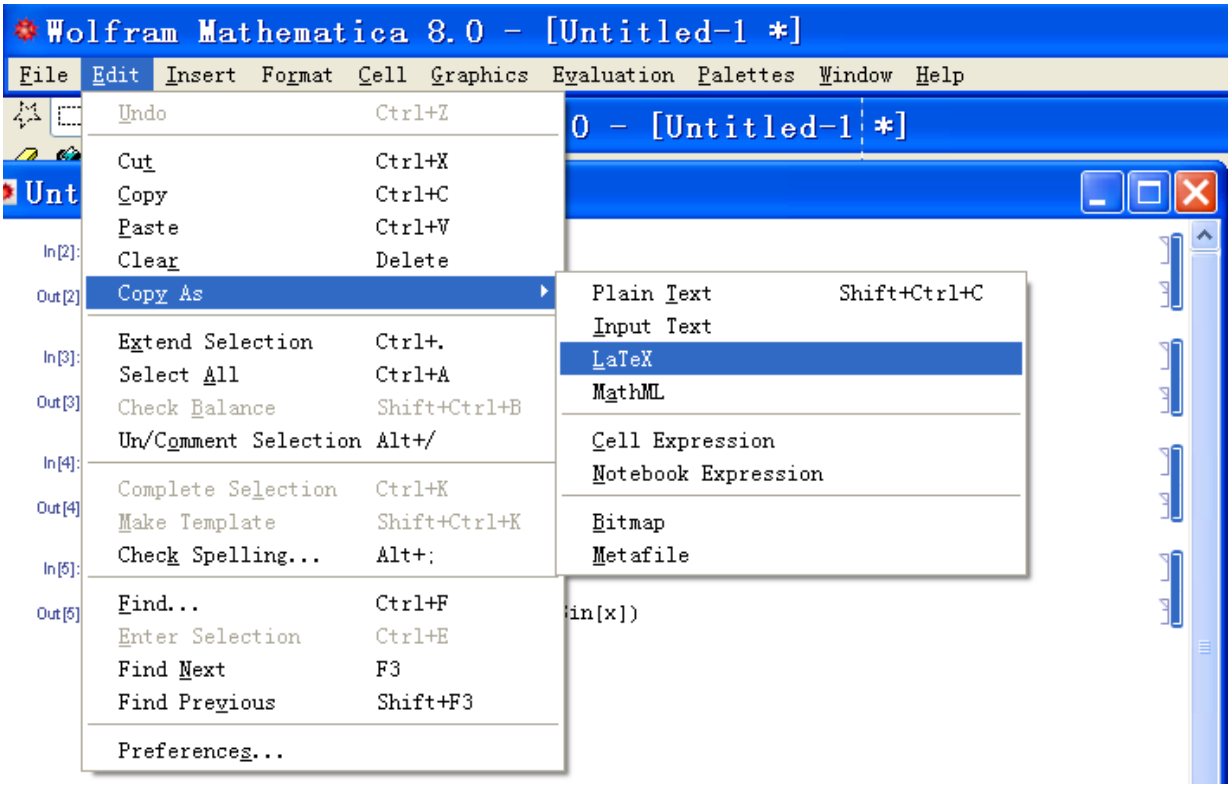
基于数学软件（Mathematica、Matlab 等）的 LaTeX 源程序生成

本讲要点：

一、Mathematica 与 LaTeX 源程序
二、Matlab 与 LaTeX 源程序
三、练习

一、Mathematica 与 LaTeX 源程序

Mathematica 软件直接基于符号运算，因此，可以利用它直接得到有关的 LaTeX 源程序。方法是：



例 1（简单应用）：已知 $f(x)=\sin^5(x)$，求 $f'''(x)$.

D[Sin[x]^5,{x,3}]
结果为：60 Cos[x]^3 Sin[x]^2-65 Cos[x] Sin[x]^4

选中上述细胞（cell），然后 Copy As LaTeX 格式，得到 LaTeX 源程序为：

D[\text{Sin}[x]{}^{\wedge}5,\{x,3\}]

60 \text{Cos}[x]^3 \text{Sin}[x]^2-65 \text{Cos}[x] \text{Sin}[x]^4

例 2（较复杂应用）：已知 $f(x)=(\sin x)^{\cos x}$，求 $f''(x)$.

D[(Sin[x])^Cos[x],{x,2}]
结果为：(-2 Cos[x]-Cot[x] Csc[x]-Cos[x] Log[Sin[x]]) Sin[x]$^{\text{Cos[x]}}$+Sin[x]$^{\text{Cos[x]}}$ (Cos[x] Cot[x]-Log[Sin[x]] Sin[x])^2

选中上述细胞（cell），然后 Copy As LaTeX 格式，得到 LaTeX 源程序为：

D[(\text{Sin}[x]){}^{\wedge}\text{Cos}[x],\{x,2\}]

(-2 \text{Cos}[x]-\text{Cot}[x] \text{Csc}[x]-\text{Cos}[x] \text{Log}[\text{Sin}[x]]) \text{Sin}[x]^{\text{Cos}[x]}+\text{Sin}[x]^{\text{Cos}[x]} (\text{Cos}[x] \text{Cot}[x]-\text{Log}[\text{Sin}[x]] \text{Sin}[x])^2

也可使用自定义函数：

例3（较复杂应用）：已知 $f(x,y)=(\sin x)^{\cos y}$，求 $\dfrac{\partial^3 f(x,y)}{\partial x^2 \partial y}$.

myfun[x_,y_]:=Sin[x]^Cos[y]
D[myfun[x,y],{x,2},{y,1}]
结果为：
-Cos[x]^2 (-1+Cos[y]) Sin[x]$^{\text{-2+Cos[y]}}$ Sin[y]-Cos[x]^2 Cos[y] Sin[x]$^{\text{-2+Cos[y]}}$ Sin[y]-Cos[x]^2 (-1+Cos[y]) Cos[y] Log[Sin[x]] Sin[x]$^{\text{-2+Cos[y]}}$ Sin[y]+Sin[x]$^{\text{Cos[y]}}$ Sin[y]+Cos[y] Log[Sin[x]] Sin[x]$^{\text{Cos[y]}}$ Sin[y]

选中上述细胞（cell），然后 Copy As LaTeX 格式，得到 LaTeX 源程序为：

\text{myfun}[\text{x$_$},\text{y$_$}]\text{:=}\text{Sin}[x]{}^{\wedge}\text{Cos}[y]
D[\text{myfun}[x,y],\{x,2\},\{y,1\}]

-\text{Cos}[x]^2 (-1+\text{Cos}[y]) \text{Sin}[x]^{-2+\text{Cos}[y]} \text{Sin}[y]-\text{Cos}[x]^2 \text{Cos}[y] \text{Sin}[x]^{-2+\text{Cos}[y]} \text{Sin}[y]-\text{Cos}[x]^2 (-1+\text{Cos}[y]) \text{Cos}[y] \text{Log}[\text{Sin}[x]] \text{Sin}[x]^{-2+\text{Cos}[y]} \text{Sin}[y]+\text{Sin}[x]^{\text{Cos}[y]} \text{Sin}[y]+\text{Cos}[y] \text{Log}[\text{Sin}[x]] \text{Sin}[x]^{\text{Cos}[y]} \text{Sin}[y]

例 4（复杂应用）：已知 $f(x)=x^{x^{x^x}}$，求 $f'''(x)$.

（1）Mathematica 命令：
D[x^x^x^x,{x,3}] （或 D[x^(x^(x^x)),{x,3}]）
（2）Mathematica 结果：
x$^{x^{x^x}}$ (x$^{\text{-1+x}^x}$ + x$^{x^x}$ Log[x] (x^(-1+x)+x^x Log[x] (1+Log[x])))3+3 x$^{x^{x^x}}$ (x$^{\text{-1+x}^x}$ + x$^{x^x}$ Log[x] (x-1+x+xx Log[x] (1+Log[x]))) (x$^{\text{-1+x}^x}$ (x-1+x+xx Log[x] (1+Log[x]))+x$^{x^x}$ Log[x] (x^(-1+x)+x^x Log[x] (1+Log[x]))2+x$^{\text{-1+x}^x}$ ((-1+xx)/x+xx Log[x] (1+Log[x]))+x$^{x^x}$ Log[x] (x-1+x Log[x]+x-1+x (1+Log[x])+xx Log[x] (1+Log[x])2+x-1+x ((-1+x)/x+Log[x])))+ x$^{x^{x^x}}$ (x$^{\text{-1+x}^x}$ (x^(-1+x)+x^x Log[x] (1+Log[x]))2+ x$^{x^x}$ Log[x]

(x^(-1+x)+x^x Log[x] (1+Log[x]))3+ x^{-1+x^x} (x-1+x+xx Log[x] (1+Log[x])) ((-1+xx)/x+xx Log[x] (1+Log[x]))+x^{-1+x^x} ((-1+x^x)/x+x^x Log[x] (1+Log[x]))2+x^{-1+x^x} (-((-1+xx)/x2)+x-1+x Log[x]+2 x-1+x (1+Log[x])+xx Log[x] (1+Log[x])2)+2 x^{-1+x^x} (x-1+x Log[x]+x-1+x (1+Log[x])+xx Log[x] (1+Log[x])2+x-1+x ((-1+x)/x+Log[x]))+3 x^{x^x} Log[x] (x-1+x+xx Log[x] (1+Log[x])) (x-1+x Log[x]+x-1+x (1+Log[x])+xx Log[x] (1+Log[x])2+x-1+x ((-1+x)/x+Log[x]))+ x^{x^x} Log[x] (2 x-2+x+(-((-1+x)/x2)+2/x) x-1+x+2 x-1+x Log[x] (1+Log[x])+x-1+x (1+Log[x])2+xx Log[x] (1+Log[x])3+x-1+x Log[x] ((-1+x)/x+Log[x])+x-1+x (1+Log[x]) ((-1+x)/x+Log[x])+x-1+x ((-1+x)/x+Log[x])2))

（3）LaTeX 命令 1（原始程序）：

```
x^{x^{x^x}} \left(x^{-1+x^x}+x^{x^x} \text{Log}[x] \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)\right)^3+3 x^{x^{x^x}} \left(x^{-1+x^x}+x^{x^x} \text{Log}[x] \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)\right) \left(x^{-1+x^x} \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)+x^{x^x} \text{Log}[x] \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)^2+x^{-1+x^x} \left(\frac{-1+x^x}{x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)+x^{x^x} \text{Log}[x] \left(x^{-1+x} \text{Log}[x]+x^{-1+x} (1+\text{Log}[x])+x^x \text{Log}[x] (1+\text{Log}[x])^2+x^{-1+x} \left(\frac{-1+x}{x}+\text{Log}[x]\right)\right)\right)+x^{x^{x^x}} \left(x^{-1+x^x} \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)^2+x^{x^x} \text{Log}[x] \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)^3+x^{-1+x^x} \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right) \left(\frac{-1+x^x}{x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)+x^{-1+x^x} \left(\frac{-1+x^x}{x}+x^x \text{Log}[x] (1+\text{Log}[x])\right)^2+x^{-1+x^x} \left(-\frac{-1+x^x}{x^2}+x^{-1+x} \text{Log}[x]+2 x^{-1+x} (1+\text{Log}[x])+x^x \text{Log}[x] (1+\text{Log}[x])^2\right)+2 x^{-1+x^x} \left(x^{-1+x} \text{Log}[x]+x^{-1+x} (1+\text{Log}[x])+x^x \text{Log}[x] (1+\text{Log}[x])^2+x^{-1+x} \left(\frac{-1+x}{x}+\text{Log}[x]\right)\right)+3 x^{x^x} \text{Log}[x] \left(x^{-1+x}+x^x \text{Log}[x] (1+\text{Log}[x])\right) \left(x^{-1+x} \text{Log}[x]+x^{-1+x} (1+\text{Log}[x])+x^x \text{Log}[x] (1+\text{Log}[x])^2+x^{-1+x} \left(\frac{-1+x}{x}+\text{Log}[x]\right)\right)+x^{x^x} \left(2 x^{-2+x}+\left(-\frac{-1+x}{x^2}+\frac{2}{x}\right) x^{-1+x}+2 x^{-1+x} \text{Log}[x] (1+\text{Log}[x])+x^{-1+x} (1+\text{Log}[x])^2+x^x \text{Log}[x] (1+\text{Log}[x])^3+x^{-1+x} \text{Log}[x] \left(\frac{-1+x}{x}+\text{Log}[x]\right)+x^{-1+x} (1+\text{Log}[x]) \left(\frac{-1+x}{x}+\text{Log}[x]\right)+x^{-1+x} \left(\frac{-1+x}{x}+\text{Log}[x]\right)^2\right)\right)
```

（4）LaTeX 命令 2（经过加工后的程序）：

```
$$
```

```
\begin{array}{l}
x^{x^{x^x}}  \left(x^{-1+x^x}+x^{x^x}  \ln(x)  \left(x^{-1+x}+x^x  \ln(x)
(1+\ln(x))\right)\right)^3+\\
 3  x^{x^{x^x}}  \left(x^{-1+x^x}+x^{x^x}  \ln[x)  \left(x^{-1+x}+x^x  \ln(x)
(1+\ln(x))\right)\right) \\
 \left(x^{-1+x^x} \left(x^{-1+x}+x^x \ln(x) (1+\ln(x))\right)+x^{x^x} \ln(x)
 \left(x^{-1+x}+x^x \ln(x) (1+\ln(x))\right)^2+\right.\\
 x^{-1+x^x} \left(\dfrac{-1+x^x}{x}+x^x \ln(x) (1+\ln(x))\right)+\\
 x^{x^x}  \ln(x)  \left(x^{-1+x}  \ln(x)+x^{-1+x}  (1+\ln(x))+x^x  \ln(x)
(1+\ln(x))^2+\right.\\
\left.\left. x^{-1+x} \left(\dfrac{-1+x}{x}+\ln(x)\right)\right)\right)+\\
 x^{x^{x^x}} \left(x^{-1+x^x} \left(x^{-1+x}+x^x \ln(x) (1+\ln(x))\right)^2+
 x^{x^x} \ln(x) \left(x^{-1+x}+x^x \ln(x) (1+\ln(x))\right)^3+\right.\\
 x^{-1+x^x}        \left(x^{-1+x}+x^x        \ln(x)        (1+\ln(x))\right)
\left(\dfrac{-1+x^x}{x}+x^x \ln(x) (1+\ln(x))\right)+\\
 x^{-1+x^x} \left(\dfrac{-1+x^x}{x}+x^x \ln(x) (1+\ln(x))\right)^2+\\
 x^{-1+x^x}     \left(-\dfrac{-1+x^x}{x^2}+x^{-1+x}     \ln(x)+2     x^{-1+x}
(1+\ln(x))+x^x \ln(x) (1+\ln(x))^2\right)+\\
 2   x^{-1+x^x}   \left(x^{-1+x}   \ln(x)+x^{-1+x}   (1+\ln(x))+x^x   \ln(x)
(1+\ln(x))^2+\right.\\
 \left.x^{-1+x} \left(\dfrac{-1+x}{x}+\ln(x)\right)\right)+3 x^{x^x} \ln(x)
  \left(x^{-1+x}+x^x \ln(x) (1+\ln(x))\right) \\
  \left(x^{-1+x} \ln(x)+x^{-1+x} (1+\ln(x))+x^x \ln(x) (1+\ln(x))^2+x^{-1+x}
  \left(\dfrac{-1+x}{x}+\ln(x)\right)\right)+\\
  x^{x^x} \ln(x) \left(2 x^{-2+x}+\left(-\dfrac{-1+x}{x^2}+\dfrac{2}{x}\right)
  x^{-1+x}+2 x^{-1+x} \ln(x) (1+\ln(x))+\right.\\
  x^{-1+x}     (1+\ln(x))^2+x^x     \ln(x)     (1+\ln(x))^3+x^{-1+x}     \ln(x)
\left(\dfrac{-1+x}{x}+\ln(x)\right)+\\
  \left.\left.x^{-1+x}                                                    (1+\ln(x))
\left(\dfrac{-1+x}{x}+\ln(x)\right)+x^{-1+x}
  \left(\dfrac{-1+x}{x}+\ln(x)\right)^2\right)\right)
\end{array}
$$
```

注：加工工作主要有：
1）将所有的西文方括号“[”与“]”换成西文圆括号“(“与”)”；
2）将函数书写规范，例如：将\text{Log}[x] 换成\ln(x)；
3）将长公式分行，\left(与\right)配对问题，\left.与\right.的意义与具体应用；
4）将\frac 换成\dfrac；
等等。

（4）LaTeX 结果：

$$x^{x^{x^x}}\left(x^{-1+x^x}+x^{x^x}\ln(x)\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)\right)^3+$$
$$3x^{x^{x^x}}\left(x^{-1+x^x}+x^{x^x}\ln[x]\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)\right)$$
$$\left(x^{-1+x^x}\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)+x^{x^x}\ln(x)\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)^2+\right.$$
$$x^{-1+x^x}\left(\frac{-1+x^x}{x}+x^x\ln(x)(1+\ln(x))\right)+$$
$$\left.x^{x^x}\ln(x)\left(x^{-1+x}\ln(x)+x^{-1+x}(1+\ln(x))+x^x\ln(x)(1+\ln(x))^2+\right.\right.$$
$$\left.\left.x^{-1+x}\left(\frac{-1+x}{x}+\ln(x)\right)\right)\right)+$$
$$x^{x^{x^x}}\left(x^{-1+x^x}\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)^2+x^{x^x}\ln(x)\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)^3+\right.$$
$$x^{-1+x^x}\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)\left(\frac{-1+x^x}{x}+x^x\ln(x)(1+\ln(x))\right)+$$
$$x^{-1+x^x}\left(\frac{-1+x^x}{x}+x^x\ln(x)(1+\ln(x))\right)^2+$$
$$x^{-1+x^x}\left(-\frac{-1+x^x}{x^2}+x^{-1+x}\ln(x)+2x^{-1+x}(1+\ln(x))+x^x\ln(x)(1+\ln(x))^2\right)+$$
$$2x^{-1+x^x}\left(x^{-1+x}\ln(x)+x^{-1+x}(1+\ln(x))+x^x\ln(x)(1+\ln(x))^2+\right.$$
$$\left.x^{-1+x}\left(\frac{-1+x}{x}+\ln(x)\right)\right)+3x^{x^x}\ln(x)\left(x^{-1+x}+x^x\ln(x)(1+\ln(x))\right)$$
$$\left(x^{-1+x}\ln(x)+x^{-1+x}(1+\ln(x))+x^x\ln(x)(1+\ln(x))^2+x^{-1+x}\left(\frac{-1+x}{x}+\ln(x)\right)\right)+$$
$$x^{x^x}\ln(x)\left(2x^{-2+x}+\left(-\frac{-1+x}{x^2}+\frac{2}{x}\right)x^{-1+x}+2x^{-1+x}\ln(x)(1+\ln(x))+\right.$$
$$x^{-1+x}(1+\ln(x))^2+x^x\ln(x)(1+\ln(x))^3+x^{-1+x}\ln(x)\left(\frac{-1+x}{x}+\ln(x)\right)+$$
$$\left.\left.x^{-1+x}(1+\ln(x))\left(\frac{-1+x}{x}+\ln(x)\right)+x^{-1+x}\left(\frac{-1+x}{x}+\ln(x)\right)^2\right)\right)$$

二、Matlab 与 LaTeX 源程序

Matlab 软件也有符号运算功能，可以利用它得到有关的 LaTeX 源程序，方法是利用 Matlab 的转换函数 latex（…）。Matlab 给出的帮助文件如下：

```
>> help latex
 --- help for sym/latex.m ---

 LATEX  LaTeX representation of a symbolic expression.
    LATEX(S) returns the LaTeX representation of the symbolic expression S.

    Examples:
       syms x
       f = taylor(log(1+x));
       latex(f) =
          x-1/2\,{x}^{2}+1/3\,{x}^{3}-1/4\,{x}^{4}+1/5\,{x}^{5}

       H = sym(hilb(3));
       latex(H) =
```

```
   \left [\begin {array}{ccc} 1&1/2&1/3\\\noalign{\medskip}1/2&1/3&1/4
   \\\noalign{\medskip}1/3&1/4&1/5\end {array}\right ]

syms alpha t
A = [alpha t alpha*t];
latex(A) =
   \left [\begin {array}{ccc} \alpha&t&\alpha\,t\end {array}\right ]
```

See also pretty, ccode, fortran.

例 5（简单应用）：已知 $f(x)=\sin^5(x)$，求 $f'''(x)$.

```
>> syms x
>> latex(diff(sin(x)^5,x,3))
```

得到的 LaTeX 命令为：

```
60\, \left( \sin \left( x \right)  \right) ^{2} \left( \cos \left( x \right)
\right) ^{3}-65\, \left( \sin \left( x \right)  \right) ^{4}\cos \left( x \right)
```

例 6（较复杂应用）：已知 $f(x)=(\sin x)^{\cos x}$，求 $f''(x)$.

```
>> syms x
>> latex(diff(sin(x)^cos(x),x,2))
```

得到的 LaTeX 命令为：

```
 \left( \sin \left( x \right)  \right) ^{\cos \left( x \right) } \left( -\sin
\left( x \right) \ln  \left( \sin \left( x \right)  \right) +{\frac { \left( \cos
\left( x \right)  \right) ^{2}}{\sin \left( x \right) }} \right) ^{2}+ \left( \sin
\left( x \right)  \right) ^{\cos \left( x \right) } \left( -\cos \left( x \right)
\ln  \left( \sin \left( x \right)  \right) -3\,\cos \left( x \right) -{\frac
{ \left( \cos \left( x \right)  \right) ^{3}}{ \left( \sin \left( x \right)
\right) ^{2}}} \right)
```

也可使用自定义函数：

例7（较复杂应用）：已知 $f(x,y)=(\sin x)^{\cos y}$，求 $\dfrac{\partial^3 f(x,y)}{\partial x^2 \partial y}$.

```
>> syms x y
>> myfun = sin(x)^cos(y);
>> result= diff(diff(myfun,x,2),y)
>> latex(result)
```

Matlab 的结果为：

```
-sin(x)^cos(y)*sin(y)*log(sin(x))*cos(y)^2*cos(x)^2/sin(x)^2-2*sin(x)^cos(y)
*cos(y)*cos(x)^2/sin(x)^2*sin(y)+sin(x)^cos(y)*sin(y)*log(sin(x))*cos(y)+sin
(x)^cos(y)*sin(y)+sin(x)^cos(y)*sin(y)*log(sin(x))*cos(y)*cos(x)^2/sin(x)^2+
```

sin(x)^cos(y)*sin(y)*cos(x)^2/sin(x)^2

得到的 LaTeX 命令为：

```
-{\frac { \left( \sin \left( x \right)  \right) ^{\cos \left( y \right) }\sin \left( y \right) \ln  \left( \sin \left( x \right)  \right)  \left( \cos \left( y \right)  \right) ^{2} \left( \cos \left( x \right)  \right) ^{2}}{ \left( \sin \left( x \right)  \right) ^{2}}}-2\,{\frac { \left( \sin \left( x \right)  \right) ^{\cos \left( y \right) }\cos \left( y \right)  \left( \cos \left( x \right)  \right) ^{2}\sin \left( y \right) }{ \left( \sin \left( x \right)  \right) ^{2}}}+ \left( \sin \left( x \right)  \right) ^{\cos \left( y \right) }\sin \left( y \right) \ln  \left( \sin \left( x \right)  \right) \cos \left( y \right) + \left( \sin \left( x \right)  \right) ^{\cos \left( y \right) }\sin \left( y \right) +{\frac { \left( \sin \left( x \right)  \right) ^{\cos \left( y \right) }\sin \left( y \right) \ln  \left( \sin \left( x \right)  \right) \cos \left( y \right)  \left( \cos \left( x \right)  \right) ^{2}}{ \left( \sin \left( x \right)  \right) ^{2}}}+{\frac { \left( \sin \left( x \right)  \right) ^{\cos \left( y \right) }\sin \left( y \right)  \left( \cos \left( x \right)  \right) ^{2}}{ \left( \sin \left( x \right)  \right) ^{2}}}
```

例8（复杂应用）：已知 $f(x)=x^{x^{x^x}}$，求 $f'''(x)$.

（1）Matlab 命令：**(注意不可写成：diff(x^x^x^x,x,3)，为什么？)**

```
diff(x^(x^(x^x)),x,3)
```

（2）Matlab 结果：

```
x^(x^(x^x))*(x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)*log(x)+x^(x^x)/x)^3+3*x^(x^(x^x))*(x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)*log(x)+x^(x^x)/x)*(x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)^2*log(x)+x^(x^x)*(x^x*(log(x)+1)^2*log(x)+x^x/x*log(x)+2*x^x*(log(x)+1)/x-x^x/x^2)*log(x)+2*x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)/x-x^(x^x)/x^2)+x^(x^(x^x))*(x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)^3*log(x)+3*x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)*log(x)*(x^x*(log(x)+1)^2*log(x)+x^x/x*log(x)+2*x^x*(log(x)+1)/x-x^x/x^2)+3*x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)^2/x+x^(x^x)*(x^x*(log(x)+1)^3*log(x)+3*x^x*(log(x)+1)*log(x)/x+3*x^x*(log(x)+1)^2/x-x^x/x^2*log(x)+3*x^x/x^2-3*x^x*(log(x)+1)/x^2+2*x^x/x^3)*log(x)+3*x^(x^x)*(x^x*(log(x)+1)^2*log(x)+x^x/x*log(x)+2*x^x*(log(x)+1)/x-x^x/x^2)/x-3*x^(x^x)*(x^x*(log(x)+1)*log(x)+x^x/x)/x^2+2*x^(x^x)/x^3)
```

（3）LaTeX 命令 1（原始程序）：

```
{x}^{{x}^{{x}^{x}}} \left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln  \left( x \right) +1 \right) \ln  \left( x \right) +{\frac {{x}^{x}}{x}} \right) \ln \left( x \right) +{\frac {{x}^{{x}^{x}}}{x}} \right) ^{3}+3\,{x}^{{x}^{{x}^{x}}} \left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln  \left( x \right) +1 \right) \ln \left( x \right) +{\frac {{x}^{x}}{x}} \right) \ln  \left( x \right) +{\frac {{x}^{{x}^{x}}}{x}} \right)  \left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln  \left( x \right) +{\frac {{x}^{x}}{x}} \right)
```

```
^{2}\ln \left( x \right) +{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) ^{2}\ln \left( x \right) +{\frac {{x}^{x}\ln \left( x \right) }{x}}+2\,{\frac {{x}^{x} \left( \ln \left( x \right) +1 \right) }{x}}-{\frac {{x}^{x}}{{x}^{2}}} \right) \ln \left( x \right) +2\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\frac {{x}^{x}}{x}} \right) {x}^{-1}-{\frac {{x}^{{x}^{x}}}{{x}^{2}}} \right) +{x}^{{x}^{{x}^{x}}} \left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\frac {{x}^{x}}{x}} \right) ^{3}\ln \left( x \right) +3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\frac {{x}^{x}}{x}} \right) \ln \left( x \right) \left( {x}^{x} \left( \ln \left( x \right) +1 \right) ^{2}\ln \left( x \right) +{\frac {{x}^{x}\ln \left( x \right) }{x}}+2\,{\frac {{x}^{x} \left( \ln \left( x \right) +1 \right) }{x}}-{\frac {{x}^{x}}{{x}^{2}}} \right) +3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\frac {{x}^{x}}{x}} \right) ^{2}{x}^{-1}+{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) ^{3}\ln \left( x \right) +3\,{\frac {{x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) }{x}}+3\,{\frac {{x}^{x} \left( \ln \left( x \right) +1 \right) ^{2}}{x}}-{\frac {{x}^{x}\ln \left( x \right) }{{x}^{2}}}+3\,{\frac {{x}^{x}}{{x}^{2}}}-3\,{\frac {{x}^{x} \left( \ln \left( x \right) +1 \right) }{{x}^{2}}}+2\,{\frac {{x}^{x}}{{x}^{3}}} \right) \ln \left( x \right) +3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) ^{2}\ln \left( x \right) +{\frac {{x}^{x}\ln \left( x \right) }{x}}+2\,{\frac {{x}^{x} \left( \ln \left( x \right) +1 \right) }{x}}-{\frac {{x}^{x}}{{x}^{2}}} \right) {x}^{-1}-3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\frac {{x}^{x}}{x}} \right) {x}^{-2}+2\,{\frac {{x}^{{x}^{x}}}{{x}^{3}}} \right)
```

（4）LaTeX 命令 2（经过加工后的程序）：

```
$$
\begin{array}{l}
{x}^{{x}^{{x}^{x}}} \left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\dfrac {{x}^{x}}{x}} \right) \ln \left( x \right) +{\dfrac {{x}^{{x}^{x}}}{x}} \right) ^{3}+\\
3\,{x}^{{x}^{{x}^{x}}} \left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\dfrac {{x}^{x}}{x}} \right) \ln \left( x \right) +{\dfrac {{x}^{{x}^{x}}}{x}} \right) \\
\left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) \ln \left( x \right) +{\dfrac {{x}^{x}}{x}} \right) ^{2}\ln \left( x \right) +{x}^{{x}^{x}} \left( {x}^{x} \left( \ln \left( x \right) +1 \right) ^{2}\ln \left( x \right) +{\dfrac {{x}^{x}\ln \left( x \right) }{x}}+\right.\right.\\
\left.\left.2\,{\dfrac {{x}^{x} \left( \ln \left( x \right) +1 \right) }{x}}-{\dfrac {{x}^{x}}{{x}^{2}}} \right) \ln \left( x \right)
```

```
+2\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln  \left( x \right) +1 \right) \ln
\left(  x  \right)  +{\dfrac  {{x}^{x}}{x}}  \right)  {x}^{-1}-{\dfrac
{{x}^{{x}^{x}}}{{x}^{2}}} \right) \\
+{x}^{{x}^{{x}^{x}}} \left( {x}^{{x}^{x}} \left( {x}^{x} \left( \ln  \left( x
\right) +1 \right) \ln  \left( x \right) +{\dfrac {{x}^{x}}{x}} \right) ^{3}\ln
\left( x \right) +3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln  \left( x \right)
+1 \right) \ln  \left( x \right)
+{\dfrac {{x}^{x}}{x}} \right)\right. \\
\ln  \left( x \right)  \left( {x}^{x} \left( \ln  \left( x \right) +1 \right)
^{2}\ln  \left(  x  \right)  +{\dfrac  {{x}^{x}\ln  \left(  x
\right)  }{x}}+2\,{\dfrac  {{x}^{x}  \left(  \ln  \left(  x  \right)  +1
\right) }{x}}-{\dfrac {{x}^{x}}{{x}^{2}}} \right) \\
+3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln  \left( x \right) +1 \right) \ln
\left( x \right) +{\dfrac {{x}^{x}}{x}} \right) ^{2}{x}^{-1}+{x}^{{x}^{x}}
\left( {x}^{x} \left( \ln  \left( x \right) +1 \right) ^{3}\ln  \left( x \right)
+3\,{\dfrac {{x}^{x} \left( \ln  \left( x \right) +1 \right) \ln  \left( x
\right) }{x}}\right.\\
\left.+3\,{\dfrac  {{x}^{x}  \left(  \ln  \left(  x  \right)  +1  \right)
^{2}}{x}}-{\dfrac  {{x}^{x}\ln  \left(  x  \right)  }{{x}^{2}}}+3\,{\dfrac
{{x}^{x}}{{x}^{2}}}-3\,{\dfrac  {{x}^{x}  \left(  \ln  \left(  x  \right)  +1
\right) }{{x}^{2}}}+
2\,{\dfrac {{x}^{x}}{{x}^{3}}} \right)\\
\left. \ln  \left( x \right) +3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln
\left( x \right) +1 \right) ^{2}\ln  \left( x \right) +{\dfrac {{x}^{x}\ln
\left( x \right) }{x}}+2\,{\dfrac {{x}^{x} \left( \ln  \left( x \right) +1
\right) }{x}}-{\dfrac {{x}^{x}}{{x}^{2}}} \right) {x}^{-1}-\right.\\
\left.3\,{x}^{{x}^{x}} \left( {x}^{x} \left( \ln  \left( x \right) +1 \right)
\ln  \left( x \right) +{\dfrac {{x}^{x}}{x}} \right) {x}^{-2}+2\,{\dfrac
{{x}^{{x}^{x}}}{{x}^{3}}} \right)
\end{array}
$$
```

注：加工工作主要有：（注意：没有方括号问题；函数书写也基本规范）
1）将长公式分行，\left(与\right)配对问题，\left.与\right.的意义与具体应用；
2）将\frac 换成\dfrac；
等等。

（5）LaTeX 结果：

$$x^{x^{x^x}}\left(x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)\ln(x)+\frac{x^{x^x}}{x}\right)^3+$$
$$3\,x^{x^{x^x}}\left(x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)\ln(x)+\frac{x^{x^x}}{x}\right)$$
$$\left(x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)^2\ln(x)+x^{x^x}\left(x^x\left(\ln(x)+1\right)^2\ln(x)+\frac{x^x\ln(x)}{x}+\right.\right.$$
$$\left.\left.2\,\frac{x^x\left(\ln(x)+1\right)}{x}-\frac{x^x}{x^2}\right)\ln(x)+2\,x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)x^{-1}-\frac{x^{x^x}}{x^2}\right)$$
$$+x^{x^{x^x}}\left(x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)^3\ln(x)+3\,x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)\right.$$
$$\ln(x)\left(x^x\left(\ln(x)+1\right)^2\ln(x)+\frac{x^x\ln(x)}{x}+2\,\frac{x^x\left(\ln(x)+1\right)}{x}-\frac{x^x}{x^2}\right)$$
$$+3\,x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)^2x^{-1}+x^{x^x}\left(x^x\left(\ln(x)+1\right)^3\ln(x)+3\,\frac{x^x\left(\ln(x)+1\right)\ln(x)}{x}\right.$$
$$\left.+3\,\frac{x^x\left(\ln(x)+1\right)^2}{x}-\frac{x^x\ln(x)}{x^2}+3\,\frac{x^x}{x^2}-3\,\frac{x^x\left(\ln(x)+1\right)}{x^2}+2\,\frac{x^x}{x^3}\right)$$
$$\ln(x)+3\,x^{x^x}\left(x^x\left(\ln(x)+1\right)^2\ln(x)+\frac{x^x\ln(x)}{x}+2\,\frac{x^x\left(\ln(x)+1\right)}{x}-\frac{x^x}{x^2}\right)x^{-1}-$$
$$3\,x^{x^x}\left(x^x\left(\ln(x)+1\right)\ln(x)+\frac{x^x}{x}\right)x^{-2}+2\,\frac{x^{x^x}}{x^3}\Bigg)$$

三、练习

分别用 Mathematica 与 Matlab 求解下列数学问题，并给出结果的 LaTeX 源程序和相应的 PDF 文件；

1. 已知函数 $f(x)=\tan^2(x)$，求 $f''(x)$；
2. 已知函数 $g(x)=\tan(x)^{\cot(x)}$，求 $g''(x)$；
3. 已知函数 $h(x)=\dfrac{\tan(x)^{\cot(x)}}{\sin(x)^{\cos(x)}}$，求 $h^{(5)}(x)$；
4. 已知函数 $l(x,y)=\dfrac{\tan(x)^{\cot(y)}}{\sin(x)^{\cos(y)}}$，求 $\dfrac{\partial^5 l(x,y)}{\partial x^2\partial y^3}$.