university of groningen // PASTAQ

Requirements Document

Software Engineering Project Feb 2022
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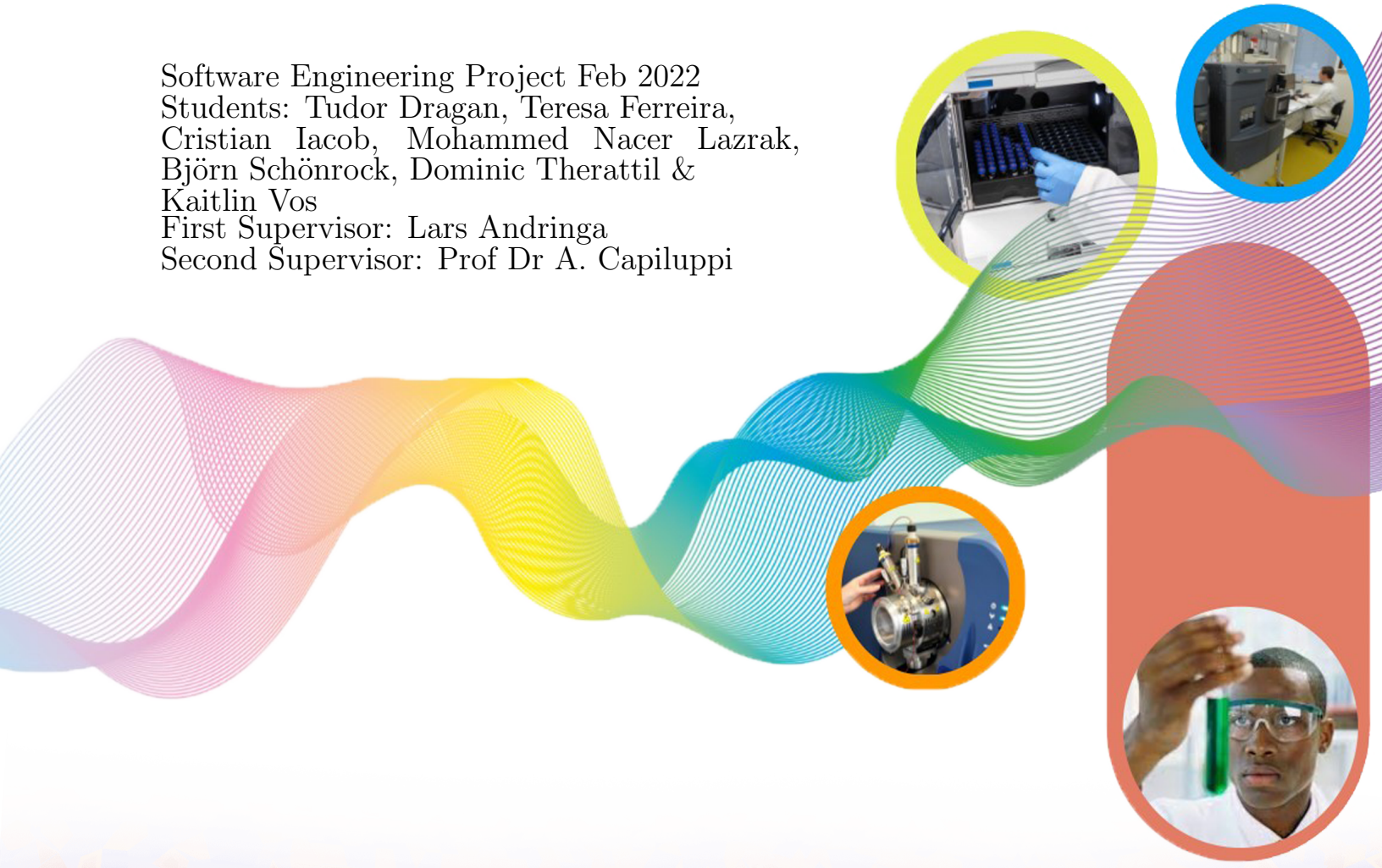

Contents

1 Introduction

The project presented in this document is a Graphical User Interface (GUI) which aims to ease the use of the PASTAQ pipeline for users that do not wish to interact with it from a terminal and need an easy to use application to process their data. To be able to understand the context in which our GUI exists we need to take a closer look at liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS).

LC-MS/MS is an advanced analytical chemistry technique that aims to identify and quantify proteins and their peptides in a sample. The instruments used in this technique output large amounts of data that need to first be converted through msConvert into two formats: .mgf and .mzXML. The former is then run through another suite of software meant to identify the peptides in the sample and then converted into an .mzID file. This together with the .mzXML files are fed into PASTAQ.

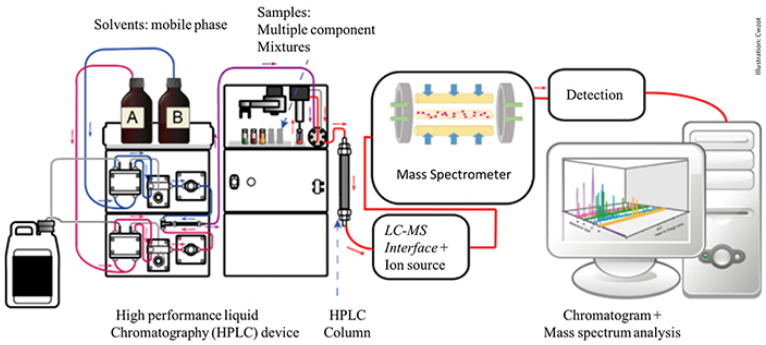

Figure 1: Diagram of liquid chromatography tandem Mass spectrometry. *Credit: Daniel Norena-Caro, reproduced under the Creative Commons CC0 1.0 Universal Public Domain Dedication licence.*

PASTAQ's intended use is in metabolomics and proteomics as it employs certain specialized algorithms. The pipeline outputs data as .csv files that identify proteins and features of the sample. These results are then meant to be interpreted through Python or R. It also outputs quality control plots as .png files. This process is summarized in Figure 2. The application is available as a library that can be imported and used in C++ or Python. For users that are not familiar with programming, the GUI offers a simple alternative that also includes quality-of-life functionalities.

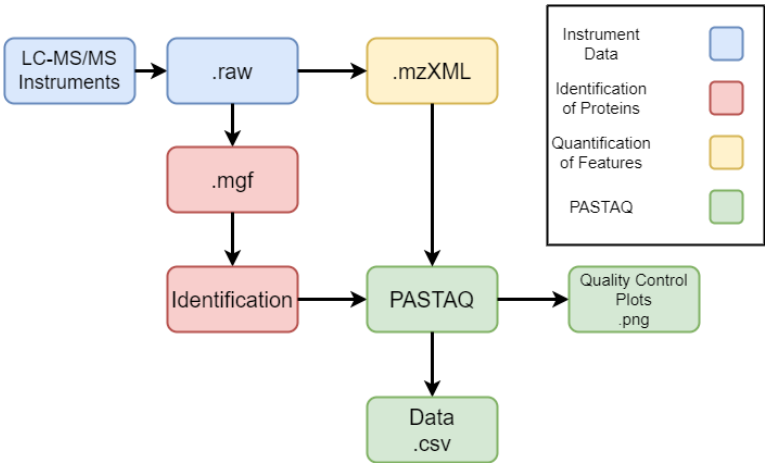

Figure 2: Overview of the ecosystem where PASTAQ is used

2 Scope

The scope of our project is to enhance the user experience of the GUI and refactor the code base for future developers. The GUI we are building upon is usable albeit unpolished. There are several bugs present and it is missing certain features that would greatly benefit the user experience, which includes but is not limited to automatic file processing, tool tips and shortcuts. Furthermore, the entire GUI currently runs from one monolithic piece of code with minimal documentation and many code smells, which makes debugging and adding features extremely challenging for future developers.

Hence, we will first refactor the entire code base and eliminate code smells. This enables our team to work on the project concurrently without merge conflicts, easily identify bugs and more importantly better help achieve our main goal which is to improve the user experience of the GUI.

The central improvement we will bring to the GUI is integrating the identification process of proteins. This is usually done through complex external applications and the researcher has different alternatives in which software to use. Through our improvements, the researcher will not have to worry about tediously converting the files through the terminal, and will be able to select all wanted parameters inside the GUI, making it easier to use and centralising the process.

3 Stakeholders

3.1 Team - University of Groningen

- **Members**: Tudor Dragan, Teresa Ferreira, Cristian Iacob, Mohammed Nacer Lazrak, Björn Schönrock, Dominic Therattil, Kaitlin Vos
- **Supervisor**: Lars Andringa
- **Course Coordinator**: Prof Dr A. Capiluppi

3.2 Client

- Alejandro Sánchez Brotons
- Prof Dr Peter L. Horvatovich

3.3 General Users

- Researchers, as PASTAQ automatically generates quality control plots, which allow the assessment of the overall dataset similarity between samples, as well as the distribution of peak widths, the retention time and the mass shifts.
- Data scientists, as PASTAQ provides full data traceability from the beginning to end of the analysis, which allows for post hoc analysis and data exploration.
- Chemists, as PASTAQ detects and quantifies compounds which are separated by liquid chromatography based on their chemical properties (e.g. hydrophobicity).
- Biologists, as PASTAQ can help identify the proteins of peptides through the use of tandem mass spectrometry.

4 Requirements list

We have decided to separate the requirements list based on whether said requirements are functional or non-functional. The functional requirements are further split according to the MoSCoW technique, such that the priority of each requirement is clearly specified. The MoSCoW technique is further explained in Figure 3. The last part of this section will describe the importance of each requirement. To further ensure the appropriateness of our requirements we considered the SMART technique (specific, measurable, attainable, realisable, testable). We have sorted our requirements in decreasing priority.

The requirements are color coded according to the following schema to display which use case belongs to which requirements.

Table 1: Requirements user case schema

Related Use Case	Color
UC1	Red
UC2	Blue
UC3	Green
UC4	Violet
UC5	Orange
UC6	Teal
UC7	Olive
UC8	Purple

4.1 Functional Requirements

Identifier: R

1. **Must have**:

   1.1. [UC2] When given an .mzXML/.mzML and an .mgf file, assuming successful file processing, the GUI must execute the pipeline and output .csv data as well as .png quality control plots.

   1.2. [UC2] When given an .mgf file and the three paths to MSFragger,idconvert and the .params file, the GUI must use MSFragger to process .mgf files into a .pepXML format.

   1.3. [UC2] After processing the .mgf identification file into a .pepXML, the GUI must use idconvert to convert the file into an .mzID file.

   1.4. [UC2] The GUI must use the .params file to execute MSFragger.

   1.5. [UC2] When the automatic identification process fails, the pipeline must not be executed.

   1.6. [UC7] When the project is saved, the paths to MSFragger and idconvert must be stored in a configuration file.

   1.7. [UC7] The configuration file must be accessible from any project.

   1.8. [UC7] The configuration file must be loaded when the user opens a project or creates a new project.

   1.9. [UC2] The path of the .params file must be stored in the project.

   1.10. [UC2] The automatic identification processing must be executed when the user chooses to run the pipeline.

1.11. [UC7] After loading a project into the GUI, the paths to the identification files and quantification files must be evaluated to determine their validity.

1.12. [UC2] The intermediary .pepXML file must be discarded after creating the .mzID file.

1.13. [UC7] When a path of the identification or quantification file is not valid, the user must be informed.

1.14. [UC7] When the automatic file processing fails, the user must be informed.

1.15. [UC7] When the reading and loading of the configuration file fails, the user must be informed.

1.16. [UC2] The GUI must allow the user to browse for the path to the MSFragger .jar file.

1.17. [UC2] The GUI must allow the user to browse for the path to the idconvert .exe file.

1.18. [UC2] The GUI must allow the user to browse for the path to the .params file.

1.19. [UC1] The GUI must accept .mzID files.

1.20. [UC2] The GUI must accept .mgf files.

1.21. [UC3] The GUI must have tool-tips for the parameters to explain its functionalities to the user.

1.22. [UC7] The GUI must offer a drop down navigation menu where the user can reset parameters to their default values.

1.23. [UC7] The GUI must have a button to select all the given files.

1.24. [UC2] The run button must be disabled if there are no input files or if at least one file path is invalid.

2. **Should have**:

2.1. [UC4]~~Canceling the pipeline while it is running should not cause the GUI to crash.~~ Not possible since the problem lies in the pipeline codebase and not the GUI codebase

2.2. [UC7] The GUI should have a shortcut to create a new project.

2.3. [UC7] The GUI should have a shortcut to open a project.

2.4. [UC7] The GUI should have a shortcut to save the opened project.

2.5. [UC7] The GUI should have a shortcut to remove the selected files.

2.6. [UC7] The GUI should have a shortcut to select all the given files.

2.7. [UC1] The GUI should have a means of inputting files through a drag and drop feature.

2.8. [UC6] MacOS users should be informed that the automatic file processing is not supported on their operating system.

2.9. [UC8] An executable file for Windows should automatically be generated using Github CI.

3. **Could have**:

3.1. [UC8] An executable file for Linux could automatically be generated using Github CI.

3.2. [UC8] An executable file for MacOS could automatically be generated using Github CI.

3.3. [UC8] The Github CI pipeline could run a test suite for every new release to ensure that the user does not get incorrect code.

3.4. [UC2] The uploaded .mgf files could be processed using SearchGUI and PeptideShaker, instead of MSFragger and idconvert.

3.5. [UC7] The GUI could have a splash page with the ability to select or make a new project.

4.2 Non-Functional Requirements

Identifier: NFR

4. **Non-functional**:

   4.1 [UC7] Attempting to close the GUI must display a pop up dialog box if there are any unsaved changes.

   4.2 [UC7] Attempting to close the GUI must display a pop up dialog box to clarify, whether to save the project and close.

   4.3 [UC7] Attempting to close the GUI must display a pop up dialog box to clarify, whether to discard any changes and close.

   4.4 [UC7] Attempting to close the GUI must display a pop up dialog box to clarify, whether cancel the action and not close the GUI.

   4.5 [UC7] The parameters tab must be reorganized in a way that only one parameter category is shown at a time, including the parameter category description.

   4.6 [UC7] The user must be able to navigate through the parameter categories.

   4.7 [UC7] The PASTAQ-GUI guide must be updated to reflect the changes.

   4.8 [UC7] The user must be sufficiently informed about all the components of the GUI.

   4.9 [UC7] Running the GUI must not display the cancel button after completion.

   4.10 [UC7] The GUI window must be resizable.

   4.11 [UC7] The GUI must have the top row of buttons (New project, Open project, Save and Save as) represented by a drop down navigation menu instead.

   4.12 [UC7] The user should be able to keep track of their own progress while setting the parameters by the use of checkboxes.

   4.13 [UC7] The GUI should provide the possibility to access the PASTAQ-GUI guide found under the following link [1].

   4.14 [UC5] The code should have comments that are descriptive and accurate.

   4.15 [UC7] The GUI window should support a fullscreen option.

   4.16 [UC6] Support for Windows should be maintained.

   4.17 [UC6] Support for Linux should be maintained.

   4.18 [UC6] Support for MacOS could be maintained.

   The requirement has been moved from should to could due to testing constraints.

   4.19 [UC7] The GUI could have a logo.

   4.20 [UC7] The GUI could have a splash screen, which appears before the GUI.

   4.21 [UC7] The GUI could have the logo as its icon.

   4.22 [UC7] The GUI could display the logo in the main window.

   4.23 [UC5] The code quality should be improved by refactoring code smells.

   4.24 [UC7] Buttons could respond in under 1 second when the GUI is used on an environment with at least 8GB RAM and a 2GHz processor.

   4.25 [UC7] The GUI's elements could have their color changed to become more intuitive.

   4.26 [UC7] The GUI could have a dark mode theme which offers a darker color palette.

4.3 Won't Have

5. **Won't have:**

   5.1 The GUI will not have built-in data visualisation tools.

[1] https://pastaq.horvatovichlab.com/gui-tutorial/index.html

4.4 Importance Justification

In this section, we will provide justifications as to why we categorized our requirements the way we did. The MoSCoW prioritization can be viewed in the following Figure:

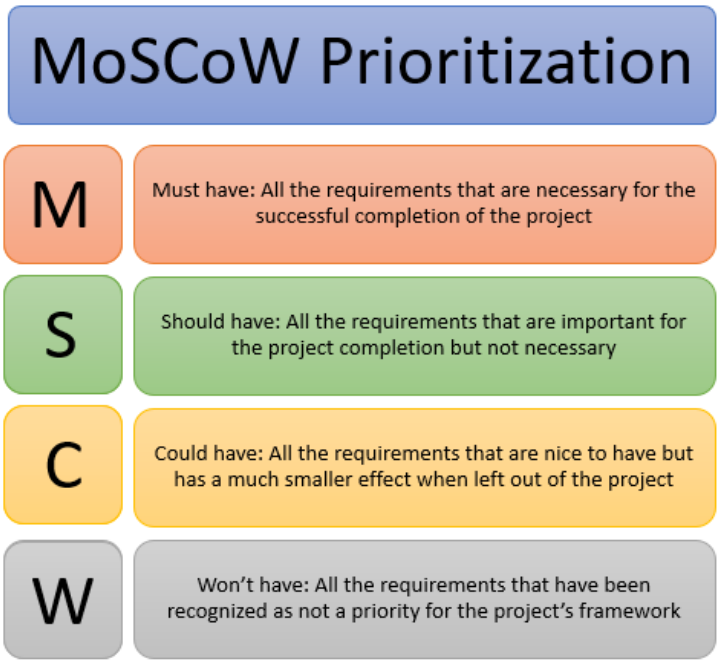

Figure 3: MoScoW Prioritization

- **MUST** - Having the possibility of inputting the unprocessed files and having them turned into the appropriate formats is crucial for simplifying the workflow of researchers. Configuration files to save settings and tool-tips also play a very important role in speeding up the parametrization and use of the pipeline, thus cutting on work time. Moreover, performing checks for path validity and properly informing the user of problems is important to prevent users from encountering unexpected errors. The features tied to the ease of use of the program are a must to implement as they cover essential functionalities such as the saving, creating and editing of files and projects.
- **SHOULD** - Currently, stopping the pipeline while it is running causes the application to crash. We should find a way to handle the multi-threading correctly and pass back control to the GUI thread. The shortcuts for projects and files and the drag and drop feature to input files should be added since they significantly increase the accessibility and ease of use of the application. Furthermore, generating executable files is important to make the program more accessible and allow researchers to use the application without performing complex installation steps. The executable for Windows is particularly important, since the installation of PASTAQ on Windows is more complex compared to other operating systems and may form a significant barrier for users who are unfamiliar with the required libraries.
- **COULD** - Since the project is open source and its purpose is to aid researchers, we would like to maintain the software usable for as many users as possible, and therefore we could try to make executables available for all major operating systems and inform the users of any problems or incompatibilities we are aware of. Features like offering various paths for processing the files are not necessary but could be a welcome addition to the GUI, since each researcher has their own preferred type of software that they use. A splash screen for the creation or opening of a project could also be implemented, however, this does not add any extra functionality so it's of low importance.

- **NON-FUNCTIONAL** - The non-functional requirements are concerned with the accessibility, the look and feel of the interface. We would like these to be as friendly as possible so that the tool is used by more researchers. We should also refactor the code base and add comments to make it manageable for future developers. Respectively, since we're looking into making the project usable by as many users as possible, we'll have to maintain the software on all major operating systems.
- **WON'T** - Advanced data visualization tools are available out there and introducing this to the GUI will be an unnecessary effort.

5 Use Cases

All requirements for this single system can be related to the same GUI. This led us to choose use cases over user stories because we think they give a better structure to our requirements. This section is divided into eight different use cases. We will consider each one of them individually and state their specifications.

5.1 File Acceptance | UC1

Requirement:

- R1.19
- R2.7

Primary Actors:

- General Users

User Story:
As a general user, I would like to upload an .mzID file to the GUI so that I can run the PASTAQ pipeline.

Context:
The general user wishes to be able to upload an .mzID file.

Main Success Scenario:

- The user is able to upload the .mzID file

Alternative Scenarios:

- The .mzID file fails to get uploaded
- An error message is displayed
- Prompted to try again

Preconditions:

- .mzID file is uploaded

Postconditions:

- .mzID file is accepted and loaded into the GUI

Frequency of Occurrence:
High usage frequency, since whenever the users accesses the GUI they could be uploading an .mzID file.

5.2 File Processing | UC2

Requirement:

- R1.1 - R1.5
- R1.9 - R1.10
- R1.12
- R1.16 - R1.18
- R1.20
- R1.24
- R3.5

Primary Actors:

- General Users

User Story:
As a general user, I would like to upload an .mgf to the GUI and have it converted automatically, so that I do not need to manually process it with MSFragger and idconvert into an .mzID.

Context:
The general user wishes to avoid the tedious process of manually converting the .mgf files using the command line or other applications, instead the general user can upload .mgf files to the GUI, which will then be processed automatically to .mzID files with MSFragger and idconvert.

Main Success Scenario:

- The user is able to upload the .mgf file
- The .mgf file gets processed to an .mzID file with MSFragger and idconvert
- The newly converted .mzID file gets loaded into the GUI

Alternative Scenarios:

- The .mgf file fails to get processed to .mzID
- An error message is displayed
- Prompted to try again or manually convert the file to an .mzID file

Preconditions:

- .mgf file is uploaded

Postconditions:

- File is processed to an .mzID and loaded into the GUI

Frequency of Occurrence:
High usage frequency, since whenever the users accesses the GUI they could be uploading an .mgf file.

5.3 Tool-tips | UC3

Requirement:

- R1.21

Primary Actors:

- General Users

User Story:
As an inexperienced user, I would like to be able to get tips and hints when setting parameters for the PASTAQ-GUI, so that I can understand how they will modify the analysis.

Context:
The user wants to access the PASTAQ-GUI, however, the user does not know how to fully work with the parameter options.

Main Success Scenario:

- The user is able to follow the tooltips and correctly modify the analysis of his data.

Alternative Scenarios:

- The tooltips are not simple enough, the user gets confused
- The tooltips are too simple, they do not contain enough information to achieve the users task

Preconditions:

- Tooltips written and explained to informed users
- User has enough knowledge to work with the GUI and understand the tooltips

Postconditions:

- The tooltips help the user understand the parameters
- User successfully processes his data

Frequency of Occurrence:
Moderate usage frequency, whenever a beginner user uses the parameterization tab of the GUI and as the user gets more experienced they will use this feature less.

5.4 Process interrupting errors | UC4

Requirement:

- R2.1

Primary Actors:

- General Users

User Story:
As a general user, I want all processes to terminate without errors by pressing the cancel button when the pipeline is running, so that I can close the PASTAQ-GUI without any errors.

Context:
In the currently existing version of the GUI, if the pipeline is started, it will have an option to cancel the processing of the data. This causes an error that makes the GUI crash and exit.

Main Success Scenario:

- The pipeline is ended and the GUI still runs.

Alternative Scenarios:

- The program crashes upon shutting down the pipeline
- The general user is provided with the appropriate crash information

Preconditions:

- GUI is running
- The user starts the pipeline
- The user wishes to stop the pipeline and presses the cancel button.

Postconditions:

- The pipeline is stopped
- The GUI is still running

Frequency of Occurrence:
Moderate usage frequency, since this will take place only when the user starts the pipeline and decides it does not want to let it finish.

5.5 Code Smells | UC5

Requirement:

- NFR4.14
- NFR4.23

Primary Actors:

- PASTAQ-GUIs Developers

User Story:
As a developer of PASTAQ-GUI, I want the code to be error-free and properly structured and documented, so that it is easily understandable and extendable.

Context:
Since the PASTAQ-GUI is an open-source project, there can be users with an understanding of programming who wish to fork the project and adjust the code for their own specific needs.

Main Success Scenario:

- The user is able to easily understand the structure of the program and implement their features into the PASTAQ-GUI

Alternative Scenarios:

- The user is unable to understand the code and can raise an issue on the repository
- The user encounters a bug and can open a pull request to fix it

Preconditions:

- The user is able to understand the code
- The user is experienced with programming

Postconditions:

- The user is able to successfully extend the GUI with their new functionality

Frequency of Occurrence:
This would occur every time someone decided to fork the project. Moderate to low frequency as there are not that many people that have experience with programming and do research in chemistry and biology.

5.6 Operating System | UC6

Requirement:

- R2.8
- NFR4.16-NFR4.18

Primary Actors:

- PASTAQ-GUI General Users
- Developers
- The Product Owner

User Story:

- **PASTAQ-GUI General Users**
  As a general user, I would like to be able to run the PASTAQ-GUI on any operating system, so that it ensures versatility and consistency.
- **Developers**
  As a developer, I would like to be able to deploy the application on any operating system, such that I can work on the project.
- **The Product Owner**
  As the product owner, I would like the software to be available on as many platforms as possible, so that it can be successful.

Context:
The user wants to use the PASTAQ-GUI in any Windows, Linux or MacOS- based operating system.

Main Success Scenario:

- The user is able to run the GUI on Windows, Linux and MacOS

Alternative Scenarios:

- The user is informed with an error message as to why the program is not running

Preconditions:

- Program runs on the users operating system

Postconditions:

- Program Terminates successfully

Frequency of Occurrence:
Every time the PASTAQ-GUI is run.

5.7 Ease of Use | UC7

Requirement:

- R1.6-R1.8
- R1.11
- R1.13-R1.15
- R1.22-R1.23
- R2.2-R2.6
- R3.6
- NFR4.1-NFR4.13
- NFR4.15
- NFR4.19-NFR4.22
- NFR4.24-NFR4.26

Primary Actors:

- General Users

User Story:
As a general user, I want the GUI to be aesthetically pleasing, so that I will be more inclined to choose it over other software.
As an inexperienced user, I want to see an intuitive and responsive so that I can get my work done without having to spend time on understanding the system.

Context:
The user wants the current implementation of the GUI to be responsive, more pleasing to look at and easier to use. Aside from necessary GUI changes, we have also identified a minor bug which is that the cancel button doesn't get removed from the GUI after the completion of a run.

Main Success Scenario:

- The user found the GUI to be pleasing to look at.
- The user found the GUI responsive and intuitive to use.

Alternative Scenarios:

- The user found the GUI displeasing to look at.
- The user found the GUI to be unintuitive.
- The user found the GUI to be unresponsive.

Preconditions:

- The GUI is intuitive to use.
- User has enough knowledge to work with the GUI.

Postconditions:

- The GUI helps the user process his data more easily.
- User successfully processes his data.

Frequency of Occurence: Very high, every time the PASTAQ-GUI is accesed by the user.

5.8 Continuous Integration & Executables | UC8

Requirement:

- R3.1 - R3.4

Primary Actors:

- PASTAQ-GUI General Users
- The Product Owner

User Story:

- **PASTAQ-GUI General Users**
  As a general user, I would like to be able to download a working executable file, so that I do not have to perform complex installation steps.
  As a general user, I would like to get a working executable, so that I do not have to deal with bugs.
- **The Product Owner**
  As the product owner, I would like to have automatically generated executables, so that I do not have to do that manually for every update.

Context:
The user wants to run the PASTAQ-GUI in any Windows, Linux or MacOS-based operating system without having to perform complex installation steps.

Main Success Scenario:

- Executable files for Windows, Linux and MacOS are automatically generated through Github CI

Alternative Scenarios:

- Github CI fails to generate executables and raises an error message.
- An executable generated by Github CI fails to run and raises an error message.
- The new release fails the tests and some parts have to be fixed.

Preconditions:

- An updated version of the code is pushed to Github.

Postconditions:

- Executable files are generated by Github CI.

Frequency of Occurrence:
Every time a new release of PASTAQ-GUI is made.

A Terminology

Glossary

.mgf Mascot generic format files are the standard format to store protein data. 2, 5, 6, 11

.mzID The .mzID format stores peptide and protein identifications based on mass spectrometry and captures metadata about methods, parameters, and quality metrics. 2, 5, 6, 10, 11

.mzXML An XML (eXtensible Markup Language) based common file format for proteomics mass spectrometric data. 2, 5

.params The .params file is needed to execute MSFragger. It contains the path to the FASTA database and the search parameters for MSFragger. 5, 6

.pepXML An open data format developed at the SPC/Institute for Systems biology for the storage, exchange, and processing of peptide sequence assignments of MS/MS scans. 5, 6

idconvert A command line tool for converting between various file formats. 5, 6, 11

liquid chromatography A technique in analytical chemistry used to separate, identify, and quantify each component in a mixture. 2, 4

metabolomics The scientific study of chemical processes involving metabolites, the small molecule substrates, intermediates and products of cell metabolism. 2

msConvert A command-line utility for converting between various mass spectrometry data formats, including from raw data from several commercial companies (with vendor libraries, Windows-only). 2

MSFragger Database search tool for peptide identification in mass spectrometry. 5, 6, 11

PASTAQ Pipelines and Systems for Threshold-Avoiding Quantification; PASTAQ provides a set of tools for high-performance pre-processing of LC-MS/MS data. 2, 4, 7, 10, 12–15, 17, 18

peptide Short chains of amino acids linked by peptide bonds. 2, 4

PeptideShaker A search engine independent platform for protein identification. 6

post hoc analysis A type of statistical analysis that is conducted following the rejection of an omnibus null hypothesis. 4

proteomics The large-scale study of proteins. 2

SearchGUI Open-source common interface for configuring and running protein data search. 6

tandem mass spectrometry A technique in instrumental analysis where two or more mass analyzers are coupled together using an additional reaction step to increase their abilities to analyse chemical samples. 2, 4

B Client Meeting Log

Table 2: Client Meeting Log

Meeting Date	Content
2022-02-25	• Had a general introduction • Discussed available projects • The client presented a short overview of the system
2022-03-02	• Discussed project choice • The client provided an overview of the whole system • Discussed specific requirements (fix bugs, small improvements, etc.) • Brainstormed possible requirements (integration of visuals and statistics)
2022-03-09	• Reported an error that occurs when trying to install PASTAQ • Cleared up uncertainties about all the files and programs involved • Discussed the scope of the project • Agreed on the requirements of the project • Corrected the languages and technologies • Assisted us on setting up the necessary tools for the project

Continued on next page

Table 2: Client Meeting Log (Continued)

Meeting Date	Content
2022-03-18	• Reported issues we encountered when trying to install PASTAQ • Went through the installation step-by-step • Encountered errors throughout the meeting and solved them with the help of the client • Installed PASTAQ successfully • Asked leftover questions
2022-05-02	• Gave progress demo to client • Discussed implementation possibilities for certain features • Discussed pipeline threading • Asked questions regarding testing and implementation into CI
2022-05-19	• Informed client of everything that has been implemented as a means of adjusting to their wishes • Demonstrated CI testing to the client • Discussed the usability of the GUI
2022-06-02	• Discussed acceptance testing • Discussed GUI features

C Change log

Table 3: Change Log

Date	Time	Team Member	Changes	Version
12.2.2022	13:58	Kaitlin Vos	Inserted change log table	1.0
15.2.2022	12:16	Dominic Therattil	Added cover page draft	1.1
16.2.2022	16:45	Tudor Dragan	Added client meeting log	1.1.1
19.2.2022	13:39	Dominic Therattil	Updated cover page	1.1.2
01.03.2022	13:39	Dominic Therattil	Updated banner for PASTAQ	1.1.2
02.03.2022	12:55	Björn Schönrock	Updated meeting log	1.1.3
04.03.2022	12:30	Kaitlin Vos	Changed meeting log format to table and added notes from the second meeting	1.1.4
04.03.2022	13:00	Björn Schönrock	Wrote first draft of requirement	1.1.5
04.03.2022	13:00	Mohammed Nacer Lazrak	Wrote first draft of requirements	1.1.5
05.03.2022	08:00	Cristian Iacob	Added stakeholders, system's scope and frameworks	1.1.6
05.03.2022	13:00	Kaitlin Vos	Made the requirements more detailed	1.1.6
05.03.2022	22:00	Tudor Dragan	Added introduction	1.1.8
06.03.2022	19:00	Dominic Therattil	Added use cases	1.1.9
06.03.2022	19:00	Teresa Ferreira	Added use cases	1.1.10
06.03.2022	19:00	Dominic Therattil	Added terminology	1.1.11
06.03.2022	23:41	Kaitlin Vos	Fixed grammar and fine-tuned introduction	1.1.12
07.03.2022	12:00	Cristian Iacob	Moved system scope to scope and added to it	1.1.13
07.03.2022	12:21	Kaitlin Vos	Added terminology glossary	1.1.14
08.03.2022	11:39	Kaitlin Vos	Extended terminology and did general clean-up	1.1.15
08.03.2022	12:04	Kaitlin Vos	Fixed images and added use case diagrams folder	1.1.16
09.03.2022	13:36	Nacer Lazrak	Fixed requirements & reviewed syntax	1.1.17
09.03.2022	14:00	Tudor Dragan	Improved the scope	1.1.18
09.03.2022	14:30	Cristian Iacob	Cleaned up the scope and frameworks based on feedback	1.1.19

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Table 3: Change Log (Continued)

Date	Time	Team Member	Changes	Version
09.03.2022	22:13	Kaitlin Vos	Updated the client meeting log	1.1.20
11.03.2022	11:52	Kaitlin Vos	Updated the terminology	1.1.21
11.03.2022	11:52	Tudor Dragan	Improved requirements & added justification section	1.2
12.03.2022	22:00	Cristian Iacob	Moved team & client to stakeholders, added justification for users	1.2.1
13.03.2022	15:55	Kaitlin Vos	Fixed all inconsistencies, grammar issues and updated terminology	1.2.2
14.03.2022	10:00	Björn Schönrock	Clarified requirements & document fixes and cleanup	1.2.3
14.03.2022	12:11	Kaitlin Vos	Upgraded tables	1.2.4
15.03.2022	12:11	Dominic Therattil	Did some small fixes and corrections	1.2.5
16.03.2022	20:00	Teresa Ferreira	Updated use cases	1.2.6
16.03.2022	22:00	Tudor Dragan	Added diagrams for scope and requirements	1.2.7
17.03.2022	15:03	Kaitlin Vos	Fixed image placement	1.2.8
17.03.2022	16:00	Dominic Therattil	Updated use cases	1.2.9
20.03.2022	20:00	Tudor Dragan	Improved UC 3,4,5,6	1.2.10
21.03.2022	05:44	Cristian Iacob	Color coded the requirements based on respective use case	1.2.11
21.03.2022	11:41	Kaitlin Vos	Completed color coding	1.2.12
22.03.2022	12:00	Dominic Therattil	Improved use cases and fixed alignment/formatting issues	1.2.13
22.03.2022	12:00	Dominic Therattil	Added diagrams for UC1 & UC2	1.2.14
22.03.2022	17:00	Björn Schönrock	Added CI requirement	1.2.15
23.03.2022	11:00	Dominic Therattil	Updated UML diagram for UC3 & 4 and cover page	1.2.16
23.03.2022	19:33	Teresa Ferreira	Resized UML diagrams for UC1, UC2, UC3 & UC4	1.2.17
23.03.2022	19:34	Teresa Ferreira	Added UML diagram for UC5	1.2.18
23.03.2022	19:47	Teresa Ferreira	Divided user story for UC6	1.2.19
23.03.2022	16:07	Teresa Ferreira	Added UML diagram for UC6	1.2.20
25.03.2022	16:00	Kaitlin Vos	Changed justification layout and updated client meeting log	1.2.21

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Table 3: Change Log (Continued)

Date	Time	Team Member	Changes	Version
25.03.2022	16:17	Kaitlin Vos	Rewrote requirements 2.1 - 2.7 and edited UC6	1.2.22
29.03.2022	20:30	Cristian Iacob	Added new requirements and broke larger requirements into smaller more specific ones	1.3
30.03.2022	14:10	Cristian Iacob	Added use case 7 and updated requirements accordingly	1.3.1
30.03.2022	14:10	Björn Schönrock	Added use case 8 and updated requirements	1.3.2
30.03.2022	20:10	Cristian Iacob	Updated importance justification of requirements and moved some requirements to non functional	1.3.3
30.03.2022	21:10	Cristian Iacob	Added abstract section	1.3.4
30.03.2022	22:06	Cristian Iacob	Updated requirements priority diagram	1.3.5
30.03.2022	22:30	Tudor Dragan	Added diagram for UC7 and UC8	1.3.6
01.04.2022	10:23	Cristian Iacob	Fixed formatting issues	1.3.7
01.04.2022	13:46	Cristian Iacob	Changed UC4 & UC7, updated requirements accordingly	1.3.8
02.04.2022	12:00	Tudor Dragan	Improved UC8 & refactored small mistakes	1.3.9
03.04.2022	23:52	Kaitlin Vos	Added requirements for consistency	1.4
04.04.2022	11:01	Kaitlin Vos	Proof-read entire document, fixed typos, syntax, logic	1.4.1
19.04.2022	19:45	Teresa Ferreira	Removed some NFR	1.4.2
28.04.2022	12:15	Teresa Ferreira	Defined inexperienced users and labeled figure 1	1.5.1
28.04.2022	12:30	Kaitlin Vos	Checked terminology and removed sequence diagrams	1.5.2
28.04.2022	12:55	Kaitlin Vos	Deleted the abstract and moved section 7 to the architecture document	1.5.3
29.04.2022	13:30	Cristian Iacob	Made the client log and change log consistent	1.5.4
29.04.2022	15:40	Cristian Iacob	Turned change log, client log and terminology from sections to appendices	1.5.6
12.05.2022	12:00	Tudor Dragan	Updated client meeting log	1.5.7

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Table 3: Change Log (Continued)

Date	Time	Team Member	Changes	Version
28.05.2022	13:32	Kaitlin Vos	Updated client meeting log, glossary and all the requirements	1.5.8
28.05.2022	18:15	Björn Schönrock	Added requirement for run button	1.5.9
29.05.2022	9:15	Cristian Iacob	Updated use cases and importance justification section for new requirements	1.5.10
29.05.2022	21:00	Dominic Therattil	Updated scope to meet current project standard	1.5.11
05.06.2022	10:15	Cristian Iacob	Updated use cases and importance justification section for new requirements	1.5.12
07.06.2022	13:11	Kaitlin Vos	Finalized requirements & updated client meeting log	1.5.13