

MAthematics with PLEasure

What is Maple?

Maple is one of the leading mathematic software's available. It is an advanced mathematical computation engine with fully integrated numerals and symbols. Maple displays graphs with state-of-the-art graphics and animations, and allows users to do simple to complex calculations in a user friendly setting

Brief History:

A general-purpose commercial mathematics software package was first introduced in 1980 at University of Waterloo, Canada. Since 1988, Maple has been developed further more and sold commercially by Waterloo Maple Inc., which is also known as Maplesoft.

This computer program, Maple, can be used to solve wide range of mathematical problems. They include but not limited to differentiate, integrate, and manipulate formulas, plot curves and surfaces in two and three dimensions, etc.

Here list a few commands that can be used in Maple...

- All Maple commands must be terminated with a semicolon (;) (if output is desired) or a colon (:) (to suppress output).
- `a:=1.53;` Assigns the value 1.53 to the variable **a**.
- `Pi;` The *exact* constant π .
- `f:=x^2+5;` Defines the *expression* $f = x^2 + 5$.
- `f:=x->x^2+5;` Defines the *function* $f(x) = x^2 + 5$.

- **eqn:=x^2-3=2*x**; Assigns the *equation* $x^2 - 3 = 2x$ to the variable **eqn**.
- **exp(x)**; The exponential function e^x .
- **sqrt(x)**; The square root of x , \sqrt{x} .
- **evalf(expr)**; Evaluates the expression **expr** as a floating point decimal number.
- **expand(x^2*(2*x+1)^3)**; Distributes multiplication over addition :

$$x^2(2x+1)^3 = x^2(8x^3 + 12x^2 + 6x + 1) = 8x^5 + 12x^4 + 6x^3 + x^2$$
- **simplify(expr)**; Algebraically simplifies the expression **expr**.
- **factor(expr)**; Factors a polynomial **expr**.
- **solve(eqn,x)**; Tries to give an *exact* solution listing all x 's which solve the equation stored in **eqn**. If the equation is a polynomial of degree 3 or more, the solution may be expressed using **RootsOf**. Decimal approximation may be obtained using **evalf(%)**. Maple may not know how to find *exact* solutions in some cases.
- **plot(expr,x=a..b,y=c..d)**; Plots **expr** over the interval $a \leq x \leq b$, but restricts the displayed values of y to the range $c \leq y \leq d$.
- **Limit(expr,x=a)**; Displays (but does not evaluate) $\lim_{x \rightarrow a} f(x)$, where $f(x)$ is the expression **expr**. This is referred to as the "inert" version of the limit command. In general, when Maple encounters a command that begins with a capital letter, it will return the mathematical symbol for that operation, without carrying out that operation.
- **value(%)**; Computes the value of the previous output. The result will be an expression.
- **evalf(%)**; Computes a floating point approximation to the previous result.
- **diff(expr,x)**; Differentiates the *expression* **expr** with respect to the variable **x**. The **x** is required even though there may be no other variables in **expr**.
- **int(expr,x=a..b)**; Computes $\int_a^b f(x)dx$, where $f(x)$ is the expression **expr**.
- **Sum(expr,i=m..n)**; Displays (but does not evaluate) $\sum_{i=m}^n \mathbf{expr}$.
- **sum(expr,i=m..n)**; Sums the expression **expr** as i goes from m to n . The arguments **m** and **n** may be integers or arbitrary expressions.

In Maple, there are two main input tools, the text and math cursors. The text tool is used to insert plain text after the current execution and the math tool is used to insert Maple input such as functions, graph plots, and other commands in which Maple can execute. Using F5, one can toggle between these two tools.

Text and Customization

Using the text toolbar, customizations of text is as simple as choosing the respected buttons for each customizations. A handful of text customizations will be familiar, such as:

- Font
 - The different styles of lettering
- Font Size
 - The different sizes of the font ranging from 8 to 288
- Bold
- Italic
- Underline
- Align paragraph left, center, right Font Color
 - Changes the color of font using three different methods
 - The swatches menu allows one to choose predetermined colors
 - HSB menu allows to customize the colors using different hues of each color
 - RGB menu uses different amounts of red, green, and blue to change the color
- Highlight Color
 - The color that will be the highlight, or background, of the text field
 - Highlight colors are customized in the same fashions as the Font color

Expressions

The math tool is used to insert Maple input such as expressions, graph plots, and other commands in which Maple can execute. Once the math tool is initiated, by using F5 to toggle between text and math tools, enter Maple commands at the Maple prompt. Maple recognizes your entry as Maple input and executes the command.

1. Enter the Maple input followed by a semi-colon. If the input ends with a semi-colon, the result is usually displayed such as,

```
> factor(x^2 + 2*x + 1);  
      (x + 1)2
```

2. Press the Enter key. Maple evaluates the input and displays the output, provided that the input ends with a semicolon.

Maple also allows one to assign expressions to names, allowing easy access to the expression. This allows the user to execute an expression without having to rewrite the expression each time the expression is used. Assign a Maple expression to a name so that you can use the expression again in subsequent calculations.

- 1) In math mode, begin by typing the name of the expression, such as `expn`, followed by a colon and an equal sign.
- 2) Input the expression followed by the semicolon to complete the input.

```
> expn := 3 * sin(x) + 2 * cos(x);  
expn := 3 sin(x) + 2 cos(x)
```

```
> sin(x) * expn;  
sin(x) (3 sin(x) + 2 cos(x))
```

The user can also assign equations to names:

```
> expn := 3 * sin(x) + 2 * cos(x);  
expn := 3 sin(x) + 2 cos(x)
```

```
> sin(x) * expn;  
sin(x) (3 sin(x) + 2 cos(x))
```

The user can define own function:

```
> f := x -> x * 2;  
f := x → 2x
```

```
> f(3);
```

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```
> f(y + 1);
```

Graphing on Maple:

The Main function on maple is defined with:

```
> plot(f(x), options);
```

Just plotting a graph in maple is quite easy and effective. However just graphing a simple function from $x = (-10, 10)$ can be done effectively on a graphing calculator as well. It is the options and details of graphing on Maple that make it a utility that you might want to utilize in your classroom.

Graphing Options:

Setting up the graphing window (defining the domain and co-domain that are displayed):

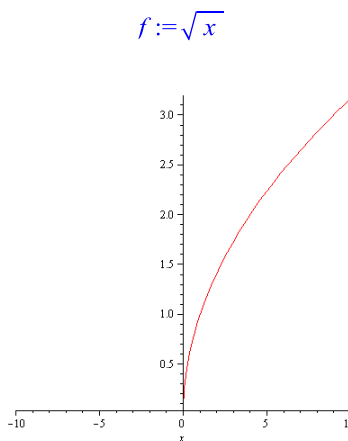
This parameter is defined in using:

```
x=a..b, y=c..d
```

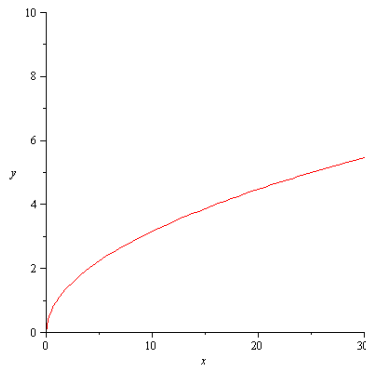
this line will display a graph where the x axis has values a to b displayed and the y axis has values c to d displayed. Being able to change your window will allow the viewer to get a better feel for what certain functions actually look like. For example if we just try and graph the function $y = \sqrt{x}$ the graph displayed does not look nearly as good as when we change the window to $0 \leq x \leq 30$ and $0 \leq y \leq 10$. This is what the change looks like:

```
>  
> f:=sqrt(x);
```

```
> plot(f);
```



```
> plot(f,x=0..30,y=0..10);
```



Plotting multiple functions on one set of axis:

Maple is great for plotting two functions. It allows you to choose the colors of each line and gives great detail. The calling sequence for graphing multiple functions is as follows:

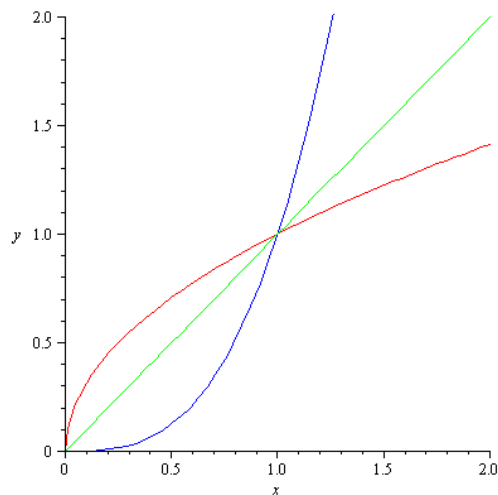
```
plot([f(x),g(x)],options);
```

The main difference to notice is that when plotting multiple functions we need [] sectioning off the two (or more) functions that we want graphed. Now under the options we can choose the color that we want our functions to show up in.

```
color=[color1,color2]
```

This input will make the graphs that you have defined previously the colors you want (respectively). Here is an example of what you can show while graphing multiple functions:

```
plot([sqrt(x),x^3,x],x=0..2,y=0..2,color=[red,blue,green]);
```



A Few other helpful Maple graphing commands...

We can change the way the x and y axis are displayed and add gridlines to make graphs more readable. The commands to change the axes are as follows:

axes=boxed, framed, none, normal

We can change the thickness of a given equation:

Thickness=n

(where n is an integer, if not specified the default thickness in maple is 0)

We can change the style of each line:

linestyle=solid,dot,dash,dashdot,longdash,spacedash

We can apply these options to our previous example to get the following example:

```
>plot([sqrt(x), x^3, x], x=0..2, y=0..2, color=[red, blue, green],  
thickness=[0, 2, 5], linestyle=[dash, dot, solid], axes=boxed);
```

