

Help for Graphics Calculator

By Braedon Wooding

Introduction

This guide will instruct you to how to use the Graphics Calculator python app by Braedon Wooding. Its split up into multiple sections:

1. How to install?
2. UI Screens
3. Common Functions
4. & Symbol
5. Graphing Tools
6. Common Commands
7. All Colours
8. All Functions
9. All Commands
10. FAQ

How to install?

There are two packages that need to be installed for the application to function. First is wxpython phoenix which can be installed using the following command:

```
python3 -m pip install -U --pre \
  --trusted-host wxpython.org \
  -f http://wxpython.org/Phoenix/snapshot-builds/ \
  wxPython_Phoenix
```

That will download and install wxpython nicely onto your python3 system. You will also need to install numpy which can be downloaded and installed using the following command:

```
python3 -m pip install numpy
```

Note: Numpy is only needed for wxpython to graph the data and its math functions aren't used.

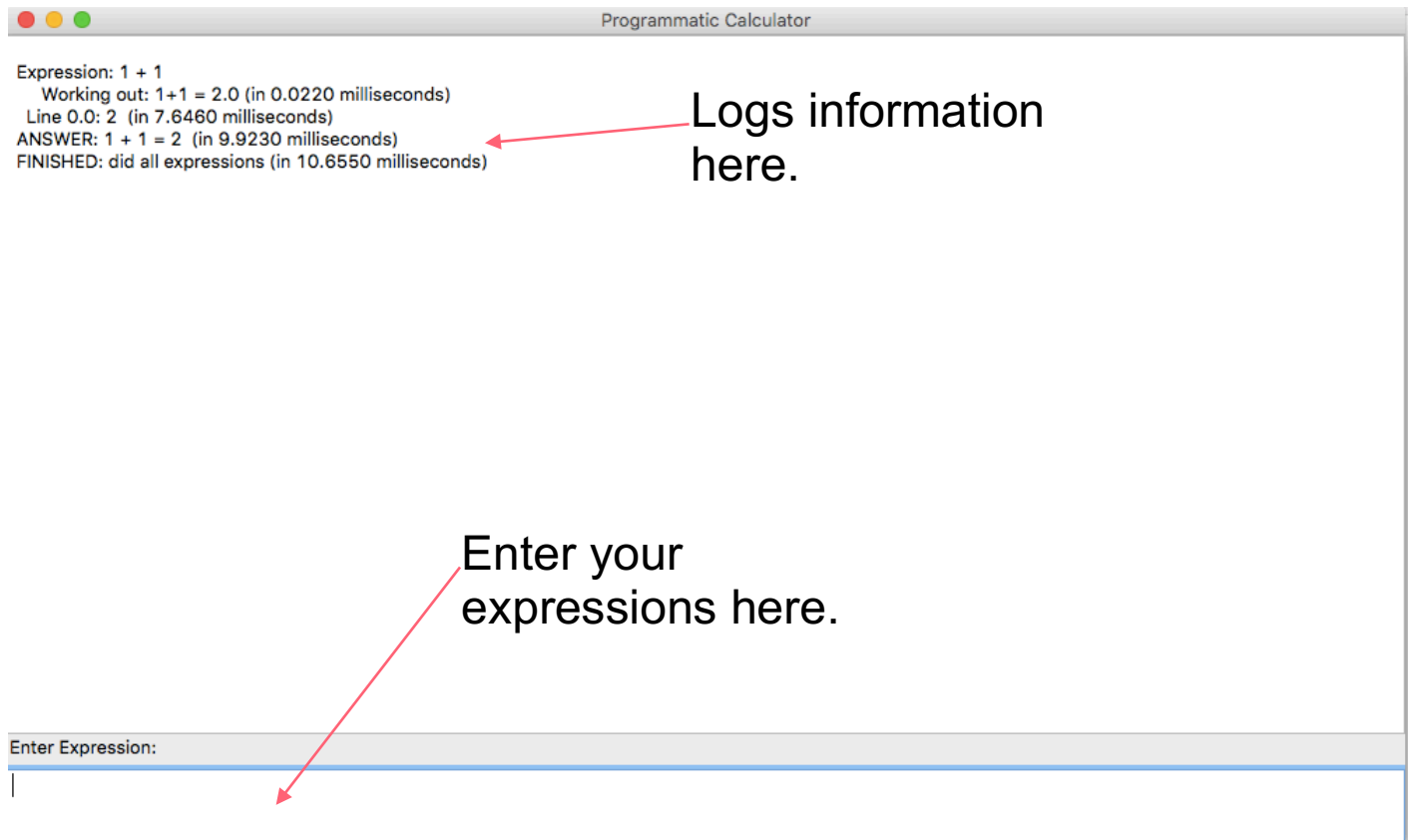
The program needs no further installation except the packages above. To run the program just either run the main.py script in idle using open -> run, or use terminal to run the main.py script.

UI Screens

Intro

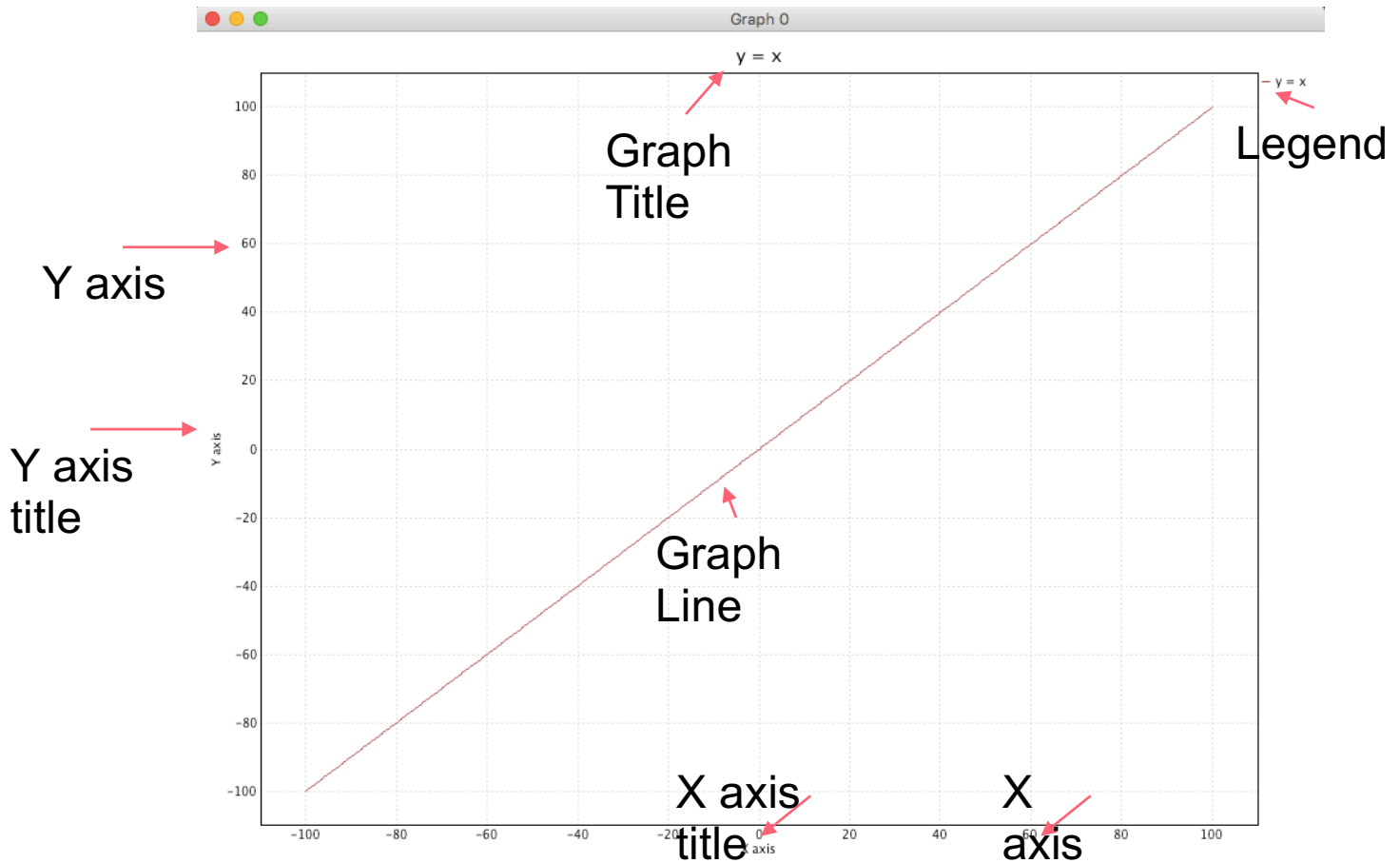
While all screens are in OSX format, they will work on a PC but look slightly different. All the shortcuts should be the same just using the relevant PC key instead of the command mac key.

Main Screen



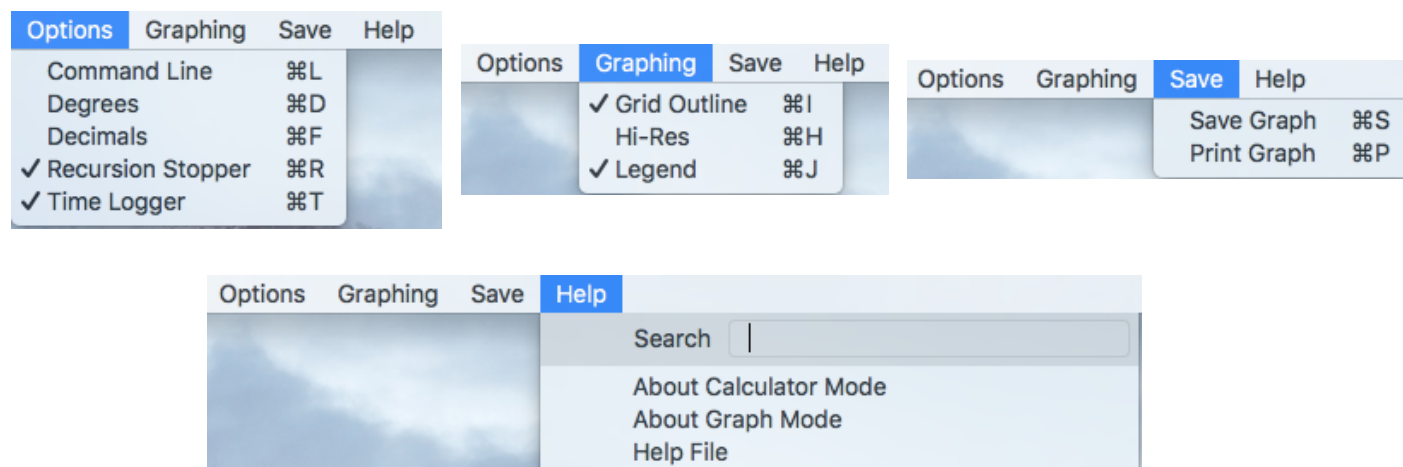
Pretty self-explanatory, enter your expressions in the text box, if it's just a problem (i.e. $1 \cdot \tan(20)$) then it will solve it showing every step. Else if it contains an x or a y then it will graph it. Graphing options are located under common graphing tools. The various functions and operations are located under common and all functions.

Graph Screen



The graph shown is a really simple graph of $y = x$ (or a straight line). The system allows a large range of tools to build various graphs that includes multiple graphs, vectors, domains, and ranges to name a few. All the labels and axis's can be renamed and resized, through the command line.

Top Tool Bar



Options:

- Command Line *CMD+L*- Used to input complex commands for manipulating built graphs.
- Degrees *CMD+D*- Toggle between degrees and radians for trigonometry functions.
- Decimals *CMD+F*- Toggle between decimal and fraction outputs.
- Recursion Stopper *CMD+R*- Enables/Disables the recursion stopper system which stops the system from repeating the processing of an equation, if an equation is too complex (more than 100 operations/functions) then this needs to be disabled for it to process it.
- Time Logger *CMD+T*- Enables/Disables the logging system which logs time for each step and operation.

Graphing:

- Grid Outline *CMD+I*- Enables/Disables the grid outline (automatically is disabled when Hi-Res is on)
- Hi-Res *CMD+H*- Generates graphs in a higher resolution, turns off grid outline since it essentially converts it to an image then displays, so the graph outline interferes with the hi-res.
- Legend *CMD+J*- Enables/Disables the legend on the right side

Save:

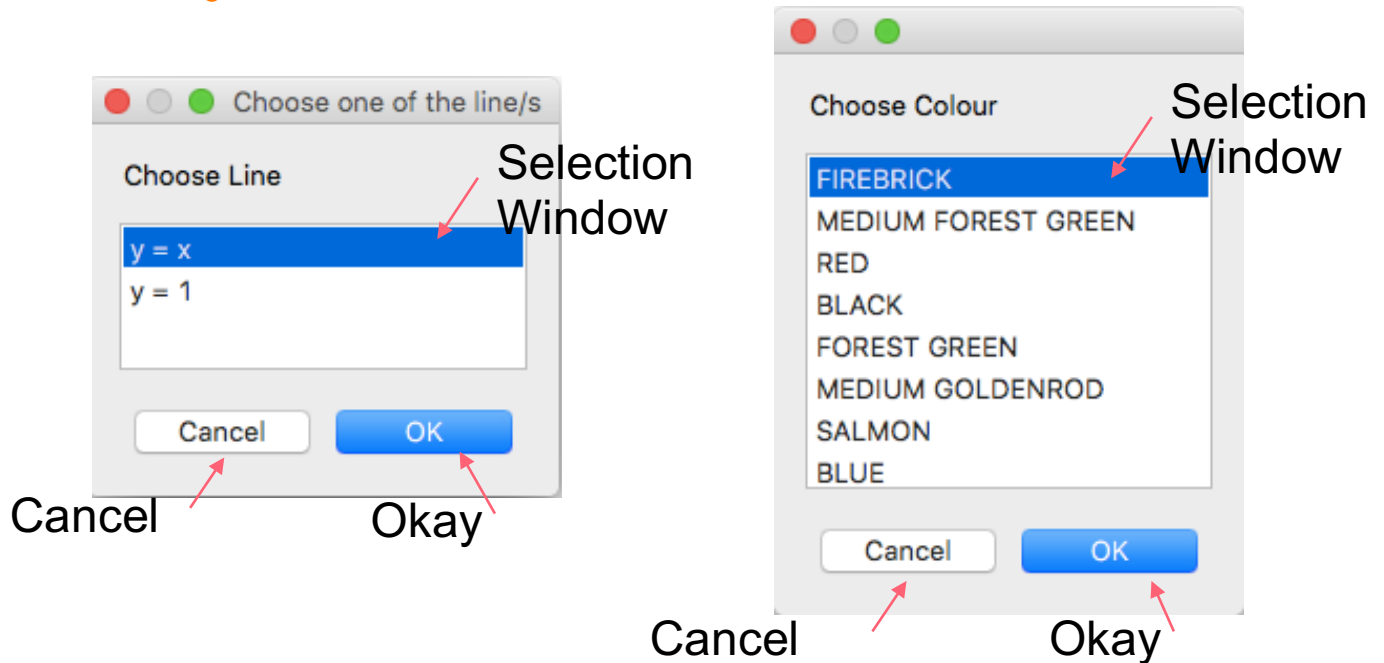
- Save Graph *CMD+S*- Opens a dialog that allows you to save one of your graphs (you select a graph first), you can save it as a BMP, JPEG or PNG.
- Print Graph *CMD+P*- Opens a dialog that allows you to print one of your graphs (you select a graph first), you can either print or save as PDF.

Help:

- Search- Search window for all menu commands

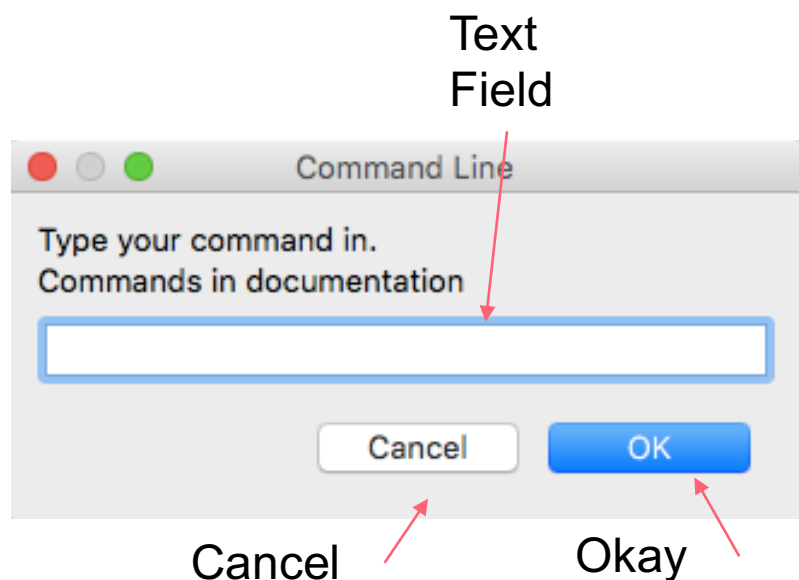
- About Calculator Mode- Just a short dialog that displays quick information about the calculator window.
- About Graph Mode- Just a short dialog that displays quick information about the graph window.
- Help- Opens this help file.

Selection Dialogs



Just a few selection windows, you just select the appropriate value then press okay to continue or cancel to cancel the action.

Text Dialogs



Very similar to selection dialogs but with a text field. In this case this is used to enter commands in to manipulate graphs after creation (commands in either common commands and all commands). They are used to either ask for text such as titles for labels or sizes.

Common Functions

There is a large amount of functions available to use for expressions, below are the most commonly used functions with the rest being in the all functions section.

Note: These are just for regular expressions but can be used for graphing, graphing tools such as y/x or domain/range aren't covered in this section but in Common Graphing Tools.

- $\text{sqrt}(x)$ or \sqrt{x} – Square root of x
- $\text{cubt}(x)$ – Cube root of x
- Placeholders:
 - Pi or π – 3.141...
 - E or euler – 2.718...
- Standard Operators:
 - x^y – x to the power of y
 - x/y – x divided by y
 - $x*y$ – x times y
 - $x-y$ – x minus y
 - $x+y$ – x plus y
 - $x\%y$ or $\text{mod}(x, y)$ – x modulo y (remainder of division)

- $x\%$ - $x/100$ (percentage)
 - $x!$ – x factorial
- `round(x, y)` – Rounds x to y decimal places
- `root(x, y)` – Roots x by y ($x^{1/y}$)
- `Trig Functions(x)` – Applies the trig function on x :
 - `sin`, `cos`, `tan` – Standard rules
 - `asin`, `acos`, `atan` – Inverse `sin`, `cos`, `tan` rules
- `M` – Memory (last answer)
- `ans(x)` – Answer x numbers back
- `rand(x, y)` – Randomises a number between x and y
- `base(x, n)` – Converts x of base n to base 10
- `clear` – Clears the logger window
- `void` – Fun little graph (not a bug, a feature)

& symbol

Special symbol that allows more than one graph/expression to be evaluated. By adding this to the end of an expression/graph you can add another to the end to chain them.

E.G.

Expression: $1 + 10/25 \& 2 + 4 * 90 = 1.4 \& 362$

Graph: $y = x \& y = 1$; a $y = x$ straight line and a straight line of $y = 1$ where y always = 1 and x equals all possible values.

Graphing Tools

There are multiple different tools that can be used to manipulate the graph during execution. Below are all the graphing commands

- Domain/Range $\{x < y, a < b\}$
 - You can have multiple of these braces and you can have x or y variables as x or y or you can have numbers, or a mix of x/y and numbers. The comma tells the system that it is either $x < y$ or $a < b$ in the example. If the check succeeds then it will graph that point else it won't.
 - Example: $\{x < 1, x \geq 3\} \{2 \leq y\}$
 - If x is less than 1 or greater than or equal to 3 and 2 is less than or equal to y then the values are valid.
- Range of graph values [start: x end: y step: z]
 - Chooses the start, end, and step values for the graph generation (default is -100, 100, 0.25). Will begin at x and step by z while it is less than or equal to end.

- Colour of line <x>
 - After every line/graph (allows chaining just add to end or start of expression).
 - Put the desired colour in place of x. A list of colours is under all colours.
- T<x, y>
 - Allows the T symbol in your expression, will replace it with values between x and y (inclusive). So if you had $y = T \ T<1, 3>$ it will create $y = 1$ & $y = 2$ & $y = 3$
- R<x, y, z...>
 - Same as T but doesn't do between x and y rather does x, y, z and so on... So if you had $x = R \ R<1, 3, 5>$ it will create $x = 1$ & $x = 3$ & $x = 5$.
- P<x₁, y₁ - x₂, y₂>
 - Creates a line from (x₁, y₁) to (x₂, y₂). Can have multiple P<> statements and/or can have multiple within the P statement as long as they are split up by a ','.
 - Example: $P<1,3 - 4,5; 2,2 - 0,0>$ Creates two lines one from (1,3) to (4,5) and the other from (2,2) to (0,0).

Common Commands

There is a large assortment of commands that can be used to manipulate graphs after creation. Below are the most commonly used ones:

Note: All console commands are case-insensitive so you don't have to make sure it is capitalised or capitalised.

- Colour- Choose a line from a graph and then you can choose from a range of colours for that line. The colours available are under all colours.
- Clear, Redraw- clears the graph, redraws the graph.
- Sizex, Sizey- Choose the min and max shown values for x and y.
- Name- Change the graph's title
- Width- Change line width
- Background, Foreground – Change the background (the background of the graph) colour and the foreground or text colour.
- Hide- Choose a line to hide from the graph.
- Unhide- Choose a line to unhide from the graph.

All Colours

FIREBRICK	MEDIUM FOREST GREEN	RED	YELLOW GREEN
BLACK	FOREST GREEN	MEDIUM GOLDENROD	SALMON
BLUE	GOLD	MEDIUM ORCHID	SEA GREEN
BLUE VIOLET	GOLDENROD	MEDIUM SEA GREEN	SIENNA
BROWN	GREY	MEDIUM SLATE BLUE	SKY BLUE
CADET BLUE	GREEN	MEDIUM SPRING GREEN	SLATE BLUE
CORAL	GREEN YELLOW	MEDIUM TURQUOISE	SPRING GREEN
CORNFLOWER BLUE	INDIAN RED	MEDIUM VIOLET RED	STEEL BLUE
CYAN	KHAKI	MIDNIGHT BLUE	TAN
DARK GREY	LIGHT BLUE	NAVY	THISTLE
DARK GREEN	LIGHT GREY	ORANGE	TURQUOISE
DARK OLIVE GREEN	LIGHT STEEL BLUE	ORANGE RED	VIOLET
DARK ORCHID	LIME GREEN	ORCHID	VIOLET RED
DARK SLATE BLUE	MAGENTA	PALE GREEN	WHEAT
DARK SLATE GREY	MAROON	PINK	WHITE
DARK TURQUOISE	MEDIUM AQUAMARINE	PLUM	YELLOW
DIM GREY	MEDIUM BLUE	PURPLE	

All Functions

Here are all the functions (not including graphing ones).

- Standard Operators:
 - x^y – x to the power of y
 - x/y – x divided by y
 - $x*y$ – x times y
 - $x-y$ – x minus y
 - $x+y$ – x plus y
 - $x\%y$ or $\text{mod}(x,y)$ – x modulo y (remainder of division)
 - $x\%$ – $x/100$ (percentage)
 - $x!$ – x factorial
- Trig Functions(x) – Applies the trig function on x:
 - sin, cos, tan – Standard rules
 - asin, acos, atan – Inverse sin, cos, tan rules
 - cosec, sec, cot – $1/\sin$, $1/\cos$, $1/\tan$
 - acosec, asec, acot – $1/\text{asin}$, $1/\text{acos}$, $1/\text{atan}$
- Root Functions:
 - $\text{sqrt}(x)$ or \sqrt{x} – Square root of x
 - $\text{cubt}(x)$ – Cube root of x
 - $\text{root}(x, y)$ – root x by y ($x^{1/y}$)
 - $\text{rt.y}(x)$ – root x by n ($x^{1/y}$)
- Memory Functions:
 - M – Memory (last answer)
 - $\text{ans}(x)$ – Answer x numbers back
- Placeholders:
 - Pi or π – 3.141...
 - pB – (3.141...)
 - E or euler – 2.718...
 - eB – (2.718...)
- Rounding Functions:
 - $\text{floor}(x)$ – Rounds down x
 - $\text{ceil}(x)$ – Rounds up x
 - $\text{round}(x, y)$ – Rounds x to y decimal places
 - $\text{int}(x)$ – Drops the decimal place of x (same as floor essentially)
- Random Functions:
 - $\text{rand}(x, y)$ – Randomises between x and y
 - $\text{randInt}(x,y)$ – Randomises between x and y and only integers
 - randInt – Randomises integer number between 0 and 100
 - srnd – Randomises number between 0 and 1
 - rand – Randomises number between 0 and 100

- Base Functions:
 - `base (x, y)` – Converts x of base y to base 10
 - `bin (x)` – Converts x of base 2 to base 10
 - `hex (x)` – Converts x of base 16 to base 10
 - `oct (x)` – Converts x of base 8 to base 10

All Commands

All the available console commands that allow manipulation of graphs.

- Colours:
 - `Colour`- Choose a line from a graph and then you can choose from a range of colours for that line. The colours available are under all colours.
 - `Background, Foreground` – Change the background (the background of the graph) colour and the foreground or text colour.
- Window:
 - `Clear, Redraw`- clears the graph, redraws the graph.
 - `Close`- Closes the window
- Size:
 - `SizeX, SizeY`- Choose the min and max shown values for x and y.
 - `Width`- Change line width
- Labels:
 - `Name`- Change the graph's title.
 - `LabelX, labelY`- Change the axis's labels.
- Hiding:
 - `Hide`- Choose a line to hide from the graph.
 - `Show`- Choose a line to show from the graph.
 - `Hide All`- Hides all lines.
 - `Show all`- Show all lines.

FAQ (Frequently Asked Questions)

1) *What happens if I accidentally enter it in wrong?*

If a certain function is misspelt or doesn't exist, the system will just leave it as it is. If you just are calculating a value (not building a graph) then it will return a wrong result (cause you misspelt the function) and you can just re-enter the equation. If you are building a graph you have to be more careful since sometimes it can take a few seconds for it to exit the graph building since it won't recognise the misspelling.

2) *The graph I chose is empty? It's just a blank screen?*

This can happen in multiple cases, one if you misspell something and it exits the graph building or two if the graph for some reason is too complicated and it creates an error. The

second is very unlikely to occur but due to the nature of there being infinite possibilities of graphs it could occur. Double check all spelling if you get an empty graph. Also it could be that you are generating a graph that violates the recursion stopper, if you are make sure to disable the recursion stopper under options.

3) *Can I turn off the time logging and/or recursion stopper?*

Yes, you can turn both off by going into the options menu and unchecking them. Time logging is just a feature and won't increase any risks by turning it off, however recursion stopper prevents errors by stopping the graph building process if each iteration takes more than or equal to 100 steps to complete. In most cases this won't affect your expressions since most will take less than 10 steps to complete, however if you are doing either a complicated or odd equation (for example $y = 1 + 1 + 1 + 1 \dots$ 100 times) then you will need to disable recursion stopper/blocker for it to work.

4) *Why does the time logging differ so much?*

This is more complicated to explain but it comes down to a little bit of random nature and what functions you are executing, the quickest functions to run are always the operators since they don't require any external functions just a simple operation. The more complicated functions can take a little while longer but all time logs are in milliseconds (1000 milliseconds to a second) so a time of 0.26 ms is really 0.00026 seconds. However when using the graphing functionality time can be exponentially increased, this is due to the nature of how graphs are generated. If you have a simple graph of $y = x$ then it creates values for x and solves so $y = 0$, $y = 1$, $y = 2$ and so on. This means that if you have an equation like $y = x + 2$ it can take around 177ms or 0.177 seconds which while quite a bit longer than just $1 + 2$ it is doing $0 + 2$, $1 + 2$, all the way from -100 to 100 for x in steps of 0.25 (by default), this means that it is doing around 800 functions.

5) *The graph is taking a while to load?*

Graphs that use T and/or R values take significantly longer to generate since they have to build multiple lines/graphs on top of each other. This means that complicated graphs can take around 5-12 seconds to generate fully, if it takes longer than 20 seconds and you don't have a ridiculously amount of lines (1000+ lines) then you may have to force quit the program.

6) *What happens if I don't have the required packages?*

If you don't have wxPython the program will not work at all. If you don't have numpy then graphing won't work but all other aspects should work. It is recommended however that you have both numpy and wxPython.