

GraphKey User Guide

A Microbiology Lab Information Management and
Visualization System

Senior Design Project

2020

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Team Website: <https://sddec20-29.sd.ece.iastate.edu>

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1. Overview

The purpose of this User Guide is to provide a user of GraphKey all the details needed to use the GraphKey application. This Guide will walk the user through generating Projects within the application, importing data, generating various types of graphs, creating graph templates, and exporting graphs. All available options within the application will be explained.

2. Getting Started

This product is a software application that allows the user to import pre-existing data from Excel and manage and visualize the data. The application supports the importation of data in CSV and JSON format. Users can select the type of graph they would like to generate along with the data they would like to be graphed. Three graph types are supported: scatter plots, bar graphs, and box plots. Multiple graphs can be generated at once if the users selects more than one data grouping for each graph variable at a time. Specifically, the application will generate all permutations of the selected data grouping. Depending on the graph type, the user can also select to use colors and symbol markers to visually group the data on the graph. The user can also customize various graph settings, including but not limited to, the dimensions of the graph, the axis labels, and the title of the graph. Lastly, the application allows the user to export the generated graphs to a specified location on the local machine as well as their Google Drive account.

2.1. Obtaining the Application

A copy of the application can be found on the Senior Design website for Team 29.¹ On the **Home Page**, download **GraphKey.zip**.

2.2. Running the Application

2.2.1. Requirements

- Python (at least version 3.8.5)²
- GraphKey.zip (see Section 2.1)

2.2.2. Installing Requirements

To install Python, please see Python's Website².

¹<https://sddec20-29.sd.ece.iastate.edu/>

²<https://www.python.org/downloads/>

To install GraphKey, please follow the instructions below:

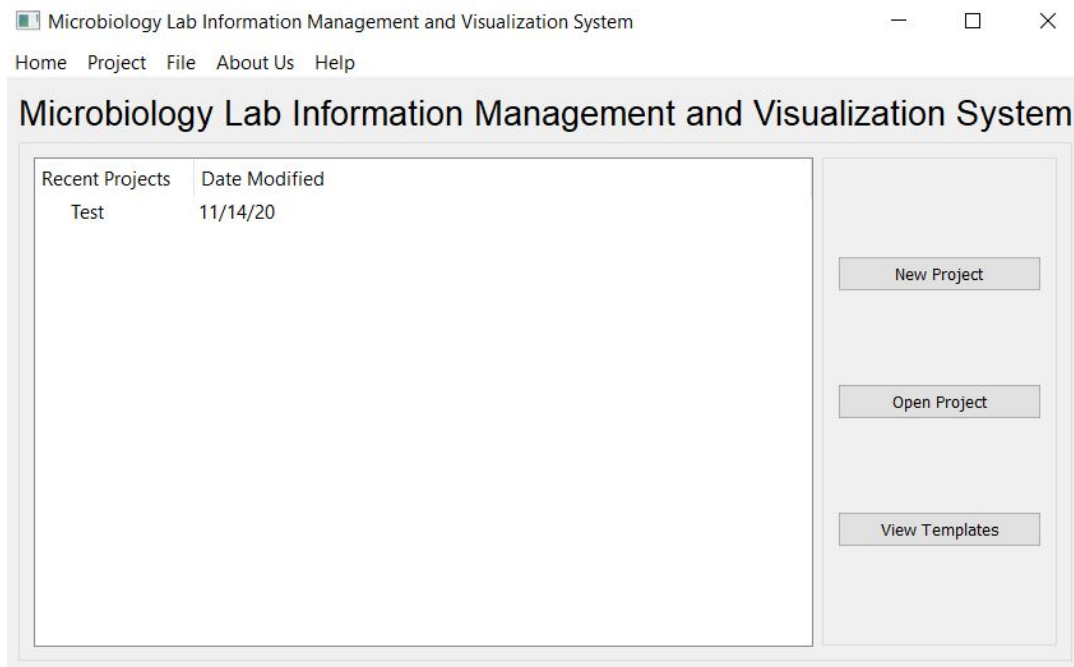
1. Unpack the **GraphKey.zip** file into a desired directory
2. Verify that the **requirements.txt** file is within that directory
3. Start up a command prompt and navigate to the directory where **GraphKey.zip** was unpacked
4. Type `python -m pip install -r requirements.txt` either in a Virtual Environment or your native Python installation

2.2.3. Starting the Application

There are two ways to start the application.

1. Find **GraphKey.py** in your file system and double click on it.
2. On a command line interface, type `python GraphKey.py`.

Please note that it can take up to 30 seconds for the application to launch, especially on the first time launching the application. Once the application has launched, you should see this window (recent projects may be blank if this is the first time launching the application):

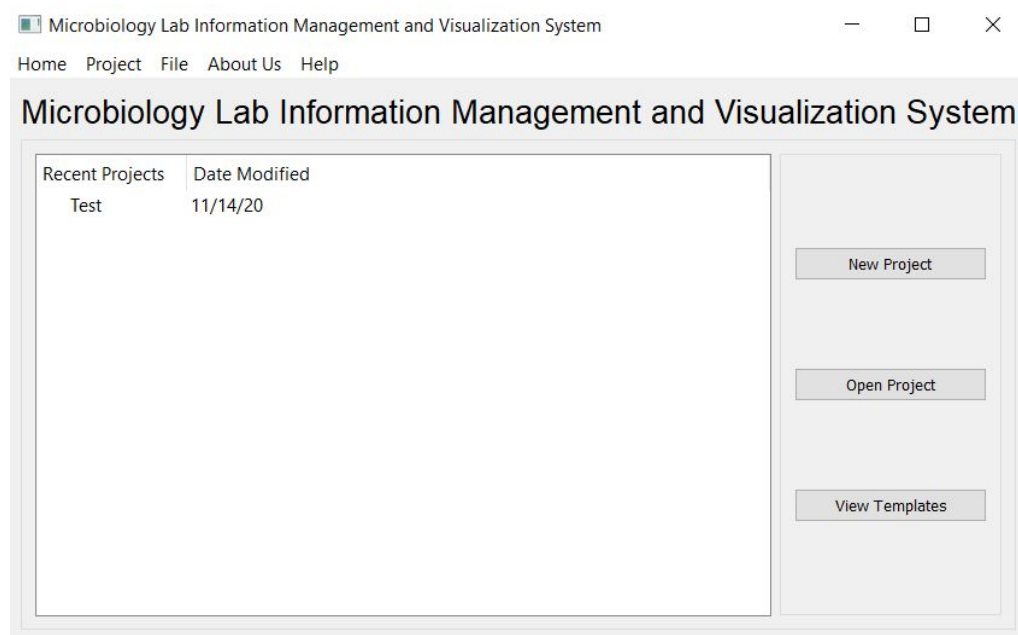


3. Projects

Projects serve as an easy way to keep imported data and generated graphs organized. It is recommended to keep the data and graphs of one experiment separated from another experiment through the use of Projects.

3.1. Creating a New Project

The **Home Screen** of the application looks like the following:



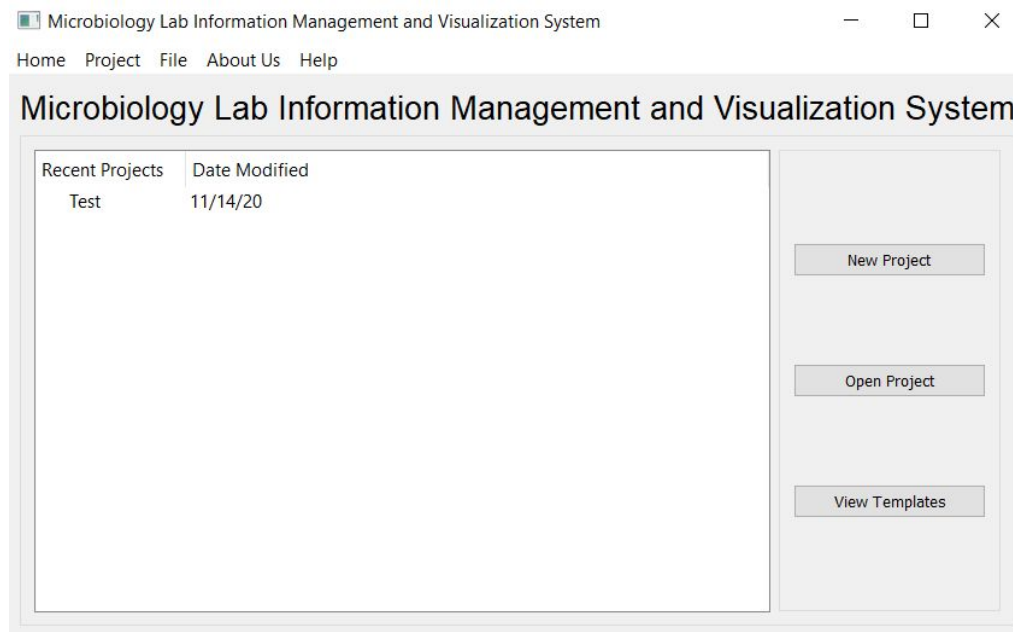
To create a new project using this window, click on the **New Project** button in the right column of the window. A **New Project Pop-Up** window will be displayed.



Enter in a name for the new project and click **OK**. The **New Project Pop-Up** will close, and the project will show up under **Recent Projects** on the **Home Screen**.

3.2. Opening a Project

The **Home Screen** of the application looks like the following:



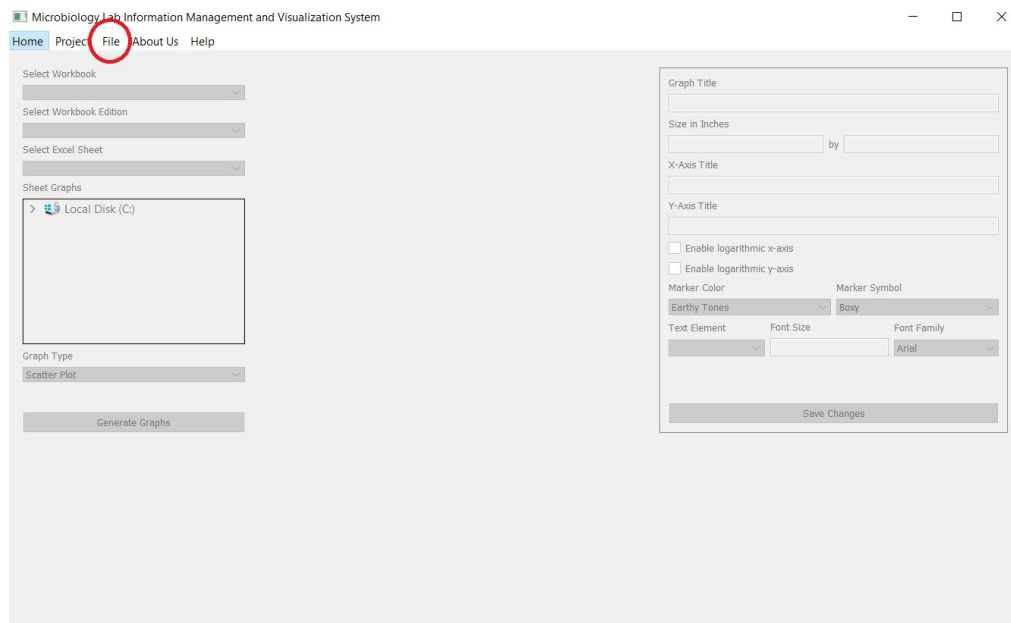
To open a project using this window, either double-click on the project to be opened in the Recent Projects window, or single-click on the project to be opened in the Recent Projects window and then click on the **Open Project** button in the right column of the window. The screen will change into the **Graphing Screen**.

4. Importing Data

Data can only be imported while on the **Graphing Screen**. There are two types of data that can be imported: a new data set and a revised version of an older data set (i.e. a data set that has been imported before). Allowing the importation of a revised version of a data set allows a user to keep old versions of the data within the application as well as older versions of graphs. This allows for easy data and graph comparison between data versions.

4.1. Importing New Data

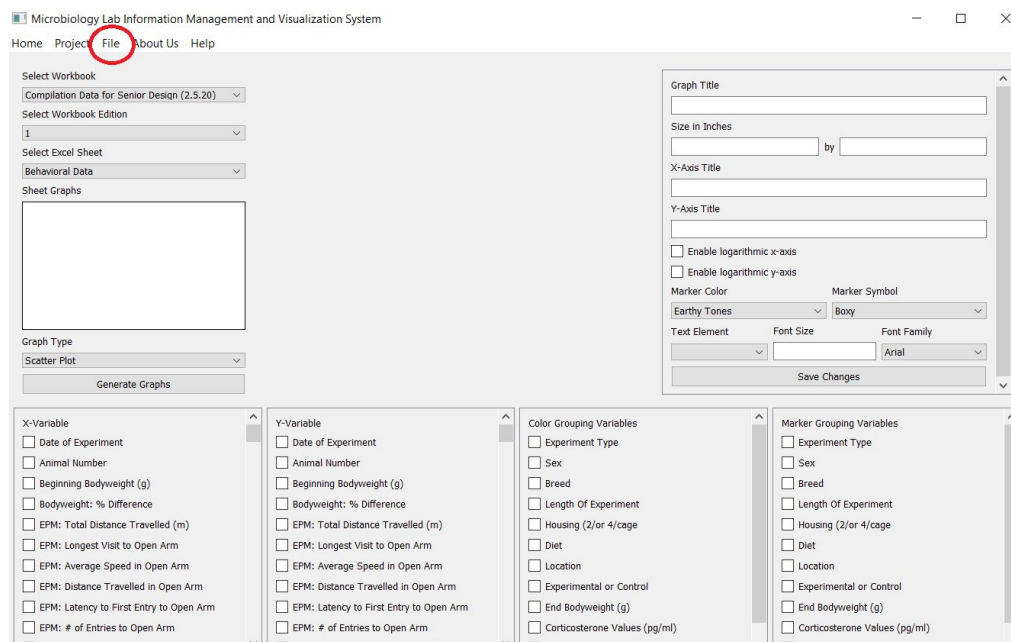
Click on the **File Dropdown Menu** in the upper left of the window.



From the dropdown menu, click on **Import File**. A file system browser will pop-up. Browse to the file to be imported. Select the file and click **Open**. If the file is large, a pop-up window explaining to please wait may appear. Once the file is done importing, it will become available to be selected in the **Select Workbook Dropdown Menu**.

4.2. Importing Revised Data

Click on the **File Dropdown Menu** in the upper left of the window.



From the dropdown menu, click on **Import Revision**. The **Add Workbook Edition Pop-Up** will appear.

Microbiology Lab Information Management and Visualization System

Add Workbook Edition ? X

Workbook Selected: ExperimentData

Select Revision: Import Workbook Revision

Import Cancel

Select the Workbook that has a revised version of its data. Then select the **Import Workbook Revision** button. A file system browser will pop-up. Browse to the file to be imported. Select the file and click **Open**. The **Add Workbook Edition Pop-Up** will now display the select file.

Microbiology Lab Information Management and Visualization System

Add Workbook Edition ? X

Workbook Selected: ExperimentData

Select Revision: Import Workbook Revision

File Selected: ExperimentData-rev.xlsx

Import Cancel

Select the **Import** button to begin importation. If the file is large, a pop-up window explaining to please wait may appear. Once the file is done importing, it will become available to be selected in the **Select Edition Dropdown Menu**.

Microbiology Lab Information Management and Visualization System

Home Project File About Us Help

Select Workbook: Complete Record for Sensor Data (2019)

Select Workbook Edition: 1

Import Excel Sheet

Behavioral Data

Sheet Graphs

Graph Type: Scatter Plot

Generate Graphs

Graph Title

Size in Inches

X-Axis Title

Y-Axis Title

Enable logarithmic x-axis

Enable logarithmic y-axis

Marker Color: Earthy Tones

Marker Symbol: Body

Text Element

Font Size

Font Family: Arial

Save Changes

X-Variable

- Date of Experiment
- Animal Number
- Beginning Bodyweight (g)
- Bodyweight: % Difference
- EPM: Total Distance Travelled (m)
- EPM: Longest Visit to Open Arm
- EPM: Average Speed in Open Arm
- EPM: Distance Travelled in Open Arm
- EPM: Latency to First Entry to Open Arm
- EPM: # of Entries to Open Arm

Y-Variable

- Date of Experiment
- Animal Number
- Beginning Bodyweight (g)
- Bodyweight: % Difference
- EPM: Total Distance Travelled (m)
- EPM: Longest Visit to Open Arm
- EPM: Average Speed in Open Arm
- EPM: Distance Travelled in Open Arm
- EPM: Latency to First Entry to Open Arm
- EPM: # of Entries to Open Arm

Color Grouping Variables

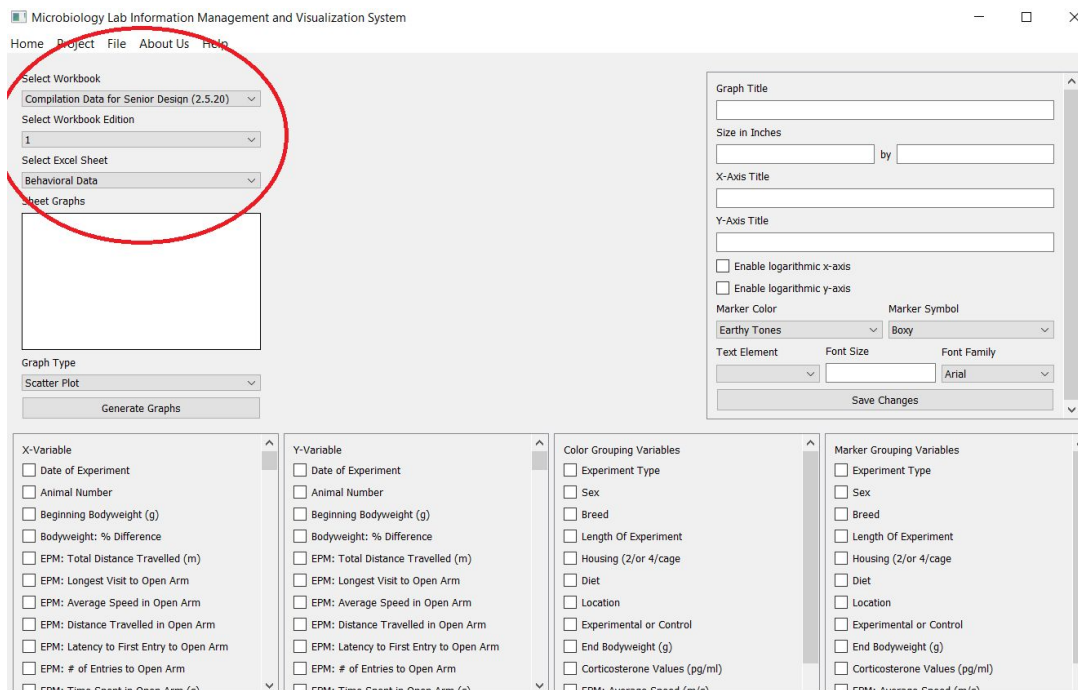
- Experiment Type
- Sex
- Breed
- Length Of Experiment
- Housing (2/or 4/cage)
- Diet
- Location
- Experimental or Control
- End Bodyweight (g)
- Corticosterone Values (pg/ml)

Marker Grouping Variables

- Experiment Type
- Sex
- Breed
- Length Of Experiment
- Housing (2/or 4/cage)
- Diet
- Location
- Experimental or Control
- End Bodyweight (g)
- Corticosterone Values (pg/ml)

5. Selecting Workbook, Edition, and Sheet

On the Graphing Screen for a project, the selected workbook, workbook edition, and Excel sheet can all be changed in the upper left hand corner of the screen.



The workbook can be selected from the first dropdown menu. To import another workbook, see Section 4.

The workbook edition can be selected from the next dropdown menu. This reflects any revisions that may have been imported for the selected workbook. So, if the current workbook has no other versions, there will only be “1” to choose from in this dropdown.

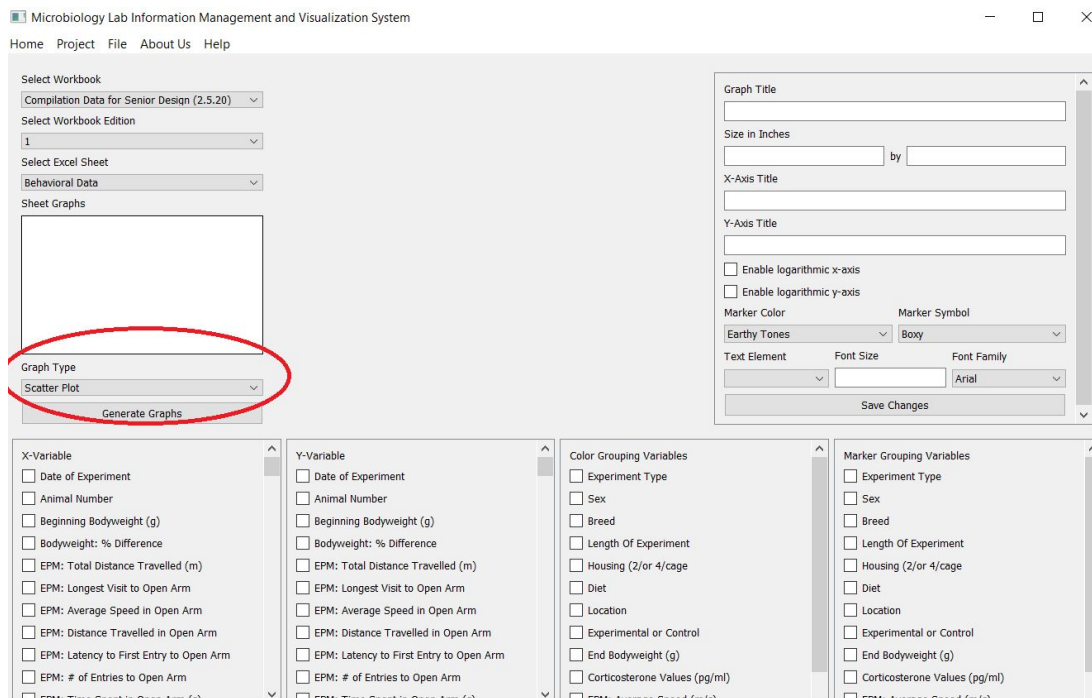
The next dropdown is for selecting a specific Excel sheet in the specified workbook. The dropdown options will simply include the names given to the sheets in the specified workbook.

6. Generating Graphs

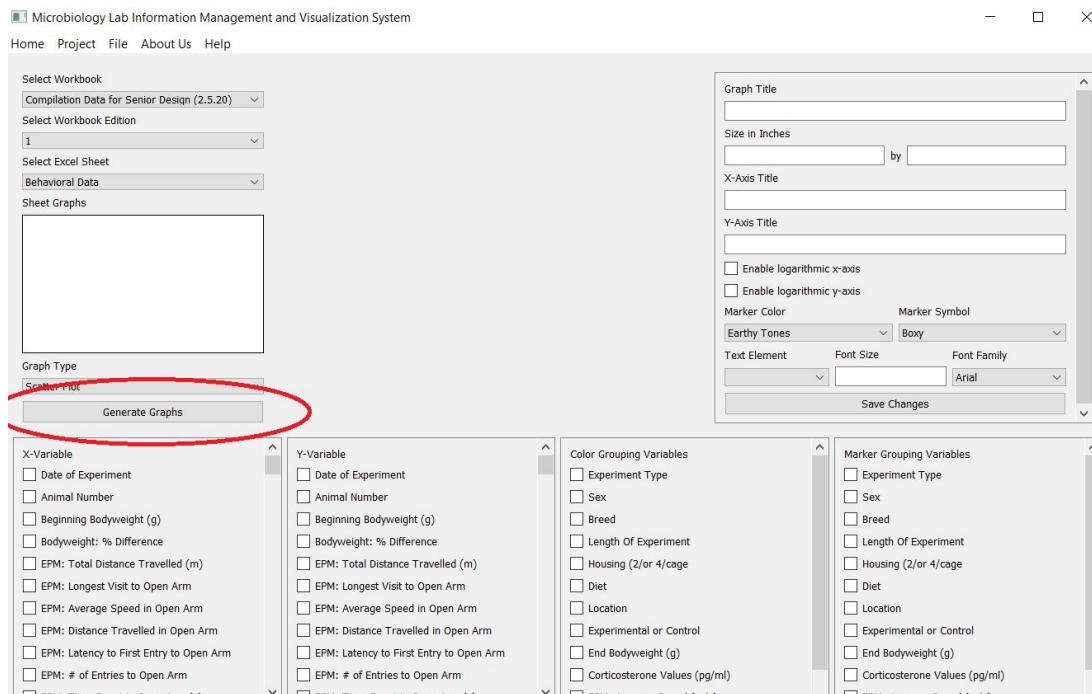
Before generating the graphs, please ensure that the correct **Graph Preferences** are selected. Please see Section 11 for details on **Graph Preferences**.

Additionally, select the **Workbook**, **Workbook Edition**, and **Excel Sheet** where the data to be graphed is located. Please see Section 5 for details.

Then, select the desired **Graph Type**. Scatter Plots, Bar Graphs, and Box Plots can all be generated. See Sections 8 and 9 for details on these graph types and how to select data for the given type.



After the data and Graph Preferences have been selected, click on the **Generate Graphs** button located midway down the screen on the left side.



If the graph generation is expected to take a long time, a pop-up window explaining to please wait may appear. Once graph generation is complete, the graphs will appear under the **Sheet Graphs** window section on the left side of the **Graphing Screen**.

7. Viewing Graphs

Graphs available for viewing will be located in the **Sheet Graphs** window section on the left side of the **Graphing Screen**. To view a graph, simply click on the name in this window section. The graph will then appear in the center of the **Graphing Screen**. Note that large graphs may take a while to appear.

The screenshot displays the 'Microbiology Lab Information Management and Visualization System' interface. The main window is titled 'Bodyweight % Difference Vs. Beginning Bodyweight'. The central plot shows a scatter of data points with a legend for 'Sex, Breed' including Male, CF-1 (red), Male, CD-1 (orange), Male, BL-6 (yellow), Female, CF-1 (green), and Male, CF-1 (blue). The x-axis is labeled 'Beginning Bodyweight (g)' and the y-axis is 'Bodyweight: % Difference'. A 'Generate Graphs' button is visible below the plot. The right-hand side contains a configuration panel with fields for 'Graph Title', 'Size in Inches', 'X-Axis Title', 'Y-Axis Title', and checkboxes for 'Enable logarithmic x-axis', 'Enable logarithmic y-axis', and 'Enable linear trendline'. The bottom of the screen has four panels for selecting variables: 'X-Variable', 'Y-Variable', 'Color Grouping Variables', and 'Marker Grouping Variables', each with a list of checkboxes for various experimental parameters.

Please note that only the graphs for the currently selected sheet are available for viewing. To view a graph from another sheet, workbook, or edition, change the corresponding selections. See Section 5 for more information.

8. Scatter Plots

8.1. Selecting Data

Data groupings can be selected on the bottom-half of the **Graphing Screen**.

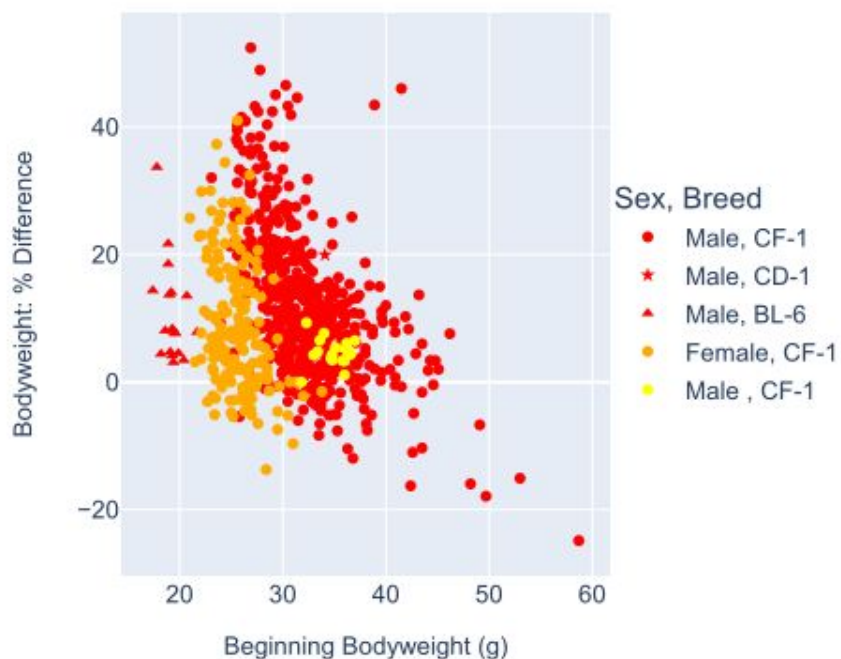
X-Variable	Y-Variable	Color Grouping Variables	Marker Grouping Variables
<input type="checkbox"/> Date of Experiment	<input type="checkbox"/> Date of Experiment	<input type="checkbox"/> Experiment Type	<input type="checkbox"/> Experiment Type
<input type="checkbox"/> Animal Number	<input type="checkbox"/> Animal Number	<input type="checkbox"/> Sex	<input type="checkbox"/> Sex
<input type="checkbox"/> Beginning Bodyweight (g)	<input type="checkbox"/> Beginning Bodyweight (g)	<input type="checkbox"/> Breed	<input type="checkbox"/> Breed
<input type="checkbox"/> Bodyweight: % Difference	<input type="checkbox"/> Bodyweight: % Difference	<input type="checkbox"/> Length Of Experiment	<input type="checkbox"/> Length Of Experiment
<input type="checkbox"/> EPM: Total Distance Travelled (m)	<input type="checkbox"/> EPM: Total Distance Travelled (m)	<input type="checkbox"/> Housing (2/or 4/cage)	<input type="checkbox"/> Housing (2/or 4/cage)
<input type="checkbox"/> EPM: Longest Visit to Open Arm	<input type="checkbox"/> EPM: Longest Visit to Open Arm	<input type="checkbox"/> Diet	<input type="checkbox"/> Diet
<input type="checkbox"/> EPM: Average Speed in Open Arm	<input type="checkbox"/> EPM: Average Speed in Open Arm	<input type="checkbox"/> Location	<input type="checkbox"/> Location
<input type="checkbox"/> EPM: Distance Travelled in Open Arm	<input type="checkbox"/> EPM: Distance Travelled in Open Arm	<input type="checkbox"/> Experimental or Control	<input type="checkbox"/> Experimental or Control
<input type="checkbox"/> EPM: Latency to First Entry to Open Arm	<input type="checkbox"/> EPM: Latency to First Entry to Open Arm	<input type="checkbox"/> End Bodyweight (g)	<input type="checkbox"/> End Bodyweight (g)
<input type="checkbox"/> EPM: # of Entries to Open Arm	<input type="checkbox"/> EPM: # of Entries to Open Arm	<input type="checkbox"/> Corticosterone Values (pg/ml)	<input type="checkbox"/> Corticosterone Values (pg/ml)
<input type="checkbox"/> EPM: Time Spent in Open Arm (s)	<input type="checkbox"/> EPM: Time Spent in Open Arm (s)	<input type="checkbox"/> EPM: Average Speed (m/s)	<input type="checkbox"/> EPM: Average Speed (m/s)
<input type="checkbox"/> EPM: Time Spent in Closed Arm (s)	<input type="checkbox"/> EPM: Time Spent in Closed Arm (s)	<input type="checkbox"/> BMZ: Short-Term: # of Secondary Errors	<input type="checkbox"/> BMZ: Short-Term: # of Secondary Errors

For Scatter Plots, the user will be required to select at least one **X-Variable** and at least one **Y-Variable**. For multiple graphs to be generated, select more than one **X-Variable** and/or **Y-Variable**.

Optionally, the user can select **Color Grouping Variables** and **Marker Grouping Variables**. This will group the scatter points by color and symbol markers respectively, based on the groupings selected. To generate multiple graphs with different groupings of the scatter points, select more than one **Color Grouping Variables** and/or **Marker Grouping Variables**.

8.2. Example Scatter Plot

Bodyweight % Difference Vs. Beginning Bodyweight



9. Bar Graphs and Box Plots

9.1. Selecting Data

Data groupings can be selected on the bottom-half of the **Graphing Screen**.

The screenshot displays a software interface with four columns of selection options:

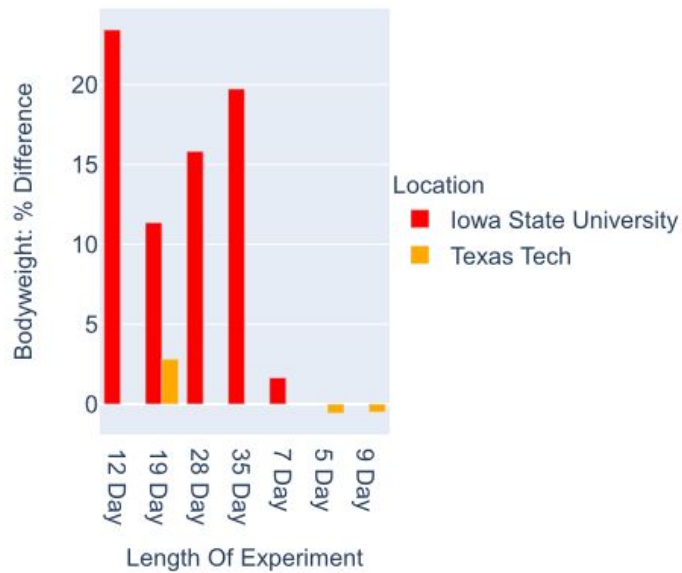
- Groupings:**
 - Experiment Type
 - Sex
 - Breed
 - Length Of Experiment
 - Housing (2/or 4/cage)
 - Diet
 - Location
 - Experimental or Control
 - End Bodyweight (g)
 - Corticosterone Values (pg/ml)
 - EPM: Average Speed (m/s)
 - BMZ: Short-Term: # of Secondary Errors
- Group Filtering:**
 - CF-1
 - CD-1
 - BL-6
- Sub-Groupings:**
 - Experiment Type
 - Sex
 - Length Of Experiment
 - Housing (2/or 4/cage)
 - Diet
 - Location
 - Experimental or Control
 - End Bodyweight (g)
 - Corticosterone Values (pg/ml)
 - EPM: Average Speed (m/s)
 - BMZ: Short-Term: # of Secondary Errors
 - Rotarod: Day 2: Latency to Fall
- Y-Variable:**
 - Date of Experiment
 - Animal Number
 - Beginning Bodyweight (g)
 - Bodyweight: % Difference
 - EPM: Total Distance Travelled (m)
 - EPM: Longest Visit to Open Arm
 - EPM: Average Speed in Open Arm
 - EPM: Distance Travelled in Open Arm
 - EPM: Latency to First Entry to Open Arm
 - EPM: # of Entries to Open Arm
 - EPM: Time Spent in Open Arm (s)
 - EPM: Time Spent in Closed Arm (s)

For Box Plots and Bar Graphs, the user will be required to select at least one **Grouping** and at least one **Y-Variable**. For multiple graphs to be generated, select more than one **Grouping** and/or **Y-Variable**.

Optionally, the user can filter the groups shown, as well as select **Sub-Groupings** (for Bar Graphs) and **Color Grouping Variables** (for Box Plots). This will group the bars and boxes by color based on the groupings selected. To generate multiple graphs with different groupings of the bars and boxes, select more than one **Color Grouping Variables** or **Sub-Groupings**.

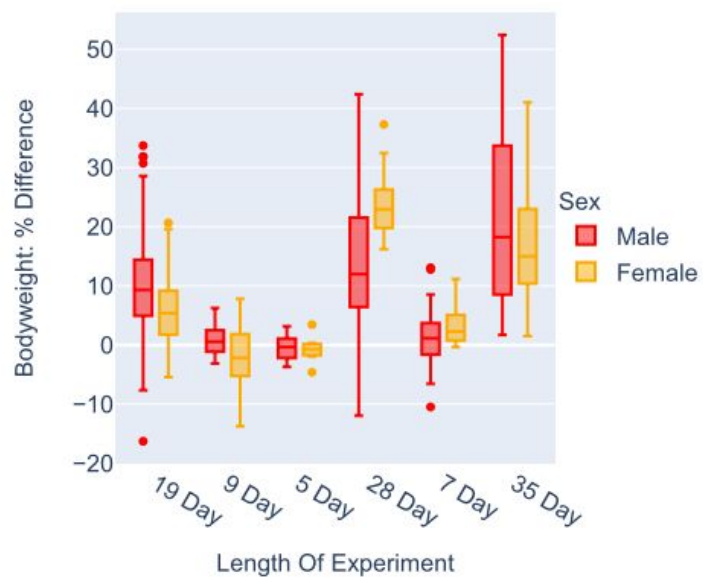
9.2. Example Bar Graph

Bodyweight % Difference vs Length of Experiment



9.3. Example Box Plot

Bodyweight % Difference vs. Length of Experiment



10. Editing Graphs

Graphs can be edited after they have been generated. To edit a graph, first select it from the **Sheet Graphs** window. Then, the upper right window of the Graphing Screen will contain information above the settings of the graph.

The screenshot displays the 'Microbiology Lab Information Management and Visualization System' interface. The main window is titled 'Bodyweight % Difference Vs. Beginning Bodyweight'. The central area shows a scatter plot with data points colored by sex and breed. The x-axis is labeled 'Beginning Bodyweight (g)' and ranges from 20 to 60. The y-axis is labeled 'Bodyweight: % Difference' and ranges from -20 to 40. A legend on the right indicates that red dots represent 'Male, CF-1', yellow dots represent 'Male, CD-1', and blue dots represent 'Female, CF-1'. The plot includes a 'Generate Graphs' button and statistical values: 'T-Value: 44.63332 P-Value: 0.0'.

On the right side, there is a 'Graph Title' panel with various settings:

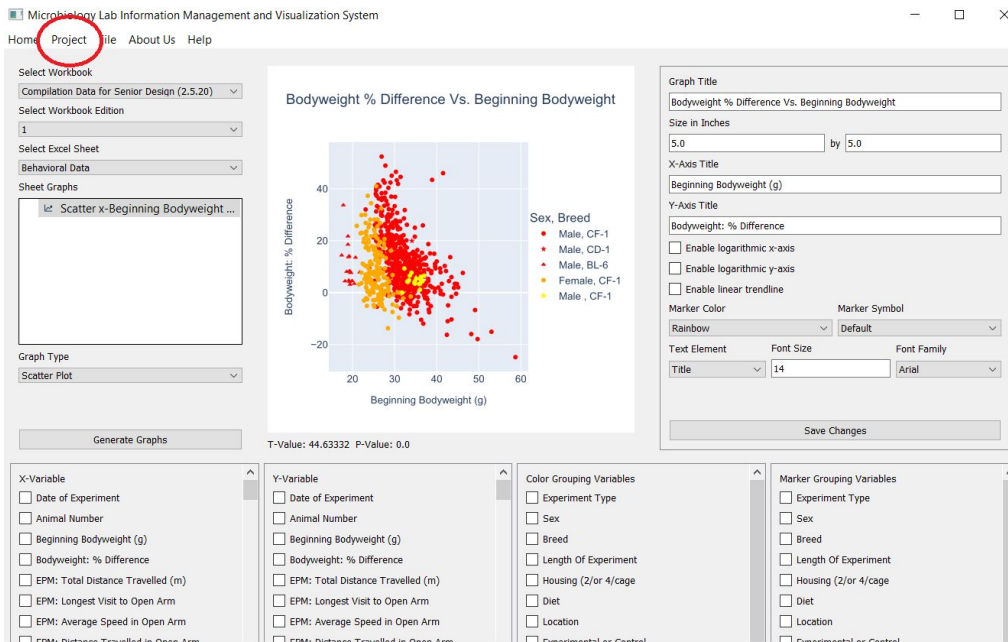
- Graph Title:** Bodyweight % Difference Vs. Beginning Bodyweight
- Size in Inches:** 5.0 by 5.0
- X-Axis Title:** Beginning Bodyweight (g)
- Y-Axis Title:** Bodyweight: % Difference
- Logarithmic Axes:** Unchecked for both x and y axes.
- Linear Trendline:** Unchecked.
- Marker Color:** Rainbow
- Marker Symbol:** Default
- Text Element:** Title, **Font Size:** 14, **Font Family:** Arial
- Save Changes:** Button at the bottom.

At the bottom of the window, there are four columns of checkboxes for 'X-Variable', 'Y-Variable', 'Color Grouping Variables', and 'Marker Grouping Variables'. The 'X-Variable' column includes options like 'Date of Experiment', 'Animal Number', 'Beginning Bodyweight (g)', 'Bodyweight: % Difference', and 'EPM: Total Distance Travelled (m)'. The 'Y-Variable' column includes 'Date of Experiment', 'Animal Number', 'Beginning Bodyweight (g)', 'Bodyweight: % Difference', and 'EPM: Total Distance Travelled (m)'. The 'Color Grouping Variables' column includes 'Experiment Type', 'Sex', 'Breed', 'Length Of Experiment', 'Housing (2/or 4/cage)', 'Diet', and 'Location'. The 'Marker Grouping Variables' column includes 'Experiment Type', 'Sex', 'Breed', 'Length Of Experiment', 'Housing (2/or 4/cage)', 'Diet', and 'Location'.

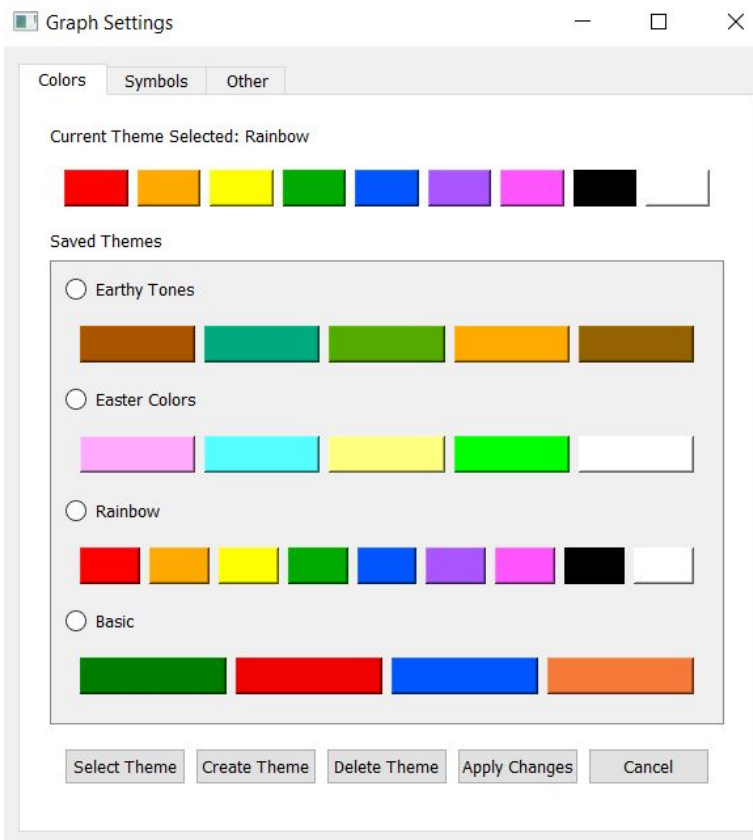
From this window, the graph title, size, x and y-axis labels, x and y-axis scales, marker color, and marker symbol can be changed. Additionally, the x and y-axis ranges can be manually adjusted, and a trendline can be selected to appear on the graph. After making the necessary adjustments, click **Save Changes**.

11. Graph Preferences

To view and/or change the **Graph Preferences**, click on the **File Dropdown Menu** in the upper left of the window.



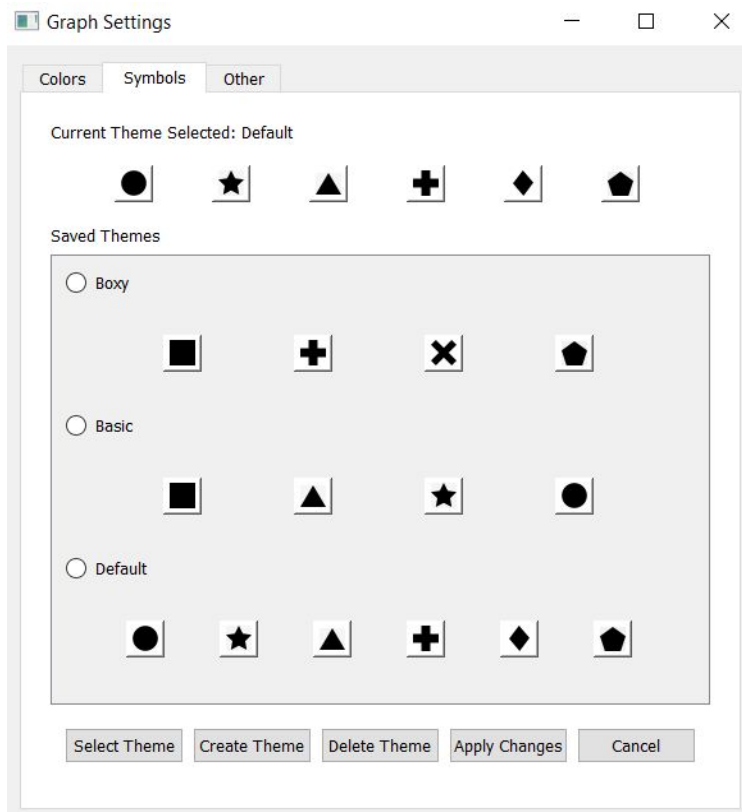
From the dropdown menu, click on **Graph Preferences**. The **Graph Settings Pop-Up** will appear.



On this settings window, there are multiple preferences to view/change: **Color Theme**, **Symbol Theme**, and **Other**. To switch between them, click on the corresponding tab.

The **Color Scheme** represents the colors used in the graphs generated. The tab to change this preference looks like the above picture. If a **Color Grouping Variable** was selected, the graph will rotate through the selected **Color Scheme**. If the **Color Grouping Variable** has more categories than the number of colors in the selected **Color Scheme**, the graph will rotate through all the colors in the selected **Color Scheme** and then start again with the first color in the scheme. Users can select, create, and delete themes on this tab.

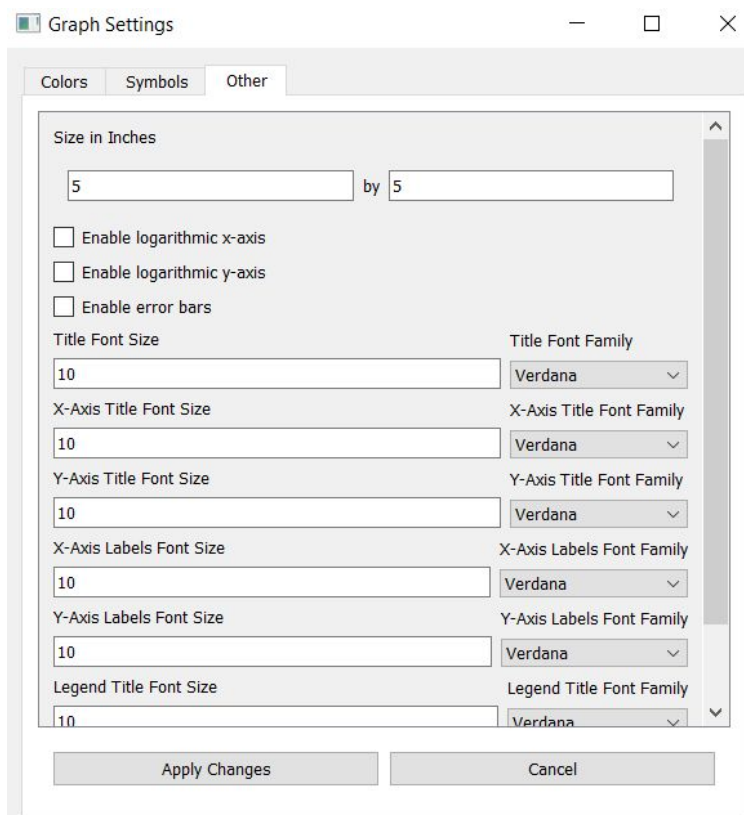
The **Symbol Scheme** represents the marker symbols used in the graphs generated. The tab to change this preference looks like this:



If a **Symbol Grouping Variable** was selected, the graph will rotate through the selected **Symbol Scheme**. If the **Symbol Grouping Variable** has more categories than the number of symbols in the selected **Symbol Scheme**, the graph will rotate through all the symbols in the selected **Symbol Scheme** and then start again with the first symbol in the scheme. Users can select, create, and delete themes on this

tab.

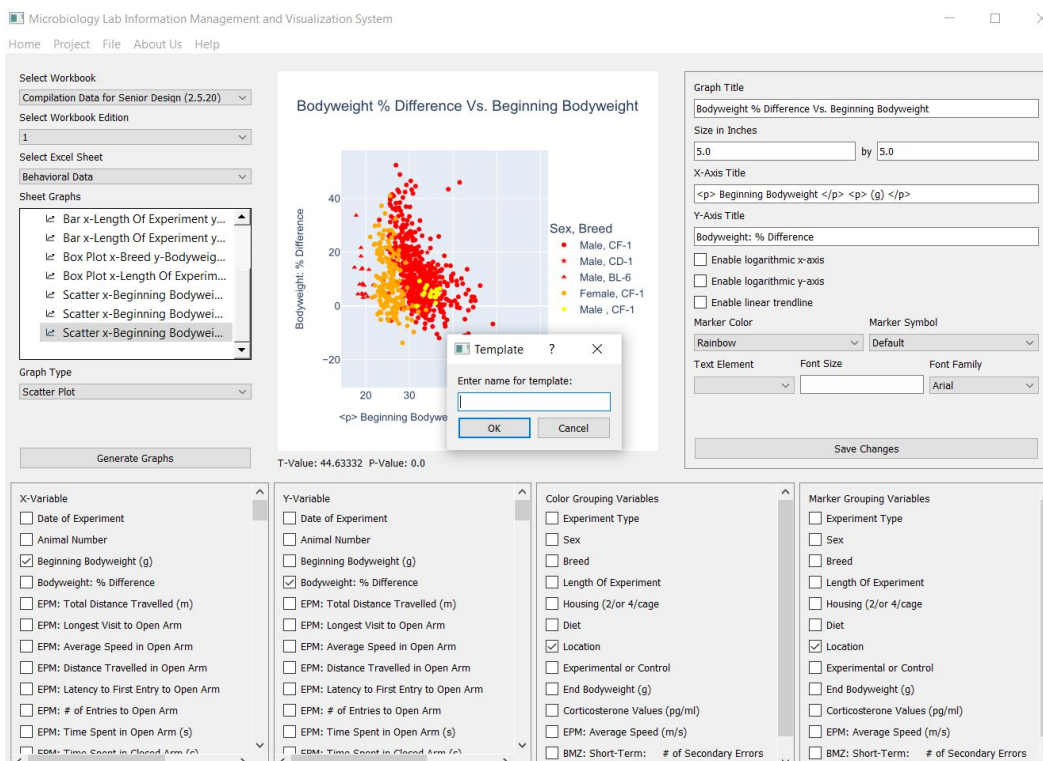
The **Other** tab has additional graph settings, including: the dimensions of the generated graph image, logarithmic capabilities for x and y-axis, error bar capabilities, as well as font Size and Type for the graph title and x and y-axis labels.



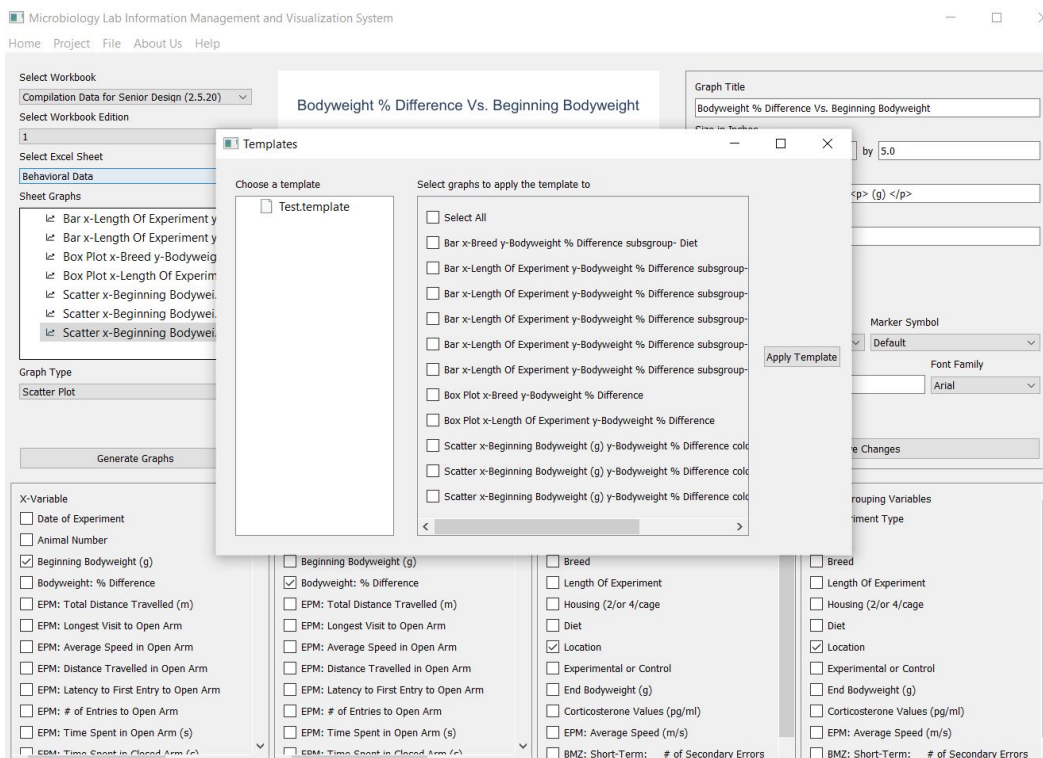
12. Graph Templates

A graph template is used to save the configuration of a graph so that the same configuration can be applied to other graphs later on.

To create a template of a graph, click on a graph file in the **Sheet Graphs** section that was previously generated. When the graph appears, on the **Project Dropdown** select **Create Template**. An alert will appear prompting for a name for the template. Enter a name for the template and select **OK**.

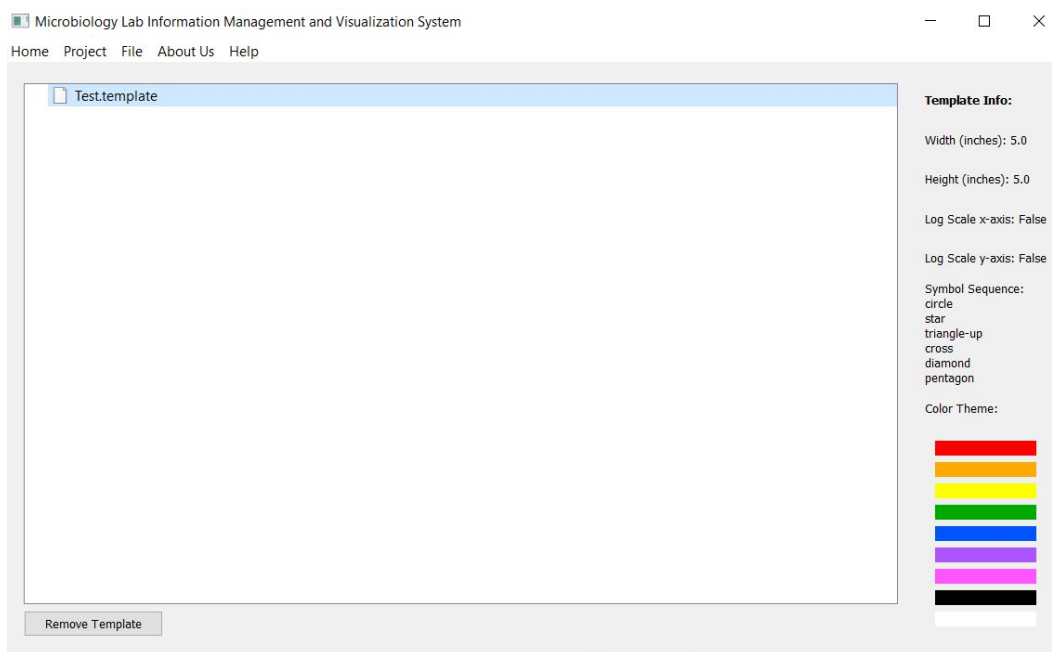


To apply the template to one or multiple graphs, on the **Project Dropdown** select **Apply Template**.



A new window will appear. Select a template from the panel on the left of this window and select the graphs the template will apply to. After **Apply Template** is clicked, the height, width, color theme, shape theme, and the logarithmic scale states of each axis are copied to the graphs that have been selected.

To view the contents of a template and delete templates, click on the **View Templates** button on the **Home Screen**.



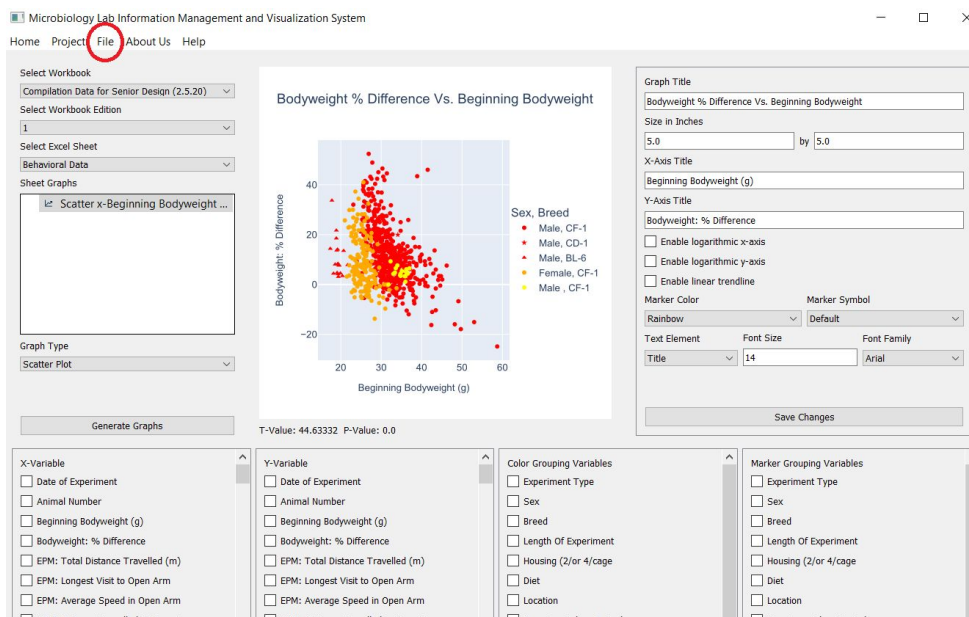
After selecting a template, the contents of it will appear on the right side of the window. The template can also be removed by selecting **Remove Template**.

13. Exporting Graphs

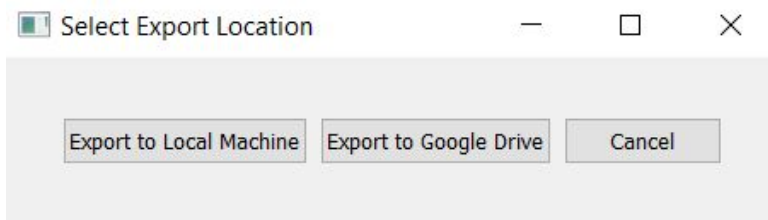
Please note that Exporting will only work if graphs have been generated and the **Sheet Graphs** window is populated.

13.1. Exporting to the Local Machine

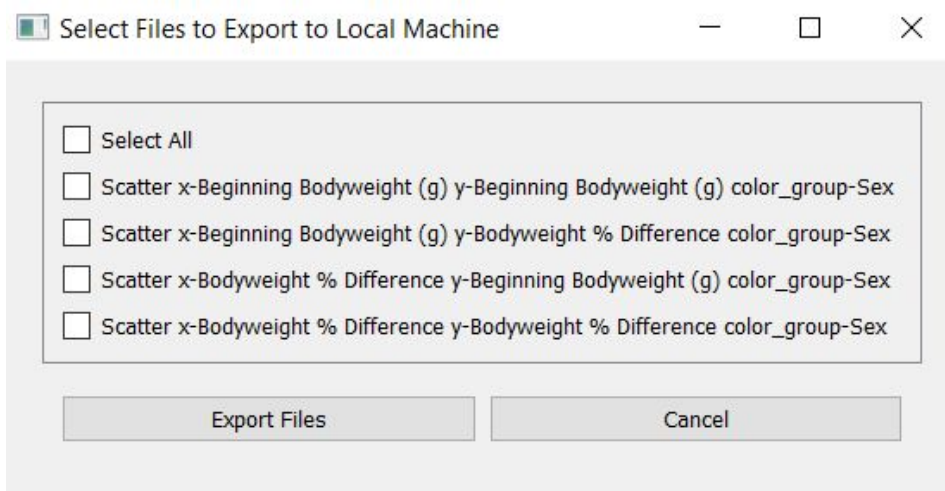
First, click on the **File** tab, and select **Export File(s)**.



A small pop-up window will appear.



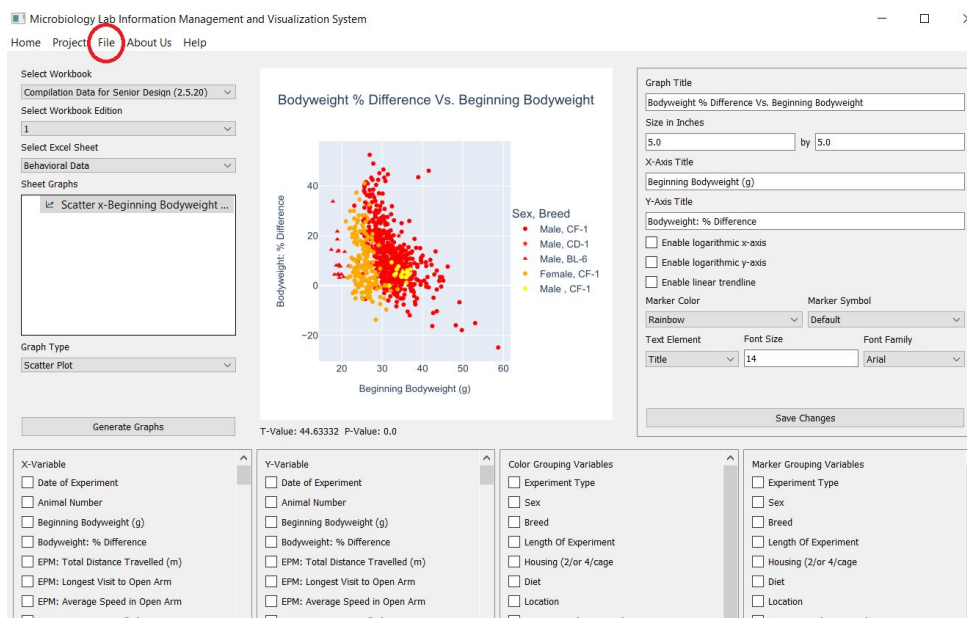
Choose **Export to Local Machine**.



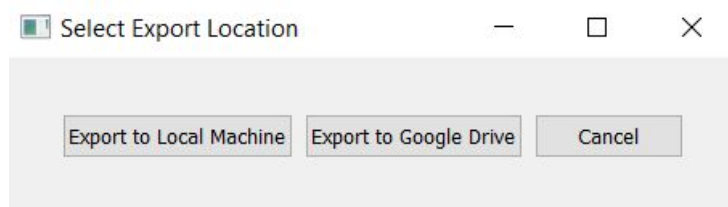
A window populated with the generated graphs will appear and look similar to the above screenshot. Select the files that are to be exported and click **Export Files**. A file system browser will appear. Navigate to the location the files are to be saved, and click **OK**.

13.2. Exporting to Google Drive

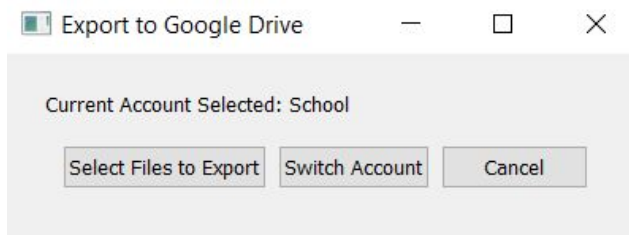
First, click on the **File** tab, and select **Export File(s)**.



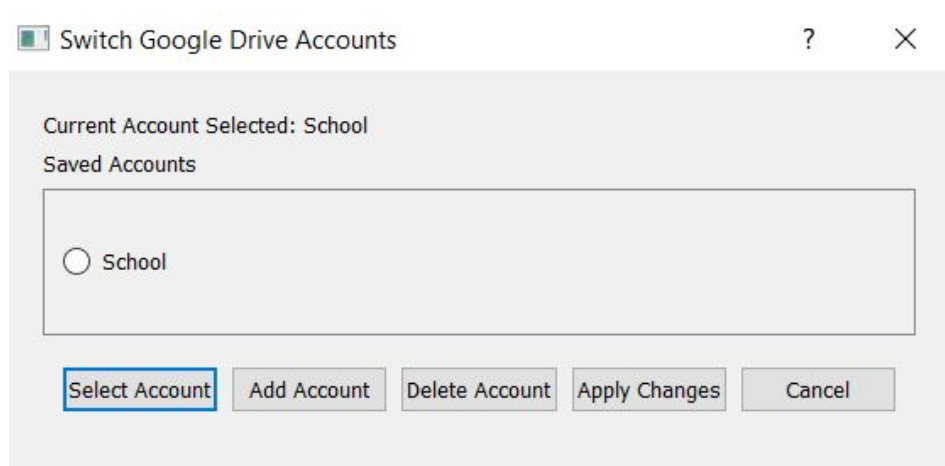
A small pop-up window will appear.



Choose **Export to Google Drive**. The following window will appear.



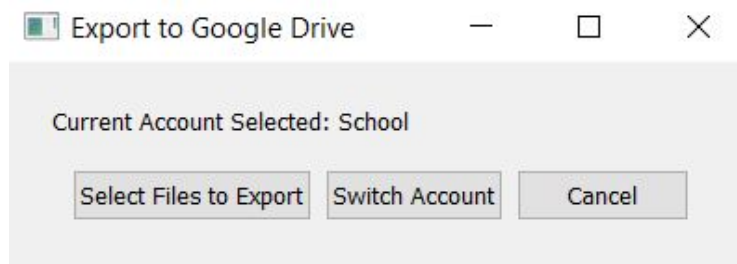
For new users, **None** will be the current account selected. If that is the case, **Switch Account** can be used to add a new Google Drive account. The following window will appear when **Switch Account** is clicked.



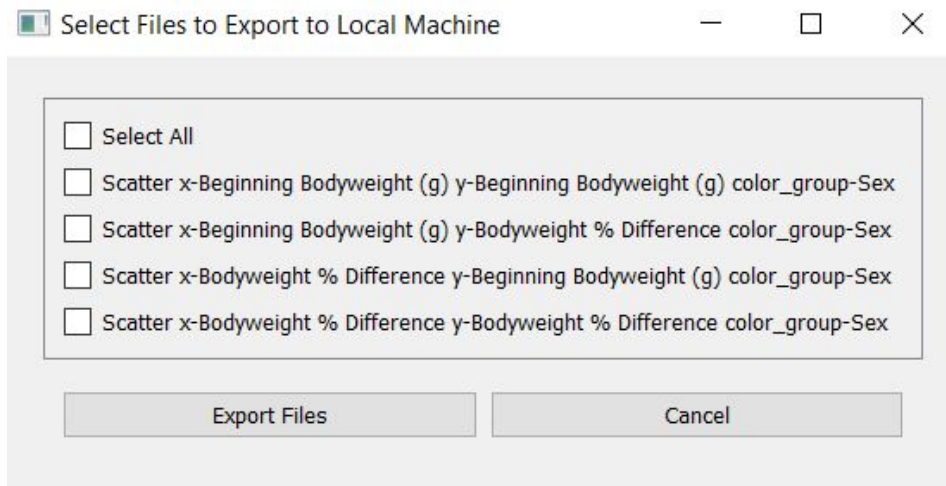
From this window, new Google Drive accounts can be added by clicking on the **Add Account** button. After clicking on the **Add Account** button, go through the Google Drive authentication flow (a browser window will appear). Allow **Quickstart** to have access. There is a 30-second timeout in place, waiting for a successful authentication response. If no response is given within 30 seconds, the process will be cancelled. If an authentication error occurred, please try restarting the **GraphKey** application.

Additionally, Google Drive accounts can be deleted by clicking on the **Delete Account** button.

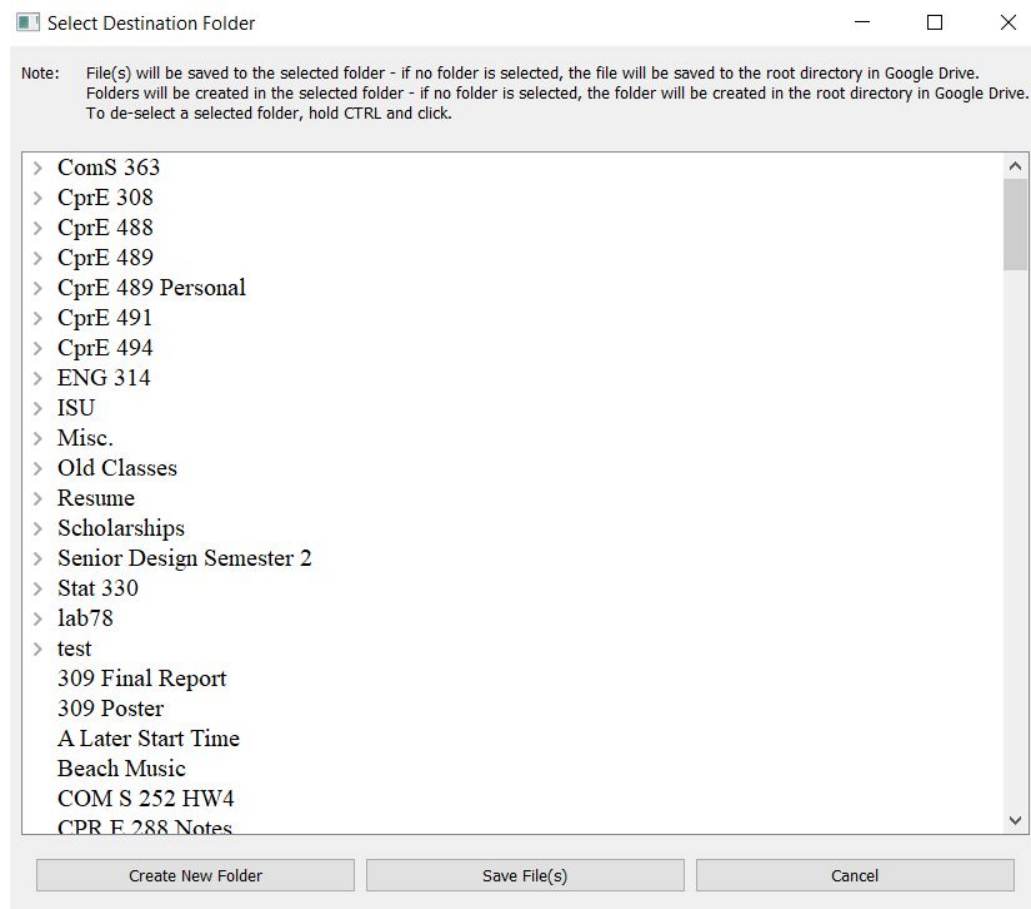
Once at least one Google Drive account is hooked up to **GraphKey**, use the **Select Account** button to select it. Then, click **Apply Changes**. The new Google Drive account should be selected in the following window:



To export files, click on **Select Files to Export**.



A window populated with the generated graphs will appear and look similar to the above screenshot. Select the files that are to be exported and click **Export Files**. The application will now retrieve the file structure of the selected Google Drive account. Depending on how much content is on the Google Drive Account, this may take a while. Eventually, the following window will appear (with the contents of the selected Google Drive of course).



Navigate to the folder the graphs are to be saved to, and click **Save File(s)**.

From the window above, new folders in the Google Drive account can also be created. Navigate to where the new folder should be created, and click **Create New Folder**. Enter in a name at the prompt window and press **OK**. The application will then take some more time to create the new folder and re-retrieve the contents of the selected Google Drive account.

Tip: Hold the **CTRL** button down on the keyboard and click on a selection to unselect it.

14. Appendix

14.1. Reference Links

- Team 29 Senior Design Website:
<https://sddec20-29.sd.ece.iastate.edu/>

Contains information about our project including presentations, reports, and further links to source code and code documentation. Also contains an executable of the GraphKey application that can be downloaded and run.

- Python Downloads: <https://www.python.org/downloads/>

The Python website where Python can be downloaded and installed. Python is required for our application to run.

14.2. About Us

We are the 29th Senior Design team of the graduating class of Fall 2020. Our group is made up of Software Engineering students as well as one Computer Engineering student. Please go to <https://sddec20-29.sd.ece.iastate.edu/team.html> for more information.

To contact us, please email us at sddec20-29@iastate.edu.