Abstract

This document is the software user manual for The Callisto plug-in. Callisto is a plug-in for Jupyter which enables analysis of data from the MIMIC-III database [2]. The MIMIC-III database contains medical information of more than 40,000 critical care patients. With this information, researchers hope to obtain relevant information which can help critical care patients in the future. This document complies with the ESA software standard.
# Callisto | Software User Manual

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</tr>
</tbody>
</table>

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Callisto | Software User Manual

TU/e

November 11, 2016
1 INTRODUCTION

1.1 INTENDED READERSHIP

There are two user categories: end user and administrator. End users are allowed to create new notebooks and do research on the MIMIC-III database within such a notebook. The end user does not need any experience in any programming languages. However, the user is expected to know the basics of a Jupyter Notebook. Jupyter Notebook are human readable documents containing both computer code and rich text elements[1]. A tutorial can be found on: https://jupyter.readthedocs.io/en/latest/index.html.

The administrator is allowed to manage users and manage presets. The administrator should be comfortable with SQL, Python and Linux. For the end user the sections about creating graphs and exporting to .docx is most relevant. For the administrator the sections about managing users and managing presets is most relevant.

1.2 APPLICABILITY

This document applies to the latest release of Callisto.

1.3 PURPOSE

The purpose of Callisto is to give clinical scientists an easy way to work with the MIMIC-III database [2]. Callisto allows to easily query the database and create graphs based on those queries. Callisto furthermore allows for an fast and easy way to generate documents that contain the graphs created by the scientists. The purpose of this software manual is to describe for the end user how to use the Callisto plug-in. For the administrator there is a description on how to manage users and presets. A description on how to setup the system is also given.

1.4 HOW TO USE THIS DOCUMENT

The intended use of this document is firstly to learn how to use the Callisto plug-in, manage users and presets. Secondly, it can be used as a reference guide.

1.5 RELATED DOCUMENTS

The URD of Callisto. [3]

1.6 CONVENTIONS

Clickable content (buttons, menu items etc.) will be written in *italic*. For example: "click login to login". Furthermore commands are between single quotes (""") and written in *italic*, furthermore
the variables within such a text are detonated with "<>". For example: "type in 'sudo adduser -m <username>'".

1.7 PROBLEM REPORTING

There could be two kind of problems that the user could encounter. If the problem is related to Jupyter Notebook, the user should report an issue on the github repository. This can be done at: https://github.com/jupyter/notebook/issues. Otherwise, if the problem is related to the Callisto plug-in, the user should contact Royal Philips for support.

1.8 LIST OF REFERENCES


2 OVERVIEW

This document contains several tutorials. These tutorials are described in chapter 3 and will explain how to setup and use the system. The tutorials consist of:

1. Logging in and out of the system.
2. Creating Callisto cells.
3. Creating graphs.
5. Managing presets.
6. Exporting to .docx.
3 APPLICATION TUTORIALS

Callisto is a plug-in for Jupyter Notebook, therefore the user is assumed to have basic knowledge on how to use Jupyter Notebook. If the user does not have this knowledge, it is advised to follow a tutorial. A tutorial can be found on: https://jupyter.readthedocs.io/en/latest/. Furthermore the administrator is assumed to have basic knowledge on how to work with a Linux system. If not the administrator is advised to follow a tutorial. A tutorial can be found on https://help.ubuntu.com/lts/serverguide/user-management.html We start with tutorials that are interesting to every user. After that there are tutorials specific for the end user and administrator.

3.1 EVERY USER

3.1.1 LOGIN

Functional description
This tutorial describes how you can log into the JupyterHub. This procedure is the same for each user.

Preconditions
1. User should be registered to be able to login.

Cautions and Warnings
1. User names are unique in the system.

Procedure
1. Open your favorite browser.
2. Go to the address of the JupyterHub server. The address will be provided by the administrator after the installation of the system.
3. Fill in your username and password in the username and password boxes, as can be seen in Figure 1a.
4. Press login.

Likely errors
1. The combination username/password is invalid, Figure 1b will be shown.

Figures
3.1.2 LOGOUT

Functional description
This tutorial describes how you can log out the JupyterHub. This procedure is the same for each user.

Preconditions

1. User should be logged in.

Cautions and Warnings
None.

Procedure

1. The user presses *Logout* in the right top corner, as can be seen in Figure 2a.
2. Figure 2b will be shown. In this dialog box press the highlighted button in blue to log out.

Likely errors
None.

Figures

(a) Logout button

(b) Follow-up screen (in chrome)

Figure 2: Logout button and follow-up screen
3.2 END USER

3.2.1 MANAGING FILES

Functional description
This is part of the Jupyter notebook and not Callisto specific. See https://jupyter-notebook.readthedocs.io/en/latest/examples/Notebook/Notebook%20Basics.html for information on how to manage files.

3.2.2 CREATING A CALLISTO CELL

Functional description
This tutorial describes how to create a Callisto cell in JupyterHub.

Preconditions
The user is logged in and has opened a notebook.

Cautions and Warnings
None.

Procedure
1. Go to the menu insert
2. Press Insert Cell Above or Insert Cell Below, as shown in Figure 3a.
3. Select the newly created cell by clicking on that cell.
4. Go to the cell type dropdown and select "Callisto", as shown in Figure 3b.

Likely errors
None.

Figures
(a) Insert a new cell
(b) Convert to Callisto cell

Figure 3: Insert cell and convert to Callisto cell screen
3.2.3  CREATING GRAPHS

Functional description
This tutorial describes how the user can create a graph.

Preconditions
The user is logged in, has opened a notebook and has a Callisto cell selected.

Cautions and Warnings
None.

Procedure
1. Select the desired preset, as shown in Figure 4a.
2. Press *Create graph*, as shown in Figure 4b.

Likely errors
None.

Figures

![Select a preset](a) Select a preset

![Specify title, description and graph type](b) Specify title, description and graph type

Figure 4: Creating a graph

3.2.4  ADD FILTER

Functional description
This tutorial describes how you can add a filter to a graph.
Preconditions
The user is logged in, has opened a notebook, has a Callisto cell selected and there is a preset selected.

Cautions and Warnings
None.

Procedure
1. Select *add filter* to add another filter, as shown in Figure 5a.
2. Select the desired filter type, as shown in Figure 5b.
3. Use the newly appeared text field or slider to filter on that filter type, as shown in Figure 5c.
4. If another filter is desired. Repeat step 2, 3 and 4.
5. Press *Create graph*.

Likely errors
None.

Figures

(a) Convert to Callisto cell

(b) Add a filter

(c) Select filter type

Figure 5: Adding a filter

3.2.5 **CHANGE GRAPH TITLE**

Functional description
This tutorial describes how you can change the title to a graph.

Preconditions
The user is logged in, has opened a notebook, has a Callisto cell selected and there is a preset selected.
Cautions and Warnings
None.

Procedure
1. Specify the graph title, as shown in Figure 6a.
2. Press Create graph.

Likely errors
None.

Figures
3.2.6 CHANGE GRAPH DESCRIPTION

Functional description
This tutorial describes how you can change the description to a graph.

Preconditions
The user is logged in, has opened a notebook, has a Callisto cell selected and there is a preset selected.

Cautions and Warnings
None.

Procedure
1. Specify the graph description, as shown in Figure 7a.
2. Press Create graph.

Likely errors
None.

Figures
3.2.7 CHANGE GRAPH TYPE

Functional description
This tutorial describes how you can change the type of a graph.

Preconditions
The user is logged in, has opened a notebook, has a Callisto cell selected and there is a preset selected.

Cautions and Warnings
None.

Procedure
1. Specify the graph type, as shown in Figure 8a.
2. Press Create graph.

Likely errors
None.

Figures

3.2.8 CHANGE GRAPH COLOR

Functional description
This tutorial describes how you can change the color of a graph.
Preconditions
The user is logged in, has opened a notebook, has a Callisto cell selected and there is a preset selected which allows changing the color.

Cautions and Warnings
None.

Procedure
1. Specify the graph color, as shown in Figure 9a.
2. Press *Create graph*.

Likely errors
None.

Figures

Figure 9: Changing the graph color

3.2.9 CHANGE TYPE OF MARKER

Functional description
This tutorial describes how you can change the type of marker of a graph.

Preconditions
The user is logged in, has opened a notebook, has a Callisto cell selected and there is a preset selected which allows changing the marker.

Cautions and Warnings
None.

Procedure
1. Specify the graph type of marker, as shown in Figure 10a.
2. Press *Create graph*.

Likely errors
None.
Figures

(a) Specify the graph type of marker

Figure 10: Changing the graph type of marker
3.2.10 EXPORTING NOTEBOOK TO WORD

Functional description
This tutorial describes how you can export the document to .docx.

Preconditions
The user is logged in, has opened a notebook with an arbitrary number of markdown cells and graphs included.

Cautions and Warnings
None.

Procedure
1. Select *File* in the top menu, as shown in figure 11.
2. Press *Save and Checkpoint*, as shown in figure 11.
3. Wait for a couple of seconds.
4. Select *File* in the top menu.
5. Select *Download as*, as shown in figure 11.
6. Press *Word Doc (.docx)*, as shown in figure 11.

Likely errors
None.

Figures

![Figure 11: The file menu item.](image-url)
### 3.2.11 INCLUDING GRAPH IN WORD CONVERSION

**Functional description**  
This tutorial describes how you can include a graph in the .docx conversion.

**Preconditions**  
The user is logged in, has opened a notebook with an arbitrary number of markdown cells and at least 1 graph included.

**Cautions and Warnings**  
None.

**Procedure**  
1. Check the *Export* checkmark, as shown in figure 12.

**Likely errors**  
None.

**Figures**

![Export: Presets](image)

*Figure 12: The export graph checkmark.*
3.2.12 EXCLUDING GRAPH IN WORD CONVERSION

Functional description
This tutorial describes how you can exclude a graph in the .docx conversion.

Preconditions
The user is logged in, has opened a notebook with an arbitrary number of markdown cells and at least 1 graph included.

Cautions and Warnings
None.

Procedure
1. Uncheck the Export checkmark, as shown in figure 13.

Likely errors
None.

Figures

![Export: Presets]

- Number of patient deaths per disease class
- Filters
  - No filters selected
  - Add filter
- Graph options

Figure 13: The export graph checkmark.
3.3 ADMINISTRATOR

The administrator is assumed to know how to manage users on a Linux system. Therefore the sections, create a new user, delete a user and change password of a user do not have a detailed description.

3.3.1 STARTING THE LINUX TERMINAL

Functional description
This tutorial describes how the user can open the Linux terminal.

Preconditions
None.

Cautions and Warnings
1. Every thing that one can normally do in a Linux terminal can also be done in the terminal that jupyter starts.

Procedure
1. Log in to JupyterHub
2. click New on the top right.
3. click Terminal in the dropdown.

Figures

![Figure 14: open a terminal](image)

Likely errors
None.

3.3.2 CREATE A NEW USER

Functional description
This tutorial describes how the administrator can create a new user.

Preconditions
The user is logged in and has opened the terminal.

Cautions and Warnings
The administrator needs to make sure that the user that will be created has the right credentials to access the MIMIC-III database.

Procedure
1. Add a user with the command ‘sudo useradd -m <username>’
2. If the terminal requests the admin password, type it and press enter.

Likely errors
None.

3.3.3 DELETE USER

Functional description
This tutorial describes how the administrator can delete a user.

Preconditions
The user is logged in and has opened the terminal.

Cautions and Warnings
1. Deleting a user is an operation that cannot be undone.

Procedure
1. Delete a user with the command ‘sudo deluser <username>’.
2. If the terminal requests the admin password, type it and press enter.

Likely errors
1. username not found

3.3.4 CHANGE PASSWORD OF A USER

Functional description
This tutorial describes how the user can change the password of a user.

Preconditions
The user is logged in and has opened the terminal.

Cautions and Warnings
None.

Procedure
1. Initiate changing the password of the user with the command ‘sudo passwd username’
2. Enter the password followed by an enter twice

Likely errors
1. Passwords do not match
### 3.3.5 ADD PRESET

**Functional description**
This tutorial describes how the user can add a new preset to Callisto.

**Preconditions**
None.

**Cautions and Warnings**
Be careful with how you change the python file. Small mistakes can result in a non functioning preset.

**Procedure**
1. Open the `config/presets/` folder in a file browser.
2. Copy one of the existing python preset files and paste it in the same folder.
3. Change the name of the newly create file.
4. Open the newly created file.
5. If needed, in the options dictionary, change the name attribute.
6. If needed, in the options dictionary, change the builtin filters attribute.
7. If needed, in the options dictionary, change the blacklist filters attribute.
8. If needed, in the options dictionary, change the graph types attribute.
9. If needed, in the options dictionary, change the axis labels attribute.
10. If needed, change the SQL query.
   - An example of a query can be found in *Chapter B. Appendix - Demo Query*
11. Save the file.
12. Restart the Jupyter Hub server by running `runc.sh` in the installation folder.

**Likely errors**
Syntax errors when running the preset in Jupyter Hub.

### 3.3.6 CHANGE PRESET

**Functional description**
This tutorial describes how the user can change an existing preset in Callisto.

**Preconditions**
None.

**Cautions and Warnings**
Be careful with how you change the python file. Small mistakes can result in a non functioning preset.

**Procedure**
1. Open the `config/presets/` folder in a file browser.
2. Open the python preset file which needs changing.
3. If needed, in the options dictionary, change the name attribute.
4. If needed, in the options dictionary, change the builtin filters attribute.
5. If needed, in the options dictionary, change the blacklist filters attribute.
6. If needed, in the options dictionary, change the graph types attribute.
7. If needed, in the options dictionary, change the axis labels attribute.
8. If needed, change the SQL query.
   An example of a query can be found in Chapter B. Appendix - Demo Query
9. Save the file.
10. Restart the Jupyter Hub server by running runc.sh in the installation folder.

Likely errors
Synax errors when running the preset in Jupyter Hub.

3.3.7 DELETE PRESET

Functional description
This tutorial describes how the user can delete an existing preset in Callisto.

Cautions and Warnings
Deleted presets cannot be recovered. Be careful when deleting a preset.

Procedure
1. Open the config/presets/ folder in a file browser.
2. Delete the python preset file that you want to delete.
3. Restart the Jupyter Hub server by running runc.sh in the installation folder.

Likely errors
None.
Callisto is a plugin for Jupyter Notebook, therefore the user is assumed to have basic knowledge on how to use Jupyter Notebook. If the user does not have this knowledge, it is advised to follow a tutorial. A tutorial can be found on: https://jupyter.readthedocs.io/en/latest/index.html. Furthermore the administrator is assumed to know how to work with the lunix terminal. If the administrator does not know how to work with the terminal it is advised to look at https://help.ubuntu.com/lts/serverguide/user-management.html to learn how to manage users. Only Callisto specific views are discussed in detail.

4.1 END USER

All the views that are available to the end user are also available to the administrator.

4.1.1 LOGIN VIEW

Functional description
In this screen the user can login. It is the screen that is opened when people go to the Jupyter-Hub address. The adress is given by the administrator after the system is installed.

Cautions and warnings
None.

Formal description

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Username field.</td>
<td>A field where the user should fill in the username.</td>
<td>None.</td>
</tr>
<tr>
<td>Password field.</td>
<td>A field where the user should fill in the password.</td>
<td>None.</td>
</tr>
<tr>
<td>Login button.</td>
<td>A button that logs the user in with the given username and password.</td>
<td>The user is logged in into the system if the username and password combination is correct.</td>
</tr>
</tbody>
</table>
Possible errors
The combination username/password is invalid.

Related operations
1. Logout.

4.1.2  DAHSBOARD VIEW

Functional description
Dashboard view is part of jupyter notebook itself and not callisto specific. See https://jupyter-notebook.readthedocs.io/en/latest/examples/Notebook/Notebook%20Basics.html for more info on how to use the dashboard.

Figures

Figure 15: open a terminal

Figure 16: Login view

Figure 17: Dashboard view
4.1.3 NOTEBOOK VIEW

Functional description
The notebook view is part of Jupyter notebook itself and mostly not callisto specific. See https://jupyter-notebook.readthedocs.io/en/latest/examples/Notebook/Notebook%20Basics.html for more info on how to use the notebooks. Only parts that are Callisto specific are mentioned below.

Cautions and warnings
None.

Formal description

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callisto cell</td>
<td>The Callisto plugin adds a callisto cell under the cell type dropdown.</td>
<td>The currently selected cell will be transformed to a callisto cell.</td>
</tr>
<tr>
<td>Export to docx</td>
<td>Found under “file &gt; download as”.</td>
<td>A new tab is opened where the user is asked on where the user would like to save the docx file.</td>
</tr>
</tbody>
</table>

Figures

![Figure 18: Notebook view](image)

Possible errors
None.

Related operations
None.

4.1.4 CALLISTO CELL VIEW

Functional description
The Callisto cell view is a view within the notebook view. The user can create graphs based on presets and filters.

Cautions and warnings
None.
Formal description
The first table contains the buttons that are visible from the beginning. The second table contains the GUI elements that appear after selecting a specific filter.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preset dropdown.</td>
<td>A dropdown where the user can select a preset.</td>
<td>The selected preset is selected and filters for that preset can now be selected.</td>
</tr>
<tr>
<td>Filter dropdown.</td>
<td>A dropdown where the user can select a filter for the selected preset.</td>
<td>A filter is selected and, if necessary, extra gui elements are shown to user.</td>
</tr>
<tr>
<td>Title textfield.</td>
<td>A textfield for the title of the graph</td>
<td>The text in the textfield becomes the title for the generated graph.</td>
</tr>
<tr>
<td>Description textfield.</td>
<td>A textfield for the description of the graph</td>
<td>The text in this field becomes the description of the graph.</td>
</tr>
<tr>
<td>Style dropdown</td>
<td>A dropdown for the style</td>
<td>The selected style becomes the style of the graph.</td>
</tr>
<tr>
<td>Color selector.</td>
<td>A selector for the color of the graph line</td>
<td>The selected color becomes the color of the line in the graph.</td>
</tr>
<tr>
<td>Create graph button.</td>
<td>A button to create the graph based on the selected presets and filters.</td>
<td>A graph is created.</td>
</tr>
</tbody>
</table>

Filters
The filters work all the same, they add a filter to given preset. The kind of filters are listed below.

<table>
<thead>
<tr>
<th>Filter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis</td>
<td>A dropdown to select diagnosis</td>
</tr>
<tr>
<td>Age Filter</td>
<td>A two sided slider to select which age the patients should be minimal and maximal be.</td>
</tr>
<tr>
<td>Gender</td>
<td>A dropdown to select the gender.</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>A dropdown to select the ethnicity.</td>
</tr>
<tr>
<td>Treatment</td>
<td>A dropdown with a text input to search for treatments.</td>
</tr>
</tbody>
</table>

Figures
Figure 19: Callisto cell view

Possible errors
The possible errors are related to the connectivity of the client with the server. If the server is down for some reason, then the queries cannot be performed.

Related operations
None.
4.2 ADMINISTRATOR

4.2.1 TERMINAL VIEW

Functional description
The terminal view is a view on a Linux terminal. The administrator has full rights on the Linux system so he should be careful to not mess up the system. In this view the administrator can manage the users of JupyterHub. User management for JupyterHub is exactly the same as user management for the Linux server. This is because only server users can use JupyterHub. For a tutorial on user management see https://help.ubuntu.com/lts/serverguide/user-management.html

Figures

![Terminal view](image)

Figure 20: Terminal view

Possible errors
None.

Cautions and warnings
The administrator has root rights on the system. The administrator can thus mess up the system. Advised is to only add and delete users, and change passwords in the terminal. Doing something else may mess up the system.
A  ERROR MESSAGES AND RECOVERY PROCEDURES

• Invalid username or password

  **Diagnoses:** The username password combination is invalid. This means that either the user does not exist or the password is incorrect

  **Recovery Procedure:** None.

• Passwords do not match

  **Diagnoses:** The two passwords for the new user do not match.

  **Recovery Procedure:** Do the command for creating the user again, this time fill in two times the same password.

• Syntax errors when creating a graph

  **Diagnoses:** The syntax of the query which is being executed to create a graph is incorrect.

  **Recovery Procedure:** Use Software User Manual section 3.3.6 to change the query of the preset which causes the problem. If the query is changed to a valid query by following the steps explained in section 3.3.6, the error is resolved.

• Server not reachable

  **Diagnoses:** The user is not able to connect to Jupyter Hub.

  **Recovery Procedure:** Make sure that the server is up and running and the computer which tries to access the server has an active Internet connection.
options = {
    'name': 'This is a illustrative query',
    'builtin_filters': [],
    'blacklist_filters': ['',]
    'graph_types': ['line2d'],
    'axis_labels': ['X', 'Y'],
}

sql = ""
SELECT age AS X, COUNT(*) AS Y
FROM (SELECT admissions.hadm_id,
    (EXTRACT(YEAR FROM AGE(admissions.admittime, patients.DOB)):: INTEGER)
    AS age FROM admissions INNER JOIN patients USING (subject_id)) AS ages
WHERE ages.hadm_id IN
    {filtered_subjects}
GROUP BY age
""

def make_query(builtin_filter_variables, filtered_subjects):
    return sql.format(
        filtered_subjects=filtered_subjects
    )