

## Functions and Plots

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### Overview

You will likely to deal with graphs on a daily basis in your study of Calculus and beyond. The main objective in this lab is to learn to use Maple to produce graphs of functions. This important topic is already introduced in the New User's Tour of Lab 1 and we will go over it again here in more detail.

### Maple Essentials

- Important Maple commands introduced in this lab:

Command	Description	Example
<code>:=x-&gt;</code>	define a function in variable x	<code>f:=x-&gt;abs(x)/sqrt(x)+2*x^2;</code> <code>g:=x-&gt;sin(x)*cos(2*x)+exp(1-x^2);</code>
<code>plot</code>	plot one or more expressions	<code>plot(f(x), x=1..2, y=0..8, title=My Graph);</code> <code>plot([x, -x], x, color=[red, blue], style=[point, line]);</code>

- As introduced in Lab 1, the best way to start the *Plot Builder* maplet is right-clicking over the function to be plotted. It can also be started from the Maple 11 user interface under the **Tools** menu:

**Tools** → **Assistants** → **Plot Builder ...**

### Related course material

§1.1 and §1.2. Specially, you should review Examples 3–5 (pages 18–21) in §1.2 for choosing an appropriate viewing window for graphing.

### Activities

1. Create one plot that displays the graph of both  $f(x) = \sqrt{x}$  and  $g(x) = |x|/2$  using the viewing window  $[-3, 3] \times [0, 2]$ . Change the line style for each function so the curves can be distinguished from one another on a black and white copy. Give your plot a title and legend. Detailed steps of this activity are given on the next page.
2. Create four Plots of the same function  $y = x^3 - x$  using the following different x-ranges:  $-0.1 \leq x \leq 0.1$ ,  $-1 \leq x \leq 1$ ,  $-10 \leq x \leq 10$ , and  $-2 \leq x \leq 2$ . This example will show that choices of viewing ranges can greatly affect one's perception of how a graph looks. Your TA will lead a discussion to understand mathematics behind it.
3. Repeat Activity 1 on your own using  $f(x) = 2 \sin(4x)$ ,  $g(x) = 2 + \cos(\frac{x}{2})$ , and  $h(x) = \sin(x)$  on the viewing window  $[-\pi, \pi] \times [-4, 4]$ .

### Assignment

Use Maple to work out Exercises 9, 10, and 19 in §1.2 (page 25).

*Activity 1: detailed steps*

- Let us first define  $f(x)$  and  $g(x)$ . You should make it a habit to define a function or assign an expression to a name first. This will make them easier to call and change in the future. Remember, you can use the Expression palette if you wish. You should always inspect the output to verify that the function or expression was entered correctly.

```
> f:= x -> sqrt(x);
> g:= x -> abs(x)/2;
> f(x);
> g(x);
```

- We will start with graphing  $f(x) = \sqrt{x}$ . Launch the **Interactive Plot Builder** by right-clicking over returned  $\sqrt{x}$ . From the context menu, choose **Plots** and then **Plot Builder**.
- Change the range for  $x$  to be -3 to 3.
- Click **Options**. Under **Line**, change the style to **dash**. Under **Color**, change the color to **Blue**. Under **Title**, give your graph a title, say **My Graph**. Click **Plot**.
- Maple will return your plot with the following command (you may right-click over the equation lab (3) and choose Label Reference to change it the function it refers to).
 

```
> plot((3), x=-3..3, linestyle=dash, color="Blue", title="My Graph");
```

 Notice that each change we made using the Plot Builder brings up an option in the **plot** command and that will be very helpful for us to mimic.
- Recall that we can add other functions and choices using square brackets. We can also change the window vertically by adding a command for the y-range.
- Let us copy, paste, and edit the command to plot  $f(x)$  red with a solid line together with  $g(x)$  blue with a dashed line and change the window to  $[-3,3] \times [0,2]$ . Remember to use square brackets when needed and you should come up with something like this:
 

```
> plot([f(x),g(x)], x=-3..3, y=0..2, linestyle=[solid, dash], color=["Red", "Blue"], title="My New Graph");
```
- To create the Legend, do the follow: Right-click over the plot to see the context menu. Under the option **Legend**, select **Show Legend**. Repeat the step but select **Edit Legend** this time. Enter an appropriate label for the first curve. Repeat those steps for the other curve in the plot.
- Finally, try to copy and paste your figure to a Word document (you may need it to prepare project reports). Also right-click over the plot and try other options, for example, under option **Title**, select **Add Caption**.

*Remarks*

- If you have time left, work on some examples/exercises in §1.2 or some homework problems that involve graphs.
- You should save your worksheet as you may need it later (review,quiz,...).
- Don't forget to logout.