

Introduction to Mathematica

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2017 年 4 月 18 日

Overview

1 Brief Background

2 Features

3 Conclusion

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- A mathematical symbolic computation program
- Conceived by Stephen Wolfram
- Developed by Wolfram Research
- Written in C/C++, Java and Mathematica
- Chinese is available after Mathematica 7.0
- The latest version: Mathematica 11.0.1

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Libraries of mathematical functions

Libraries of mathematical functions



The screenshot shows the Wolfram Mathematica 11.0 interface. The title bar reads "未命名-2 * - Wolfram Mathematica 11.0". The menu bar includes "文件 (F)", "编辑 (E)", "插入 (I)", "格式 (R)", "单元 (C)", "图形 (G)", "计算 (V)", "面板 (P)", "窗口 (W)", and "帮助 (H)". The input and output history is as follows:

```
In[12]:= Pi  
          圆周率  
Out[12]=  $\pi$   
  
In[13]:= N[Pi, 10]  
          .. 圆周率  
Out[13]= 3.141592654  
  
In[14]:= E  
          自然常数  
Out[14]= e  
  
In[15]:= N[%]  
          数值运算  
Out[15]= 2.71828
```

At the bottom right of the interface, there are navigation icons: a left arrow, a right arrow, a double left arrow, a double right arrow, a search icon, and a refresh icon.

Libraries of mathematical functions



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```
未命名-2 * - Wolfram Mathematica 11.0
文件 (F) 编辑 (E) 插入 (I) 格式 (R) 单元 (C) 图形 (G) 计算 (V) 面板 (P) 窗口 (W) 帮助 (H)

In[16]:= Abs[-233]
Out[16]= 233

In[17]:= Abs[3 + 4 I]
Out[17]= 5

In[18]:= Gamma[1 / 2]
Out[18]=  $\sqrt{\pi}$ 

In[21]:= EulerPhi[100]
Out[21]= 40
```


Data and function visualization and animation tools

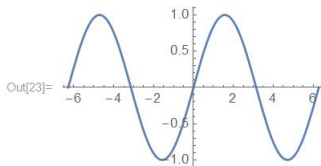
Data and function visualization and animation tools

未命名-2 * - Wolfram Mathematica 11.0

文件 (F) 编辑 (E) 插入 (I) 格式 (R) 单元 (C) 图形 (G) 计算 (V) 面板 (P) 窗口 (W) 帮助 (H)

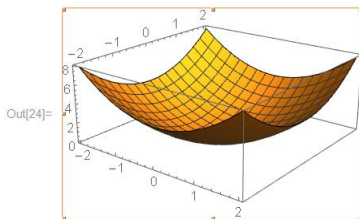
In[23]:= **Plot**[**Sin**[**x**], {**x**, -2 Pi, 2 Pi}]

绘图 正弦 ... 圆周



In[24]:= **Plot3D**[**x**^2 + **y**^2, {**x**, -2, 2}, {**y**, -2, 2}]

绘制三维图形

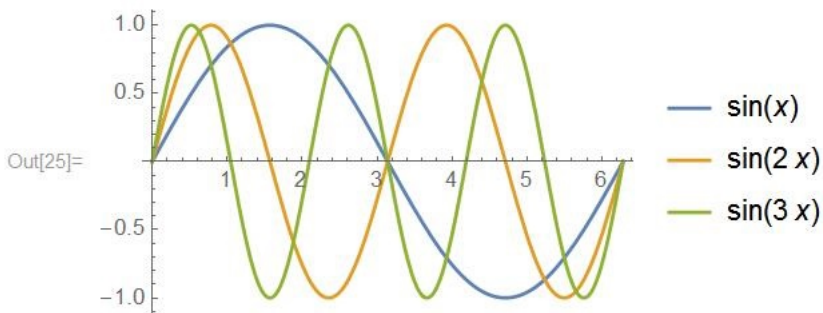


Data and function visualization and animation tools

In[25]:= **Plot**[{**Sin**[**x**], **Sin**[**2 x**], **Sin**[**3 x**]}, {**x**, **0**, **2 Pi**},
 [绘图] [正弦] [正弦] [正弦] [圆周]

PlotLegends → "Expressions"]

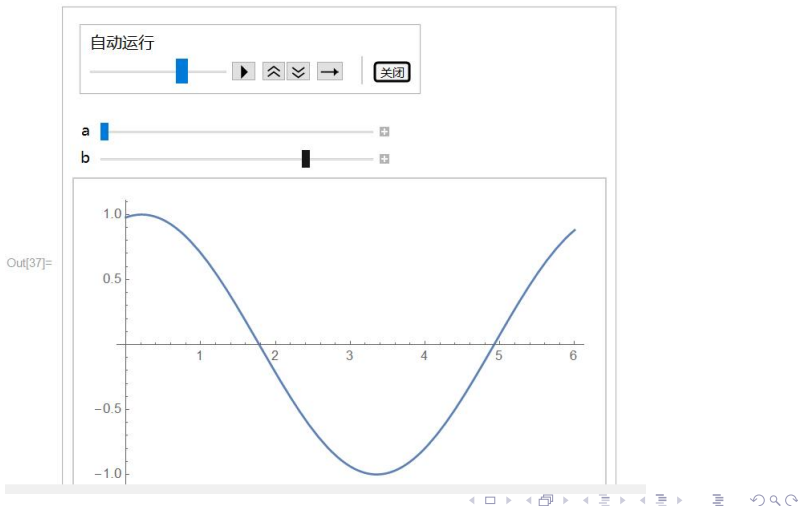
[绘图的图例]



Data and function visualization and animation tools

```
In[37]= Manipulate[Plot[Sin[a x + b], {x, 0, 6}], {a, 1, 4}, {b, 0, 10}]
```

交互式操作 绘图 正弦



Linear and non-linear control system libraries

Linear and non-linear control system libraries

```
In[62]:= Maximize[{x1 + x2, 2 x1 + x2 <= 2, x1 + 2 x2 <= 2}, {x1, x2}]
```

最大点值

```
Out[62]= {4/3, {x1 -> 2/3, x2 -> 2/3}}
```

Linear and non-linear control system libraries

```
In[65]:= Maximize[{x1 + x2, 2 x1 + x2 <= 2, x1 + 2 x2 <= 2, Element[{x1, x2}, Integers]},  
            最大点值      属于      整数域  
            {x1, x2}]  
Out[65]= {1, {x1 -> 1, x2 -> 0}}
```

Linear and non-linear control system libraries

In[88]:= **Minimize**[{**Sqrt**[**x**^2 + **y**^2], (**x** - 2)^2 + (**y** - 1)^2 == 2}, {**x**, **y**}]

最小点值 平方根

$$\text{Out[88]} = \left\{ \sqrt{7 - 2\sqrt{10}}, \left\{ x \rightarrow \frac{1}{5}(10 - 2\sqrt{10}) + \frac{1}{5}\sqrt{9 - 14(7 - 2\sqrt{10}) + (7 - 2\sqrt{10})^2}, \right. \right. \\ \left. y \rightarrow 1 - \sqrt{\left(-2 + 4\left(\frac{1}{5}(10 - 2\sqrt{10}) + \frac{1}{5}\sqrt{9 - 14(7 - 2\sqrt{10}) + (7 - 2\sqrt{10})^2}\right) - \right.} \right. \\ \left. \left. \left(\frac{1}{5}(10 - 2\sqrt{10}) + \frac{1}{5}\sqrt{9 - 14(7 - 2\sqrt{10}) + (7 - 2\sqrt{10})^2}\right)^2\right) \right\} \right\}$$

In[89]:= **Simplify**[%]

化简

$$\text{Out[89]} = \left\{ \sqrt{7 - 2\sqrt{10}}, \left\{ x \rightarrow 2 - 2\sqrt{\frac{2}{5}}, y \rightarrow 1 - \sqrt{\frac{2}{5}} \right\} \right\}$$

Calculate the sum of prime numbers below 100

Calculate the sum of prime numbers below 100

```
In[87]:= s = 0;  
t = 1;  
For[i = 1, i ≤ 100, i++, If[PrimeQ[i], s = s + i; t = t * i]]  
|For循环 |素数判定  
Print["s=", s]  
|打印  
Print["t=", t]  
|打印  
s=1060  
t=2 305 567 963 945 518 424 753 102 147 331 756 070
```

An easy parallel programming tool

An easy parallel programming tool

```
In[101]:= Table[PrimeQ[x], {x, 10^1000, 10^1000 + 10 000}]; // AbsoluteTiming
```

表格 素数判定 绝对时间

```
Out[101]:= {16.4827, Null}
```

```
In[100]:= Parallelize[Table[PrimeQ[x], {x, 10^1000, 10^1000 + 10 000}]]; // AbsoluteTiming
```

并行运行 表格 素数判定 绝对时间

```
Out[100]:= {10.5805, Null}
```

More Features

More Features

- Supervised and unsupervised machine learning tools for data, images and sounds including artificial neural networks
- Tools for 2D and 3D image processing and morphological image processing including image recognition
- Tools for visualizing and analysing graphs
- Tools to connect to dynamic-link library, SQL, Java, .NET, C++, Fortran, CUDA, OpenCL, and HTTP based systems
- Tools for financial calculations
- ...

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My Opinions

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- Advantages
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 - Powerful
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 - Expensive?

Conclusion

Choose the best tool for your work!

Thanks!