National College of Ireland

Bachelor of Science (Honours) in Computing

Cybersecurity

2023/2024

Benita Amaechi

x20387093

x20387093@student.ncirl.ie

Vulnerability Catcher

Technical Report

Contents

Executive Summary 2

1.0 Introduction 2

1.1. Background 2

1.2. Aims 3

1.3. Technology 3

1.4. Structure 3

2.0 System 3

2.1. Requirements 3

2.1.1. Functional Requirements 4

2.1.1.1. Use Case Diagram 4

2.1.1.2. Requirement 1: Vulnerability Catcher Install 4

2.1.1.3. Description & Priority 4

2.1.1.4. Use Case 4

2.1.2.1. Use Case Diagram 6

2.1.2.2. Requirement 2: NetBeans IDE Enhanced with Vulnerability Catcher 6

2.1.2.3. Description & Priority 6

2.1.2.4. Use Case 7

2.1.3. Data Requirements 8

2.1.4. User Requirements 9

2.1.5. Environmental Requirements 9

2.1.6. Usability Requirements 9

2.2. Design & Architecture 9

2.3. Implementation 10

2.4. Graphical User Interface (GUI) 13

2.5. Testing 16

2.6. Evaluation 17

3. Conclusions 17

4. Further Development or Research 17

5. References 17

6.0 Appendices 17

6.1. Project Proposal 17

1.0. Objectives 19

2.0. Background 19

3.0. State of the Art 19
4.0. Technical Approach 20
5.0. Technical Details 20
6.0. Special Resources Required 21
7.0. Project Plan 21
8.0. Testing 22
6.1. Reflective Journals 22
6.2. Other materials used 31

Executive Summary

In this report I am going to discuss in detail my overall project, highlighting the reasoning behind my decision to undertake this project, the objectives of the project, the technology tools the project will utilise, the requirements of the project both functional and non-functional, the implementation of the project, the testing, evaluation, and conclusion of the project, and the continuous development of the project upon successful completion. The purpose of this report is to define the Software Requirement Specifications (SRS) of my project, making use of Use Case Description's and Use Case Diagram's. Through defining the Software Requirement Specifications of my project, I will be enabled to plan both the backend and the frontend of my application before I begin the physical development of my project, this will make the entire development stage more efficient because I will know exactly what it is that needs to be implemented and when. Defining the Software Requirement Specification will prevent me from wasting time on functionalities that do not align with the complete project, in turn my time will be well spent on functionalities of the project that are required for the successful completion of the project. Defining the Software Requirement Specifications will give me the opportunity to fully plan each detail of my project considering all aspects of the project and not just the finished product.

1.0 Introduction

1.1. Background

I chose to undertake this project because of the work placement which I completed last semester. I completed my work placement in Edgescan, Edgescan is a cybersecurity company that scans organisations systems for vulnerabilities to web attacks. For the duration of my eight month work placement, I conducted several vulnerability checks and learnt a lot about web attack vulnerabilities, but prior to my work placement I knew nothing about these vulnerabilities. In the last four years I developed serval web applications as part of assignments and projects for my programme, during my work placement I realised that majority if not all of those web application were vulnerable to some sort of web attack. The numerous code editors I utilised in the last four years did

not detect any of these vulnerabilities in the same way they did syntax errors or logic errors, so I decided to develop a software tool that would rectify this issue.

1.2. Aims

The aim of this project is to aid both students and developers with detecting web attack vulnerabilities in their source code. The target audience for this project is students and developers, students can utilise the project while developing web applications for their various programmes, the plugin will give students the opportunity to detect web attack vulnerabilities in their source code in the same way syntax errors, and logic errors are being detected. Students will not only write secure code with this application but they will learn about web attack vulnerabilities simultaneously. Smaller businesses and organisation who do not have the funds to pay for both developers and an additional scanning of their systems for vulnerabilities, can utilise the plugin. In place of hiring both a developer and a security analyst, organisations can just hire a developer who will utilise the plugin, and their web attack vulnerabilities will automatically be detected before the deployment of the system. The plugin aims to ensure the security of source codes and teach students and developers about the web attack vulnerabilities that are being exploited by attackers.

1.3. Technology

The technology that I will utilise to achieve what I have set out to do is NetBeans, ChatGPT, Open AI API, and Java. NetBeans is the primary technology I will use for my project, this is where the plugin will be developed, and it is the code editor that users will utilise to gain access to the plugin. In NetBeans I will use Java to write the code for the plugin. I will utilise ChatGPT as the artificial intelligence tool that will check the users text for security vulnerabilities. To connect ChatGPT with the NetBeans plugin I will utilise an application programming interface (API).

1.4. Structure

In this document I will first of all discuss the requirements of my system, detailing, both functional and non-functional requirements of the system. Next, I will discuss the design and architecture of the system. Following the design and architecture, I will discuss the implementation of my system. Once I have addressed the implementation of my system, I will provide some screenshots of the Graphic User Interface (GUI) of the system. Details of the testing of my system will come after the screenshots of the functioning system have been provided. The evaluations and the conclusion of the completed system will be discussed after the testing of the system is addressed. The final discussion in the document will be on how the system can be developed further once it has been completed.

2.0 System

2.1. Requirements

The requirements of my system is a NetBeans application, Java code to check for security vulnerabilities, and a developer, from students who are just learning to code to certified developers who have years of experience. Both students and certified

developers will have access to the same plugin that will detect vulnerabilities in their source code, there is no training required for the system, users who have experience with NetBeans will immediately understand how to utilise the plugin.

2.1.1. Functional Requirements

The functional requirements of my system are, a NetBeans plugin, an API for the AI technology to communicate with the NetBeans application through, an AI technology integrated with the functioning API, and the API integrated with the NetBeans plugin.

The NetBeans plugin is the middle man between the users code and the AI technology that will check if the code is vulnerable to web attack or not, this is the frontend of the system that the user will see.

The API that will connect to the AI technology will run in the backend of the system this API will connect the AI technology that will check if the users code is vulnerable to web attacks.

The AI technology that will check if the users source code is vulnerable to web attacks must be integrated into the API in the back end of the system.

Once the AI technology is connected to the API, the API will be integrated with the NetBeans plugin.

The NetBeans plugin will send the message from the AI technology to the user through a graphic user interface, this is part of the front end of the system that will be visible to the user.

2.1.1.1. Use Case Diagram

2.1.1.2. Requirement 1: Vulnerability Catcher Install

2.1.1.3. Description & Priority

The users installation of the Vulnerability Catcher NetBeans plugin is essential for the systems functionality. Without the installation of the Vulnerability Catcher users will not have access to the NetBeans plugin, and will not be able to validate their code against security vulnerabilities.

2.1.1.4. Use Case

UC-1

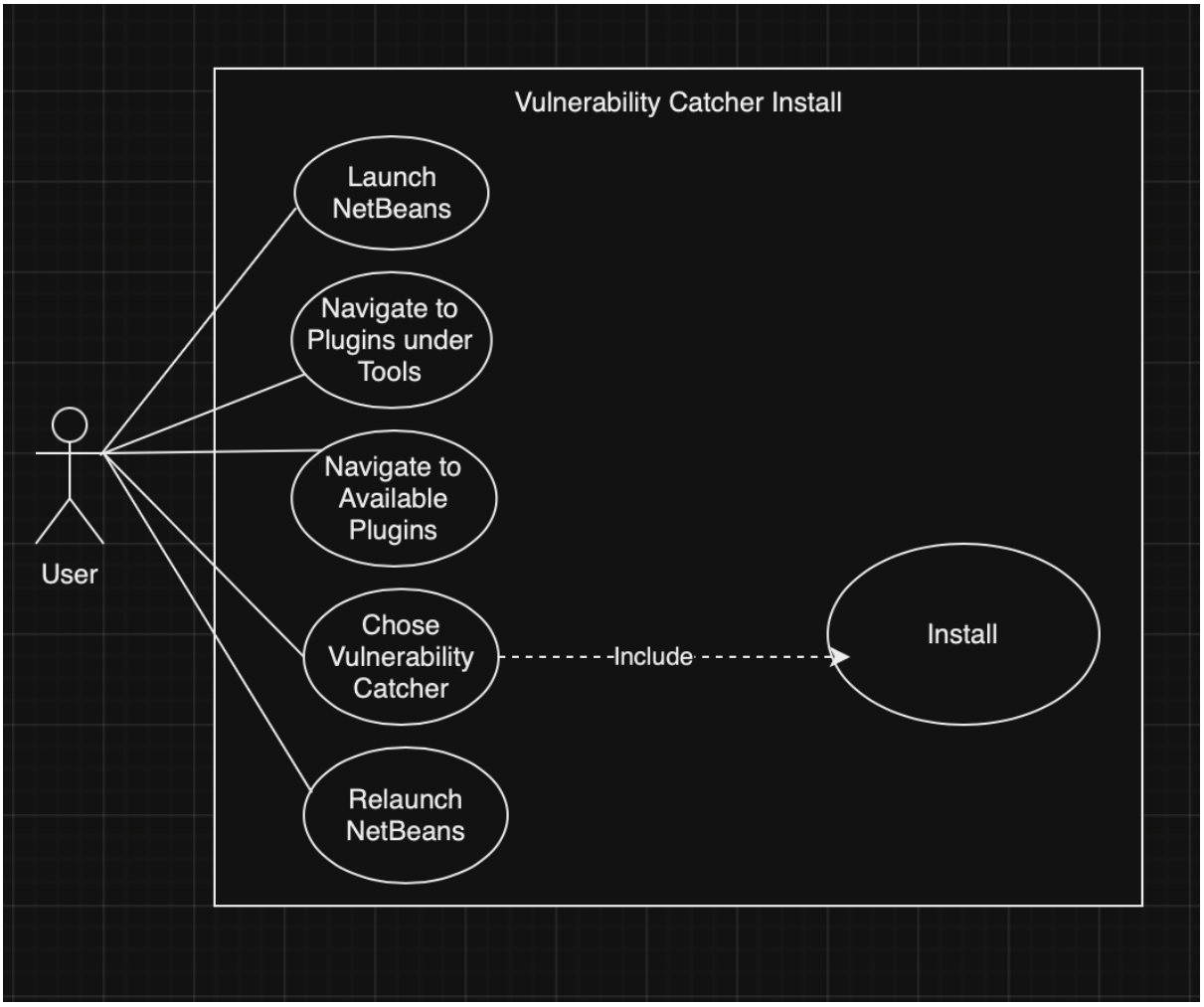
Scope

The scope of this use case is the front end of the system. It is how the user will gain access to the Vulnerability Catcher NetBeans plugin, they will utilise for the validation of their source code.

Description

This use case describes the steps a user (a student or developer) will take to successfully install the Vulnerability Catcher NetBeans plugin.

Use Case Diagram



Flow Description

Precondition

The user has downloaded the NetBeans IDE, the user has developed and saved a project in NetBeans with source code that they want to validate.

Activation

This use case begins once the actor (student or developer) launches the NetBeans IDE.

Main flow

1. The user launches the NetBeans IDE.
2. The user navigates to Plugins under Tools.
3. The user navigates to Available Plugins.
4. The user selects the Vulnerability Catcher.
5. The user clicks Install.

6. The system installs the Vulnerability Catcher.
7. The user relaunches the NetBeans IDE.
8. The system completes the installation.

Alternate flow

A1: Download through browser.

1. The user navigates to the NetBeans Plugin Portal on their browser.
2. The user navigates to the Vulnerability Catcher.
3. The user navigates to compatible NetBeans version of plugin.
4. The user clicks download.
5. The user launches the NetBeans IDE.
6. The user navigates to Plugins under Tools.
7. The user navigates to Downloaded.
8. The user clicks Add Plugins…
9. The user navigates to file where plugin was downloaded.
10. The use case continues at position 5 of the main flow.

Exceptional flow

E1: The user does not relaunch the NetBeans IDE.

1. The user clicks Restart IDE Later.
2. The system does not complete the plugin installation.
3. The use case continues at position 7 of the main flow.

E2: The user does not download a compatible NetBeans plugin version.

4. The user navigates to file where plugin was downloaded.
5. The user gets an error response.
6. The use case continues at position 3 of the alternate flow.

Termination

The system moves to UC-2.

Post condition

The users has installed the Vulnerability Catcher plugin, and can now use It to validate their NetBeans IDE projects.

2.1.2.1. Use Case Diagram

2.1.2.2. Requirement 2: NetBeans IDE Enhanced with Vulnerability Catcher

2.1.2.3. Description & Priority

The NetBeans IDE enhanced with the Vulnerability Catcher is the complete system, it is essential for the functionality of the system. The NetBeans plugin alone will not be functional, but when integrated with the NetBeans IDE it is fully functional. The NetBeans IDE enhanced with the Vulnerability Catcher enables users to check their code for security vulnerabilities. The NetBeans IDE enhanced with the vulnerability Catcher handles both the front end of the system where the user sees the plugin, and the back end of the system where the NetBeans plugin communicates with the AI technology (ChatGPT) to validate the users source code against security vulnerabilities.

2.1.2.4. Use Case

UC-2

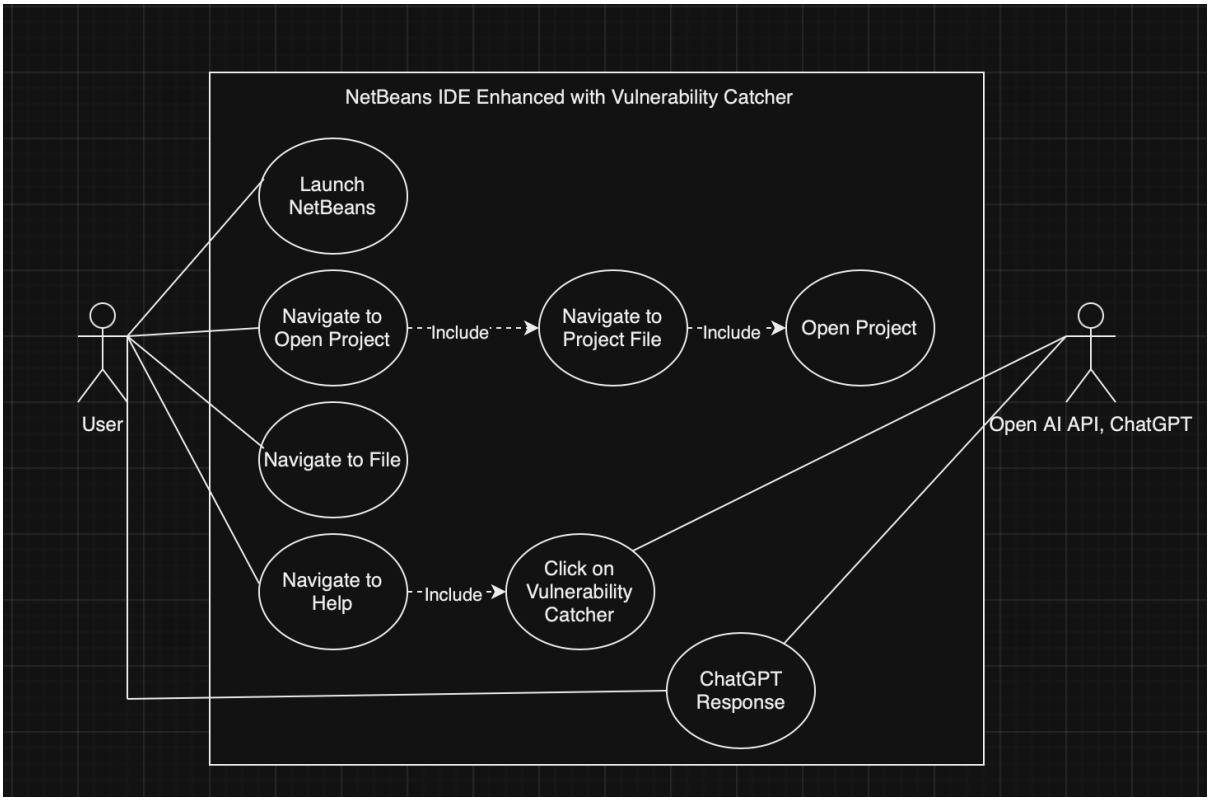
Scope

The scope of this use case is both the front end and the back end of the system. Through this use case the user will be enabled to check the source code of a project they have developed in the NetBeans IDE or other Integrated development environments for security vulnerabilities.

Description

This use case describes the steps a user (student or developer) will take to successfully utilise the Vulnerability Catcher plugin.

Use Case Diagram



Flow Description

Precondition

The user has downloaded the NetBeans IDE, the user has developed and saved a project in NetBeans with source code that they want to validate, the user has successfully installed the NetBeans plugin.

Activation

This use case begins once the actor (student or developer) launches the NetBeans IDE.

Main flow

1. The user launches the NetBeans IDE.
2. The user navigates to Open Project.
3. The user navigates to project file.
4. The user opens selected project.
5. The user navigates to files with source code they want validated.
6. The user navigates to Help.
7. The user clicks Vulnerability Catcher.
8. The system sends a prompt with the source code to ChatGPT through the Open AI API.
9. The user receives a response from ChatGPT.

Alternate flow

A1: The project is already opened.

1. The user launches the NetBeans IDE.
2. The use case continues at position 6 of the main flow.

Exceptional flow

E1: The user is not connected to the internet.

1. The user clicks on the Vulnerability Catcher plugin.
2. The user gets an error response.
3. The use case continues at position 6 of the main flow.

E2: The user does not open their source code.

4. The user clicks on the Vulnerability Catcher plugin.
5. The user gets an error response.
6. The use case continues at position 2 of the main flow.

Termination

The system is complete.

Post condition

The user has received a response from ChatGPT relaying if and what type of security vulnerabilities their source code is vulnerable to.

2.1.3. Data Requirements

The data requirements for this system, is source code written in any integrated development environment by the user for validation, and the data that will be retrieved by ChatGPT to compare the users source code against and verify if it contains security vulnerabilities. To retrieve the data from ChatGPT there is an interchange between the Vulnerability Catcher NetBeans plugin and the Open AI API. The API sends a prompt with the source code from the Vulnerability Catcher plugin to ChatGPT, in turn it retrieves a response from ChatGPT, this is done through Hypertext Transfer Protocol (HTTP) as a JSON document. Once the response is retrieved JSON is parsed and the response is extracted from the JSON response body. From the development side, the data requirement is source code with

security vulnerabilities that the I can use to check if the Vulnerability Catcher NetBeans plugin is actually analysing the code for security vulnerabilities and reporting those security vulnerabilities back to the user.

2.1.4. User Requirements

The user requirements for this system, are users with experience in Java and the NetBeans IDE. The target market is students and developers, but anyone with some experience with NetBeans, and the knowledge to write Java code should be able to successfully utilise the Vulnerability Catcher NetBeans plugin.

2.1.5. Environmental Requirements

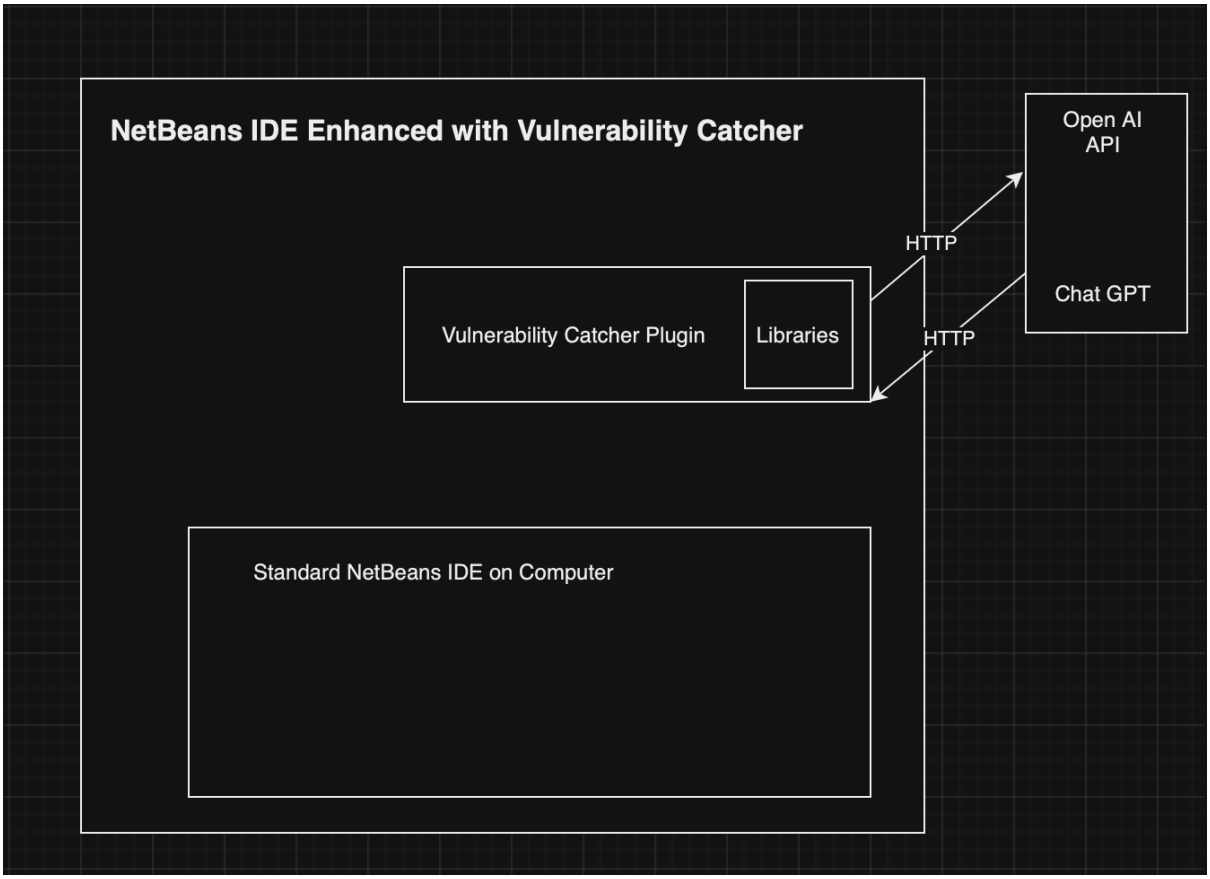
The environmental requirements for this system, are the NetBeans IDE, network connection, and an Open API subscription. To access the Vulnerability Catcher NetBeans plugin the user should have the NetBeans IDE downloaded on their system. The Vulnerability Catcher plugin implements ChatGPT, and ChatGPT cannot run without a network connection, so it is essential that users maintain network connection when the plugin is in use. The ChatGPT component of the Vulnerability Catcher requires an active Open AI API subscription which will be implemented as a charge when installing the Vulnerability Catcher NetBeans plugin.

2.1.6. Usability Requirements

The usability requirements for the system are, ease of use, efficiency, and satisfaction. The Vulnerability Plugin does not require or provide any training for its use, so it is essential that the system can be understood and used by users with little to no experience with Java and NetBeans, so it must be easy to navigate. The system must be straight forward to maximise its efficiency, regular users should only need to complete two steps to utilise the Vulnerability Catcher, opening their source code and clicking the Vulnerability Catcher plugin. The system should provide the user with satisfaction, the Vulnerability Catcher should check the users source code for security vulnerabilities and relay those vulnerabilities back to the use.

2.2. Design & Architecture

The design of the system is a NetBeans plugin that is enhanced with a NetBeans plugin called the Vulnerability Catcher. When users download the Vulnerability Catcher they are granted access to an enhanced NetBeans IDE with the vulnerability Catcher component. This component communicates with the Open AI API to generate a response and retrieve the response from ChatGPT.



In the diagram above we can see the Standard NetBeans IDE that has been downloaded onto the users system, this is where the Vulnerability Catcher NetBeans plugin is installed. In the layer we see the NetBeans IDE but it has been enhanced with the Vulnerability Catcher, the plugin has been installed and is now running here. Within the NetBeans IDE enhanced with the Vulnerability Catcher we see the Vulnerability Catcher Plugin, and the and the libraries within the plugin. The Vulnerability Catcher plugin communicates with the Open AI API and ChatGPT through the hypertext transfer protocol (HTTP).

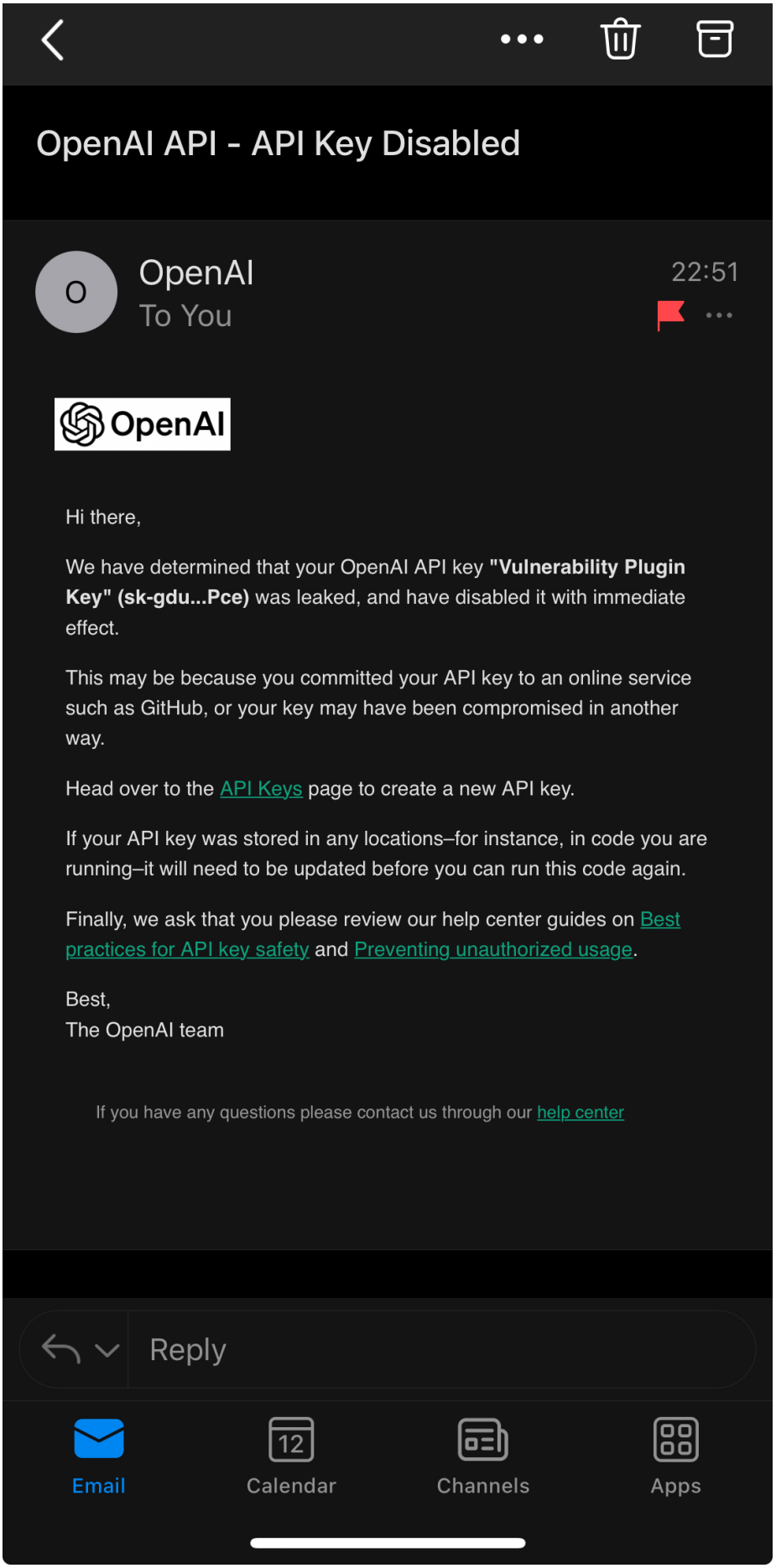
2.3. Implementation

3. The NetBeans IDE enhanced with the Vulnerability Catcher is the complete system, it is essential for the functionality of the system. The NetBeans plugin alone will not be functional, but when integrated with the NetBeans IDE it is fully functional. The NetBeans IDE enhanced with the Vulnerability Catcher enables users to check their code for security vulnerabilities. The NetBeans IDE enhanced with the vulnerability Catcher handles both the front end of the system where the user sees the plugin, and the back end of the system where the NetBeans plugin communicates with the AI technology (ChatGPT) to validate the users source code against security vulnerabilities.
4. The functional requirements of my system are, a NetBeans plugin, an API for the AI technology to communicate with the NetBeans application through, an AI technology integrated with the functioning API, and the API integrated with the NetBeans plugin.

5. The NetBeans plugin is the middle man between the users code and the AI technology that will check if the code is vulnerable to web attack or not, this is the frontend of the system that the user will see.
6. The API that will connect to the AI technology will run in the backend of the system this API will connect the AI technology that will check if the users code is vulnerable to web attacks.
7. The AI technology that will check if the users source code is vulnerable to web attacks must be integrated into the API in the back end of the system.
8. Once the AI technology is connected to the API, the API will be integrated with the NetBeans plugin.
9. The NetBeans plugin will send the message from the AI technology to the user through a graphic user interface, this is part of the front end of the system that will be visible to the user.
10.

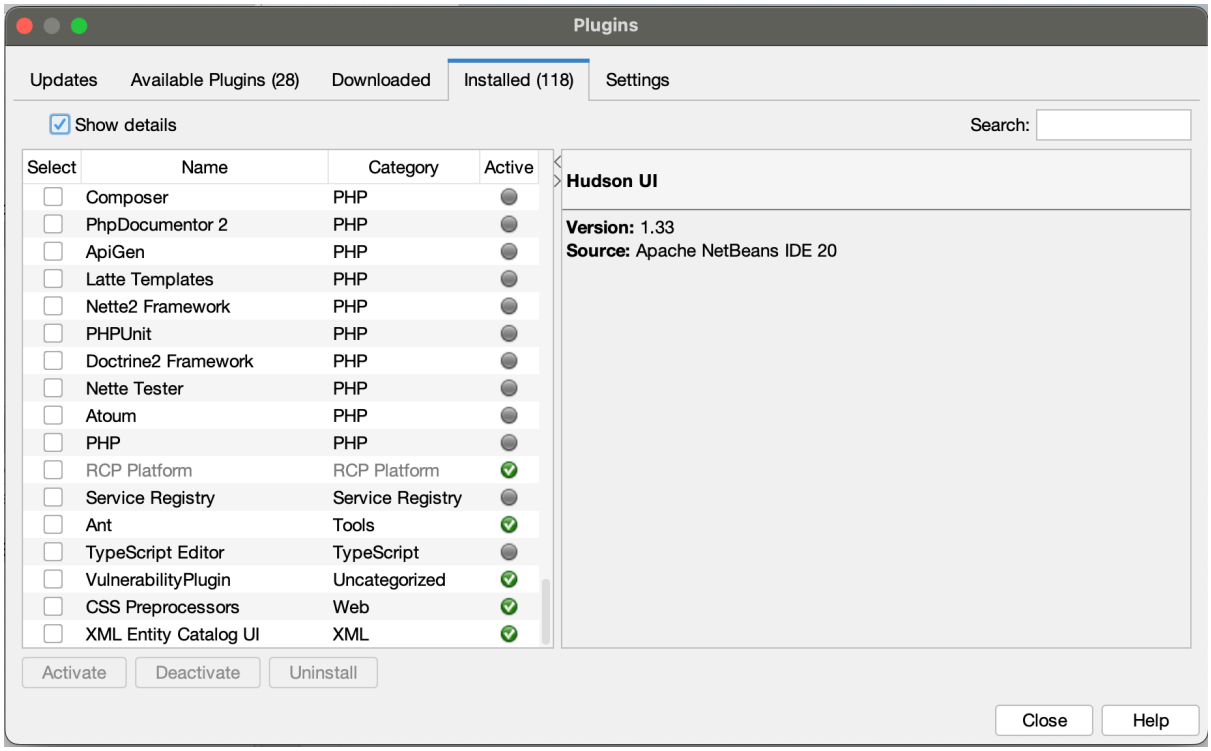
```
prompt = prompt.replaceAll("\n", " "); //new line command to send source code to ChatGPT
prompt = prompt.replace("\"", "'"); //

String prompt2 = "Can you find any security vulnerabilities in the following code: " + prompt; //prompt and source code s
System.out.println(prompt2);
String body = "{\"model\": \"" + model + "\", \"messages\": [{\"role\": \"user\", \"content\": \"" + prompt2 + "\"}]}";
System.out.println(body);
connection.setDoOutput(true);
OutputStreamWriter writer = new OutputStreamWriter(connection.getOutputStream()); //encodes characters into bytes
writer.write(body);
writer.flush();
writer.close();
```

```
public void actionPerformed(ActionEvent e) {
    //the FileObject NetBeans API is called here to be extract the users open source code for validation
    TopComponent activeTC = selectedEditorComponent();
    FileObject fo = activeTC.getLookup().lookup(FileObject.class);

    /**
     * @reference
     * https://stackoverflow.com/questions/45634482/netbeans-module-development-how-to-modify-opened-file
     */
    //ChatGPT's response to for the opened source code
    try {

        JOptionPane.showMessageDialog(null, ChatGPTAPI.chatGPT(fo.asText()), "ChatGPT Response", JOptionPane.INFORMATION_MESSAGE);
    } catch (IOException ex) {
        System.out.print("Error");
    }

}
```

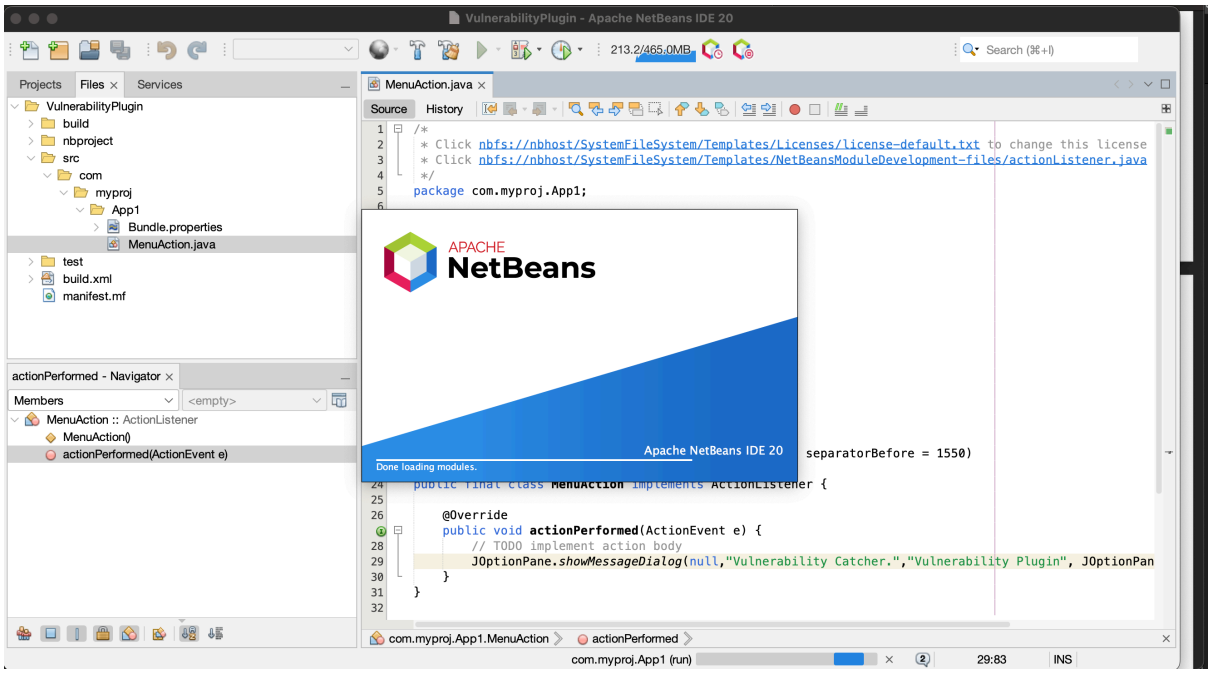

OpenAI API - API Key Disabled
O
OpenAI
To You
22:51
OpenAI
Hi there,
We have determined that your OpenAI API key "Vulnerability Plugin Key" (sk-gdu...Pce) was leaked, and have disabled it with immediate effect.
This may be because you committed your API key to an online service such as GitHub, or your key may have been compromised in another way.
Head over to the API Keys page to create a new API key.
If your API key was stored in any locations–for instance, in code you are running–it will need to be updated before you can run this code again.
Finally, we ask that you please review our help center guides on Best practices for API key safety and Preventing unauthorized usage.
Best,
The OpenAI team
If you have any questions please contact us through our help center
Reply
Email
Calendar
Channels
Apps

In the screenshot above you see that unfortunately immediately I uploaded my code to GitHub my Open AI API key was disabled because the GitHub repository was public.

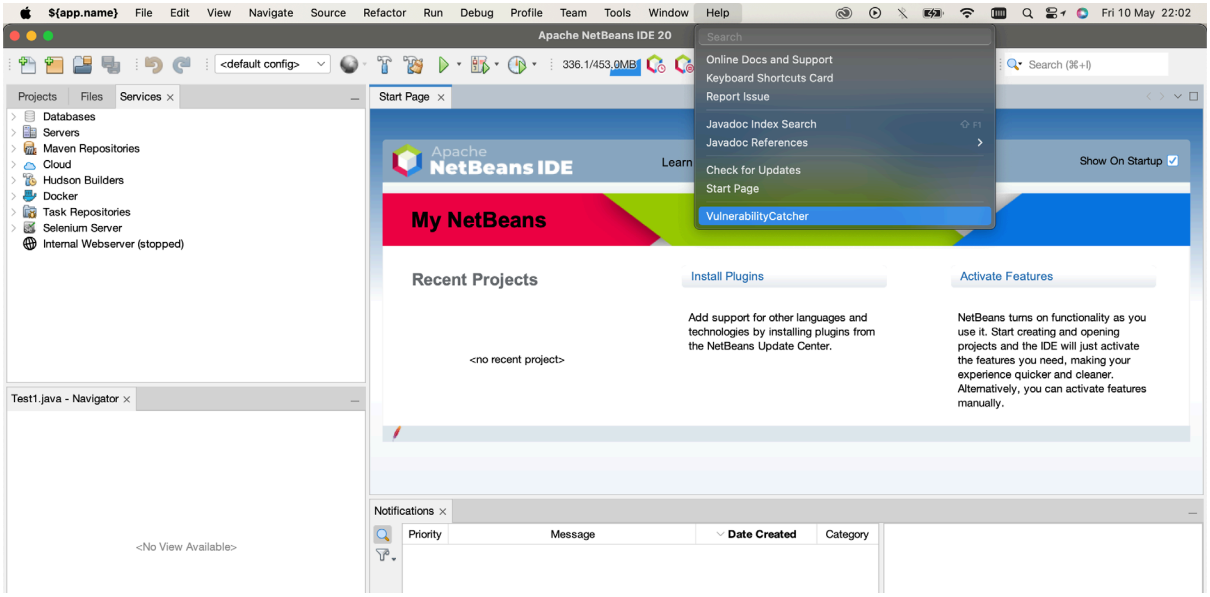
10.1. Graphical User Interface (GUI)



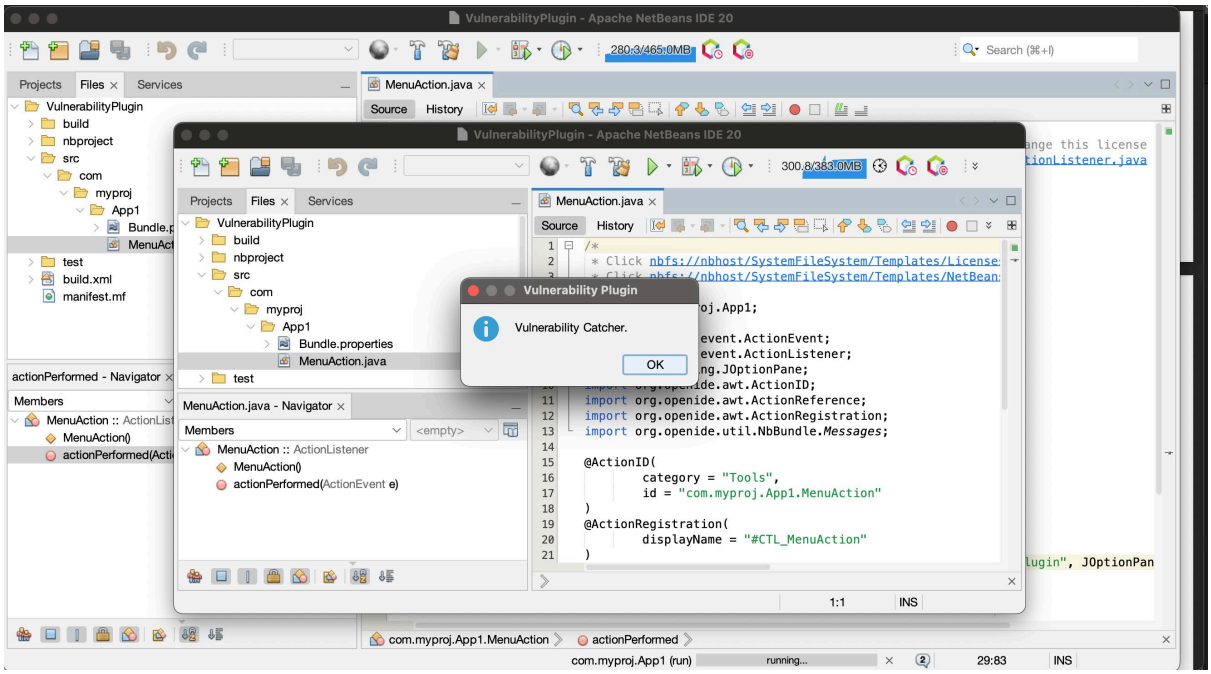
In the screenshot above, the Vulnerability Catcher NetBeans plugin that was developed was installed in NetBeans.



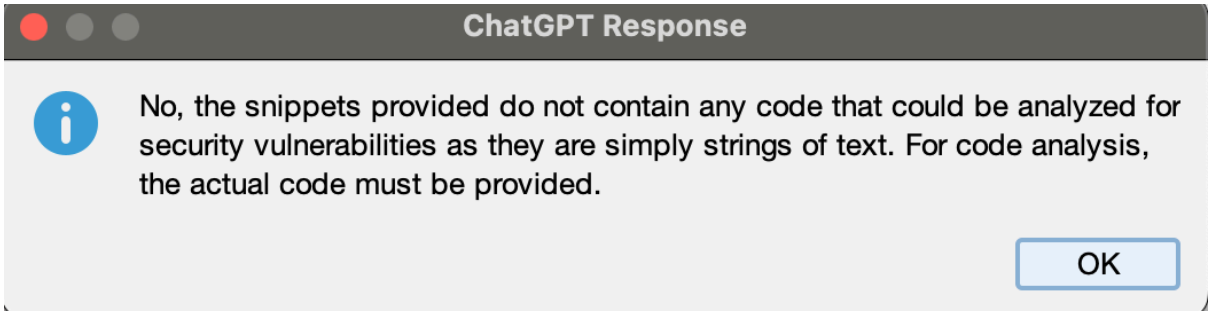
In the screenshot above, the NetBeans plugin was running.



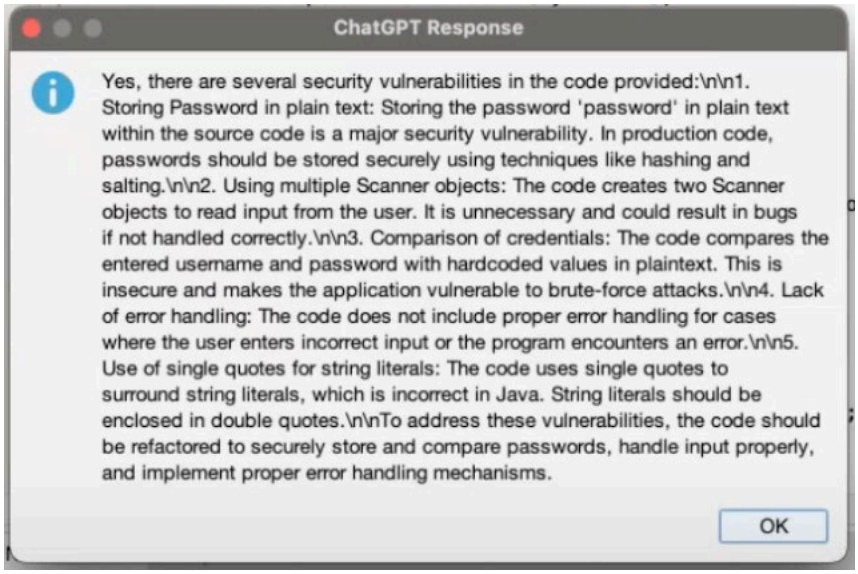
In the screenshot above, you can see the NetBeans plugin (Vulnerability Catcher) that was developed under the Help menu.



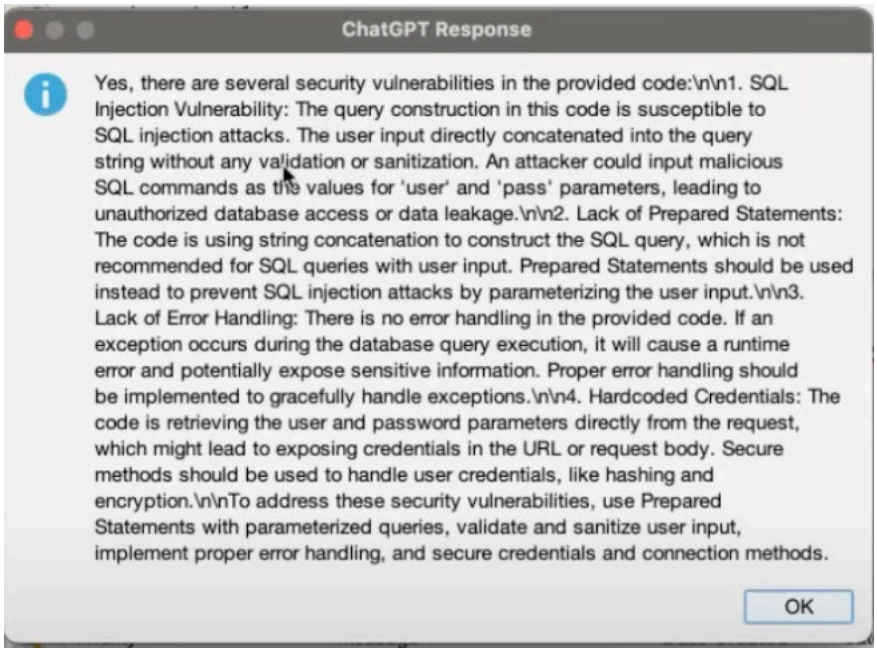
In the screenshot above, once “My Menu” has been selected the graphic user interface for the NetBeans plugin opens.



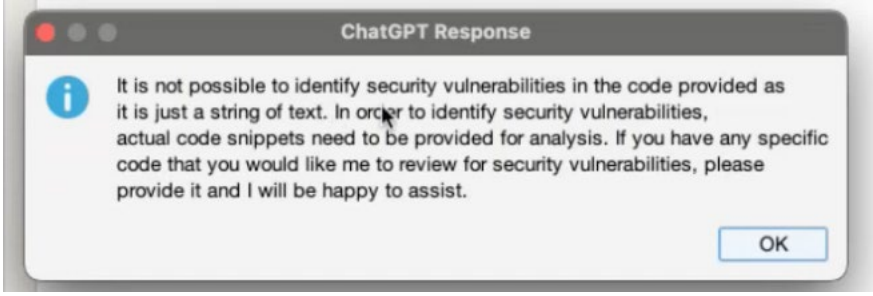
In the screenshot above you see that I sent a string of text to be validated and this is ChatGPT's response.



In the screenshot above you see I sent a login class to be validated and this is ChatGPT's response.



In the screenshot above you see I sent source code with some SQL injection vulnerabilities to be validated and this is ChatGPT's response.



In the screenshot above you see that ChatGPT may return slightly different responses for the same code but it is predominantly the same, in the screenshot above you see that I sent a string of text to be validated and this is ChatGPT's response

10.2. Testing

The testing tools I used was Microsoft's Word Document, to create tables for my test plans, and to document the results of my test cases. I conducted some manual tests on my system because although the development of the system is quite complex the system itself is quite straightforward. The testing method I used was black box testing

Condition	**Invalid Equivalence Classes**	**Valid Equivalence Classes**	**Invalid Equivalence Classes**
User opens a java file they want to check for security vulnerabilities.	The user does not open a java file, but just clicks on the plugin.	The user opens a java file, and then clicks on the plugin.	The user clicks the plugin, and then opens a java file.

Test Cases	**Scenario**	**Data Value 1**	**Data Value 2**	**Expected Results**	**Actual Result**
1	A user wants to use the NetBeans plugin to check their code for security vulnerabilities.	Open the Java file you want the plugin to check.	Click on the NetBeans plugin.	Showing the response from ChatGPT.	Pass

Test Case	**Description**	**Expected Result**	**Actual Result**	**Pass/Fail**
1	User opens source code and clicks on Help menu.	User sees the Vulnerability Catcher on the	User sees the Vulnerability Catcher on the	Pass

		bottom of the menu.	bottom of the menu.	
2	User clicks on Vulnerability Catcher.	After several seconds a response is returned to the user from ChatGPT.	After several seconds a response is returned to the user from ChatGPT.	Pass
3	User does not open-source code but clicks on Vulnerability Catcher.	User receives an error message.	User receives an error message.	Pass

10.3. Evaluation

The system was evaluated through manual tests specifically black box testing, the evaluation was successful the system met its core functional and non-functional requirements.

11. Conclusions

The advantages of my system is that it saves money for developers who can't afford to employ security analysts to check their applications for security vulnerabilities, and it teaches students about security vulnerabilities while they learn to code.

12. Further Development or Research

With additional time and resources I would like to make this plugin available on more IDE's like Visual Studio Code, Atom, and IntelliJ IDEA.

13. References

6.0 Appendices

6.1. Project Proposal

National College of Ireland

Project Proposal

Vulnerability Catcher

20th October 2023

Bachelor of Science (Honours) in Computing

Cybersecurity

2023/2024

Benita Amaechi

X20387093

x20387093@student.ncirl.ie

1.0. Objectives

The purpose of my project is to create an environment for both students and developers, where they can learn about the various web application vulnerabilities, and where they can catch the web application vulnerabilities in their individual applications before deployment. My project aims to achieve this by utilising the plugins tool on NetBeans. I will develop my own plugin that students and developers will be able to install on their NetBeans application. Once users have installed the plugin, as they write their code in NetBeans they will be able to click on the plugin, to check if their code is vulnerable to web attacks. Upon the successful completion of my project, students will gain exposure to a number of web application vulnerabilities and have the opportunity to learn about said vulnerabilities all whilst developing their own applications. Developers who are just starting a business or who may have been hired by a small business to develop a web application will be able to catch the web application vulnerabilities in their code and fix it before deploying the web application.

2.0. Background

I decided to undertake this project because in the last four years I had developed a few web applications as part of different assignments and projects for my programme, which prior to my completion of the work placement, I always thought were secure. Immediately I began my work placement in Edgescan I quickly understood that the web applications I had developed over the last four years were all vulnerable to some sort of web attack, this could have been prevented if I had been informed of the vulnerabilities in my web applications in the same way I was informed of other issues like syntax errors. By the end of my work placement I decided that the target audience for my project would be computing students, I decided to develop an application that much like a number of software tools like NetBeans and Eclipse inform students of syntax errors, the web application would inform students of web application vulnerabilities. I will meet the objectives set out in Section 1.0 of this proposal by developing a plugin in NetBeans, this plugin will send the code to an Artificial Intelligence (AI) technology, the AI technology will check if the code is vulnerable to web attacks and send a message to the plugin, in turn the plugin will relay that message back to the user. Through the data the plugin generates students will be able to research and fix the web application vulnerabilities that their code is vulnerable to, in the same way developers can fix the web application vulnerabilities in their code before deploying their web applications.

3.0. State of the Art

From the research I completed on my project it is a fairly unique project, and there does not seem to be much similar existing web applications. Software tools such as Visual Studio Code, NetBeans, and Eclipse are in a way similar to my web application because they highlight issues with the source code of a web application, and this is done throughout the development stage of the web application and not solely once an application has been fully completed. I completed my work placement in Edgescan which is a cybersecurity company it was during my work placement that my project idea came to fruition, for the duration of my work placement we would scan applications for organisations that were up and running and notify them of the vulnerabilities in their applications.

Although I thought what Edgescan was doing for these organisations was incredibly useful I did think the companies would be in a better position if they conducted these scans before deploying their applications to the public which is when the project idea came to me. What Edgescan was doing was solutional and what I wanted to do was preventative, I wanted to find vulnerabilities but in the development stage and I wanted to cater to students and developers, so I decided to simplify it. I decided on a simple web application were bits and pieces of code could be checked for vulnerabilities as oppose to entire web applications. Although the concept of checking code is similar to that of software tools such as Eclipse, Visual Studio Code, and NetBeans what it is they are checking for is completely different, my web application is checking for web application vulnerabilities and the other software tools are checking for errors in the code such as syntax errors.

4.0. Technical Approach

In regards to the development of the project, I plan on implementing the essential functions of the application first before anything else. I will prioritise the objectives of my project, which is to develop a plugin for both students and developers to utilise, the plugin will send the code written by the user to an AI technology. My first task will be to create a plugin, the plugin is the priority, because the plugin will be the middle man between the user and the AI technology that will check if the code is vulnerable or not. Following the completion of the plugin I will develop the web application where the AI technology that will check if the code is vulnerable to web application attacks or not, will run. I have not implemented the AI technology functionality before so I will need to do some research on how to go about it. Once the AI technology is running I will implement it into the existing plugin on the NetBeans application. Upon the successful integration of my AI technology and NetBeans plugin, I can work on the overall appearance of the web application where the AI technology will run, and make the web application more efficient.

I will identify the requirements of my web application by creating a Use Case Diagram, a UML Class Diagram, and speaking to my supervisor. By creating a Use Case Diagram I will have the opportunity to plan both the backend and frontend functionalities of my web application, and how exactly they will interact with each other. By creating a UML Class Diagram I will have the opportunity to plan the layout of my system and it's specific functionalities. By speaking to my supervisor I will have the opportunity to get a second opinion on my plan and find out more efficient ways to implement my web application.

With the help of my supervisor I will break down the web application requirements into project tasks, activities, and milestone. I will have a discussion with my supervisor and hopefully through their experience with other students in previous years, they will be able to enlighten me on the breakdown of my web application requirements. I will seek for advice on what should be my priority at different stages, to avoid falling behind.

5.0. Technical Details

I plan to implement this web application using the Java programming language, as it is the programming language I am most familiar with. The important Java algorithms I am taking under consideration for this web application are insertion sort algorithms and linear search algorithms. The important approaches I am taking under consideration for this web application are conditional statements namely if statements and switch cases.

6.0. Special Resources Required

For my web application to be fully functional the special resources required would be, plugin, a web application where the AI technology will run, and a resource that integrates the AI technology with the NetBeans plugin. The implementation of a NetBeans plugin, where users will click to check if their code is vulnerable to web attacks, will be required in order for the code to be checked for web application vulnerabilities. If artificial intelligence is not utilized, a database that hold the rules for web application vulnerabilities will be required, because it is through this database that it will be determined if a piece of code is vulnerable to web application vulnerabilities or not. If a database is not utilized, artificial intelligence will be required to automatically update the group of web application vulnerability rules, it is through this group of web application vulnerability rules that it will be determined if the source code is vulnerable or not, this AI technology will run on a web application. The implementation of a resource that integrates the users input with either the web application vulnerability rules in the database or the web application vulnerability rules being updated using artificial intelligence is required because, it is through this user interface that users will be informed through the NetBeans plugin if their source code is vulnerable to web application vulnerabilities or if it is not.

7.0. Project Plan

My first task will be to speak to my supervisor, I will speak to him about my overall web application and get his opinion on what he thinks I can add or remove from my initial idea to make the web application more efficient. Once I have spoken to my supervisor and established the general idea of my web application, I will discuss steps and timelines with my supervisor. Hopefully through my supervisors experience with other students in previous years, he will be able to give me a list of steps or a timeline I should have in the back of my mind whilst working on my web application so I do not fall behind. I would also like to discuss the individual deliverables for this project with my supervisor, I want to gain a better understanding of what exactly is required of me with each deliverable relating to the project. Following the discussion of the deliverables I would like to discuss the specifics of my web application, I would like to get recommendations from my supervisor on the software tools he thinks would best suit my web application and the different algorithms I should implement into my code. I would also like to get his opinion on if he thinks I should implement artificial intelligence or a database that will house the rules of the web application vulnerabilities.

Once I have spoken to my supervisor my second task will be to create my Use Case Diagram and my UML Class Diagram. The diagrams will enable me to plan the specifics of both the backend and the frontend of my web application. Upon completion of my diagrams I will try and get some feedback on them from my supervisor or lecturer, to see if they have any advice on more efficient ways to go about the web application.

My next task will be to develop a NetBeans plugin, this plugin will be the middle man that will send the users source code to the AI technology that will validate it for vulnerabilities.

Once the NetBeans plugin is developed, I will develop a web application where the AI technology will run, and I will integrate the suitable AI technology that will search for web application vulnerabilities into the web application.

Next, I will either implement artificial intelligence into my web application that will automatically update the rules of the web application vulnerabilities, or I will create a database that I will populate myself with rules to various web application vulnerabilities. Once the database is created I will integrate the database with the web application and the plugin, this will enable the users input to be held against to the web application vulnerability rules.

When my web application is fully functional and has met all the objectives in Section 1.0 of this proposal I will work on the overall appearance of the web application that will run the AI technology and make it more efficient for the user.

I understand that there are some additional deliverables such as a PowerPoint, a Word Document, and a video presentation. I will work on the additional deliverables based on the timeline given to me by either my lecturer or my supervisor. The Word Document will be my first priority, I will ensure I am working on the document simultaneously while working on my prototype as a lot of what will be in the word document, is connected to my prototype. Once the word document is completed I will work on the PowerPoint, followed by my video presentation, where I will present both the PowerPoint and my prototype.

8.0. Testing

The target market for my web application is students and developers, so as a student, I will evaluate the system using my own source code, from the numerous web applications I have developed in the last four years as part of various assignments and projects for my programme. I will test my NetBeans plugin on my code for web applications from the last four years, by opening my web applications, selecting the NetBeans plugin, and waiting for a message outlining the web application vulnerabilities in the source code. Once the plugin has sent the code to the AI technology to be checked for web application vulnerabilities, the AI technology should send the results back to the plugin and the plugin should relay the message to me on NetBeans. If the plugin does not return an interface highlighting the web application vulnerabilities associated with my code, the web application is not functioning properly.

6.1. Reflective Journals

Supervision & Reflection Template

Student Name	Benita Amaechi
Student Number	X20387093
Course	Bachelor of Science (Honours) in Computing
Supervisor	Michael Bradford

Month: October

What?

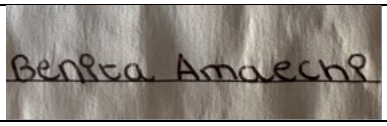
In the first week of the month we had one lecture, in this lecture we received a presentation from our lecturer outlining the Computing Project module as a whole, and explaining the overall concept of our projects. Our lecturer detailed how our projects were to be in relation to our area of specialisation, and gave us some points to keep in mind when choosing a topic for our project. We received the mid-point and final marking scheme, so we could understand what project deliverables were required and when. At the end of the lecture we received a short presentation on how to properly document our code. In the second week we received two presentation from our lecturer, one on our project pitch which was one of our project deliverables, and the second on ethics. The following week we would upload our project pitch, so were instructed to start thinking of ideas for our projects. In the third week I recorded my project pitch and uploaded it to Moodle. The following week our lecturer discussed our project proposals and the due date for that deliverable. For the next few weeks I worked on my project proposal and uploaded it to Moodle. Before the reading week our supervisors were allocated to us, and we received feedback on our project pitch. I emailed my supervisor and arranged to meet with him after the reading week to further discuss my project.

So What?

This month, after brainstorming a few ideas on project ideas over the course of the summer and my internship, I finally came to a decision on a project idea which meant I could start to work on the deliverables for my computing project. I recorded my project pitch video, and uploaded it to Moodle, and completed my project proposal where I specified the details of my project. Although I had a few project ideas prior to our first lecture this month, I was worried because I did not know which project idea to select from the list of ideas I had, and I was not sure if any of the ideas would meet the criteria of what was required from us, but after the first lecture I felt much more confident with my project ideas. I had a better understanding on the requirements of the project and it's objectives, which lead me to make a decision on a project idea and also alter the idea to fully meet the objectives of the computing project. I did not meet with my supervisor this month, but arranged to meet with him in the upcoming month.

Now What?

Now that I have a concrete project idea and have outlined a detailed description of its functionalities in my project proposal, I can meet with my supervisor to further discuss the project idea, and to get his feedback on my ideas along with some advice on the direction I should take when working on each deliverable for the project. While I completed my project proposal I encountered some possible issues with the functional requirements and the user interface of the system that I would like to address with my supervisor. Once I have met with my supervisor and he has clarified the issues I came across while working on my project proposal, I can start to work on the physical development of my project and my technical document.

Student Signature	

Supervision & Reflection Template

Student Name	Benita Amaechi

Student Number	X20387093
Course	Bachelor of Science (Honours) in Computing
Supervisor	Michael Bradford

Month: November

What?

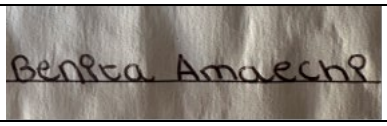
In the first week of the month we returned from the reading week, and I had my first meeting with my supervisor online. In our meeting we discussed my project pitch briefly, and my supervisor elaborated on the feedback he left under the Moodle page before the reading week. After discussing the project pitch, we looked at the project proposal I had uploaded to Moodle just before the reading week so my supervisor could get some more details on my thought process behind the project. At the end of the meeting my supervisor gave me a series of suggestions and software tools to consider and research for the implementation of my project, and we organised to meet the following week on campus. For the next two weeks I completed a lot of research for my project, I considered all the suggestions made by my supervisor and came to a decision on the specific software tools I would like to utilise for my project. I decided on the specific vulnerability I would base my project on to make it more concise, and the specific programming language that my project would cater to. In our next meeting I presented the results of my research to my supervisor, we discussed my goals for the mid-point presentation and settled on majority of the specifications for my project. At the end of the meeting he gave me some additional suggestions to consider and research before our next meeting. Throughout the month I attended some lectures where our lecturer presented us with PowerPoints and templates outlining each deliverable that is required in preparation for our mid-point presentation.

So What?

Initially when I recorded my project pitch I felt very confident, but upon completion of my project proposal, I realised that my confidence was in my project idea rather than the execution of my project. While I was writing my project proposal and outlining the specifications of my project I began to understood that the project I had in mind would require a great amount of work and time, there was a lot to consider, and I began to get a little overwhelmed when I thought of how I would execute it all. When I met with my supervisor the first time, he suggested that I simplify the project to make it more efficient and make it easier for me to execute. I took the advice of my supervisor and simplified the project by focusing on a specific vulnerability rather than a plethora of vulnerabilities, and finalizing all the specifications of my project before I start working on it in any capacity. Simplifying my project helped to relieve a lot of my worries because I developed a concrete plan with well-established specifications and this provided me with the opportunity to start to work on my project.

Now What?

Now that I have a concrete plan in place for my project with well-established specifications, I can begin to work on the deliverables for my mid-point presentation. First I will work on updating my proposal to align with the new plans for my project, after which I will work on my Use Cases, Use Case Diagrams, and specifications for my technical report. Once I have documented the specifications of my project, I will work on a prototype for my mid-point presentation, after the prototype is developed I will finish my technical report and complete my PowerPoint presentation and demonstration. I have a lot of work planned for

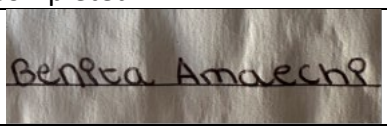
this next month, but by already establishing my requirements for the project, I think I should be able to accomplish all that is requirements for the mid-point presentation. In future I will simplify situations when I feel overwhelmed by them, to make it easier for me to digest.
Student Signature 

Supervision & Reflection Template

Student Name	Benita Amaechi
Student Number	X20387093
Course	Bachelor of Science (Honours) in Computing
Supervisor	Michael Bradford

Month: December

What? In the first week of the month, I created a list of all the deliverables required for the midpoint submission and made a decision on what I would prioritize. I decided I would work on my project proposal first, as it required the least amount of work. Prior to the reading week I had already completed my project proposal, but when I returned from the reading week I had a few meetings with my supervisor, where we made some significant changes to the requirements of the project, I thought it was essential that my project proposal reflect these changes, so I made some necessary changes throughout the document. In the second week of the month I decided to work on developing my NetBeans plugin for the system, I had a discussion with my supervisor and we decided that developing the NetBeans plugin should be my focus in regards to the prototype for the midpoint submission. With the help of some web applications and YouTube videos I developed my NetBeans plugin. In the third week of the month I began to work on my technical document, which was one of the deliverables for the midpoint submission, I created my UML class diagram using draw.io and included some screenshots of some key pages and source code of the NetBeans plugin. In the last week of the month I continued to work on technical document for the midpoint submission, in addition to the technical document, I started to work on the PowerPoint presentation, which was another deliverable for the midpoint submission. Once I completed the PowerPoint presentation, I recorded a video going through the PowerPoint presentation, and gave a brief demonstration of the NetBeans plugin I had developed, followed by a questions and answers session, this was the final part of the midpoint submission.
So What? My focus this month was my midpoint submission, I prioritised completing and submitting all the deliverables for the midpoint submission, which meant I did not get to develop much of the system itself. In the last few months I have spent majority of my time defining the requirements of the project, and more specifically in the last month, completing the deliverables for the midpoint submission, this did not afford me the time required to complete much work on the system itself, so I do not have a lot of the system completed.

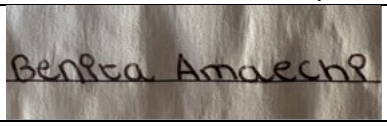
Now that I have fully completed my research on the project, and have submitted all the deliverables for the midpoint submission I can focus solely on the development of my system. The midpoint submission enabled me to plan and design the frontend and the backend of the system before I began the physical development of the system, this should be very useful once I start to develop the system. The challenges that still remain is integrating Artificial Intelligence (AI) into my system, I have not utilised this functionality before and do not know what to expect, but hopefully with the help of my supervisor I should be able to do it.
Now What? Now that I have completed the midpoint submission I can prioritize the physical development of my system. The first item I will address will be the implementation of the AI technology into my system, once I have implemented the AI technology into my system, I will work on developing a web application where the AI technology will run. Upon completion of the web application I will work on integrating the web application with the NetBeans Plugin. There is a lot of work to do as far as the system goes in the next few months, but hopefully, now that I have the planning and design stage of the project completed, I can focus fully on the physical development of my system. To avoid my system not being completed on time I can set small milestones for myself and ensure that I meet them, by doing so, when it is time to make the final submission I will not be overwhelmed but will have majority if not all of the system completed.
Student Signature 

Supervision & Reflection Template

Student Name	Benita Amaechi
Student Number	X20387093
Course	Bachelor of Science (Honours) in Computing
Supervisor	Michael Bradford

Month: January

What? For the first three weeks of the month we were on Christmas break, during the Christmas break I did not get much work done on my computing project as I had a TABA and project to complete for two other modules before the end of the semester. We returned from the Christmas break in the fourth week of the month, during this week I attended the first lecture of the semester for the computing project module. In the computing project lecture we were notified off the deadline for the final submission of the project and the lecturer went through a PowerPoint detailing the remaining deliverables for the project and the marking scheme for the final submission. For the next two weeks I completed some aspects of the technical document that I had not completed in time for the mid-point submission in December. Towards the end of the last week of the month I emailed my supervisor about our next meeting and we decided on a date and time for our next meeting where we could

further discuss my project and I could start to work on the physical development of my project.
So What? For the first few weeks of the month, I did not get the chance to complete much work on my computing project, and due to the Christmas break I could not meet with my supervisor to clarify some requirement specifications of my system, which meant I could not work on the physical development of my system, so towards the end of the month I knew I had to quickly resume work for the project to avoid falling behind. I was able to complete a few sections of the technical document and my supervisor and I decided on a date for our next meeting where we could further discuss the project, and I could start to work on the physical development of my system. This month was a little challenging for my computing project as I did not get the chance to work on the physical development of my system like I had set out to do in the previous month, hopefully this does not affect the prompt completion of my system.
Now What? Now that I have completed a significant amount of my technical document I can focus solely on the development of my system. I have organised a meeting with my supervisor, where we can discuss some of the requirement specifications for my project that I am unsure about, once the requirement specifications for the project are fully defined I can resume work immediately on the development of the system. For the next month I need to complete as much work as possible on the physical development of my system so I can have a significant amount of the system completed before the CA's are released for the other modules. This month I spent a significant amount of time completing TABA's and projects for other modules and waiting for the semester to begin, so I could email my supervisor and we could discuss the requirements specifications of the project, the time could have been utilised more effectively if I emailed my supervisor before the beginning of the semester, so immediately he received his timetable he could get back to me. In future I will email my supervisor immediately I have any issues and wait for his response.
Student Signature 

Supervision & Reflection Template

Student Name	Benita Amaechi
Student Number	X20387093
Course	Bachelor of Science (Honours) in Computing
Supervisor	Michael Bradford

Month: February

What?

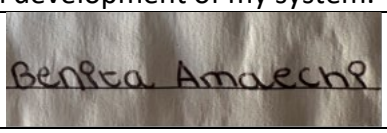
In the first week of the month in preparation for integrating an Artificial Intelligence (AI) tool with my NetBeans plugin, I completed some research on various existing AI technologies that could be utilised to analyse source code for security vulnerabilities. I gathered all the information I acquired to relay to my supervisor in our next meeting. In the second week of the month, in preparation for my meeting with my supervisor at the end of the month I gathered more information on utilising HTTP for the integration of AI tools into my NetBeans plugin. In the third week of the month, I attended the computing project lecture where we received a PowerPoint presentation on architecture and frameworks. In this lecture, the lecturer discussed in detail the characteristics of an application, the software architecture of an application, patterns and designs, along with frameworks that can be utilised for the development of an application. I found this lecture very informative, and began to consider different frameworks that I could utilise for the development of my own application. In the last week of the month, I attended another lecture on software quality and testing, during this lecture the lecturer discussed in great detail, the significance of software quality, the principles of testing an application, the various testing types, planning the testing of an application, and documenting the testing of an application. This lecture was very constructive as it propelled me to begin planning the testing of my application. My meeting with my supervisor was arranged for the end of this month, unfortunately he had to reschedule this meeting for the next week.

So What?

This month I had the opportunity to gather some information pertaining to utilising AI tools, HTTP tools and frameworks for my system, I hope to discuss my findings with my supervisor in our upcoming meeting and get his opinion on what would be the most suitable approach for my system. Unfortunately I did not get the opportunity to meet with my supervisor this month, instead I completed a vast amount of research pertaining to the overall development of my system and through this research, I have come up with some additional ideas to make my system more efficient. The two presentations I received in my lectures this month were very informative and through those lectures I have begun to plan the overall testing of my application. I have several ideas and questions to relay to my supervisor, so hopefully in our upcoming meeting we can discuss everything and I can begin the integration of AI and HTTP with my NetBeans plugin.

Now What?

I did not meet with my supervisor this month, so for our next meeting I will ensure I am well organised and have everything I want to discuss in writing so I don't forget anything, and so we can utilise the time properly. Now that I have completed all the research I need to meet with my supervisor to run my ideas by him and get his opinion on my finding so I can begin the implementation of my ideas and go ahead with the physical development of my system. I found the lectures this month really useful so I need to prioritise attending the lectures, and going over the PowerPoints that have been available to us. My priorities for this month will be to attend the lectures, and to meet with my supervisor so I don't fall behind, and so I can proceed with the physical development of my system.

Student Signature	

Supervision & Reflection Template

Student Name	Benita Amaechi
Student Number	X20387093
Course	Bachelor of Science (Honours) in Computing
Supervisor	Michael Bradford

Month: March

What?

In the first week of the month I had a meeting with my supervisor, in this meeting we discussed everything I had taken note off over the course of the previous month. For the first few minutes of the meeting he answered all my questions, and gave me some suggestions on different features he thought I could add to my system to make it more efficient and he suggested that I start to look online for various template test cases that are relevant to my system. For the remainder of the meeting my supervisor assisted me with fixing an issue I had encountered in my system, we did some research on the issue and found some solutions online to the issue, after trying a few different solutions by the end of the meeting we were able to mitigate the issue, and I could now move on with the development of my system. Towards the end of the week, I attended a lecture where the lecturer presented a PowerPoint presentation on the guidelines that should be followed when developing our showcase posters for the final project showcase. I found the lecture extremely informative, and it gave me an idea of the direction I would go when I start to develop my showcase poster. In the second week of the month, I did some research on the various suggestions my supervisor made to me in regards to what I could do to make my system more efficient and I came to some conclusions that I took note of to relay to him in our next meeting. For the remainder of the week and the following week which was the reading week I continued to work on the physical development of my project. In the final week of the month I worked on altering various sections of the technical report to reflect some of the recent changes that had been made to my system.

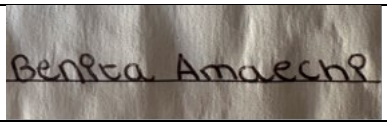
So What?

The meeting I had with my supervisor at the beginning of the month was essential to my project work this month, the meeting enabled me to proceed with the physical development of my system. Prior to the meeting with my supervisor I had come across an issue that halted the development of my system but after the issue was mitigated I was able to proceed with the physical development of my system. In the meeting with my supervisor we addressed some concerns I had with the interface of my project and once we had addressed all those concerns I was also able to proceed with the technical document for my project. The lecture I attended regarding the showcase poster was another essential element of my project progress this month, the lecture outlined the guidelines that should be followed while developing the poster, which I found very helpful because prior to the lecture I had no knowledge on the specific requirements of the showcase poster.

Now What?

Now that I have met with my supervisor and we have mitigated the issue I had with my code, I can proceed with the physical development of my project. In this month's meeting with my supervisor we addressed some interface concerns I had, and now that we have

come to a decision on the overall interface of the system I can also proceed with the technical report of my system. The lecture I attended this month has pushed me to start to develop my showcase poster, now that I have a set of guidelines to follow I can develop the poster with ease knowing that I have implemented all the necessary information into my poster. With the meeting, lecture, and information I have gathered this month I am prepared to work on all aspects of my project, the physical development, the technical report, and the showcase poster. In the next month I will continue to work on each element of my project and I will meet with my supervisor to keep him up to date on my project progress and to address any issues I may encounter while developing my system. It Is necessary that I work on each aspect of my project concurrently so I do not neglect any aspect and I meet my deadline.

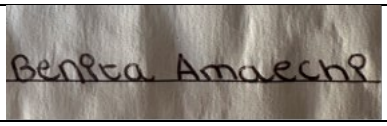
Student Signature	

Supervision & Reflection Template

Student Name	Benita Amaechi
Student Number	X20387093
Course	Bachelor of Science (Honours) in Computing
Supervisor	Michael Bradford

Month: April

What? This month I spent the majority of my time working on CA's and TABA's for the other modules of this course that were due throughout the month. Unfortunately, I did not get the opportunity to work on my computing project until the end of the month once I had completed and submitted the CA's and TABA's for the various modules. In the first week of the month we were on our easter break, throughout the week of easter break I worked on a CA for the Digital Forensics module that was due the following week. In the second week of the month once we returned from the easter break, the two TABA's for the Penetration Testing and the Digital Forensics module was released so for the next two weeks of the month I worked on the two TABA's for the respective modules and submitted them. Towards the end of the month I started to feel overwhelmed, I had been working on CA's and TABA's back to back for the duration of the month and did not get the opportunity to work on my computing project at all, so in the final week of the month I focused solely on my computing project. In the final week of the month I made a list of all the work I need to complete before the deadline, and my supervisor reached out to me to organise a meeting for the following week. In the following I had my final computing project lecture where the lecturer outlined all the deliverables for the computing project and the requirements of each deliverable. I found the final lecture really helpful, it clarified a lot of issues I was unsure about and gave me some ideas for the presentation, and showcase of my computing project.
So What?

I spent the majority of the month completing CA's and TABA's for my other two modules for this semester, so I did not get much time to work on my computing project but now that I have completed all the work for my other modules I can concentrate fully on the progression of my computing project. While I was working on the CA and TABA's for the other modules I felt overwhelmed, I still had a significant amount of work to do on my computing project and had not worked on it all month, but once I had completed and submitted the CA and TABA's I felt relieved that I could finally concentrate on completing my computing project. The lecture I attended this month was essential to the progression of my project, everything I was unsure of regarding the submission of the project was clarified and my lecture detailed the deliverables of the project and their requirements which I compared with a list I made outlining all the things I have to do for my project before the deadline. I still have a significant amount of work to do before my computing project is completed but now that I have completed my other modules I should be able to dedicate all my time to completing the computing project before the deadline.
Now What? Now that I have made a list of all the tasks I have to complete for my computing project before the deadline, and reviewed the list so it aligns with the list of deliverables and requirements the lecturer presented to us in our final lecture for the computing project, I can start to work my way through the list of tasks so I can complete each aspect of the computing project before its due date. I have a significant amount of project work to complete before the due date but have made a list where I detailed each aspect of the computing project that I have yet to complete, from the physical system to the documentation. In the next few weeks I will work on completing all the tasks I have listed and I will try to organise at least one more meeting with my supervisor where I can show him an overview of my completed project and functioning system, and I can get any feedback from him on the system itself, the PowerPoint presentation and showcase poster. I will efficiently prioritise the tasks I need to complete to ensure I have a fully functional system before the deadline next month, once my system is functioning and I have completed the necessary documentation I will work on further improving my project in any way I can.
Student Signature 

6.2. Other materials used

Any other reference material used in the project for example evaluation surveys etc.