Judges' report

Harry PLOTter

Team 7

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Contents

Chapter 1

Introduction

The purpose of this document is to present a detailed description of Harry PLOTter, a graph plotting application. It explains the purpose and scope of the application developed, the constraints under which it must operate, the interface of the application, what the application does and how it responds to external stimuli. This document is intended for the potential users of the application.

1.1 Purpose of the application

The application Harry PLOTter automates the plotting of 2D and 3D graphs which can be used widely in all fields of science. It provides easy and novel methods for graph plotting, possessing powerful features that make it tremendously advantageous for various users in any field.

1.2 Scope of the Problem

Graphs are an central part of our scientific studies. Plots make heaps of data intelligible for different purposes. Important conclusions are inferred through the results obtained from graphs. The uses of graphs include:

1. Graphs play an important role in scientific study and analysis of almost any data available.
2. Graphs are one of the good ways presently available to analyse functions.
3. Graphs make interpretation and analysis of data easier.

Automation of graph plotting is very much important in case of complex functions. This application helps users in performing the above mentioned task.

1.3 Document Overview

The remainder of this report is organised as follows.

- **Chapter 2 - Application Overview** : Provides the overview of the application along with its system dependencies.
- **Chapter 3 - Features** : Gives an overview of the features implemented in the application.
- **Chapter 4 - Architecture** : Provides a description of the architecture of the system clearly showing the different modules of the system and the interactions between them.
- **Chapter 5 - Test Plan** : Explains the methods of testing used to test the application.

Chapter 2

Application Overview

2.1 Modes of Operation

The application offers two modes of operation.

2.1.1 Two-Dimension (2D)

This mode is used in plotting two dimensional graphs. The input can be given in two different types namely from a file and as a function.

- Input File containing data points.
- Expression of the function with ranges of x and y.

2.1.2 Two-Dimension (3D)

This mode is used in plotting three dimensional graphs.The input is given in the same way as in the two dimensional mode. The input can be given in two different types namely from a file and as a function.

- Input File containing data points.
- Expression of the function with ranges of x,y and z.

2.2 Application Dependencies

The dependencies of the application are:

- Python 2.7.6
- Ubuntu 14.04 or above

The installer also installs:

- python-pip
- python-dev
- python-qt4
- python-numexpr
- PyOpenGl
- python-qt4-gl
- python-numpy
- imagemagick
- qdarkstyle
- libxml2-dev
- libxslt-dev

Chapter 3

Features

Harry PLOTter offers users wide variety of features to make it useful to all kinds of users. The features offered are described in the remainder of the section.

- **Support of 2D and 3D plotting** - The application supports plotting both two dimensional and three dimensional graphs and view them in both 2D and 3D views in separate tabs.
- **Support with multiple export formats** - The application has the feature which enables the user to export the graphs created in different file formats, including vector and image formats.
  - **2D graph formats**:
    - Vector formats : SVG
    - Image formats : PNG, JPG, BMP, TIF, ICO, JPEG, PPM, TIFF, XBM, XPM, TIFF
    - Others : Matplotlib window, CSV
  - **3D graphs formats**:
    - Vector formats: EPS, PDF
    - Image formats: PNG, BMP
- **Input format** - The application allows the user to enter the input in two ways, namely through a user-given expression or through a file containing the set of data points.
- **Zoom, Pan and Rotation** - The application provides the users with Zooming, Panning and Rotation options for providing the user with an optimal view.

- **Colours** - The application allows the plots to be drawn in various colors, which can be set by the user, in order to make them distinct from the other plots present.
- **Multiple plots in same graph** - The application allows the users to plot multiple graphs in a single tabbed view which helps in relative comparison of the plots.
- **Legend Display** - The application displays the legend for the plots in the plot area, where the plots are displayed.
- **Graph properties** - The application provides the option to users to explicitly choose the graph properties like line types, widths, and opacity.
- **Multiple tabs** - Users can open multiple tabs at the same time for ease of their usage.
- **Expression tool** - The application possesses an expression tool, which helps the user enter the expression he needs conveniently.
- **Standard Expressions** - The application presents to the user the option of selecting from a list of standard expressions for his use. The standard expressions include: The list of expressions given in the application are:
  - Normal Distribution
  - Parabolic Equation
  - Paraboloid
  - Half-Ellipsoid
  - Ellipse
  - Hyperbolic Equation
  - Semi-circle
  - Line
  - Plane
  - Witch of Agnesi
  - Half-Butterfly function
- **Line plot or Scatter plot** - The application plots two types of plots - Line plot (for 2D) and Surface/Scatter plot (for 3D).

- **Drag and Drop** - For giving an input from file, the application provides an option to drag and drop the file to the plot area for selecting the file.
- **Axes specifications** - The user can specify the axes labels and units through an option in the Menu bar.
- **Theme selection** - The application provides the user the option of selecting either a 'Black' and 'White' theme from the Menu Bar.
- **Variable opacity of 3D plots** - Since a 3D surface plot may cover another plot, the user is provided with options to adjust the opacity of the plot. This can be done by double-clicking a graph item on the plot list and changing the field 'Opacity'.
- **Shortcuts** - The application provides short-cuts for the user's convenience. These include:
  - 'Ctrl' + 'N': Opens a new Graph Specification Dialog.
  - 'Ctrl' + 'T': Opens a new Tab.
  - 'Ctrl' + 'W': Closes the selected Tab.
- **Mouse Position Indicator** - In 2D graphs, the user can find out the x,y coordinates of a point by moving the mouse to it. These coordinates are displayed on the status bar. A horizontal and vertical line intersecting at the mouse cursor position is displayed to clearly show the corresponding x and y coordinates. These lines can be shown/hidden by the user.
- **Plotting the average of 2D graphs** - The user can plot the average of the 2D plots drawn inside the same graph. The average plot is drawn along with the graphs (whose average has been computed) in the 2D plot area.
- **Transformation of 2D axes into log scale** - The user can transform the axes into log scale for easily analysing functions involving exponents and logarithms.
- **Specifying the range of axes in 2D graph** - The user may want to view only some part of the graph, in which case he/she may want to set the range of x and y axes visible in the graph.
- **Entering function using calculator** - The user may enter the right-hand-side of the equation using a calculator provided with the dialog box that pops up on pressing the Add Plot button. The cursor automatically adjusts according to the operation entered using the

Chapter 4

Architecture

4.1 Use Case Diagram

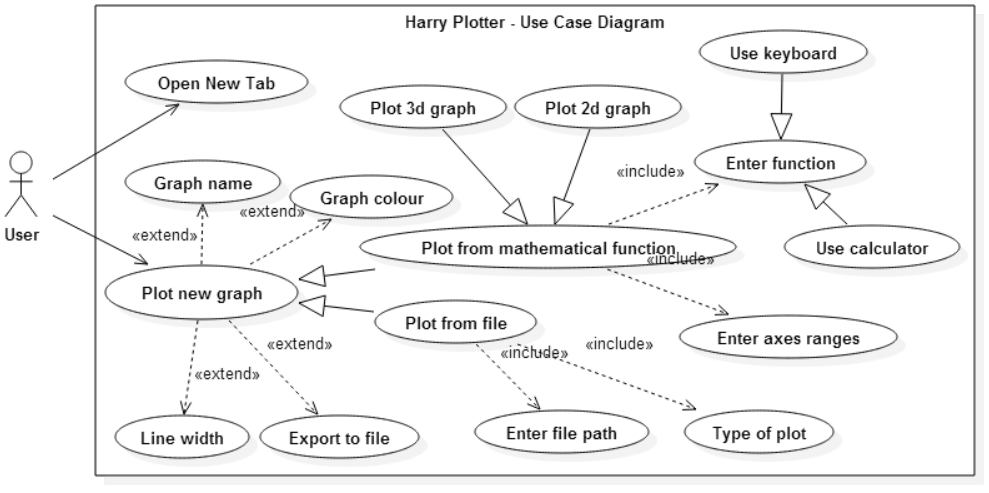

Figure 4.1: Use case diagram of Harry PLOTter

The user can draw a new plot through the Graph specification dialog box. The user can provide a name, color, line width to the plot. The user is presented with 2 options - plotting either from an expression or through the data from a file. The file can be selected through a file dialog, while the user can enter his expression for plotting in the expression box.

The user may also make use of the standard expressions in the application. The user specifies the X and Y ranges for plotting the graph. Finally, the user can view the plot in any mode convenient to him through zooming, rotating, etc. and export it to his desired file format.

4.2 Class Diagram

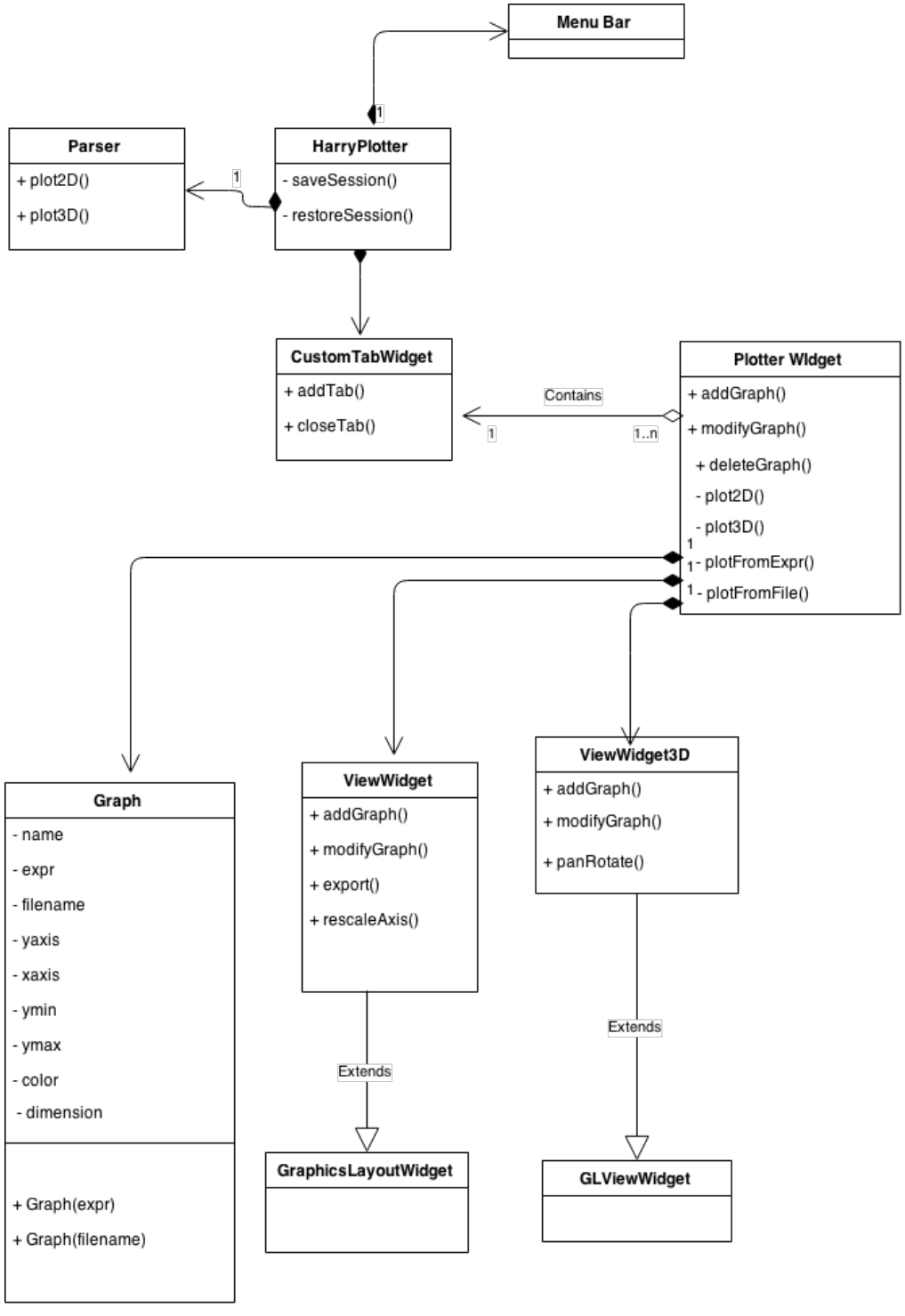

Figure 4.2: Class diagram of Harry PLOTter

Multiple entities work in tandem to perform the desired functions effectively. These functions are described as follows :

- **HarryPlotter** is the central entity containing the plots and maintains, saves or restores user sessions.
- **CustomTabWidget** manages the Tab facility for the user.
- **PlotterWidget** manages the functionality for adding graphs, allowing the user to specify all graph details.
- **Graph** is responsible for generating the graph from its specifics.
- **ViewWidget** extends GraphicsLayoutWidget and manages the 2D graphs for displaying to the user.
- **ViewWidget3D** extends the GLViewWidget and manages the 3D graphs for displaying to the user
- **Menu Bar** contains multiple options for tabs, themes, settings, description of the application, etc.

4.3 Data Flow Diagram

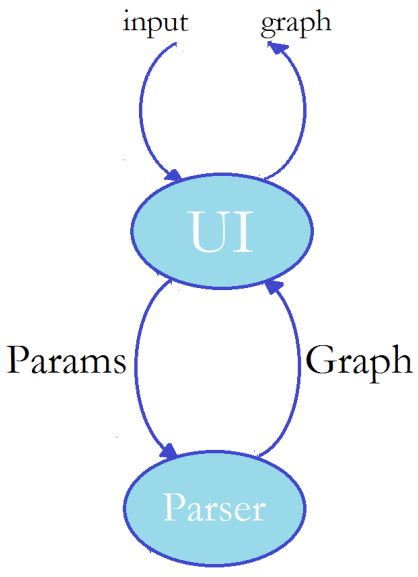

Figure 4.3: Data flow diagram of Harry PLOTter

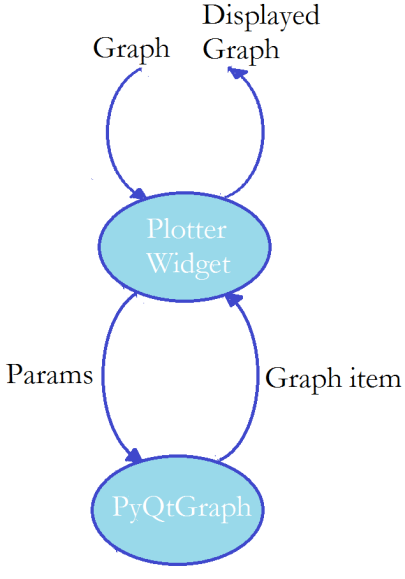

Figure 4.4: Data flow diagram of Harry PLOTter

4.4 Activity Diagram

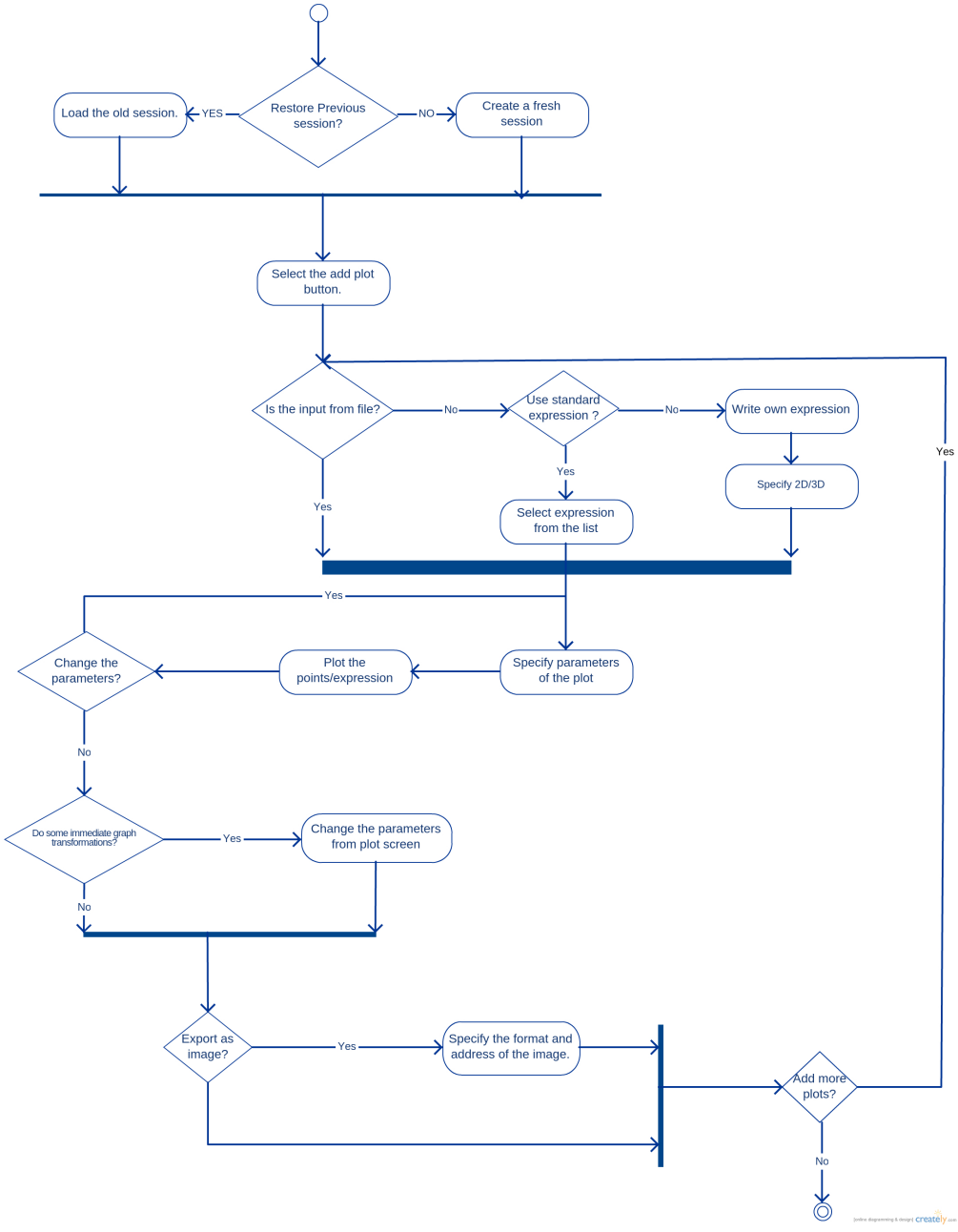

Figure 4.5: Activity diagram of Harry PLOTter

Chapter 5

Test Plan

5.1 Introduction

5.1.1 Description

This document sketches out the test plan for the *Harry PLOTter*.The test plan used the black box approach and white box approach to uncover various bugs in the software. It was necessary then to perform regression testing to ensure that no new bugs have been introduced due to the introduction of correction patches in the code.

This paradigm will include, but is not limited to, the testing criteria, methods, and test cases of the overall design. Throughout the testing process the test documentation specifications described in the IEEE Standard 829-1998 for Software Test Documentation will be applied.

5.1.2 Hardware Requirements for testing

The software is assumed to be tested on a machine with following configuration .

- RAM: 4GB
- Processor: 64 bit

5.1.3 Software Requirements for testing

Operating System: Ubuntu 14.04 or higher
Python 2.7.6

5.2 Test Items

This section consists of the lists of the things that are to be tested within the scope of the test plan.

5.2.1 Features to be tested

following configuration .

- Plotting 2D/3D graphs from mathematical expression or files.
- The different features like graph colour, graph edit, line width, expression tool, scatter plot etc. were tested.
- Input format was tested.
- Multiple plots in same graph was tested.
- Standard Expressions were included and verified.
- Multiple tabs were opened and graphs were drawn in all of them.
- Keyboard Shortcuts were tested.
- The parser for mathematical expressions was tested.
- The generator for data points for mathematical expressions was tested.
- The export feature was tested for different formats.

5.2.2 Features not to be tested

- The external library *Python-Qt4* need not be tested as it is a stable standard external library for making UI in Python and can be assumed to be bug free.
- The external library *PyOpenGL* need not be tested as it is a stable standard external library for making UI in Python and can be assumed to be bug free.
- *Python-Numpy*, *Python-Numexpr*

5.3 White Box Testing

5.3.1 HarryPlotter

The top module which controls all other UI elements.

- The last session save feature was tested.
- Restoring from the last session based on user choice was tested successfully.
- Application closing was tested.

5.3.2 MenuBar

The menu bar at top of HarryPlotter which contains various utility options.

- New Tab, Close Tab, New Plot features were tested both using mouse and keyboard shortcuts.
- Theme and Axes specification change was tested.

5.3.3 CustomTabWidget

This module contains all the tabs which further contain different graphs together.

- New tabs were added.
- Old tabs were closed.

5.3.4 PlotterWidget

Each tab is a PlotterWidget which maintains the graphs in that tab.

- New graphs were added.
- Old graphs were modified.
- Old graphs were deleted.

5.3.5 PlotBox

This module allows us to edit different settings of a graph.

- Toggle 2D/3D was tested.
- GraphWidth, Graph Type(Scatter/Line/Surface), Opacity were tested.
- Expression tool was tested successfully.

5.3.6 ViewWidget3D

This is the module which displays 3D graphs.

- Different graphs were drawn successfully.
- Pan, Zoom, Rotate was tested.
- Export to different formats was tested.

5.3.7 ViewWidget2D

This is the module which displays 3D graphs.

- Different graphs were drawn successfully.
- Pan, Zoom, Rotate was tested.
- Log scaling was tested.
- Plotting average of graphs was tested.
- Export to different formats was tested.

5.3.8 Parser

This module receives a mathematical expression and it returns the points on the graph satisfying the expression which are then plotted on the ViewWidgets.

- 2D/3D expressions were tested successfully for different X/Y ranges
- Non-Standard mathematical expressions like "z = 2xcos(x) + 3cos(xy) " were tested successfully. Standard expression for this would have been "z = 2*x*cos(x) + 3*cos(x*y)"..

5.4 Black Box Testing

ACTION	OBSERVED RESPONSE	EXPECTED RESPONSE
Add new graph	Dialog Box Opened	Dialog Box Open
Expression Tool Buttons were used	Y = sin(x)+3xcos(x)	Y = sin(x)+3xcos(x)
Adding standard expression	Standard expression was filled in the expression field and constants table was displayed	Standard expression should be filled in the expression field and the constants should be allowed to be filled.
Color Button was clicked	Color palette dialog was opened	Color should be allowed to be chosen.
Toggle between 2d and 3d radio button	Appropriate fields were disabled e.g. opacity is only enabled for 3d	Some fields should be disabled depending upon the dimension chosen.
Scatter plot was chosen	The scatter plot was displayed	The scatter plot was displayed
Dashed line was selected for a 2d plot	The line for the 2d graph became dashed	The line for the 2d graph became dashed
Y = abcd	"Invalid expression" error message was displayed	Operation should be disallowed.
X-Min field was left empty	"One of the parameters is not in the desired format " error message was displayed	Operation should be disallowed
Y-Min = 2, Y-Max=0 was chosen	"One of the parameters is not in the desired format " error message was displayed	Operation should be disallowed
File was chosen	File dialog was opened	File dialog box should be shown
File with invalid data was chosen	"File error: Error at number 10" error message was displayed since line 10 was corrupt.	Appropriate error message should be displayed.
Mouse was clicked on a graph.	The graph name was displayed.	Graph name should be shown.

A valid file was chosen	Now the expression field was cleared and disabled since we have chosen a file.	We should not be allowed to enter any expression till the file is selected.
Double click on an item in the graph list.	The plot settings dialog was opened for that graph with the existing settings and they could be edited.	Show the existing settings and make them editable.
Cross button of an item in graph list was clicked.	The corresponding graph was removed from the ViewWidget, Legend and the graph list.	Remove the corresponding graph.
Mouse was scrolled up/down.	The graph was zoomed in/out.	Zoom increase/decrease.
Mouse was dragged.	The graph was panned in the drag direction.	Graph should pan.
Mouse was dragged in 3D graph.	The graph was rotated in the correct direction.	Graph should rotate.
Right Click in the graph area and then export was clicked in the Right Click Menu.	Export dialog box was shown showing different formats to export to.	Export options should be shown.
Change Background Color was clicked in the Right Click Menu.	The color palette dialog was opened.	Background Color should be allowed to be chosen.
Average was clicked in the Right Click Menu.	The average of all graphs was plotted.	Average of all graphs should be shown.
Change Axes Specifications was clicked.	Change Axes Specifications Dialog Box was shown to change the name and units of the axes.	Name and units should be allowed to edit.
Ctrl+N was pressed.	New Plot Dialog was opened	New plot should be allowed to add
+ button on the tab bar was clicked.	A new tab was opened	New tab should be opened.
A file was dragged onto the window.	New Plot dialog was opened with the given file pre-selected and other features could be changed.	A graph should be made from this file.

y = sin(x) was entered between the ranges x = -10 to x = 10	Graph of sin(x) was plotted	sin(x) should be plotted
From the standard expressions,paraboloid was chosen	Paraboloid was drawn in 3D	Paraboloid should be plotted