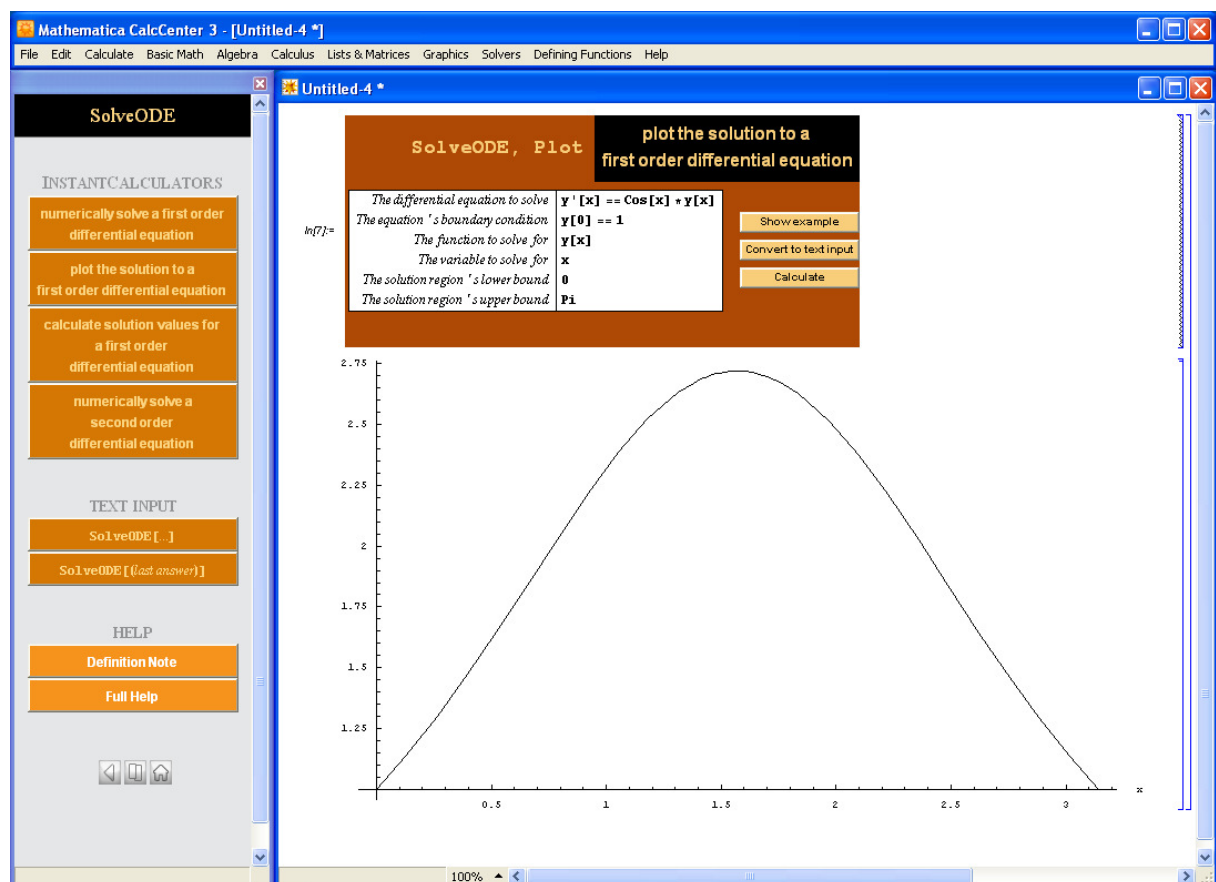# Mathematica CalcCenter

Basic features

Wolfram Mathematica CalcCenter is based on *Mathematica Professional* and it is primarily designed for technical calculations. Information about this product can be found and a trial version can be downloaded from the web pages of Wolfram research — see:

http://www.wolfram.com/products/calccenter/

Mathematica CalcCenter uses the standard MathKernel, but many of its functions are disabled. On the other hand, the front-end offers many facilities, most of which are not available in *Mathematica Professional*:

- "InstantCalculator" — each function is provided with a template, which the user can fill in and use to evaluate the function without the need to remember any keyword, sequence of parameters etc. Moreover, the template stays in the document, and so all parameters can be easily changed and the function reevaluated:
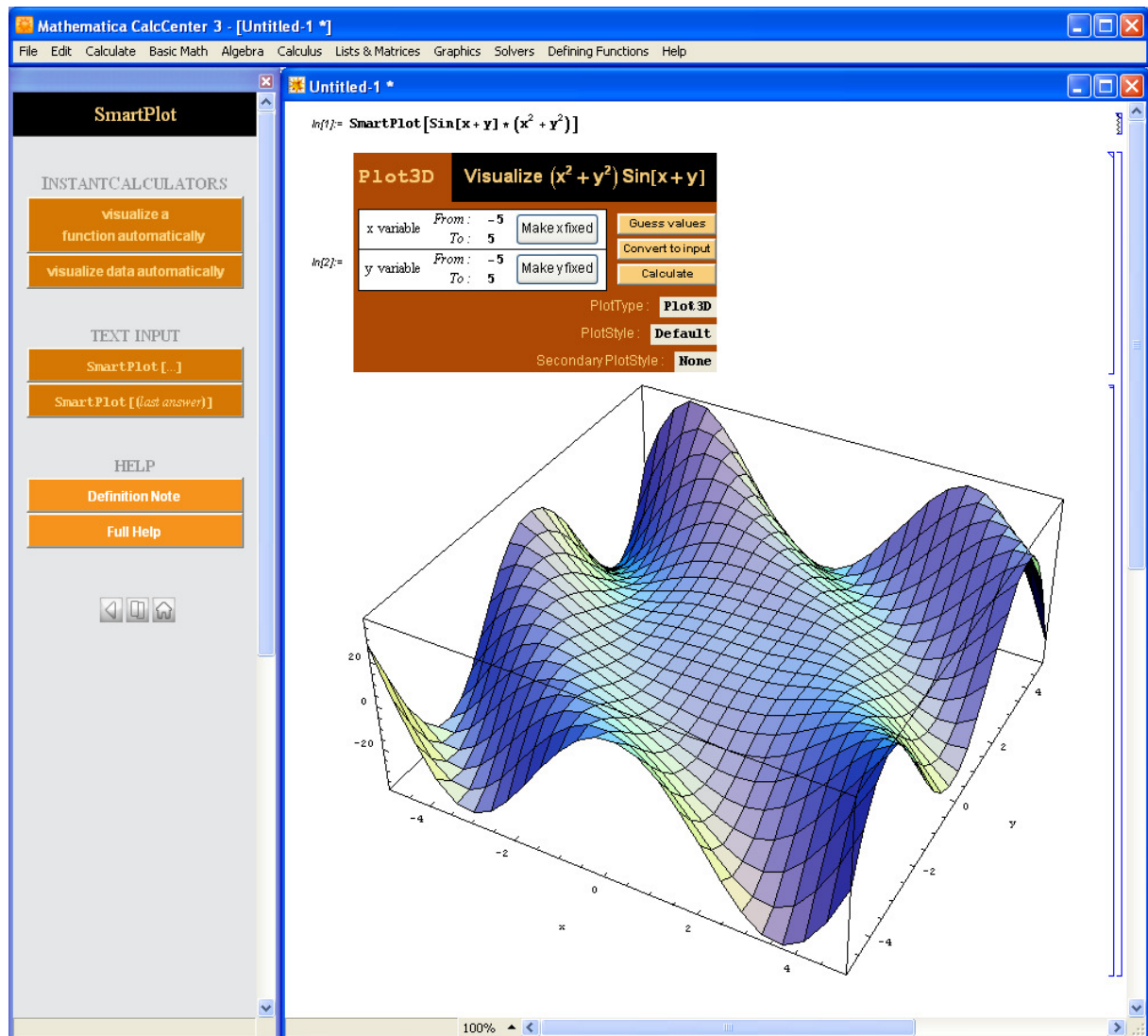
- If the user misprints a keyword, *Mathematica CalcCenter* suggests a nearest alternative:
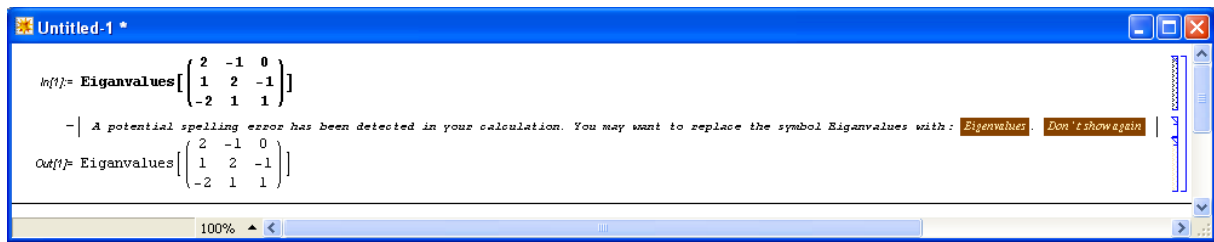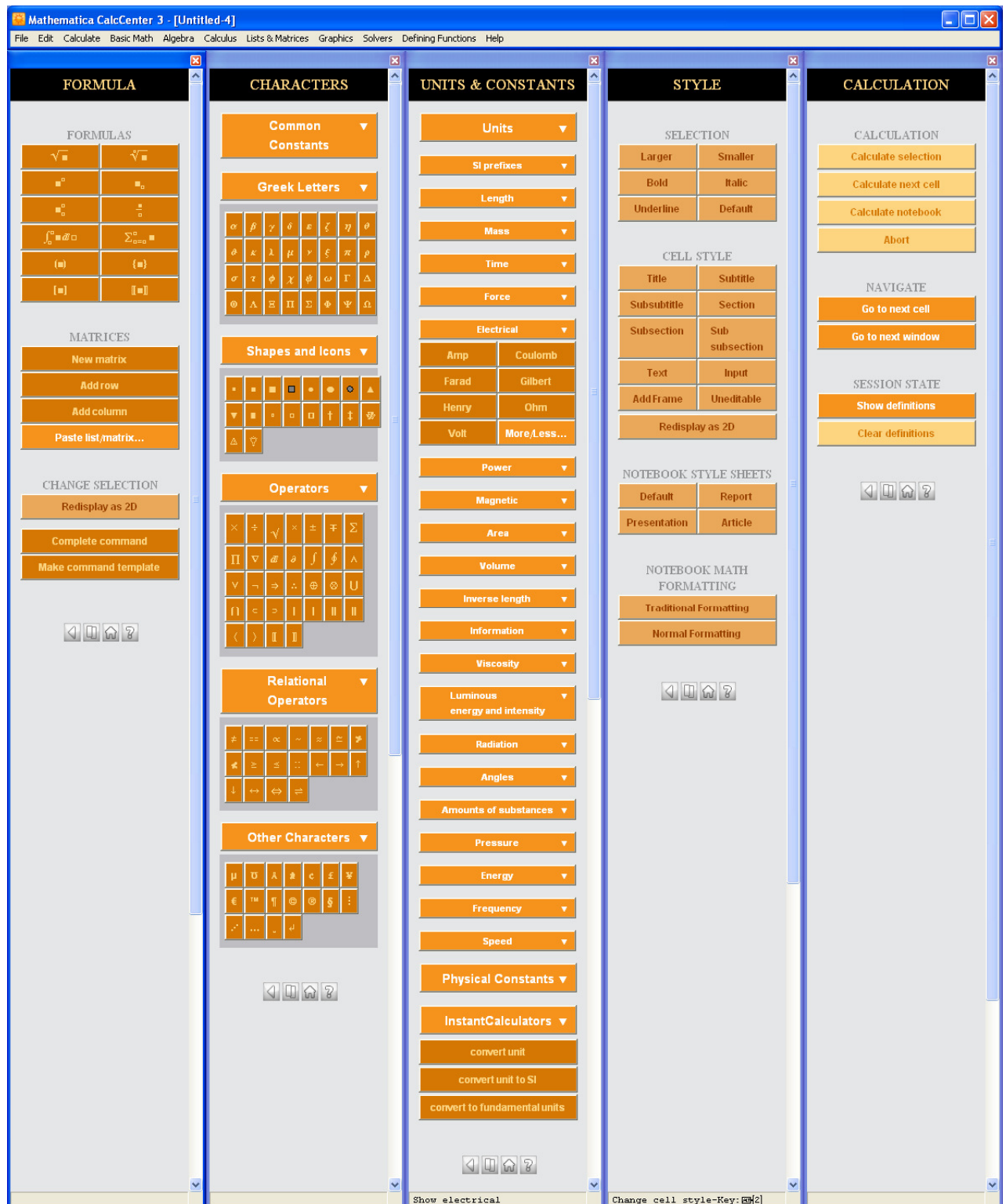

- "SmartPlot" — the user types only the definition formula of a function and the tool chooses the scale of the axes and appropriate plot type:
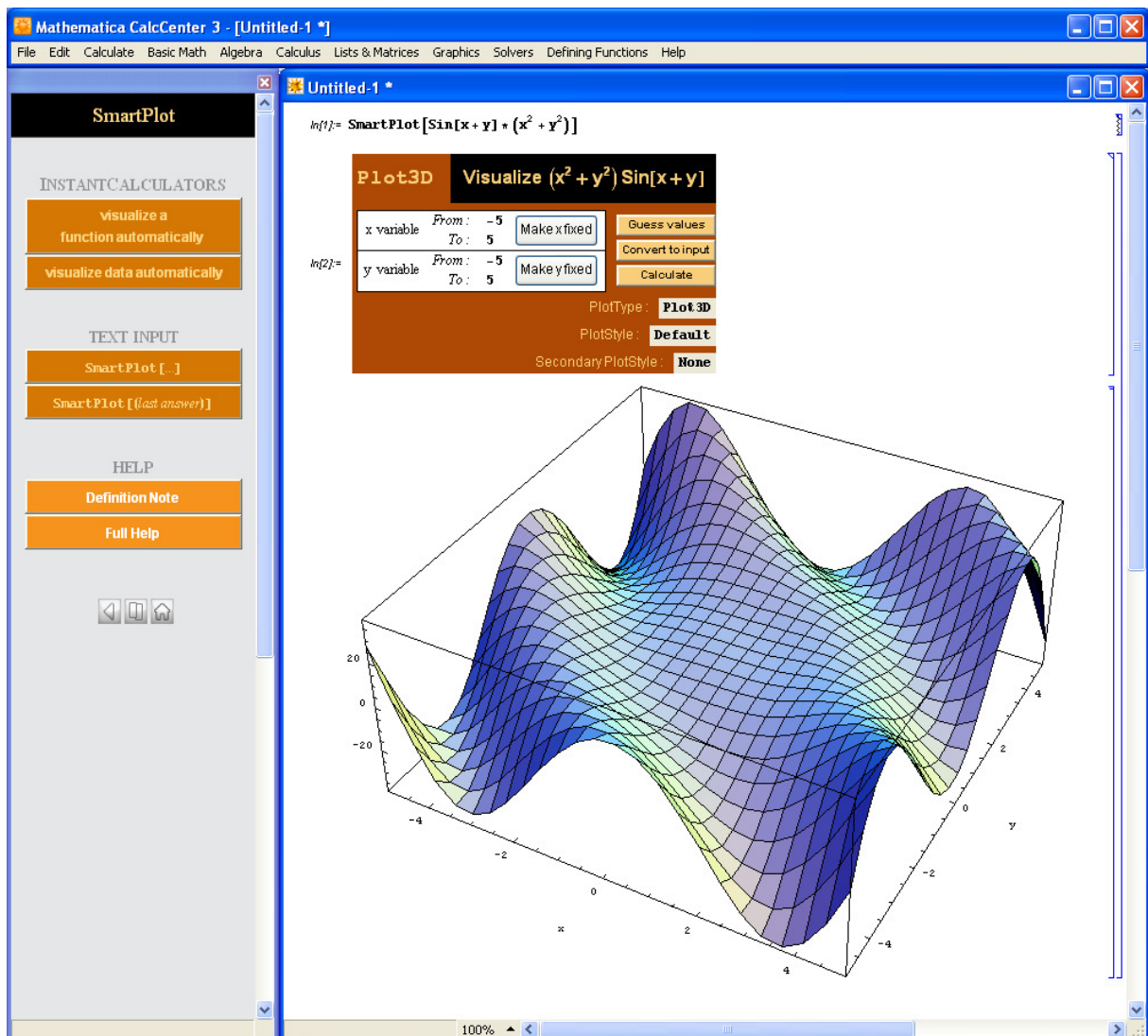
- Controllers for easy insertion of formulas, characters, units and constants, style and calculation. Many physical units and constants are predefined to make technical computations easier:

An important advantage of *Mathematica CalcCenter* compared with other packages, such as *Mathematica Professional,* is the much lower price of the license.

Numbers, Formulas

At a very basic level, it is possible to use *Mathematica CalcCenter* as a standard calculator.

$In[1]:=$ $4*12+1$

$Out[1]=$ 49

Note that the character "$*$" denotes multiplication. Alternatively, a space can be used, but this may look ambiguous. As with a standard calculator, the precision of computations is finite i.e. transcendental numbers and fractions are computed in decimal form.

$In[2]:=$ $\dfrac{10}{3} - 3.33333333333333$

$Out[2]=$ $3.552713679 \times 10^{-15}$

You see that the precision is 15 i.e.16 decimal digits (IEEE standard floating-point arithmetic, machine precision). Unlike *Mathematica Professional*, *Mathematica CalcCenter* stores all numbers in this form.

Using the controller "FORMULA", you can insert and work with matrices and vectors:

$In[3]:=$ $\begin{pmatrix} 2 & 3 & -1 \\ -3 & -4 & 7 \\ -1 & -2 & 0 \end{pmatrix} \cdot \begin{pmatrix} 5 \\ -2 \\ 1 \end{pmatrix}$

$Out[3]=$ $\begin{pmatrix} 3 \\ 0 \\ -1 \end{pmatrix}$

(here "." stands for matrix multiplication), roots:

$In[4]:=$ $\sqrt{3}$

$Out[4]=$ 1.732050808

$In[5]:=$ $\sqrt[3]{2}$

$Out[5]=$ 1.25992105 ,

powers and indices (and combinations of both):

$In[6]:=$ 2^{32}

$Out[6]=$ 4294967296

$In[7]:=$ $x_1 = 5$
$x_2 = 2$
$x_1^{x_2^2}$

$Out[7]=$ 5

$Out[8]=$ 2

$Out[9]=$ 25 ,

integrals and sums, both definite and indefinite (the symbol "∞" can be found in the controller "CHARACTERS"):

$In[10]:= \displaystyle\int_{1}^{\infty} x^{-3}\, dx$

$Out[10]= 0.5$

$In[11]:= \displaystyle\int \text{Tan}[x]\, dx$

$Out[11]= -\text{Log}[\text{Cos}[x]]$

$In[12]:= \displaystyle\sum_{n=0}^{1500} \frac{(-1)^{n}}{2\,n+1} + 2 \sum_{n=0}^{1501} \frac{(-1)^{n}}{2\,n+1} + \sum_{n=0}^{1502} \frac{(-1)^{n}}{2\,n+1}$

$Out[12]= 3.141592654$

$In[13]:= \displaystyle\sum_{i=0}^{\infty} \frac{1}{i\,!}$

$Out[13]= e$

Instead of the controllers, corresponding keywords can be typed.

$In[14]:= \textbf{Sqrt[2]}$

Infinity

$Out[14]= 1.414213562$

$Out[15]= \infty$

If you want *Mathematica CalcCenter* to display the result as a fraction, you use the command `$ShowFractions=True.`

$In[16]:= \textbf{\$ShowFractions = True}$

$Out[16]= \text{True}$

$In[17]:= \textbf{1 / 2 + 1 / 3}$

$Out[17]= \dfrac{5}{6}$

This command does not change the fact that *Mathematica CalcCenter* saves the result in machine precision. It only means that when a result is displayed, it is checked whether it is close to a fraction and if yes, this fraction is displayed instead of decimal digits.

$In[18]:= \textbf{0.83333333333}$

$\textbf{0.833333333333}$

$Out[18]= 0.8333333333$

$Out[19]= \dfrac{5}{6}$

Since the arguments of trigonometric functions are taken in radians, you can use the symbol for degrees (it is found in the controller "CHARACTERS").

In[20]:= `Sin[30 °]`

Out[20]= $\dfrac{1}{2}$

Expressions

Mathematica CalcCenter works with undefined variables symbolically, so you can apply several functions to work with expressions. For example, you can expand and simplify expressions:

In[21]:= `exp = (a + b)`^{2}

Out[21]= $(a + b)^2$

In[22]:= `ExpandAll[%]`

Out[22]= $a^2 + 2\,a\,b + b^2$

In[23]:= `Simplify[% - 4 * a * b]`

Out[23]= $(a - b)^2$

In[24]:= `Simplify`$\left[\dfrac{a^3 - b^3}{a - b}\right]$

Out[24]= $a^2 + a\,b + b^2$,

(notice that the symbol `%` refers to the last result, `%n` refers to the nth result). It is also possible to combine several fractions over a common denominator:

In[25]:= `Together`$\left[\dfrac{a}{b * (a - b)} - \dfrac{b}{a * (b - a)}\right]$

Out[25]= $\dfrac{a^2 + b^2}{a\,(a - b)\,b}$,

Polynomials can be factorised:

In[26]:= `Factor[x`^{3}` - 11 x`^{2}` + 49 x - 75]`

Out[26]= $(-3 + x)\,(25 - 8\,x + x^2)$,

Partial fractions can be expanded (in real numbers):

$In[27]:=$ `Apart`$\left[\dfrac{x^4 - 12\,x^3 + 60\,x^2 - 123\,x + 82}{x^3 - 11\,x^2 + 49\,x - 75}\right]$

$Out[27]=$ $-1 + \dfrac{1}{-3 + x} + x + \dfrac{6 - x}{25 - 8\,x + x^2}$

$In[28]:=$ `Together`$[\%]$

$Out[28]=$ $\dfrac{82 - 123\,x + 60\,x^2 - 12\,x^3 + x^4}{(-3 + x)\,(25 - 8\,x + x^2)}$.

Variables, Functions

A value can be assigned to a variable. The variable is then enumerated in all of the following expressions.

$In[29]:=$ `r = 2`
`2 * Pi * r`

$Out[29]=$ `2`

$Out[30]=$ `12.56637061`

The assignment can be cancelled using the function `Clear`.

$In[31]:=$ `Clear[r]`
`2 * Pi * r`

$Out[32]=$ `6.283185307 r`

Expressions with undefined variables can define user's functions of one or several variables.

$In[33]:=$ `CircleLength[r_] = 2 * Pi * r`
`CircleLength[2]`

$Out[33]=$ `6.283185307 r`

$Out[34]=$ `12.56637061`

$In[35]:=$ `RectangleArea[a_, b_] = a * b;`
`RectangleArea[3, 4]`

$Out[36]=$ `12`

Besides evaluation of expressions involving user's functions, *Mathematica CalcCenter* offers many additional input commands for functions e.g. computation of derivatives or plotting of graphs.

In[37]:= `f[x_] = x`^{3}` + x`^{2}` - 3 x + 1;`
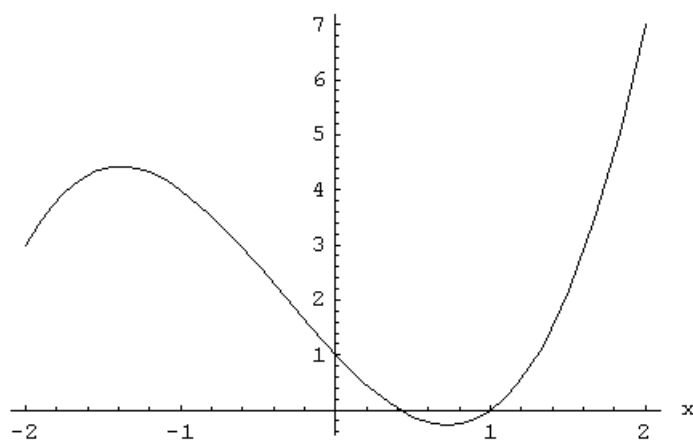`f[1]`
`f'[x]`
`f'[1]`
`f''[x]`

Out[38]= `0`

Out[39]= $-3 + 2 x + 3 x^2$

Out[40]= `2`

Out[41]= `2 + 6 x`

In[42]:= `Plot[f[x], {x, -2, 2}]`

The function `Table` displays a list of values of an expression or a (user's) function at several points.

In[43]:= `Table[x`^{2}`, {x, 0, 10}]`
`Table[E`^{i*x}`, {x, 0, Pi, Pi / 4}]`
`Table[f[x], {x, -2, 2}]`

Out[43]= `{0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100}`

Out[44]= `{1, 0.7071067812 + 0.7071067812 i, i, -0.7071067812 + 0.7071067812 i, -1}`

Out[45]= `{3, 4, 1, 0, 7}`

Solvers

Mathematica CalcCenter contains tools for numerical (not symbolical) solutions of algebraic and differential equations. Algebraic equations (and their systems) can be solved using `SolveEquation` and initial value problems for ordinary differential equations using `SolveODE`.

In[46]:= **SolveEquation [2 x + 6 == 0 , x]**
SolveEquation [{x + 2 y == 5 , 3 x - y == 1} , {x , y}]
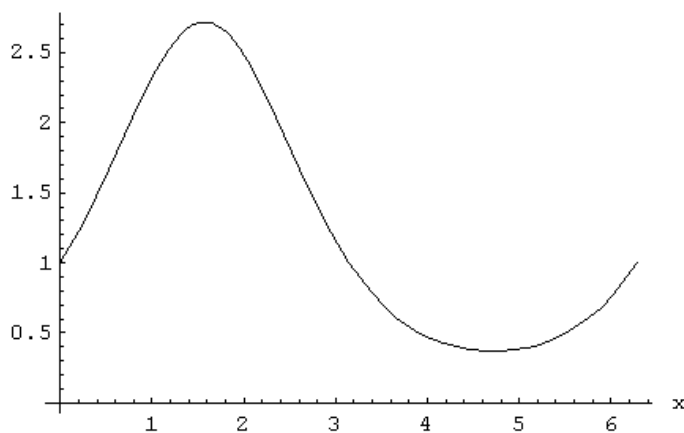
Out[46]=

x
-3

Out[47]=

x	y
1	2

In[48]:= **sol = SolveODE [{y ' [x] == Cos [x] * y [x] , y [0] == 1} , y [x] , {x , 0 , 2 Pi}]**
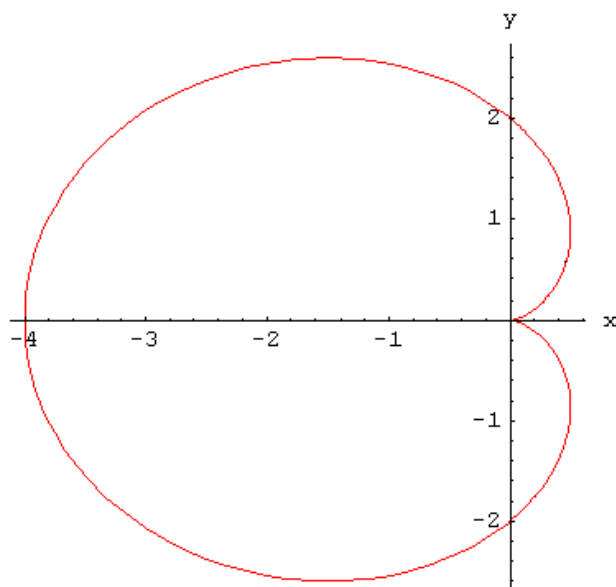
Out[48]=

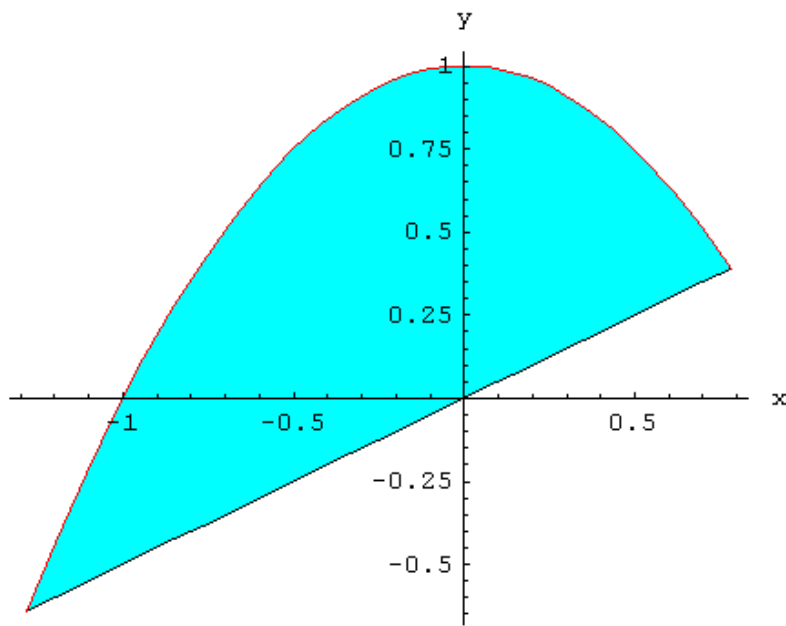| y[x] |
|------|
| InterpolatingFunction [(0   6.283185307), <>] [x] |

In[49]:= **Plot [sol , {x , 0 , 2 Pi}]**

For plotting of implicitly given planar curves and graphical solutions of inequalities, *Mathematica CalcCenter* has the function `InequalityPlot`:

In[50]:= **InequalityPlot [(x^2 + y^2 + 2 x)^2 == 4 (x^2 + y^2) , {x , -4 , 1} , {y , -3 , 3}]**

In[51]:= `InequalityPlot[{y < 1 - x`^{2}` && 2 y > x}, {x, -2, 1}, {y, -1, 1}]`

Conclusion

Mathematica CalcCenter is suitable for basic technical computations, drawing graphs, curves etc. Its much lower price compared with *Mathematica Professional* makes *Mathematica CalcCenter* a valid alternative not only for high-school students, but also for university students where some basic mathematics is taught as part of their course.