

Math's Visualization – A Brief Overview of the Code and Functionality

This project is coded in Python (version 3.9) and makes use of the following libraries. (which can be seen in requirements.txt)

- PySide2 – A QT python wrapper.
- PyQt5 – Another QT Python wrapper.
- Matplotlib – Graphing and rendering library.
- Numpy – Python mathematical tools library.
- Sympy – Mathematical tools library.

PySide2 and PyQt5 are used for creating and rendering the GUI. Matplotlib is used in helping to render the graph objects. Numpy and Sympy are used to create objects out of use input and evaluate them to mathematical functions.

Inside the modules folder is where our lexer/parser is situated for our custom syntax, that we evaluate first then parse the user input to these libraries for further processing (if applicable).

'main.py' is the main file of the code, this contains code for the main window of the GUI, as well as logic for parsing user input to our interpreter (built on pure python). It's superclass is 'QMainWindow' as we inherit from the PyQt library when creating the GUI.

Inside the 'modules/' directory is where the rest of our logical code is.

'help.py' and 'splashscreen.py' are the python files responsible for the help and splashscreen GUI pages.

'console.py' is the file responsible for when the application is running in console mode.

'TextInput.py' 'symboltext.py' 'SolutionFrame.py' 'latex_render.py' 'GraphFrame.py' and 'CustomGridLayout.py' are all custom coded QT widgets made by us.

'GraphFrame.py' is the widget used to render the graphs.

'symboltext.py' is the widget used to parse user-input and render as latex.

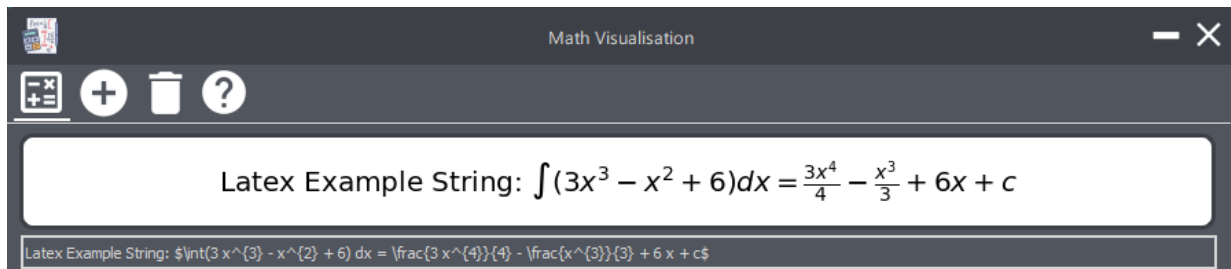
'stylesheetloader.py' is a custom class that takes allows for CSS stylesheets to be parsed from text files into python strings.

The rest of the files not mentioned above are for the interpreter, 'Lexer.py' and 'Parser.py' are the main components of our pure python interpreter.

Features overview and examples

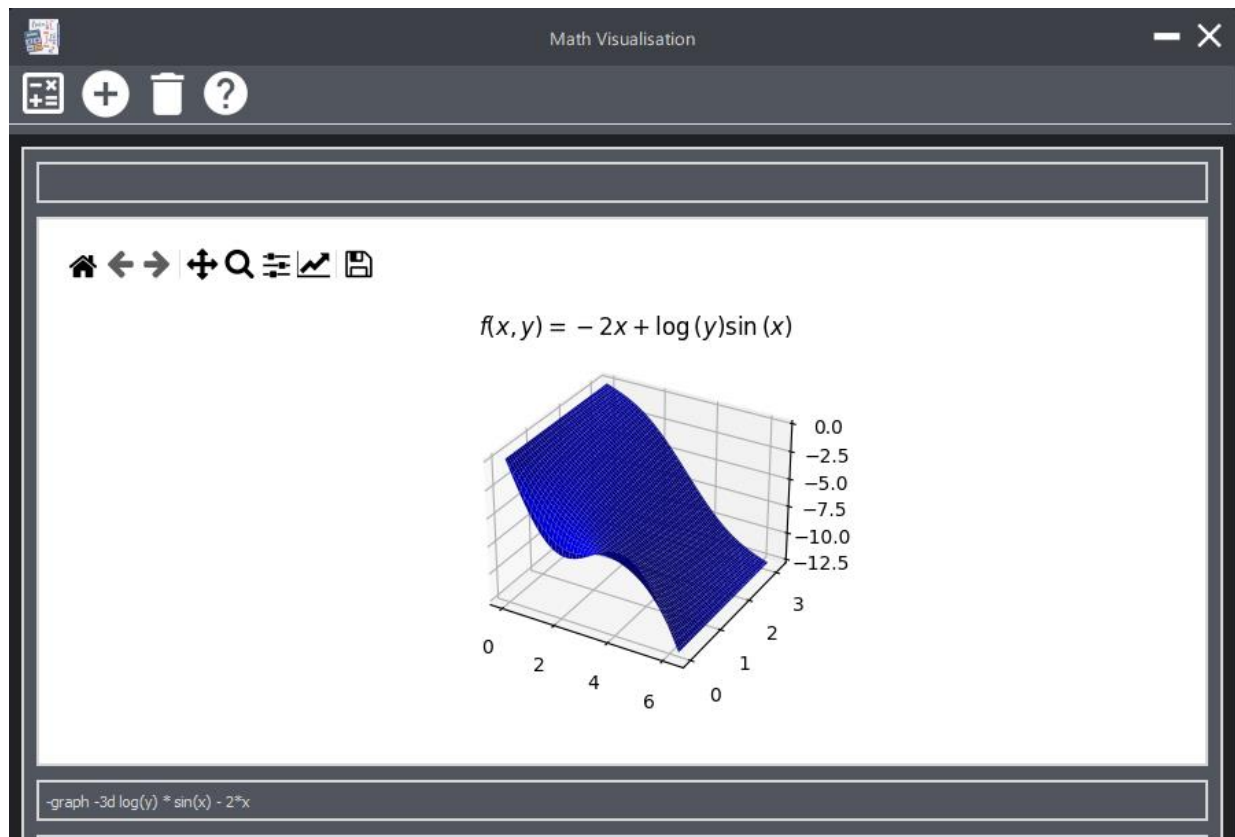
Inside the application there is also a 'help' page where most of this information will be detailed, along with examples.

The application features a dropdown menu where the user can enter latex.

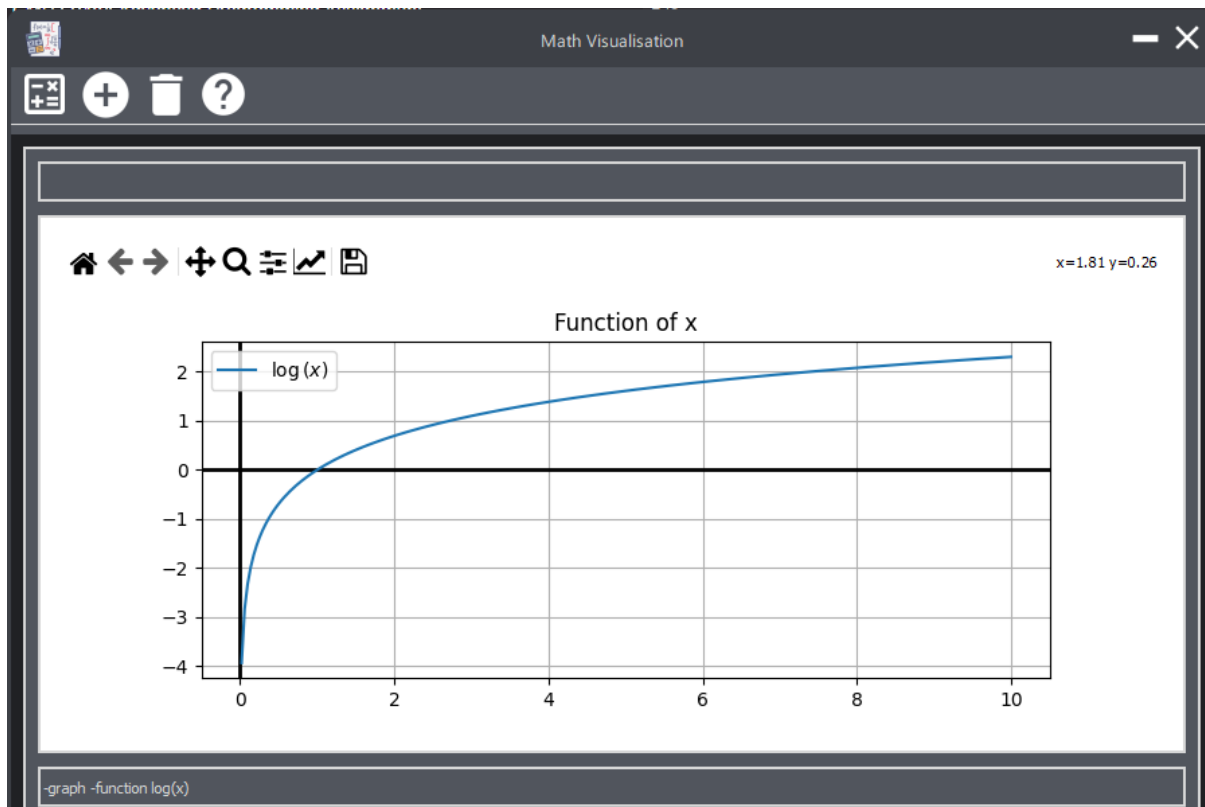


The application can support the 3D graph of a function of x and y. Mathematical functions supported are log () sin () cos () tan () sqrt (). Examples of the command:

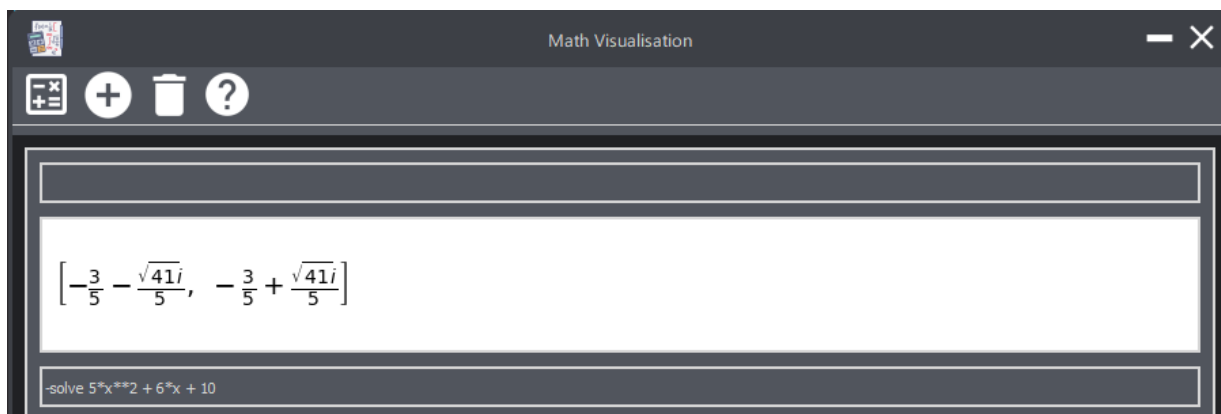
'-graph -3d sin(x) * sin(y)' '-graph -3d log(y) * sin(x) - 2*x'



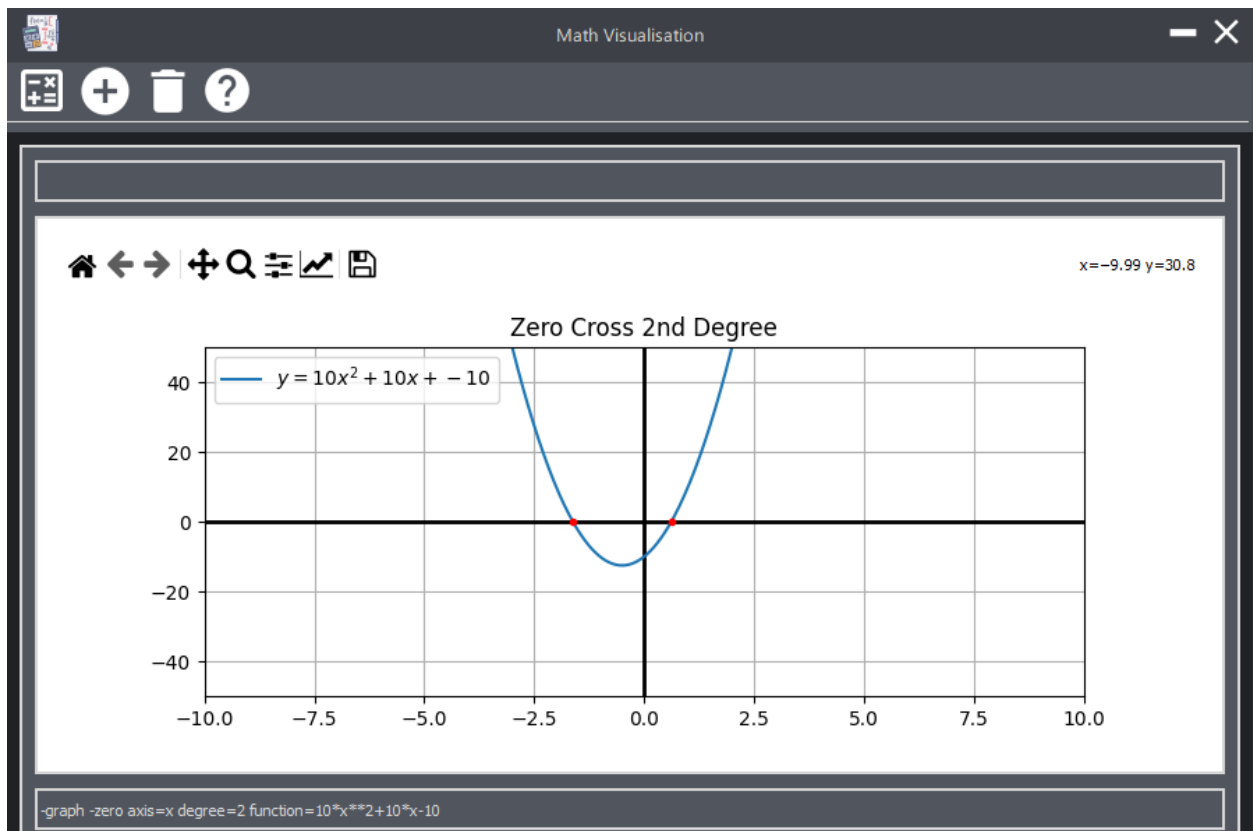
Simple graphs of functions of x ($f(x)$) are also supported. The mathematical functions supported are $\log()$ $\ln()$ $\sin()$ $\cos()$ $\tan()$ $\sqrt{}$ some examples are: '-graph -function log(x)' '-graph -function x**3' '-graph -function 2*x+1'



The application also supports solving quadratic equations for x , an example of this would be: `'-solve 5*x**2 + 6*x + 10'`. This function returns an array of the positive and negative solution for x :



The application also supports zero crossings for a 2nd or 3rd degree polynomial, on the x and y axis. An example of this command would be: `'-graph -zero axis=x degree=2 function=10*x**2+10*x-10'`.



This application also supports integration and differentiation for x.
 examples of these commands would be: '-differentiate 3*x**3-1*x**2+6'
 and '-integrate 3*x**3-1*x**2+6'.

Math Visualisation

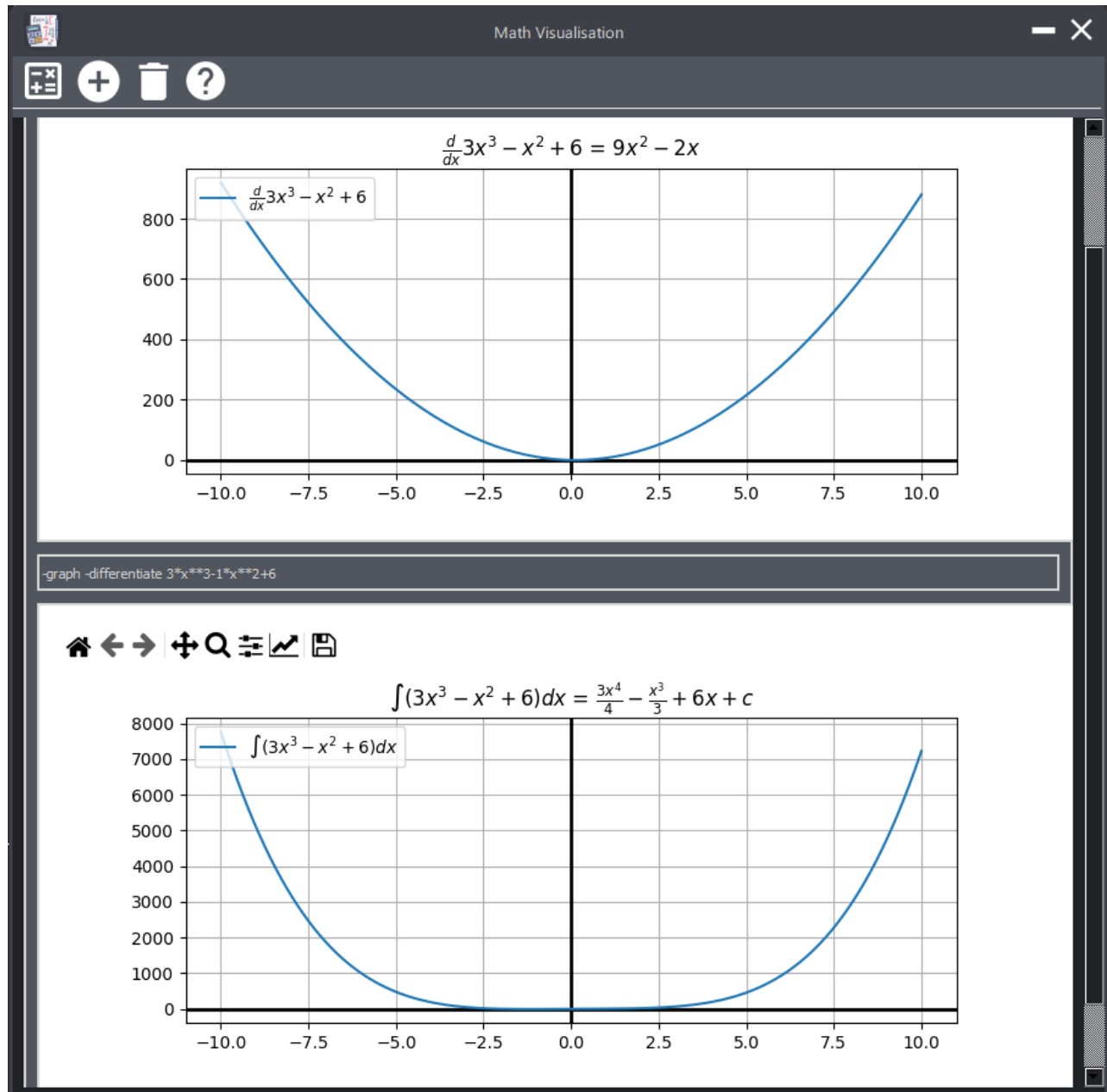
$\int (3x^3 - x^2 + 6)dx = \frac{3x^4}{4} - \frac{x^3}{3} + 6x + c$

-integrate 3*x**3-1*x**2+6

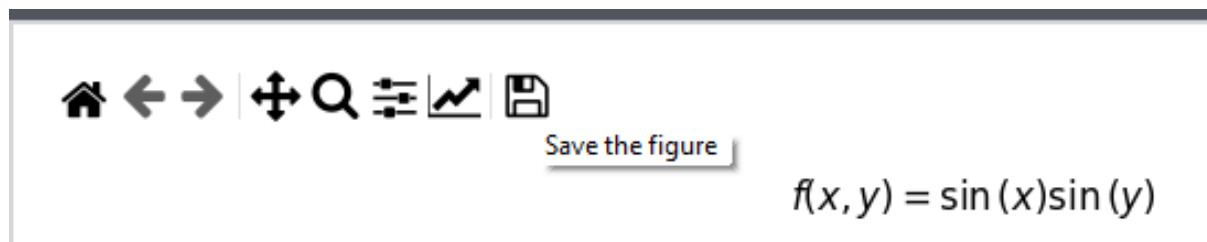
$\frac{d}{dx}(3x^3 - x^2 + 6) = 9x^2 - 2x$

-differentiate 3*x**3-1*x**2+6

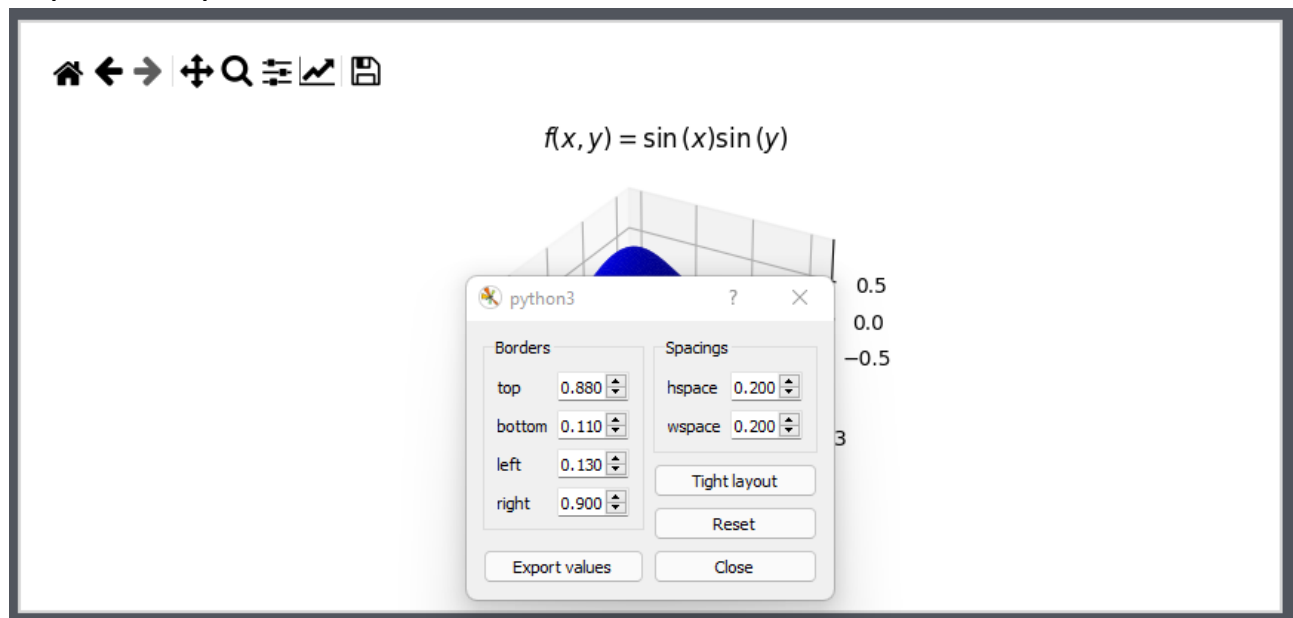
The application also supports for graphing integrals and derivatives, an example of these commands would be: '-graph -differentiate 3*x**3-1*x**2+6' and '-graph -integrate 3*x**3-1*x**2+6':



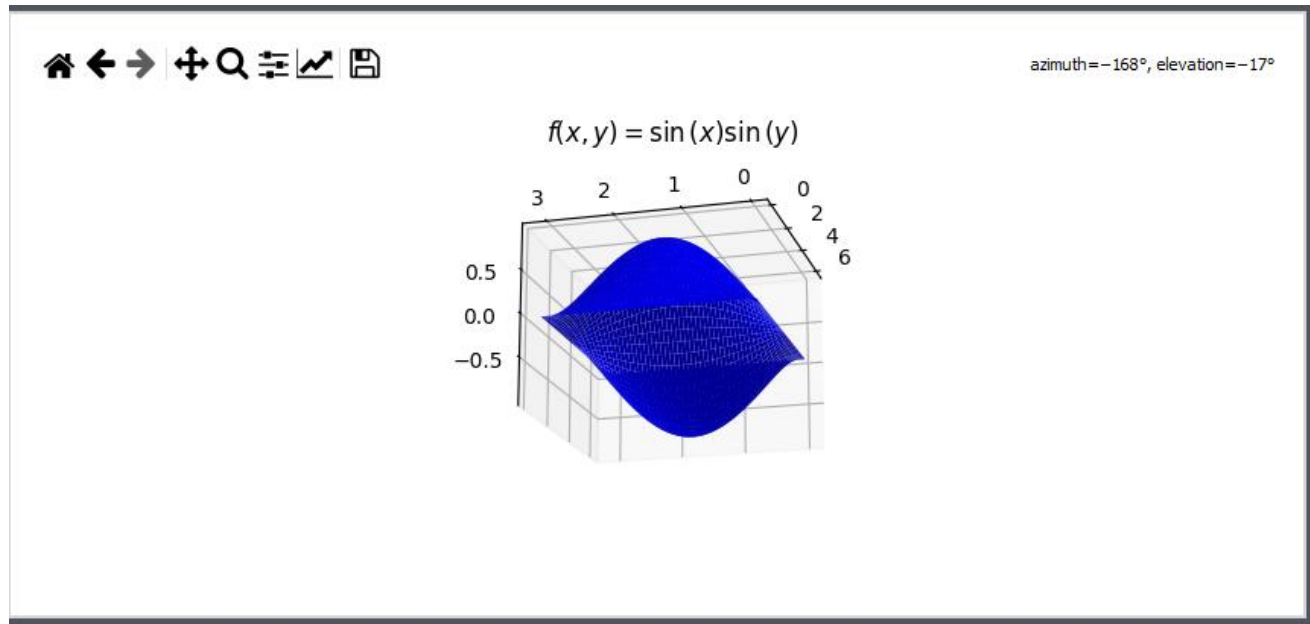
The graph widget also contains a toolbar that has multi functionality. The save figure button can be used for saving the figure to a png file.



The subplots button can be used to configure the plot dimensions and export the plot data:



The plot can also be rotated in its plane(3d or 2d) by clicking and dragging on the figure:



The figure options button allows you to change the plot title and configure the scale of the plot:

