Graphing Calculator User Documentation

Installation, user manual and frequently asked questions

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Contents

Getting Started

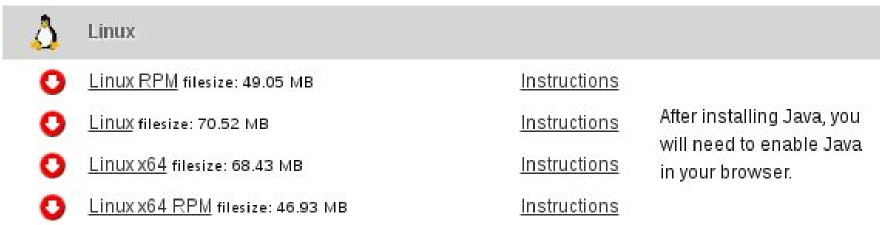
Getting Java

Java is a programming language and computing platform first released by Sun Microsystems in 1995. There are lots of applications and websites that will not work unless you have Java installed. The graphing calculator is written in Java, and will only be able to run where there is a Java Runtime Environment (JRE) installed. This may seem restrictive, but the pros far outweigh the cons; having the software run on Java means that it can be used wherever Java is installed. As a result, the graphing calculator is cross platform and will behave the same way no matter which operating system it is running on.

Thankfully, installing a JRE has always been a simple and painless process. Instructions are below:

1. Using a web-browser, navigate to https://java.com/en/download/.
2. Click on the large 'Free Java Download' button.

3. The Java website should automatically select an appropriate download for your computer's operating system. Normally, there will be only one option for a machine on a more popular operating system.



4. Once the installer file has downloaded, click it in the downloads bar. This will launch the Java installer and set up a JRE on your system.

Installation of the Graphing Calculator

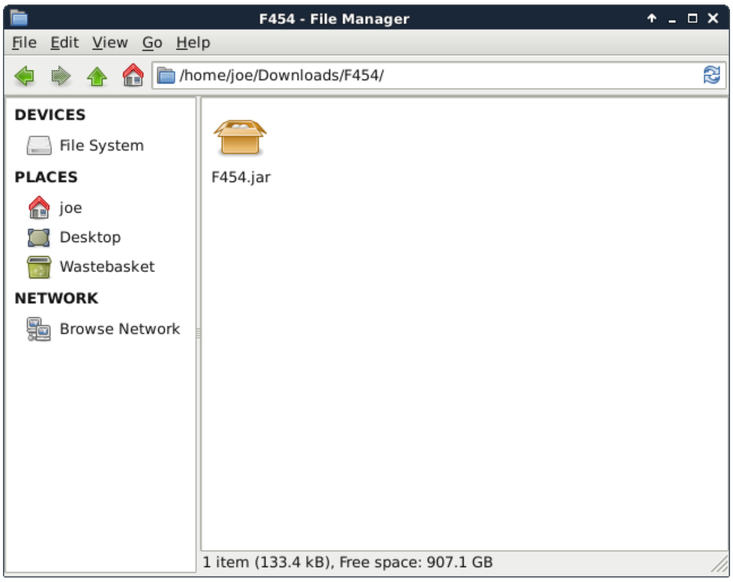
With Java installed, the graphing calculator can now be run. Download a copy of the graphing calculator by following the link below:

https://drive.google.com/file/d/0B2YN9zUKYnkOYWhJR3J0bkhyM0k/view?usp=sharing

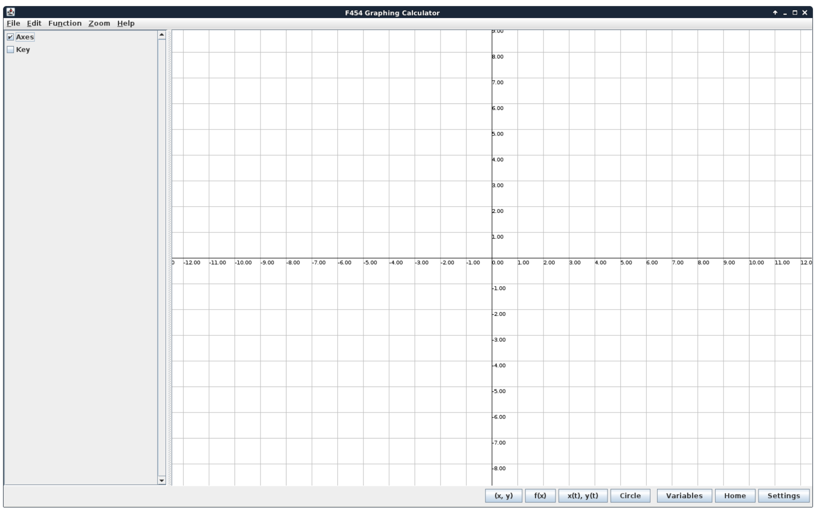
The graphing calculator is compiled as a runnable JAR file, meaning that you should only need to double click it in a file manager to launch it. Technically, the graphing calculator requires no installation.

To start the graphing calculator:

1. Navigate to where you downloaded the graphing calculator JAR file to in a file manager.



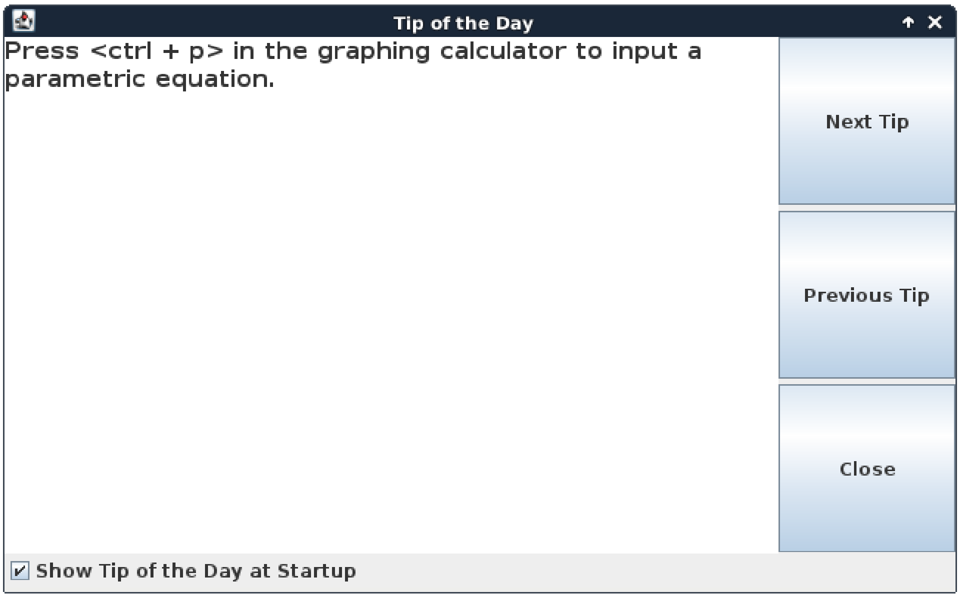
2. Simply double click the 'F454.jar' file, and the graphing calculator should launch.



Typical Use

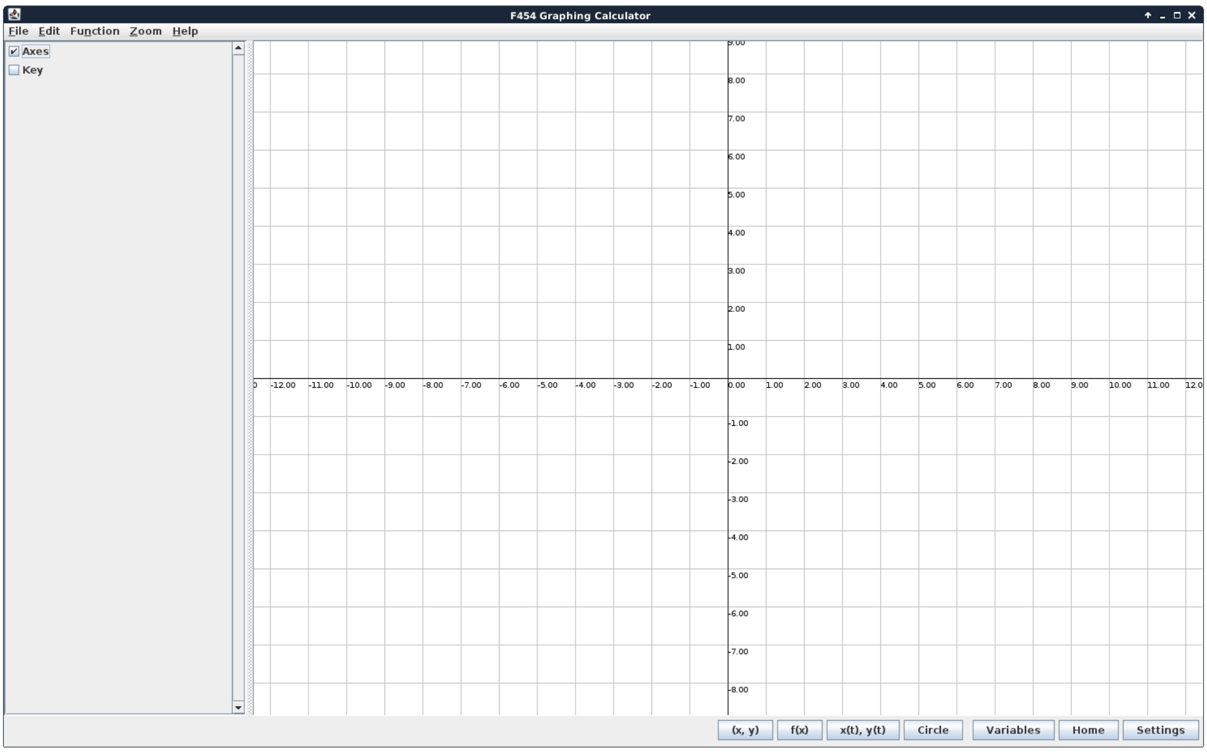
The graphing calculator is designed to allow you to quickly and easily have functions, data, circles and parametric equations plotted on-screen.

Upon starting the program for the first time, you will see the Tip of the Day dialog.



The Tip of the Day dialog offers tips and tricks that can help provide a better experience with the software. There are a total of 29 different tips to be read, and a new one is chosen at random upon startup. You can control whether or not you want to see the dialog at startup by checking or unchecking the checkbox at the bottom, titled ‘Show Tip of the Day at Startup’. You can still access it through the ‘Help -> Show Tip of the Day’.

After dismissing the Tip of the Day dialog, you are greeted with the main window.

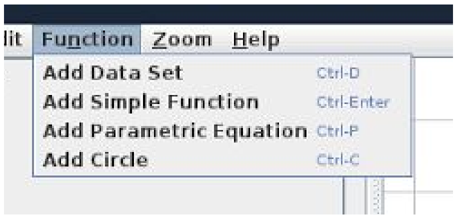


There are a few important components on this window:

- The panel on the left hand side contains a list of all of the mathematical objects present on the coordinate system. At startup, it only contains the axes and the key. As you start to add mathematical objects, this list will grow longer. The checkbox next to each entry can be used to toggle the visibility of all mathematical objects.
- The graphing panel takes up the majority of the screen. This is where the plots for the mathematical objects will appear. You can pan the coordinate system by dragging the mouse and zoom using the scroll wheel.
- The reserved space at the bottom of the window houses buttons for a few of the most important functionalities of the graphing calculator.

There are numerous ways you can input mathematical objects:

- Choose from the ‘Function’ menu at the top of the screen.

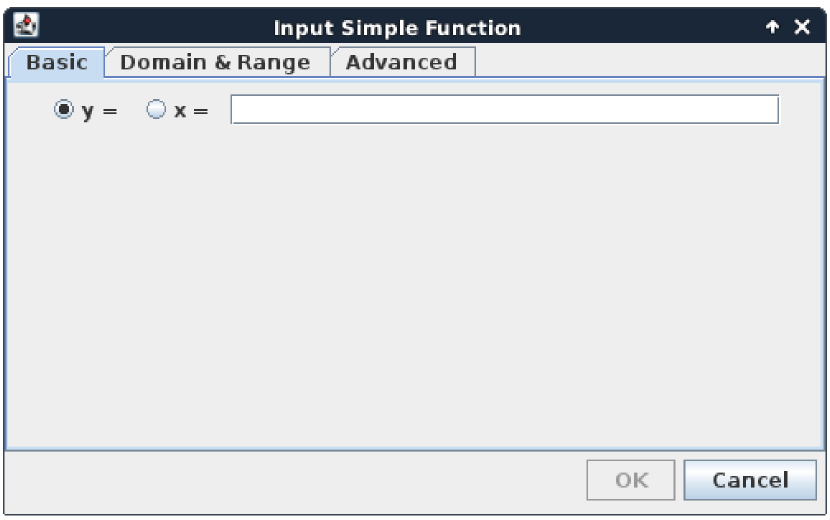


- Click any of the buttons at the bottom of the screen.

- Use the keyboard shortcuts shown in the ‘Function’ menu.

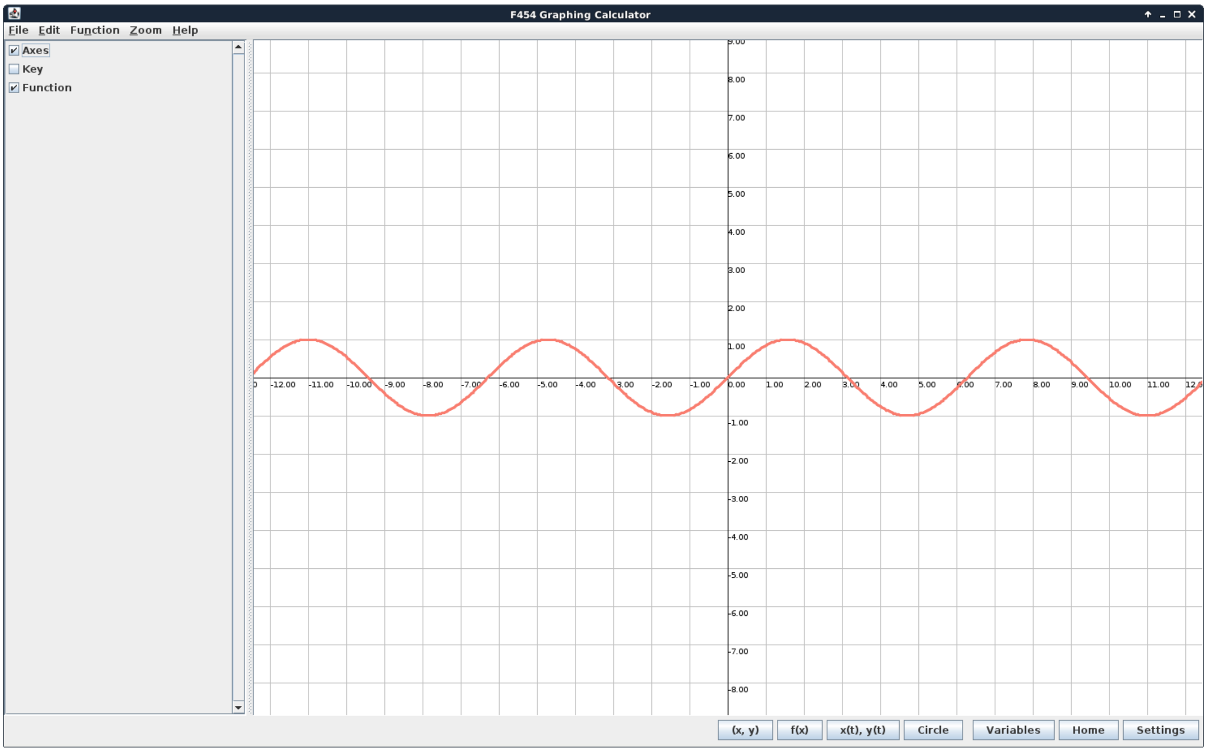
Inputting Functions

First, we will have a look at inputting functions. Using any of the methods above, you can raise the Input Simple Function dialog. This looks like:

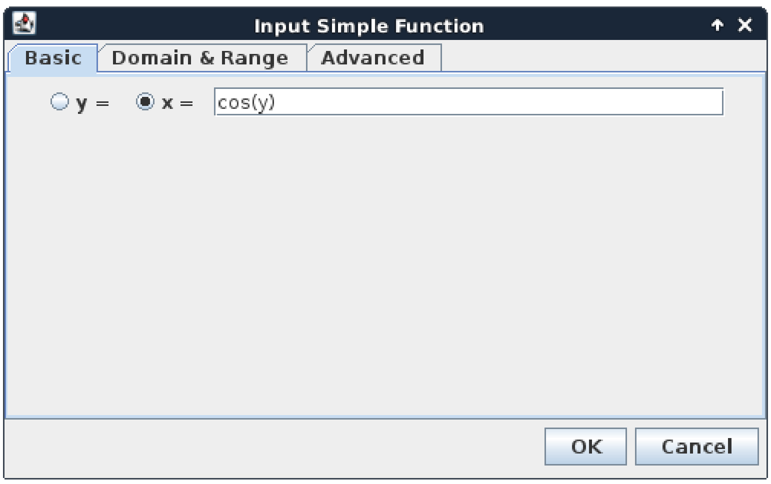


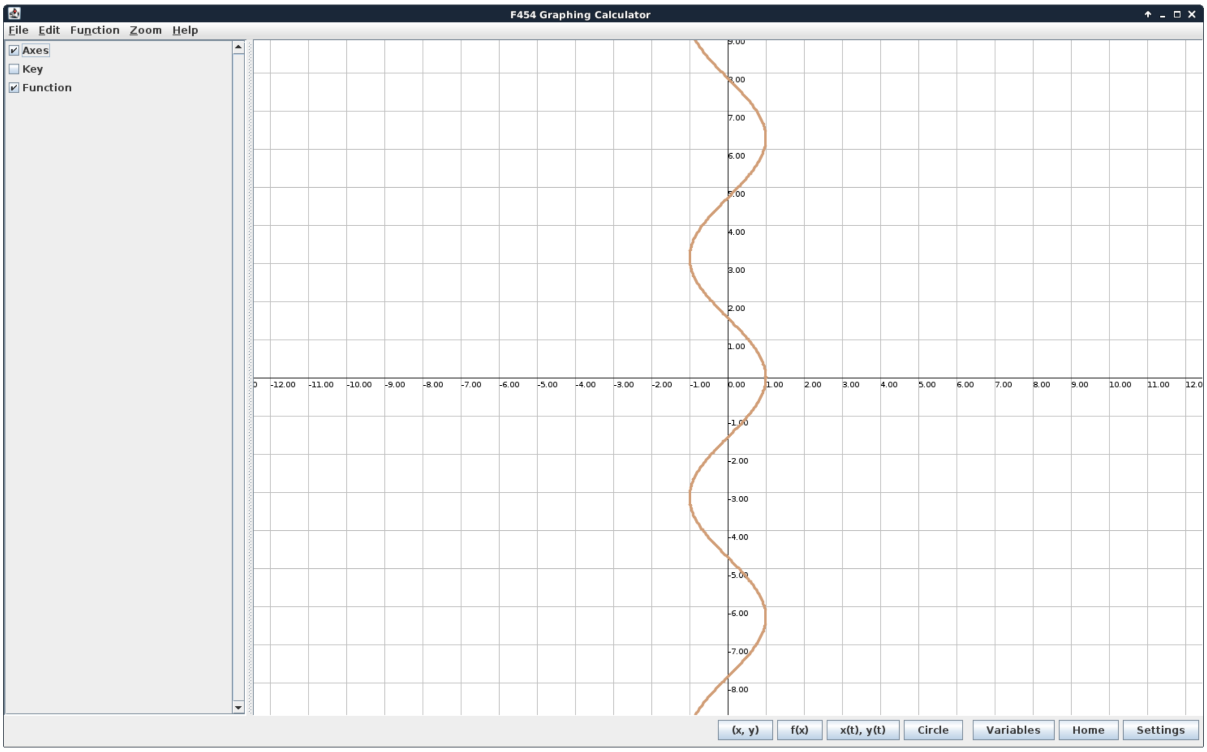
This is the basic tab for inputting a simple function. Most users will only ever need to explore this tab. Note that the ‘OK’ button is currently grayed out because the software has detected that there is no text in the textbox yet. The textbox will remain gray for as long as the contents of the text box is invalid, e.g. syntax error.

Enter the expression for your function in the text box and press enter to confirm. The graphing calculator will render the function and plot it on the coordinate system.
For instance, if we enter ‘sin(x)’ into the textbox, we will see the following:

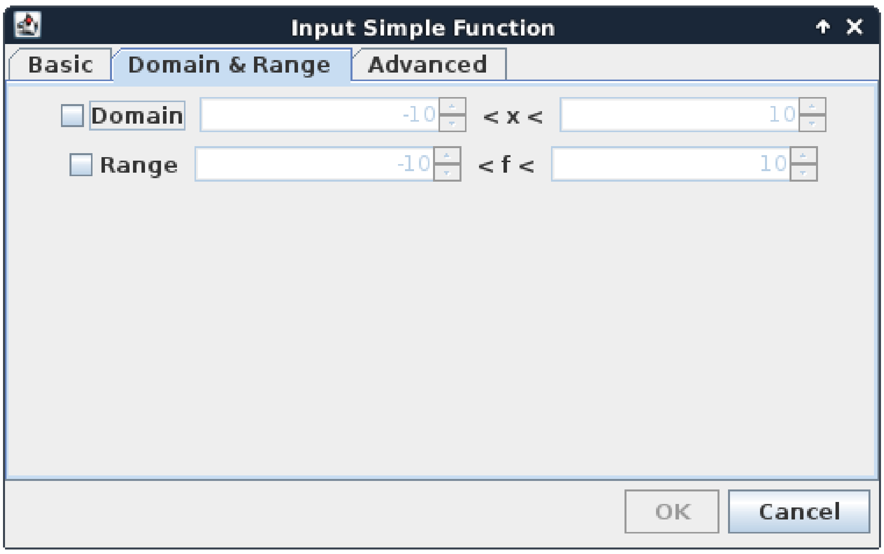


It is also possible to plot a function of the form $x = f(y)$ by changing the radio buttons in the dialog, as depicted below. Make sure that you use the y variable instead of x, though!

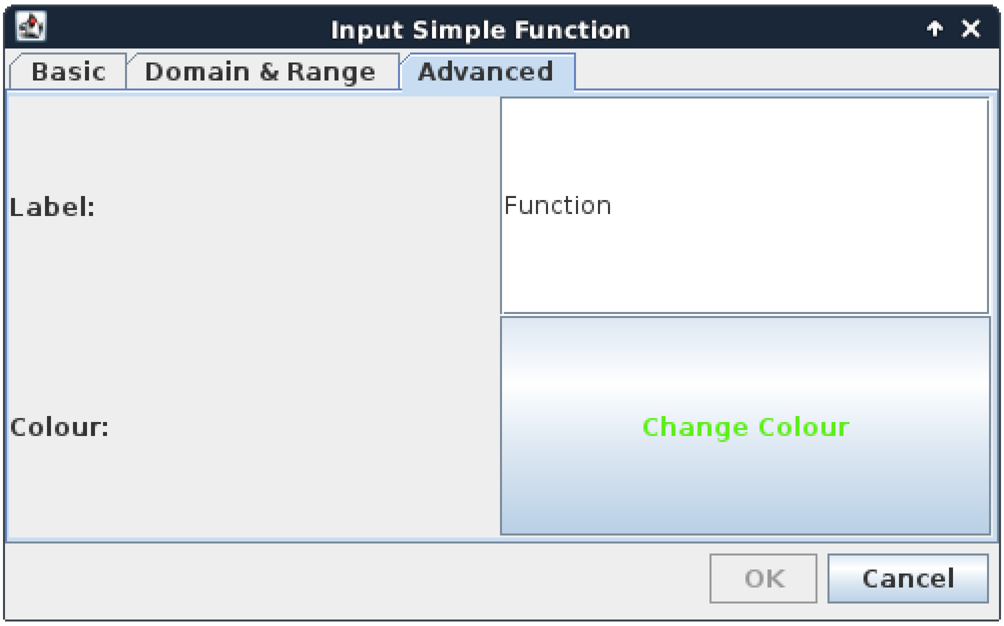




If you are an advanced user, you may want to alter the range or domain of the function. This can be done through the Domain & Range tab.



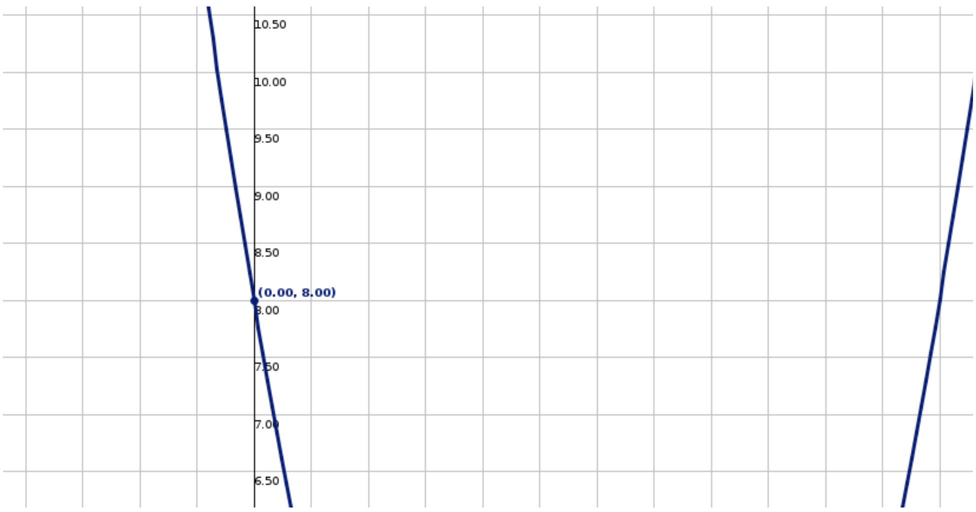
In addition to this, you can change the label and colour of the function through the advanced tab.



This advanced tab is available on all mathematical objects.

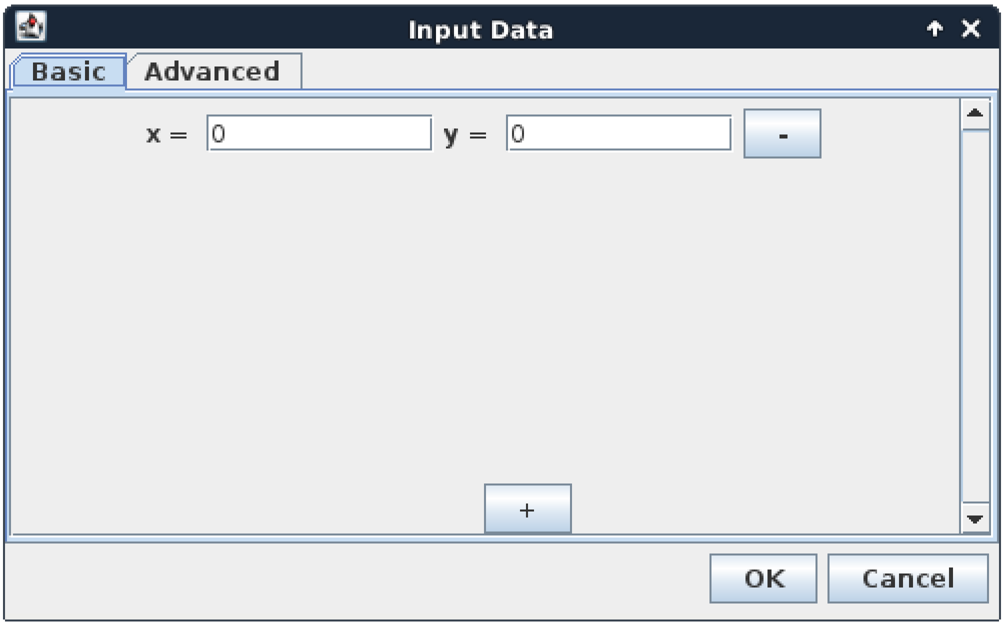
Right clicking functions in the list of mathematical objects raises a small menu:

These options are, for the most part, self-explanatory. The ‘show y-intercept’ checkbox makes the graphing calculator draw a point where the function intersects the y-axis. Examine the following screenshot:

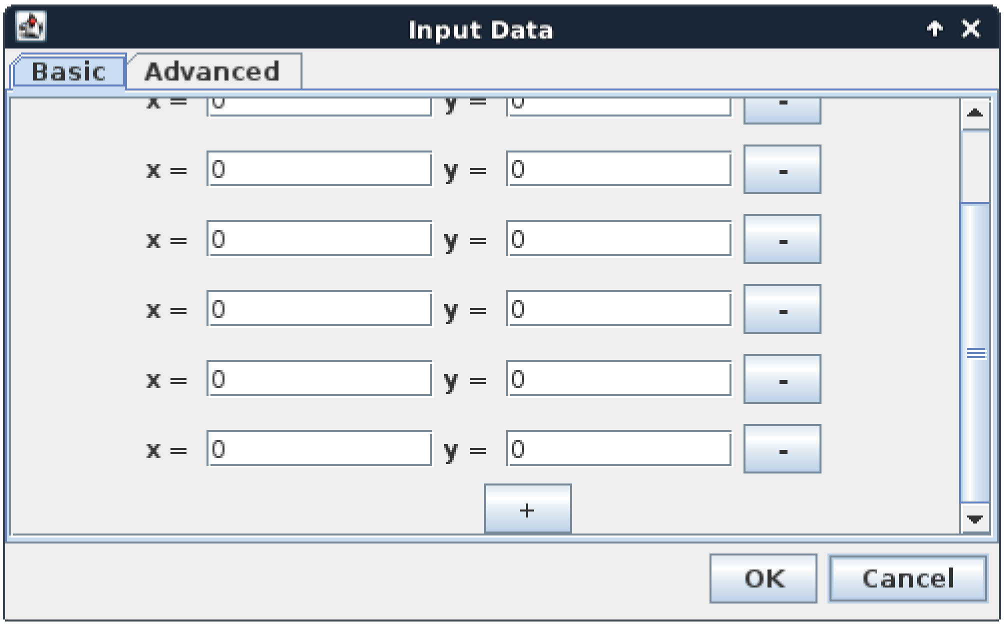


Inputting Data

Data sets can be inputted into the graphing calculator. The Input Data dialog looks like this:



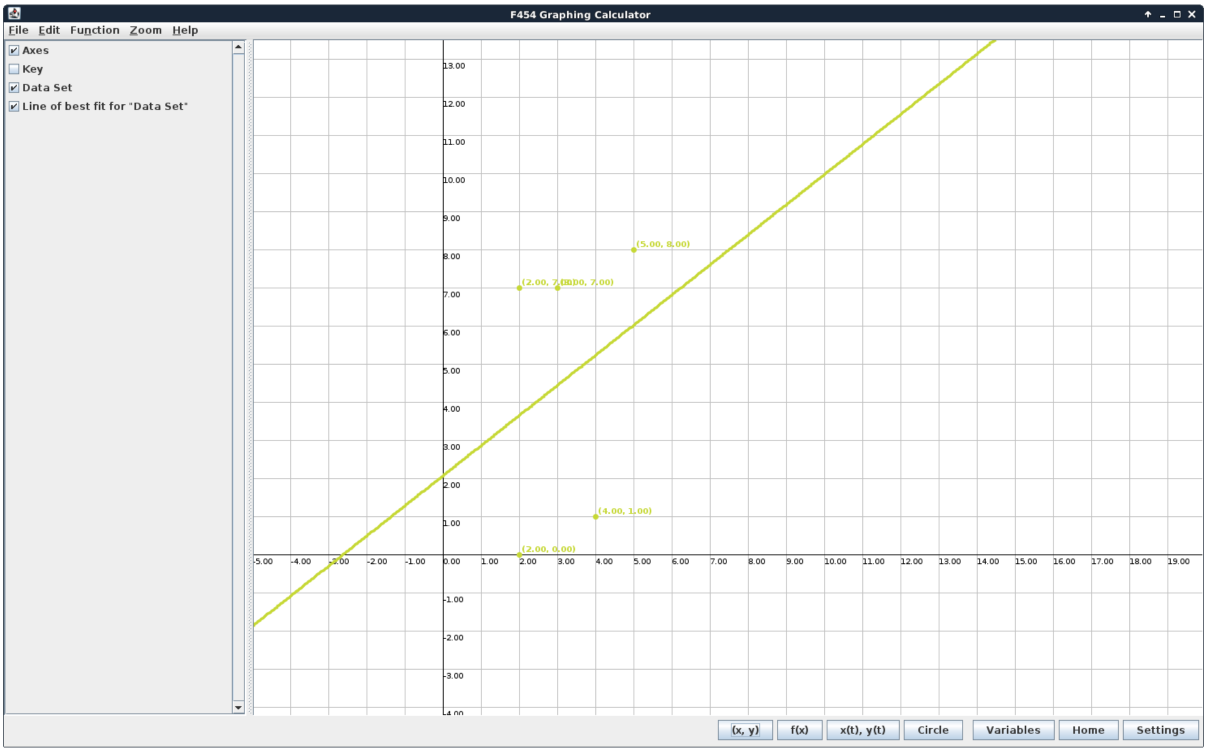
You can add more points using the ‘+’ button below.



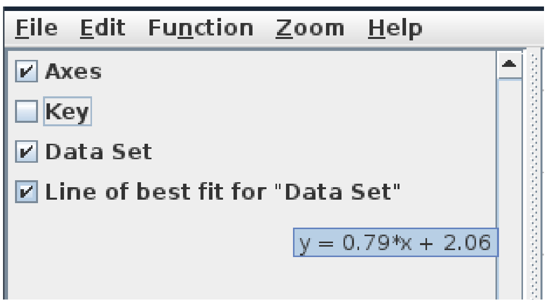
You can remove any particular point using the ‘-’ button next to its entry.

Right clicking an entry for a data set in the list will raise another small menu:

Again, most of these menus are quite self-explanatory. The ‘Show Labels’ checkbox is used to toggle whether or not the label, for example $(12, 2)$, is visible next to its corresponding point. The ‘Plot line of best fit’ menu will create a linear regression line for the given set of data, like below:



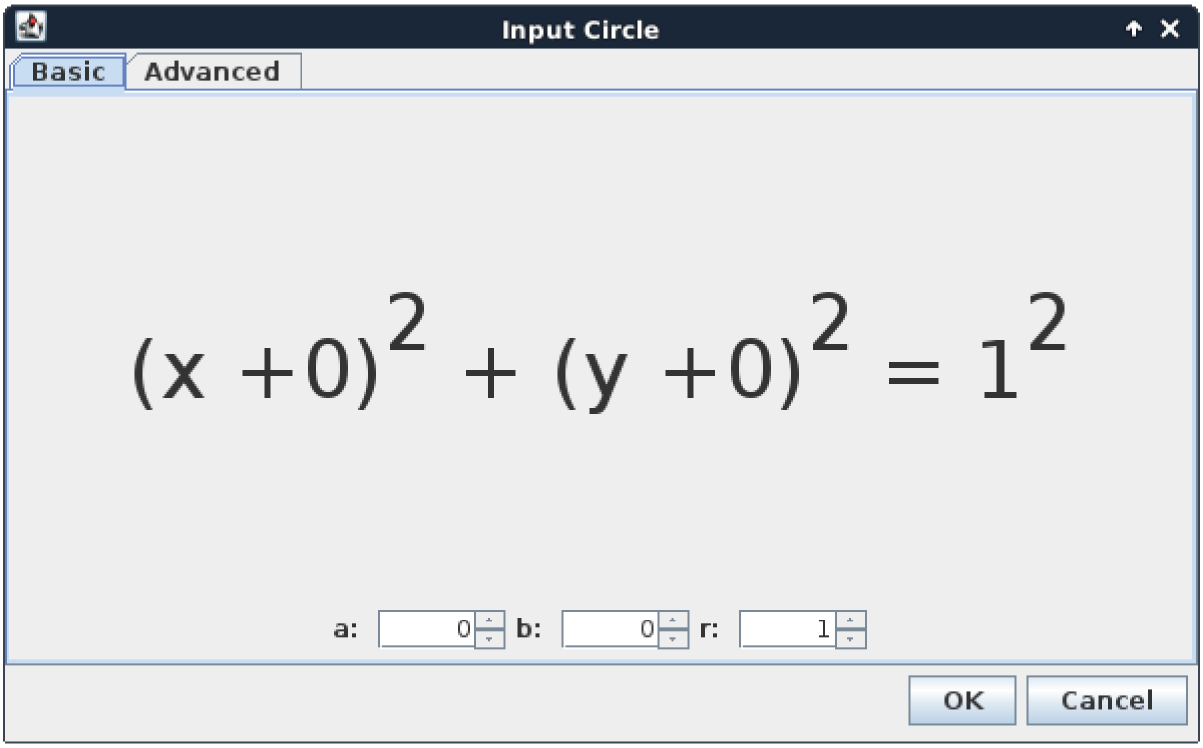
If you would like the equation for the line of best fit, hover over the entry in the list. This should raise a tooltip with its equation:



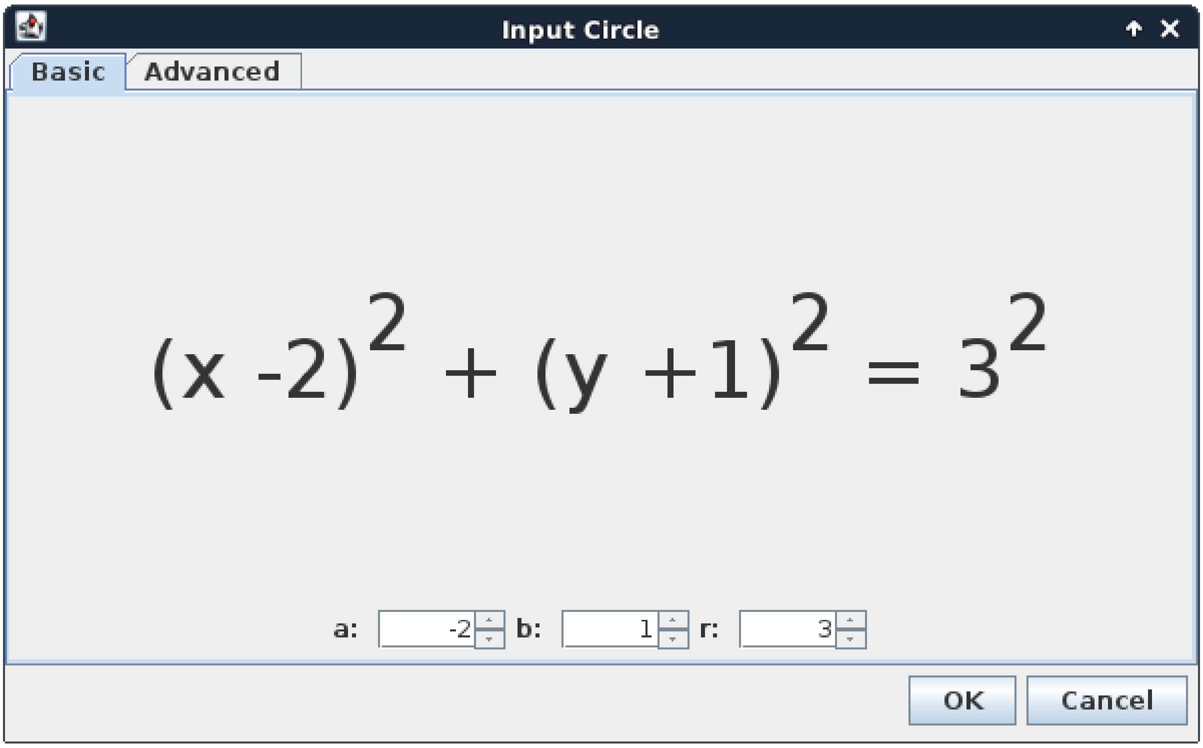
You can actually hover over any mathematical object to get its expression.

Inputting Circles

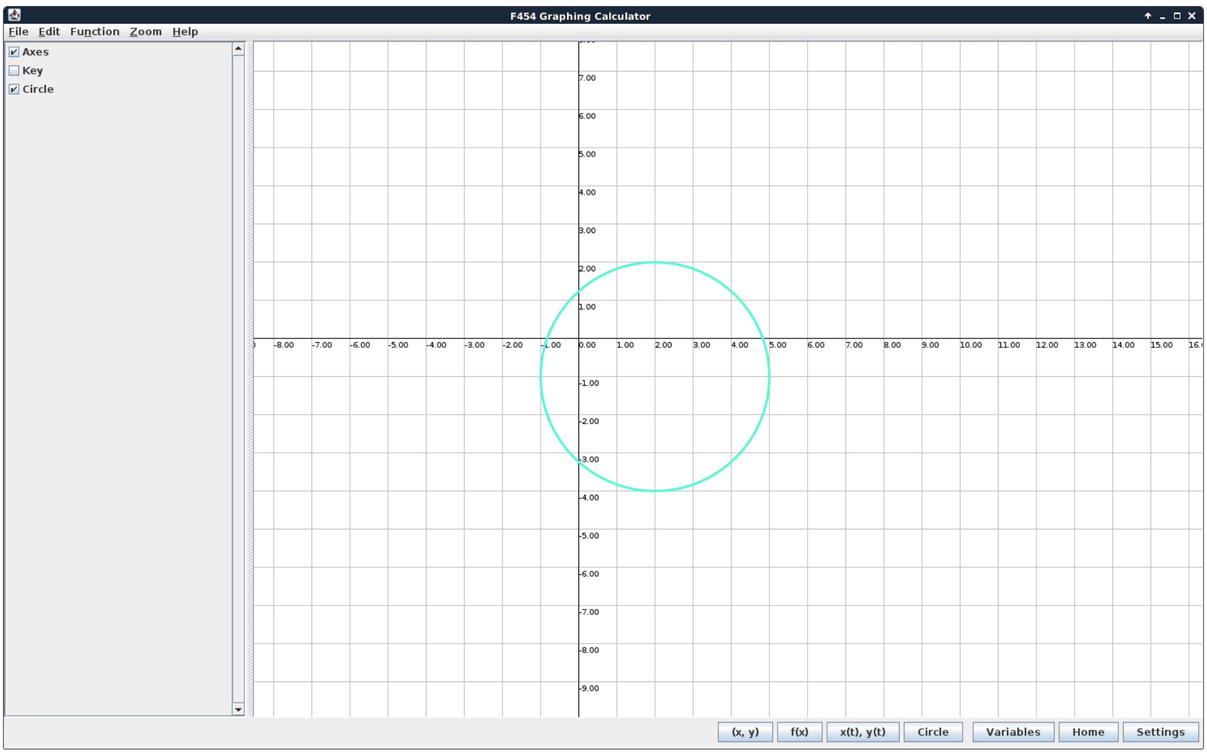
The Input Circle dialog looks like the following:



The position and radius of the circle is changed by altering the values of the spinners at the bottom of the window. For instance, if we want to draw the circle $(x-2)^2+(y+1)^2=3^2$, we would change the spinners to match:

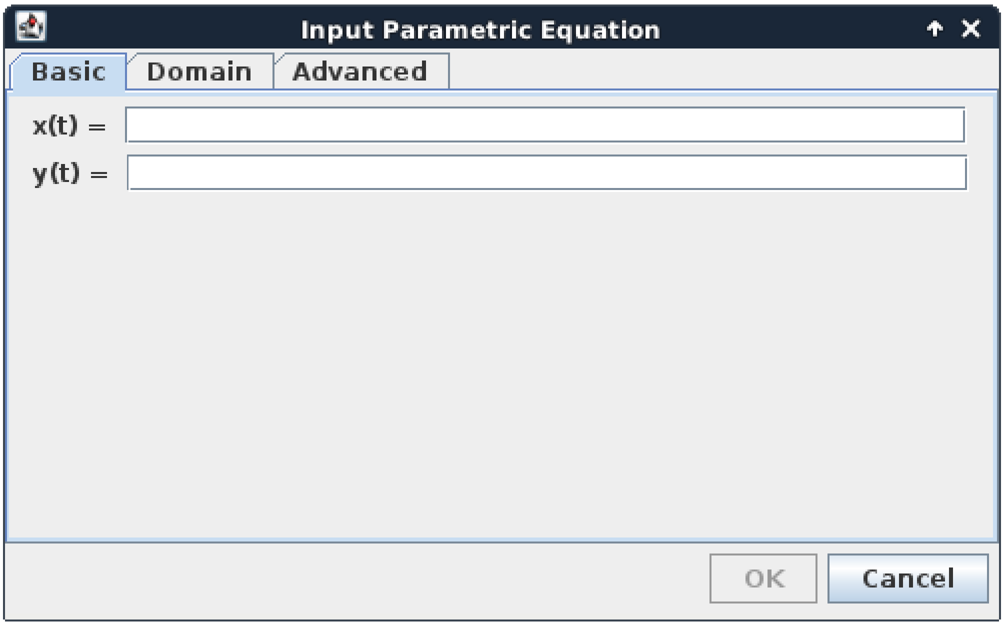


Pressing ‘OK’ would then yield:



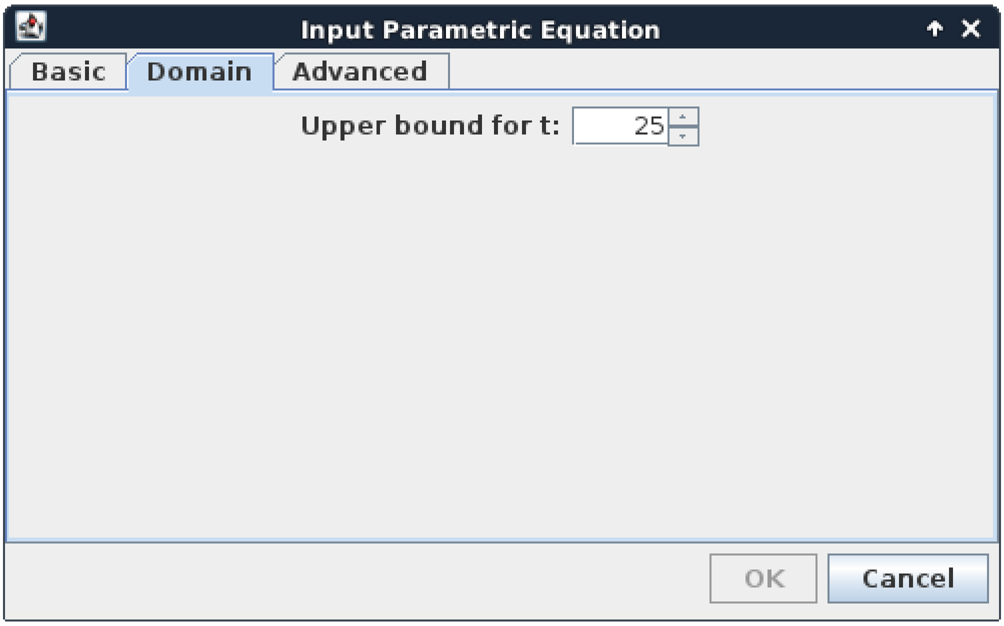
Inputting Parametric Equations

The Input Parametric Equation dialog looks like this:



In the textboxes for $x(t)$ and $y(t)$, you can enter an expression in t corresponding to the x and y-coordinates of a point at time t. Just like with the Input Simple Function dialog, the 'OK' button is only enabled once the software has detected the input has valid syntax.

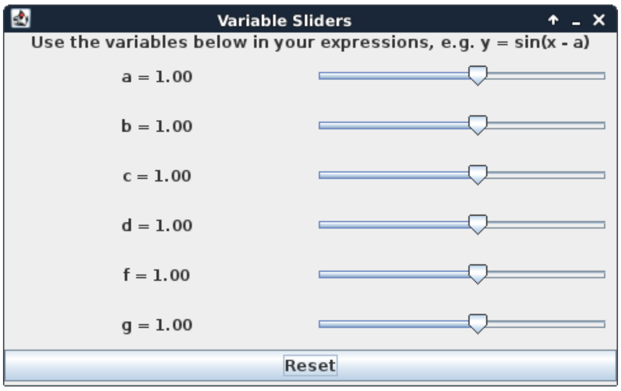
Using the Domain tab, it is possible to change the upper bound for t. You might want to change this for performance reasons, or just to limit the graphs for appearance purposes.



Variable Sliders

Variable sliders allow you to use symbolic variables, such as a and b, in your inputted expressions. Later on, you can change the value of these variables and examine how any mathematical objects that have made use of them change as a result. This is extremely helpful, and allows you to visually study how changing the values in an expression changes the image of a graph.

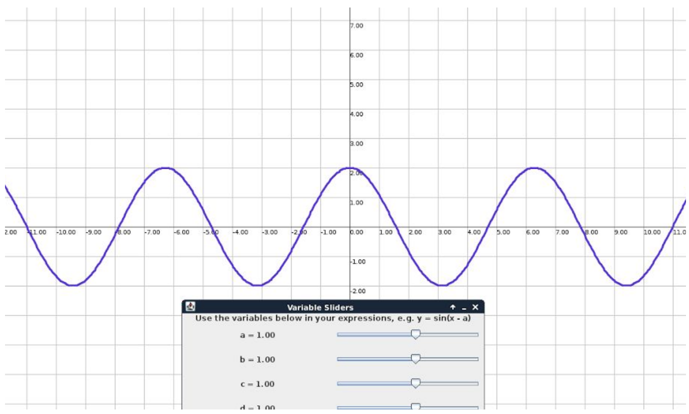
There are a total of 6 different variables that can be used. Clicking the ‘Variables’ button at the bottom of the screen will allow you to alter the variables using the dialog below:



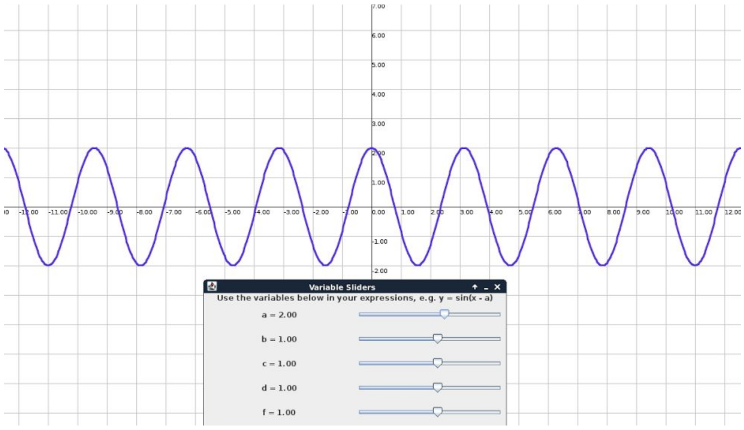
Moving the sliders will increase or decrease their respective variables, and the reset button will return the values of all variables back to 1.00. Note that there is no e variable; this is because $e \approx 2.718$ is a special mathematical constant, so its name is reserved.

It is best to explain how variable sliders work with an example. If we plot the graph of $y = 2 * cos(x * a)$, we can change the value of the variable a in the interface above and study how it affects the graph’s image.

Initially, $a = 1$.

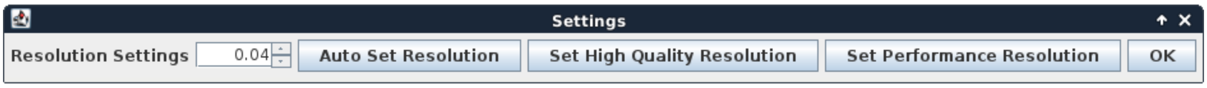


If we change the value of a such that $a = 2$:



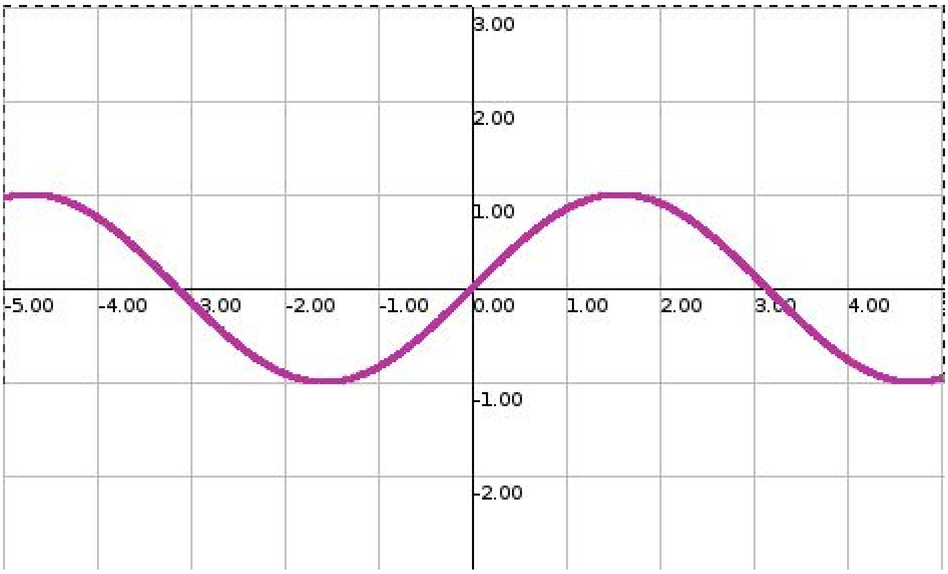
Changing the Resolution

By pressing the settings button in the bottom right of the main window, you can raise the Resolution Settings dialog. This allows you to change the quality of rendering to fit your needs.

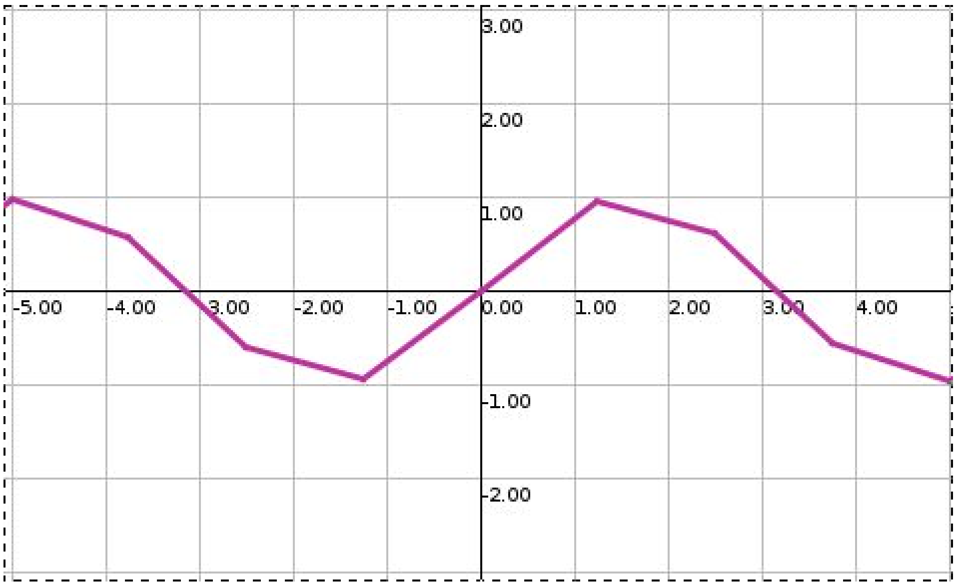


First of all, the spinner toward the left of the window allows you to set a custom value for the resolution. The buttons preceding it each have different functions:

- The ‘Auto Set Resolution’ button calculates and sets the most appropriate resolution value for your computer. Clicking this button should give you a good balance between performance and rendering quality, and most users are advised to do this.
- The ‘Set High Quality Resolution’ button sets the highest quality resolution that the software can offer, which is 0.01. There should not be any problems with the quality of rendering at this resolution. The screenshot below is of a sine curve at this resolution:



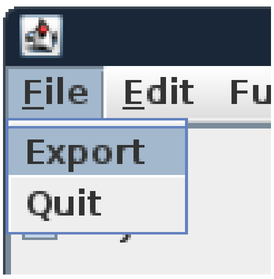
- The ‘Set Performance Resolution’ sets a low resolution of 1.25 entirely for the sake of performance. It is generally advised to stay away from such low resolutions unless you are operating the program on a very old computer. The screenshot below is of a sine curve at this resolution:



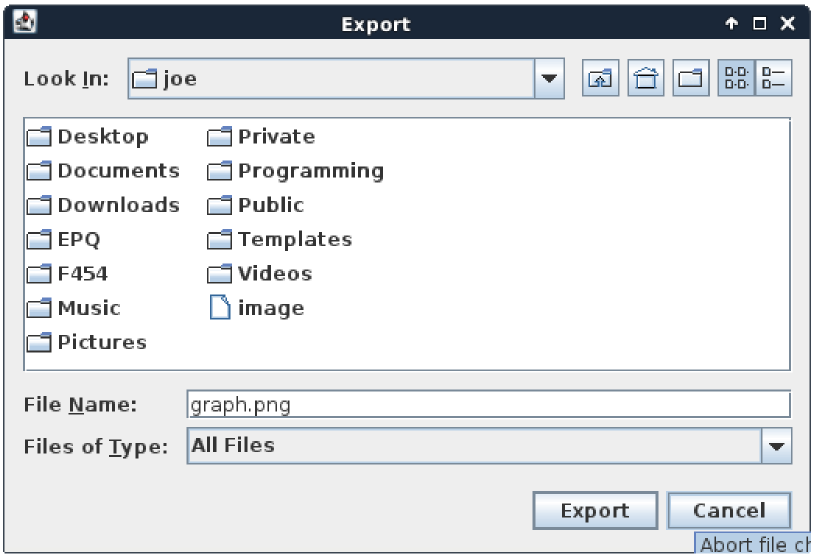
Exporting Graphs

The contents of the coordinate system can be exported as an image for use in another piece of software, such as a word processor or presentation/slideshow creator. In order to do this, ensure that all of the mathematical objects that you want to have exported are visible on the screen. You might also want to enable the visibility of the key using the list on the left, as that will show the expressions of the mathematical objects in the image.

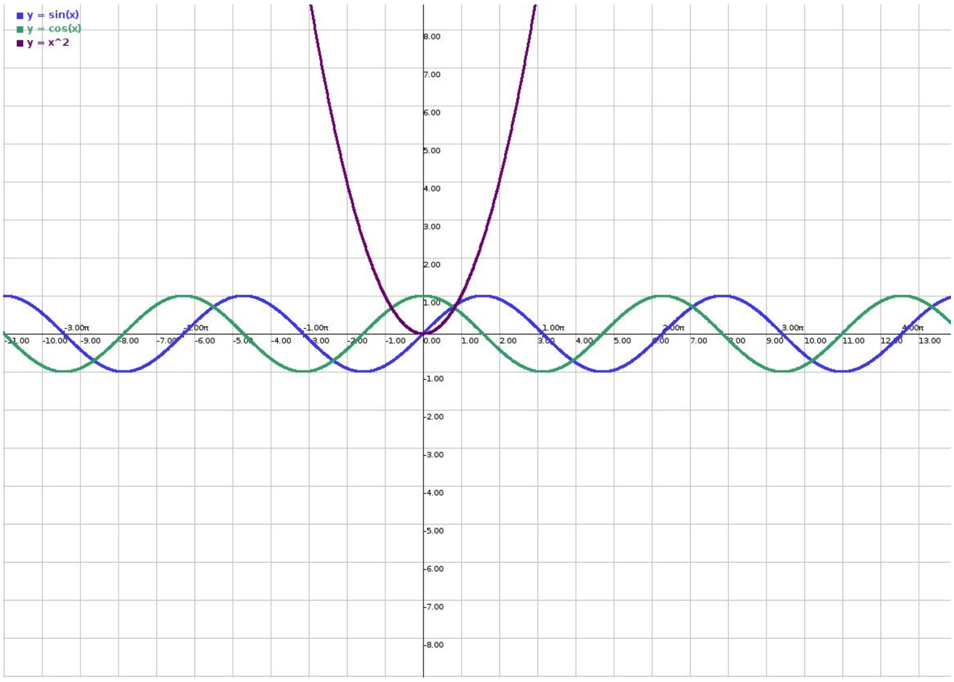
In the File menu, select export:



This will raise a file chooser dialog, allowing you to choose where you want to save your image.



Enter a name for the file and press export. It should appear on your filesystem wherever you saved it to.



A sample exported image. Notice the key in the top-left.

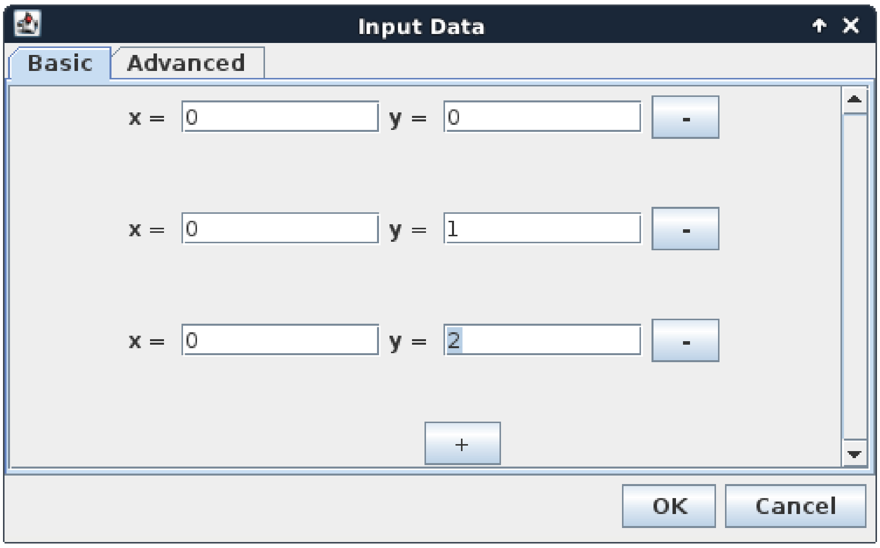
Troubleshooting

Error Messages

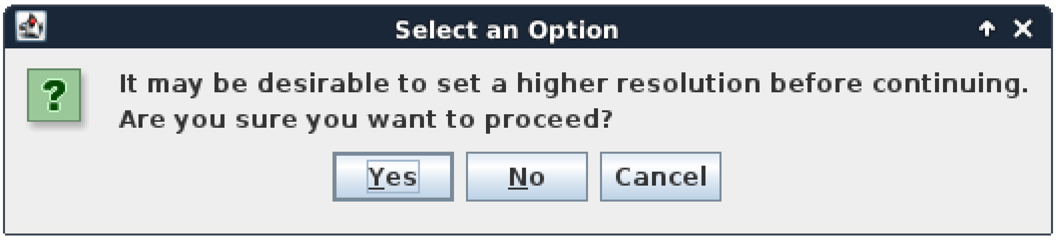
You may see the following dialogs when an error occurs in the program. This section explains what they are, what is causing them and how they can be solved.

The above dialog is raised when you have attempted to have the software plot a line of best fit for a data set that only has one entry. This error is raised because, with only one point to work with, a line of 'best fit' doesn't really exist. In order to fix this error, delete the data set and create a new one with more than one entry. The software should then have no problem with plotting a regression line.

The above dialog is raised when you have attempted to have the software plot a horizontal or vertical line of best fit. This will occur with data sets such as:



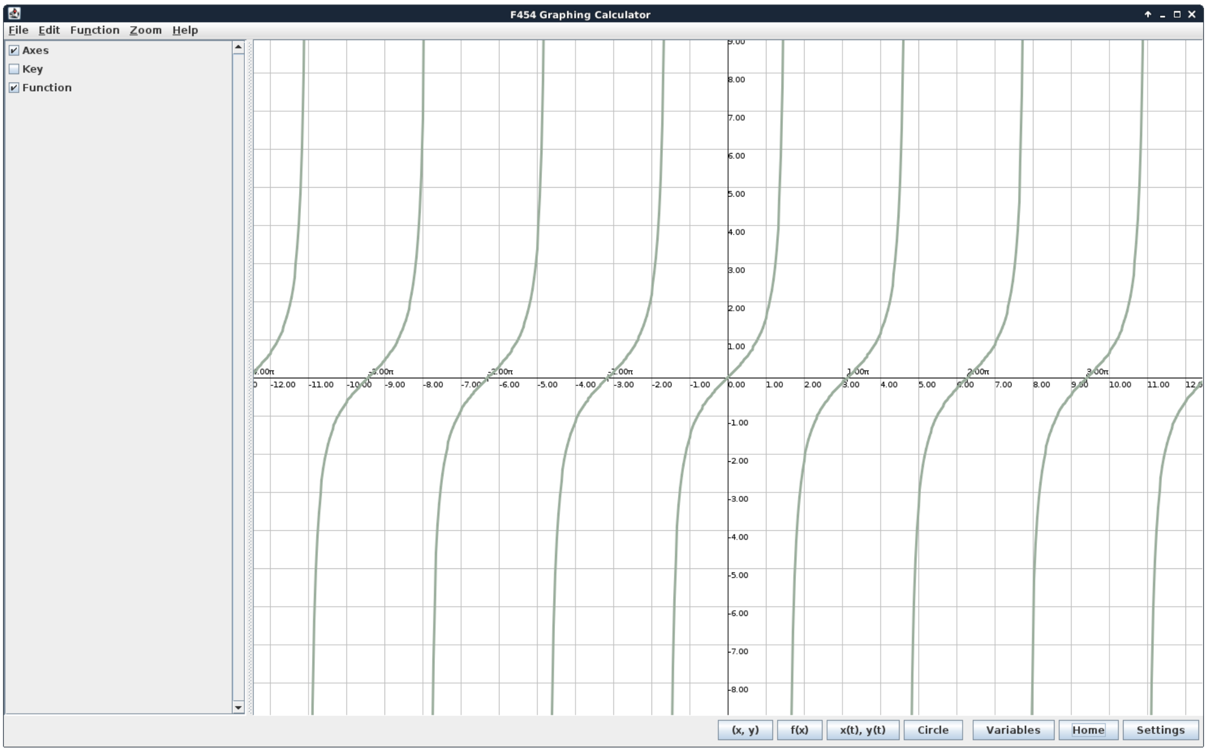
Where the points form a perfectly horizontal or vertical line. This error is raised because a line of best fit for such a data set is trivial. To plot a line connecting these points, you can input a simple function such as $x = 5$ or $y = 2$.



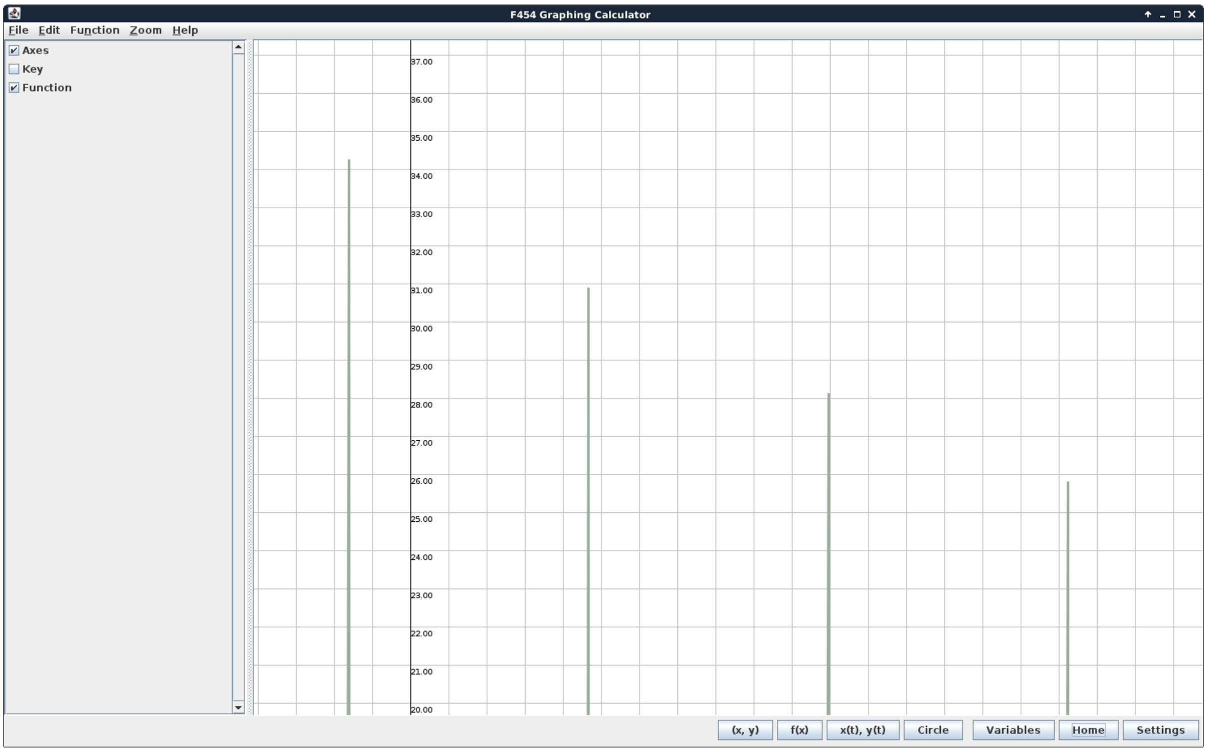
This dialog is raised when you have attempted to export the graph, but you might want to have a higher resolution set so that the image will be better quality. This isn't really an error, as such, as you can just click 'no' to dismiss it.

Graphical Errors

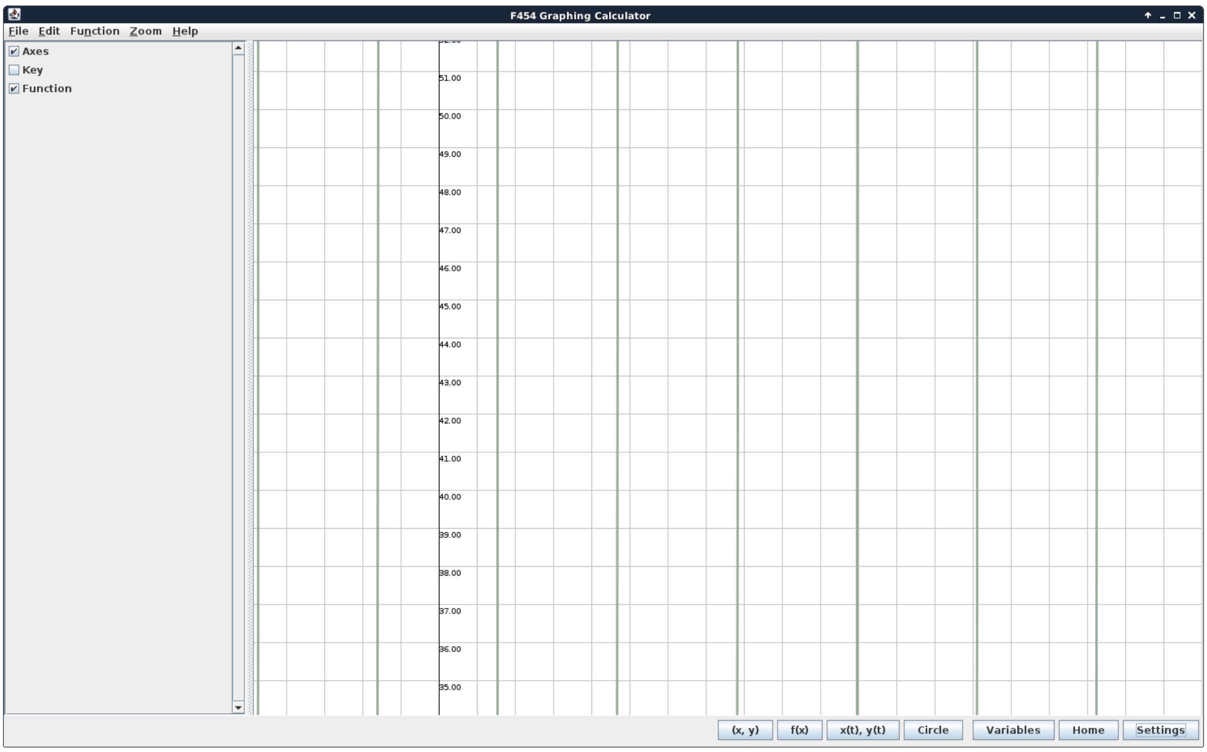
One graphical error that may occur involves asymptotes/singularities/discontinuities of functions. For instance, consider the curve $y = tan(x)$ …



Notice that the graph climbs higher and approaches a straight line. This is called an asymptote. Unfortunately, if you attempt to pan the coordinate system upwards to look at the asymptote, after a while…



The asymptotes cut off in an unpredictable manner. This is a side-effect of a cropping optimisation that makes the panning and zooming experience smoother, at the expense of this bug. Thankfully, it is possible to reduce the effects of this bug by improving the resolution:



After having decreased the resolution to 0.01, the range for which asymptotes are visible is greatly improved.

I hope to fix this bug in the near future.

Inputting Circles Using Parametric Equations

One shortcoming of the graphing calculator is the inability to enter non-integer values of a, b and r when inputting a circle using the cartesian equation $(x-a)^2+(y-b)^2=r^2$. If you would like to input circles with a bit more freedom, it may be desirable to use a parametric equation rather than the circle input dialog.
The general form for the cartesian circle $(x-a)^2+(y-b)^2=r^2$ in parametric form is:

$$x(t) = rcos(t) + a$$
$$y(t) = rsin(t) + b$$

For instance, if you wanted to plot the circle with cartesian equation $(x-2)^2+(y+3)^2=2^2$, you would input the parametric equation:

$$x(t) = 2cos(t) + 2$$
$$y(t) = 2sin(t) - 3$$

The advantage to adding circles using a parametric equation is that you can be more flexible with the values for a, b and r. In other words, unlike the Input Circle dialog, parametric equations do not limit the values of a, b and r to integers.

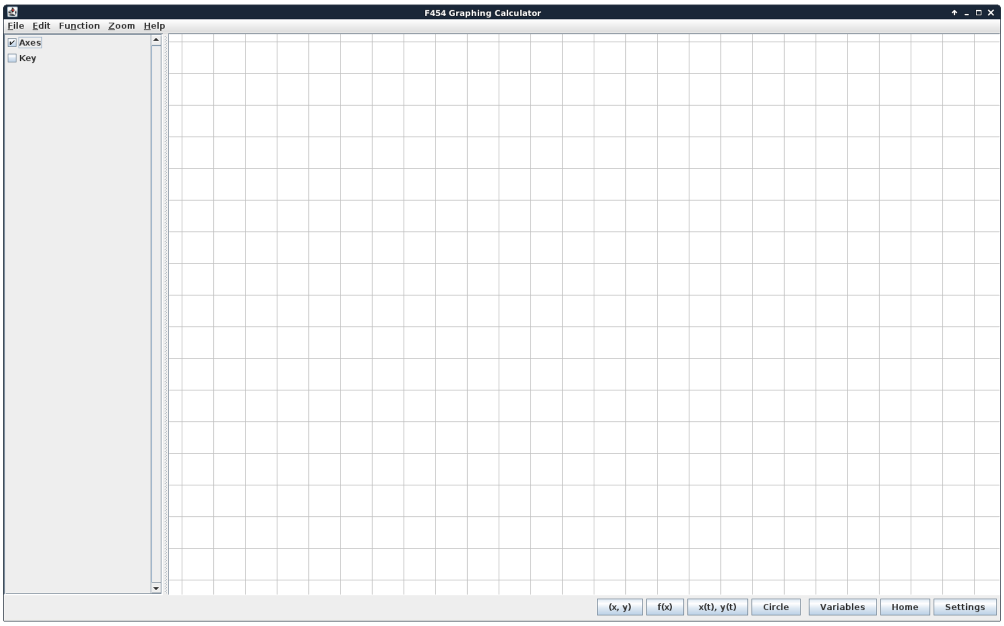
Frequently Asked Questions

What are sticky axes? When I enable the setting, nothing seems to happen!

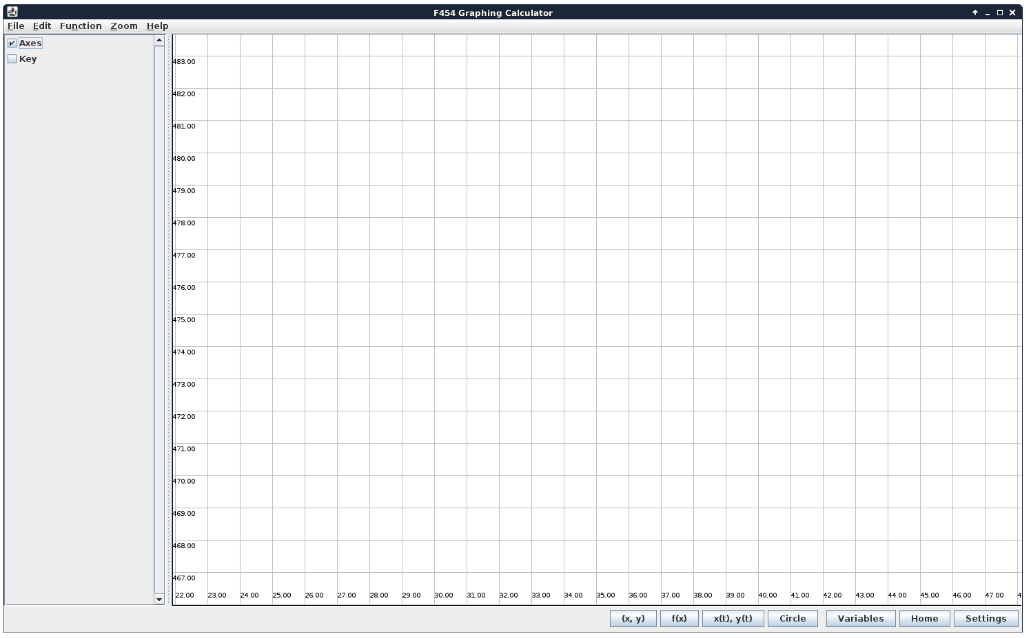
Sticky axes can be toggled by right clicking the axes entry in the list on the left-hand side of the main window. You would enable sticky axes when you want the axes (and their numberings) to be visible at all time, no matter how far out on the coordinate system you navigate.

As the name may suggest, enabling this setting causes the coordinate axes to ‘stick’ to the edge of the screen before they disappear from sight when panning. This setting has no effect until the axes would otherwise be out-of-view.

The screenshot below is the coordinate system without sticky axes:

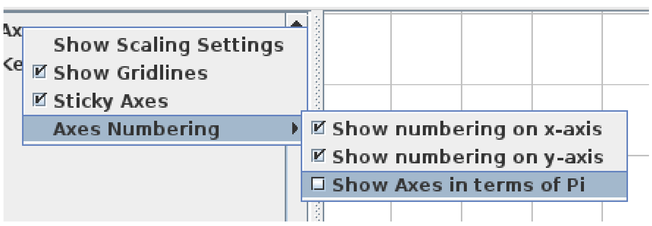


The screenshot below is the coordinate system with sticky axes:



Can I show the axes in terms of π?

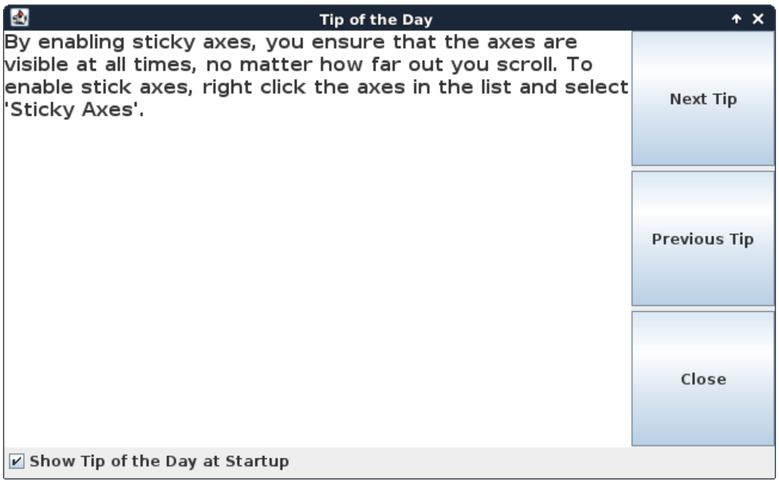
Yes. Right click the axes entry in the list, and under the menu ‘axes numbering’, choose ‘show axes in terms of pi’.



Are there any keyboard shortcuts?
Yes, there are a few particularly useful keyboard shortcuts.

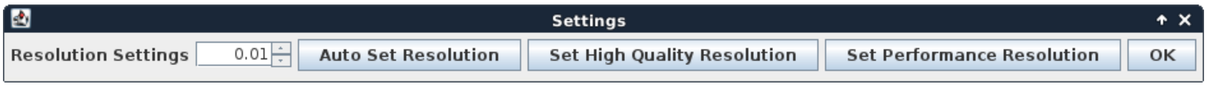
- CTRL-D raises the input data dialog.
- CTRL-ENTER raises the input simple function dialog.
- CTRL-P raises the input parametric equation dialog.
- CTRL-C raises the input circle dialog.
- CTRL-H returns to the home view.

I want to see the Tip of the Day dialog! How can I make it so that it appears at startup again?
This is quite an easy process. Enter the help menu and click ‘Show Tip of the Day’. This will raise the Tip of the Day dialog.



Next, simply check the box that says ‘Show Tip of the Day at Startup’. Any subsequent launches of the program should show the dialog on startup.

The program seems to be lagging quite a bit. Is there anything I can do to speed things up?
Yes: change the resolution. Click the settings button in the bottom right, and it will raise the resolution dialog.



Try settings the resolution to a higher value using the spinner. Alternatively, click the ‘Auto Set Resolution’ to change the resolution to something your computer can handle automatically.

Can it plot 3D graphs?

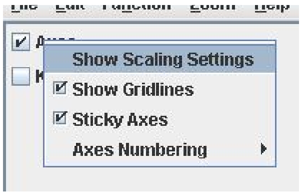
No; 3D graphs would require a 3D graphics engine. Although I would like to implement 3D graphing at some point in the future, at the moment it does not feel necessary.

Can I use the program on my phone?

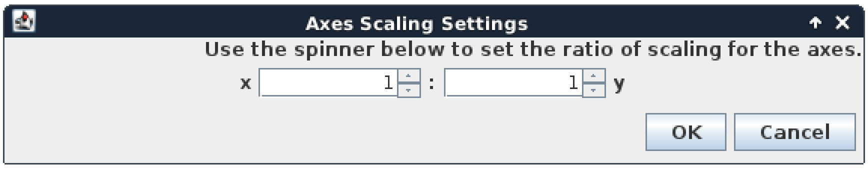
Not currently.

Is there any way I can scale the axes?

Yes, right click the axes in the list and select ‘Show Scaling Settings’.



This will raise the scaling dialog.



How can I reset the zoom and pan of the coordinate system?

You can either click the ‘Home’ button in the bottom panel or use the keyboard shortcut CTRL+h. This will return to the default view.

Can I easily get rid of all of the mathematical objects?

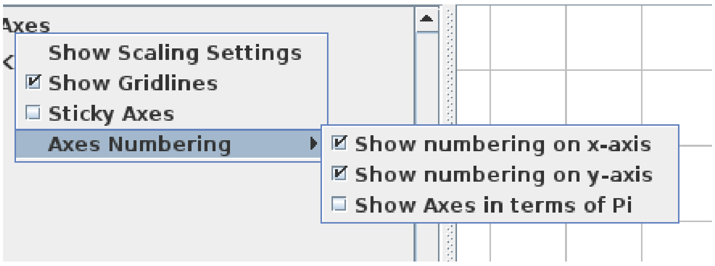
Yes. In the edit menu, click ‘Clear’. This should remove all of the mathematical objects except for the axes and the key.

Can I get rid of the axes?

You cannot remove the axes from the program, but you can make them invisible, which has the same effect. In order to do this, uncheck the checkbox for the axes in the list.

Can I get rid of the gridlines or axes numbering?

Yes. Right click on the axes in the list. This provides numerous options involving the visibility of the axes numbering and gridlines:

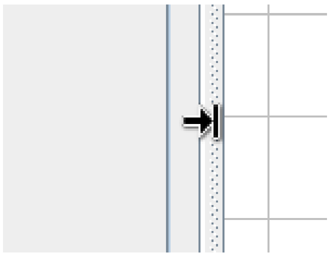


What is the '.nototd' file and why has it appeared on my computer? Can I delete it?

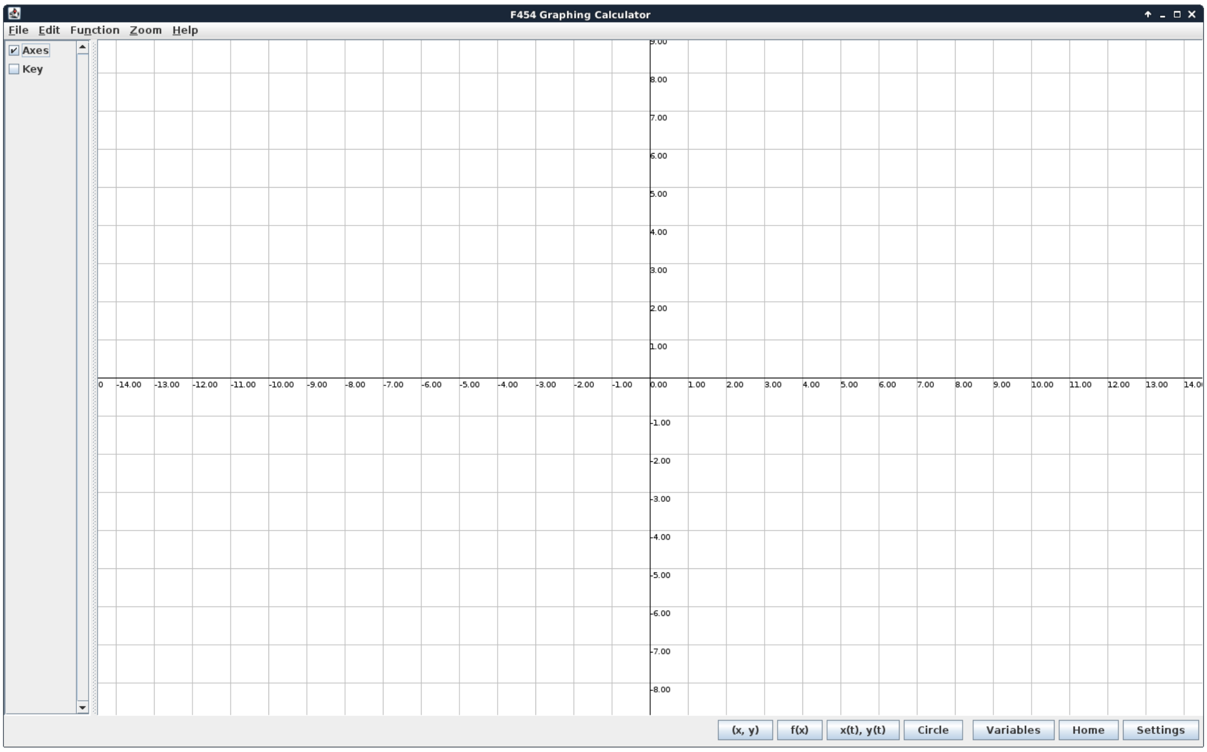
The '.nototd' file is an empty file whose existence determines whether or not the Tip of the Day dialog should be raised at startup. If this file exists, it means that you have unchecked the checkbox in the Tip of the Day dialog that says 'Show Tip of the Day at Startup'.
If you delete it, the graphing calculator will just start showing tips again when it is started.

Can I make the list smaller and the graphing panel bigger?

Absolutely; the list and the graphing panel are linked together by a 'split pane', allowing you to expand and contract the components relative to one another. All that you have to do is drag the connector between them.



For instance, if you want the graphing panel to be bigger and the list to be smaller:


F454 Graphing Calculator
File Edit Function Zoom Help
Axes
Key
(x, y)
f(x)
x(t), y(t)
Circle
Variables
Home
Settings