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SRS of ChemistryCalculator

Submitted To
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1. Introduction

The Chemistry Calculator is a software tool designed to perform a variety of calculations related to chemistry. It's quite certain that a chemist and a pharmacist have to calculate molarity, balance, reaction and electronic format for various purposes. This software is intended to help students, researchers, and professionals in the field of chemistry to perform calculations more efficiently and accurately. Chemistry Calculator System is a desktop based software.

1.1 Problem Statement

There are available softwares for chemistry calculators but all of these are online based and sometimes the calculation process does not provide accurate results and is not smoothing to use. Chemical calculations are very complex when we try to solve them using a base calculator and are much time consuming to get intended results.

1.2 Purpose

The main purpose of developing this system is for the welfare of the Chemists, researchers, professionals and also students to get intended accurate results within a short time. Even though calculations which are very much complex to be done manually, these calculations can be done easily through the chemistry calculator application.

1.3 Project Scope

The chemistry calculator will be useful for chemists, pharmacists, researchers, students and also for teachers. It can be widely used in laboratories, educational institutions and so on.

1.4 Glossary

This section provides definitions for all document names, acronyms, and abbreviations.

IIT	Institute of Information Technology
NSTU	Noakhali Science and Technology University
Molar mass	The mass of one mole of a substance
pH	A measure of the acidity or basicity of a solution
pOH	A measure of the acidity or basicity of a solution, based on the concentration of hydroxide ions (OH-)

GUI	Graphical User Interface
JRE	Java Runtime Environment
FR	Functional Requirement
NFR	Non-functional Requirement
RE	Reverse Engineering
UML	Unified Modeling Language

1.5 References

Source code (Java language) of Chemistry Calculator provided by Dipok Chandra Das (Assistant Professor, IIT, NSTU)
https://classroom.google.com/u/1/c/NTQ2ODU4NDIzOTQz/a/NTE2NDcyMTEzNjYy/details

2. Stakeholders

2.1 Users

It is rigorously specified that users are emphasised and targeted stakeholders of this system. Users can be a student, teacher, chemist, researcher, pharmacist and also general mass who have interest.

2.2 Developers

To be classified as stakeholders, persons who have a legitimate interest in the product or project must have legitimate interests. Because the developers have too much at stake, they are deemed stakeholders because they have a legitimate interest. As stakeholders, developers are responsible for software delivery and estimation on time.

3. Design and Implementation Components

Various building blocks are referred to as design and implementation components when referring to a software system. These parts can be viewed as the individual parts that are required for the software to operate as intended because they fit together to form the overall architecture of the program.

3.1 User Interface (UI)

User interface Design, also known as UI Design, is the visual organization of the parts of an application or technological product that a user might interact with. For the chemistry calculator we will use Java Swing [GUI (Graphical User Interface)] for the users interactions. Chemistry Calculator is a desktop application so the GUI will be worked smoothly. JLabel, JTextfield, JCombobox, JPanel, JButton, JCheckBox etc. are the most commonly used components in java GUI.

3.2 Programming Language

Java is both a platform and a programming language. Programming in Java is high level, reliable, object-oriented, and secure. Java has an API and runtime environment (JRE). Java will be used for both backend and frontend.

3.3 Server Side Technology

When an application is used, server-side development refers to the processes that happen in the background. Databases, scripting, application architecture, backend logic, APIs, and servers are the main topics covered. In the chemistry calculator it also will be used Java for server side and communicates with database file by serializing and deserializing data objects.

3.4 Data Modelling

The data will be stored and transmitted through the network by serialized data objects (database.ser). Through a mechanism called object serialization, which is provided by Java, an object can be portrayed as a sequence of bytes that contains the object's data as well as details about its type and the types of data it stores. A serialized object can be read from a file after it has been written there and deserialized, which means that it can be recreated in memory using the type information and bytes that represent the object and its data. The strategies for serializing and deserializing an object are contained in the high-level streams known as ObjectInputStream and ObjectOutputStream.

4. Requirements

The target system's features and functionalities are described in the software requirements. The aspirations of users for the software product are communicated through requirements. From the client's perspective, the requirements may be plainly stated or obscured, known or unknown, and anticipated or unexpected.

4.1 Functional Requirements

Functional requirements are those that are used to illustrate how a system functions internally, how the system is described, and how each subsystem works. It consists of the task that the system must complete, the associated processes, the data that the system must store, and the user interfaces.

FR - 01	Balancing Chemical Equations
Description	The calculator shall be able to balance chemical equations entered by the user.
Priority	High

FR - 02	History of balanced chemical equations
Description	The calculator will store chemical equations which are recently balanced by the chemistry calculator application.
Priority	Medium

FR - 03	Calculation of Concentration
Description	Concentration refers to the amount of a substance that is present in a given volume or mass of a solution or mixture. Molarity (M): This is defined as the number of moles of solute per litre of solution. Molality (m): This is defined as the number of moles of solute per kilogram of solvent and also Normality.
Priority	High

FR - 04	Electron configuration with atomic number, name and atomic mass
Description	The calculator shall be able to get details of atomic number, name and atomic mass and most rigorously electron configuration by entering only the symbol of a specific atom.
Priority	High

FR - 05	Calculation of Molar Mass
Description	The calculator shall be able to calculate the molar mass of a compound entered by the user.
Priority	High

FR - 06	Calculation of percent of completion
Description	The calculator shall be able to calculate completion of each atom in a compound with their total atom(s) and atomic mass by entering a compound as input.
Priority	High

FR - 07	Show the percentage in a pie-chart
Description	The completion of each atom of a compound will be visual in a pie chart to clarify their contribution more aesthetically.
Priority	Medium

FR - 08	Acid-Base Calculations (Titration)
Description	The calculator shall be able to perform acid-base calculations, including the determination of molarity of acid, volume of acid, molarity of base, volume of base, number of acid moles and number of base moles. Here users have to input any five values from these six criterias and will get the correct value of the unknown sixth criteria.
Priority	Low

FR - 09	Get instructions to use this calculator
Description	The calculator shall provide instructions to help the users to conduct it. There each module will have distinct steps along with proper examples to input by users.
Priority	High

4.2. Non-Functional Requirements

Non-functional requirements are a collection of requirements that describe how the system can be used, its limitations, and how it can be made to work better. In essence, these define how well it will function, including aspects like speed, security, dependability, data integrity, etc.

NFR - 01	User Interface
Description	The user interface shall be user-friendly and intuitive, with clear labels and instructions.
Priority	High

NFR - 02	Performance
Description	The calculator shall be able to perform calculations quickly and efficiently, without noticeable delay.
Priority	High

NFR - 03	Accuracy
Description	The calculator shall provide accurate results, with a maximum error of 0.1%.
Priority	High

NFR - 04	Security
Description	The calculator shall be secure, with appropriate measures in place to protect user data and prevent unauthorized access. Users must not access to change atom/other criterias default values.
Priority	High

NFR - 05	Make the code maintainable
Description	Code must be developed so that it can be modified later and will be readable.
Priority	Medium

5. Requirement Engineering Process

Software requirements are established using requirements engineering (RE), which takes into account customer needs or requirements. Requirements elicitation, needs modelling, requirements analysis, requirements assurance and validation, requirements management and also reverse engineering are all parts of the requirements engineering process.

5.1 Requirements Elicitation Techniques

Requirements elicitation, also known as "requirement gathering," is the process of investigating and discovering system requirements for users, clients, and other stakeholders. Contacting participants directly or conducting research, analysis, and testing are two ways to elicit requirements.

5.1.1 Reverse Engineering

Reverse engineering is the process of analyzing the source code of an existing system to determine its functional and non-functional requirements. Software requirement specifications can be made using reverse engineering tools like decompilers, disassemblers, and code analyzers to extract data from the source code.

5.2 Requirement Validation

Validating requirements makes sure they are accurate and reflect the standard you want from this program. Our requirements initially appeared to be clear-cut, but after reading them and attempting to implement them, we discovered gaps and ambiguities.

5.2.1 Review the Requirements

Among the processes that produce the highest quality software currently available, negative peer review, particularly the rigorous type known as evaluation, is exceptional. Reviewers who represented various points of view, and we carefully looked over written needs, analysis models, and related disability information.

5.2.2 Test the Requirements

As our system is already built so we can go with these requirements to check whether they are complying or not. For test accuracy of the outputs by the chemistry calculator system we might need to write some test cases.

6. Environment and Tool

6.1 Environment

The source code for a software or program product is developed in a workspace that has a number of programming tools and processes. Developers can innovate and create in development environments without risking breaking something in a live environment.

6.1.1 Hardware

The chemistry calculator shall be compatible with a standard desktop computer or laptop.

6.1.2 Operating System

The calculator shall be compatible with the stable and latest version of the Windows, Mac and Unix operating system.

6.2 Tool

The tools used to build the system.

6.2.1 Programming Language

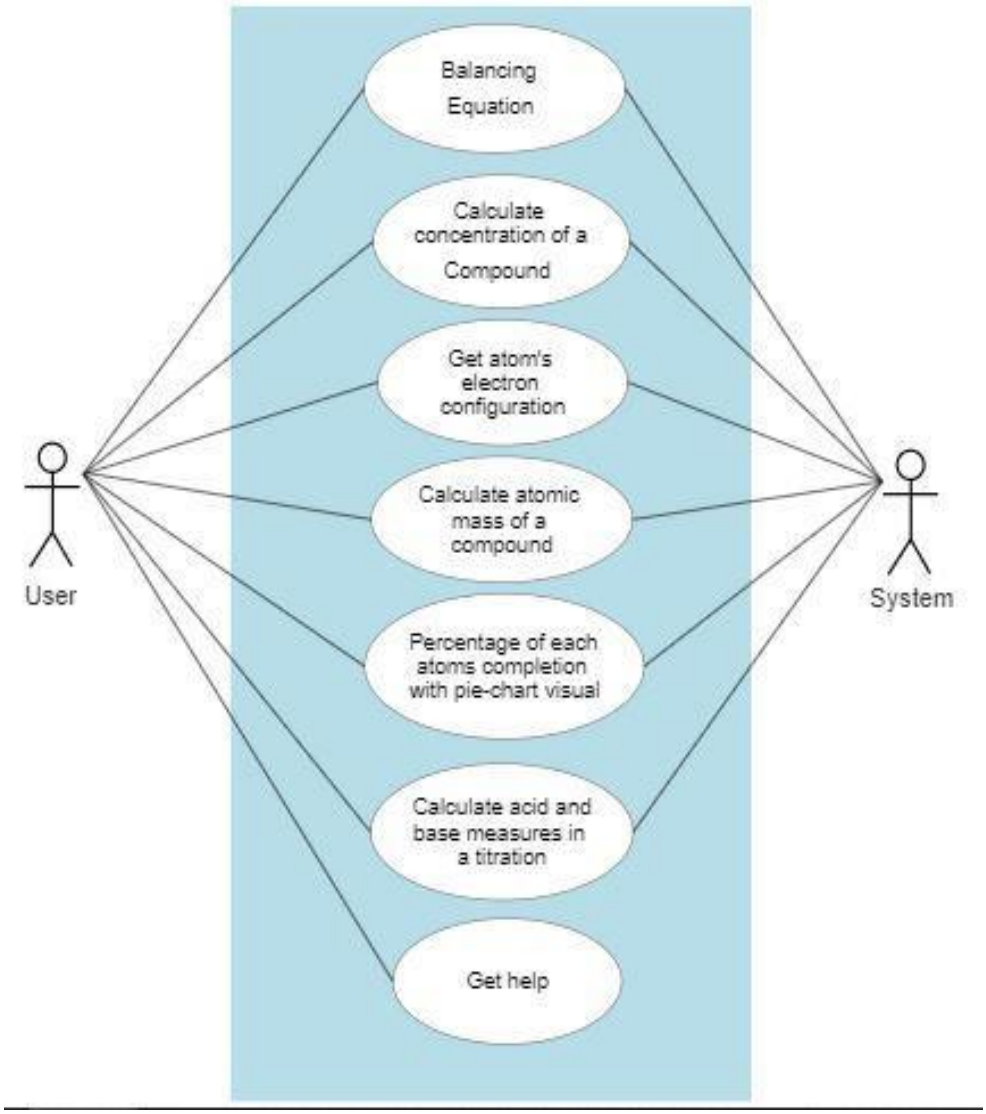
Java (swing). The best Java framework for desktop applications is without a doubt Swing. It is completely written in Java and is supported by the Abstract Windowing Toolkit (AWT) API.

6.2.2 IDE

Apache Netbeans/IntelliJ/Eclipse/JavaFX Scene Builder.

7. Use Case Diagram

A use case diagram is a visual representation of a system's functional specifications. It is a kind of UML (Unified Modeling Language) diagram that illustrates how a system interacts with its actors—that is, users, other systems, or external devices—in various scenarios or use cases.



8. Use case Description

A use case description is a written account of a particular scenario or use case within a system. It describes the interactions between a system and an actor (such as a user, system, or external device) in order to accomplish a particular objective or result.

Table 1: Balancing Equation

Use Case	Balancing Equation	
Goal	User wants to balance equation between reactants and products	
Preconditions	N/A	
Success End Condition	A user gets balance equation	
Failed End Condition	Equation is not valid symbol	
Primary Actors: **Secondary Actors:**	User System	
Trigger	"Equation Balance" button needs to be clicked.	
Main Success Flows	**Step**	**Action**
	1	User opens the "ChemCal" application.
	2	User clicks the "Equation Balance" button.
	3	User provides Reactants, products, and click balance button
	4	System check equation is valid or not
	5	System gives output a balance equation
	6	User clicks the "History" button
	7	System view history
	8	User clicks the "Clear" button
	9	System clears the form
Alternative Flows	**Step**	**Branching Action**
	4a	Equation is not a valid symbol
Quality Requirements	**Step**	**Requirement**
	4	Server will respond within 1 to 2 seconds

Table 2: Calculate concentration of a compound

Use Case	Calculate concentration of a compound	
Goal	User wants to calculate concentration of a compound	
Preconditions	N/A	
Success End Condition	A user gets concentration	
Failed End Condition	Equation is not valid symbol	
Primary Actors: **Secondary Actors:**	User System	
Trigger	"Concentration" button needs to be clicked.	
Main Success Flows	**Step**	**Action**
	1	User opens the "ChemCal" application.
	2	User clicks the "Concentration" button.
	3	User provides Compound, Compound mass, Volume of solution, Equivalent number (if check is Normality) and check format Molarity, Molality, Normality then clicks "Get Concentration" button
	4	System check equation is valid or not
	5	System gives output a concentration value
	6	User click the "Clear" button
	7	System clears the form
Alternative Flows	**Step**	**Branching Action**
	4a	Equation is not a valid symbol
Quality Requirements	**Step**	**Requirement**
	4	Server will respond within 1 to 2 seconds

Table 3: Get atom's electron configuration

Use Case	Get atom's electron configuration	
Goal	User wants to get an atom's electron configuration and mass from an atomic number or symbol.	
Preconditions	N/A	
Success End Condition	A user gets atomic configuration, atomic mass, atomic symbol, and atomic name.	
Failed End Condition	"Number or symbol" is not valid symbol	
Primary Actors: **Secondary Actors:**	User System	
Trigger	"Electron Config" button needs to be clicked.	
Main Success Flows	**Step**	**Action**
	1	User opens the "ChemCal" application.
	2	User clicks the "Electron Config" button.
	3	User provides atomic number or symbol then clicks "Get Config" button
	4	System check equation is valid or not
	5	System gives the output atomic name, atomic mass, atomic symbol, and electron configuration.
	6	User click the "Clear" button
	7	System clears the form
Alternative Flows	**Step**	**Branching Action**
	4a	"Number or symbol" is not valid symbol
Quality Requirements	**Step**	**Requirement**
	4	Server will respond within 1 to 2 seconds

Table 4: Calculate atomic mass of a compound

Use Case	Calculate atomic mass of a compound	
Goal	User wants to get atomic mass of a compound	
Preconditions	N/A	
Success End Condition	A user gets atomic mass and details of atomic mass.	
Failed End Condition	Equation is not valid symbol	
Primary Actors: **Secondary Actors:**	User System	
Trigger	"Molar mass" button needs to be clicked.	
Main Success Flows	**Step**	**Action**
	1	User opens the "ChemCal" application.
	2	User clicks the "Molar mass" button.
	3	User provides compound then clicks "Get Molar mass" button
	4	System check equation is valid or not
	5	System gives output a molar mass of a given compound and details of the molar mass.
	6	User click the "Clear" button
	7	System clears the form
Alternative Flows	**Step**	**Branching Action**
	4a	Equation is not a valid symbol
Quality Requirements	**Step**	**Requirement**
	4	Server will respond within 1 to 2 seconds

Table 5: Percentage of each atom's completion with pie chart visual

Use Case	Percentage of each atom's completion with pie chart visual	
Goal	User wants to get the percentage of each atom's completion from the compound.	
Preconditions	N/A	
Success End Condition	A user gets a percentage of each atom's completion.	
Failed End Condition	Equation is not valid symbol	
Primary Actors: **Secondary Actors:**	User System	
Trigger	"Percentage of completion" button needs to be clicked.	
Main Success Flows	**Step**	**Action**
	1	User opens the "ChemCal" application.
	2	User clicks the "Percentage of completion" button.
	3	User provides compound then clicks "Percentage of completion" button
	4	System check equation is valid or not
	5	System gives output percentage of completion of given compound and details.
	6	User click the "Clear" button
	7	System clears the form
Alternative Flows	**Step**	**Branching Action**
	4a	Equation is not a valid symbol
Quality Requirements	**Step**	**Requirement**
	4	Server will respond within 1 to 2 seconds

Table 6: Calculate acid and base measures in a titration

Use Case	Calculate acid and base measures in a titration	
Goal	User wants to get acid and base measures in a titration	
Preconditions	N/A	
Success End Condition	A user gets an unknown value.	
Failed End Condition	No response or only numbers are allowed	
Primary Actors: **Secondary Actors:**	User System	
Trigger	"Titration" button needs to be clicked.	
Main Success Flows	**Step**	**Action**
	1	User opens the "ChemCal" application.
	2	User clicks the "Titration" button.
	3	User provides molarity of acid, volume of acid, molarity of base, volume of base, number of moles of acid, number of moles of base then clicks "Get unknown value" button
	4	System check equation is valid or not
	5	System gives output an unknown value.
	6	User click the "Clear" button
	7	System clears the form
Alternative Flows	**Step**	**Branching Action**
	4a	No response or only numbers are allowed
Quality Requirements	**Step**	**Requirement**
	4	Server will respond within 1 to 2 seconds

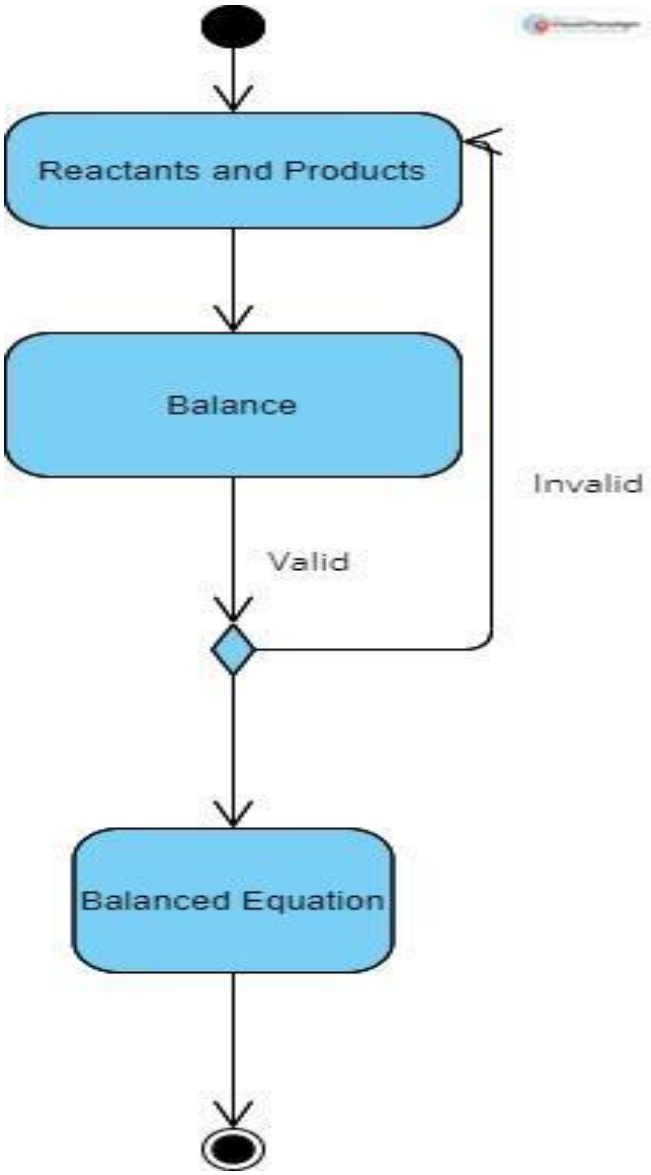
Table 7: Get help/instructions

Use Case	Get help	
Goal	User wants to get help	
Preconditions	N/A	
Success End Condition	A user can view instructions.	
Failed End Condition	N/A	
Primary Actors: **Secondary Actors:**	User	
Trigger	"Need Help?" button needs to be clicked.	
Main Success Flows	**Step**	**Action**
	1	User opens the "ChemCal" application.
	2	User clicks the "Need Help?" button.
	3	User see help content
Alternative Flows	**Step**	**Branching Action**
		N/A
Quality Requirements	**Step**	**Requirement**
	4	Server will respond within 1 to 2 seconds

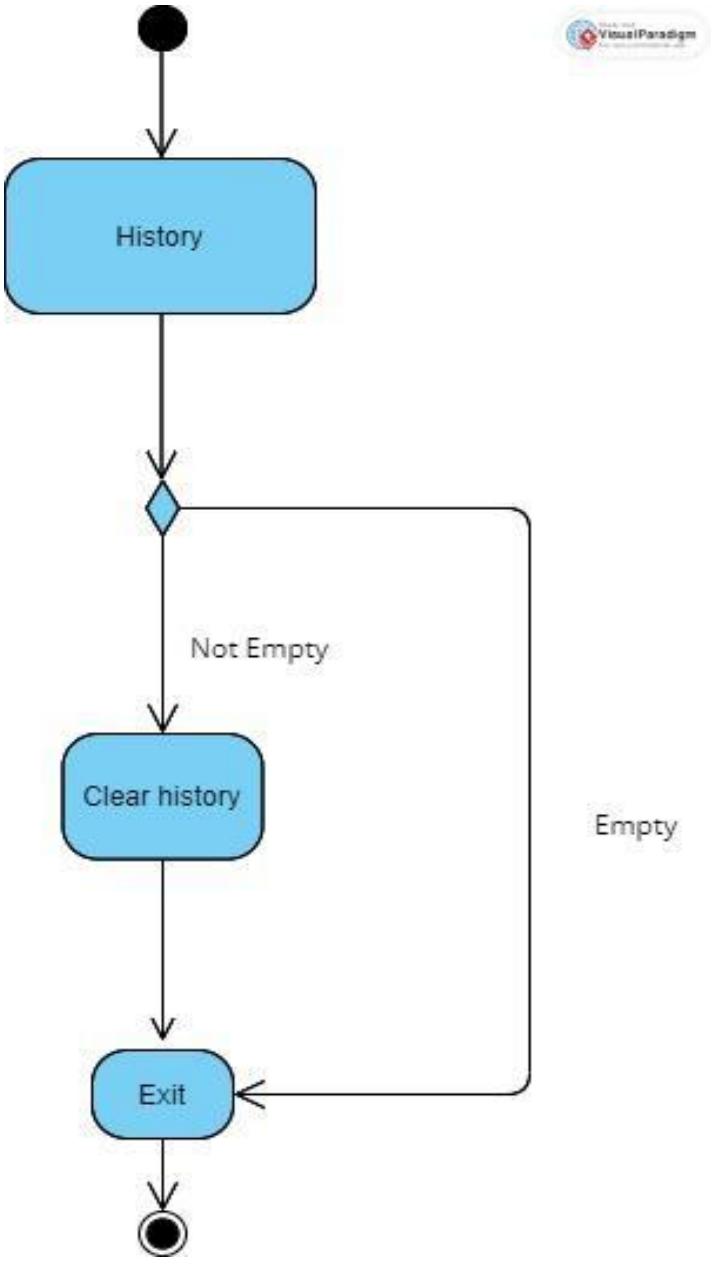
8. Activity Diagram

An activity diagram shows how a system or process's activities and actions flow. It is a visual representation of the actions that must be taken to complete a particular task or objective.

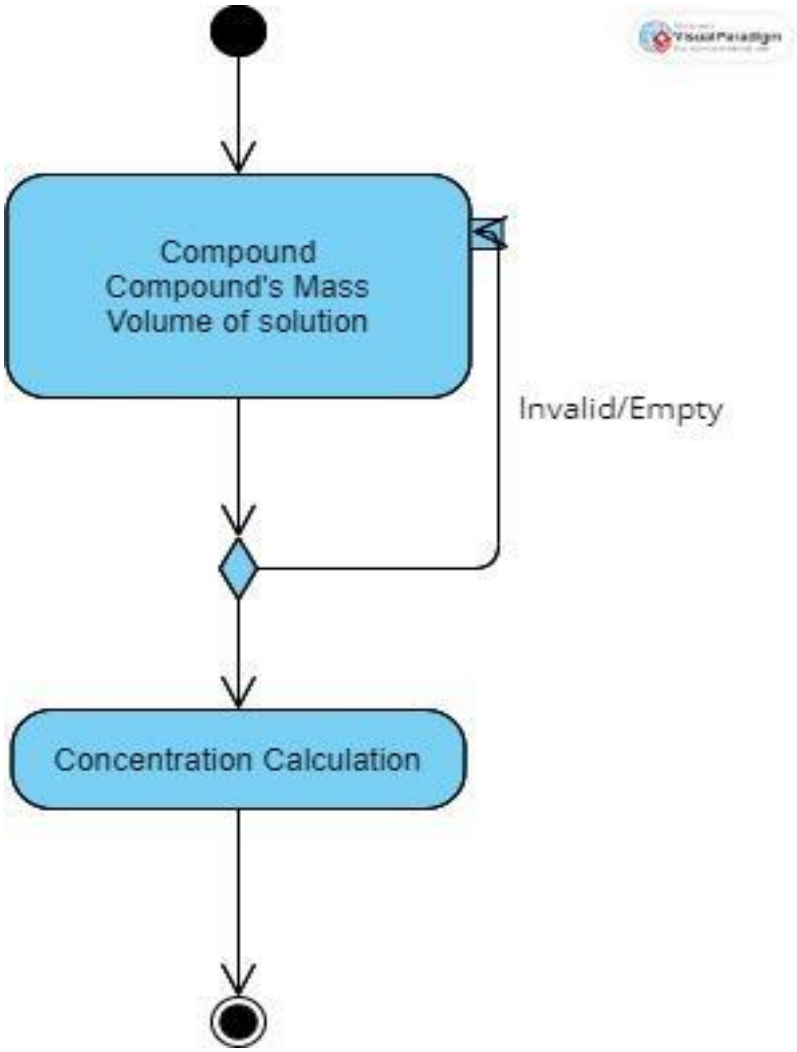
Activity Diagram 1: Equation Balancing



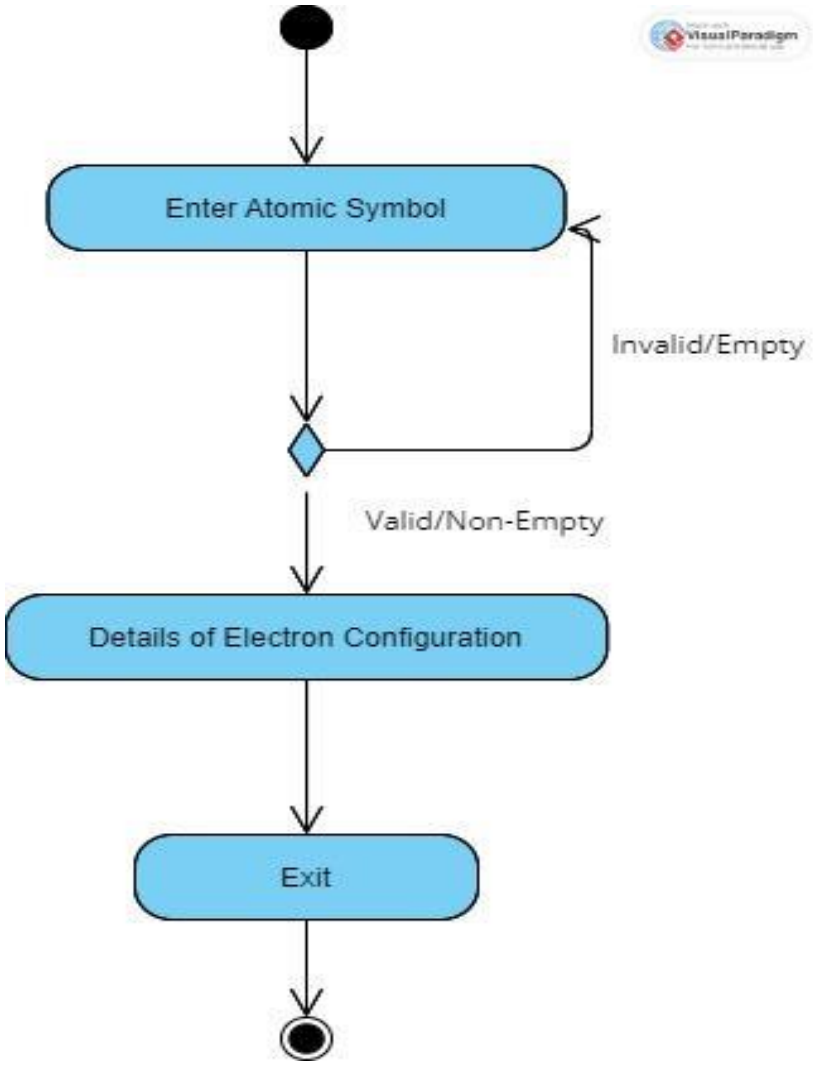
Activity Diagram 2: History checking of equation balance



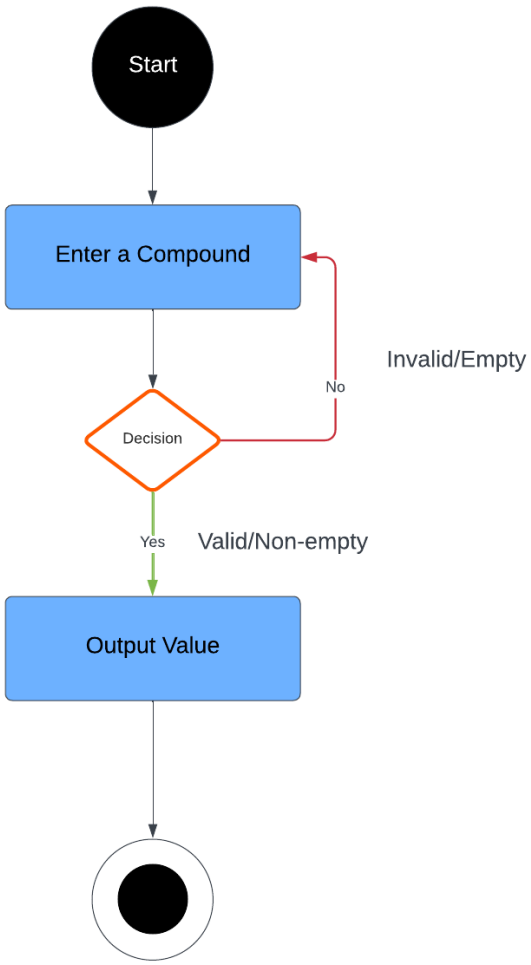
Activity Diagram 3: Calculation of Concentration of a compound



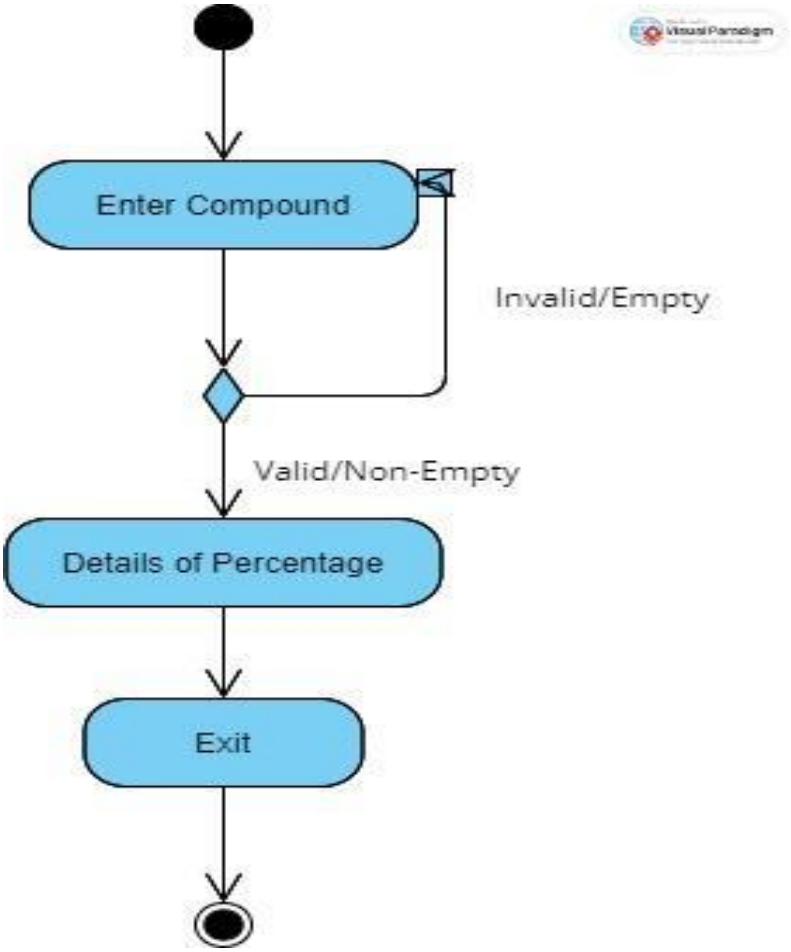
Activity Diagram 4: Get Electron Configuration of an Atom



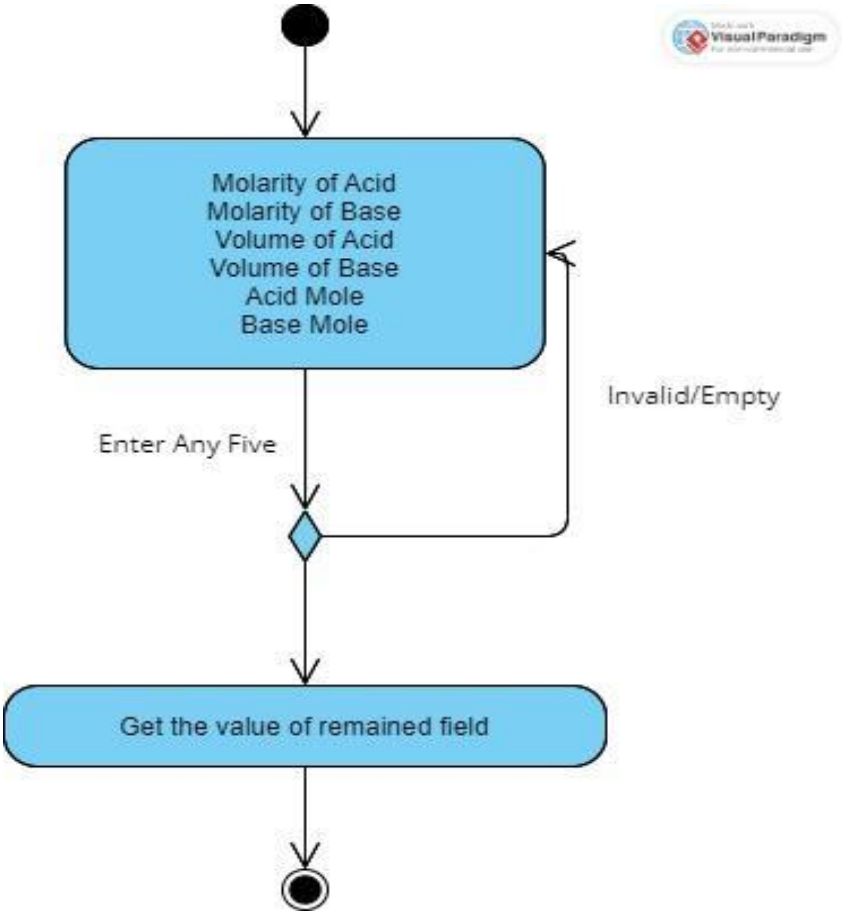
Activity Diagram 5: Calculate the Molar Mass of a Compound


Start
Enter a Compound
Invalid/Empty
No
Decision
Yes
Valid/Non-empty
Output Value

Activity Diagram 6: Get the completion percentage of each atom in a compound



Activity Diagram 7: Get the unknown value of a Titration



9. UML Diagram

The classes, their attributes, operations, and relationships between them are all represented by static structure diagrams known as UML. Classes are depicted in class diagrams by boxes with three compartments: the top compartment houses the class name; the middle compartment houses the class attributes; and the bottom compartment houses the class operations or methods. In contrast to the behaviors or actions that the class is capable of performing, the attributes are the class's characteristics. Lines between the boxes signify the relationships between classes. In the UML, relationships can take many different forms, including association, aggregation, composition, inheritance, and dependency.

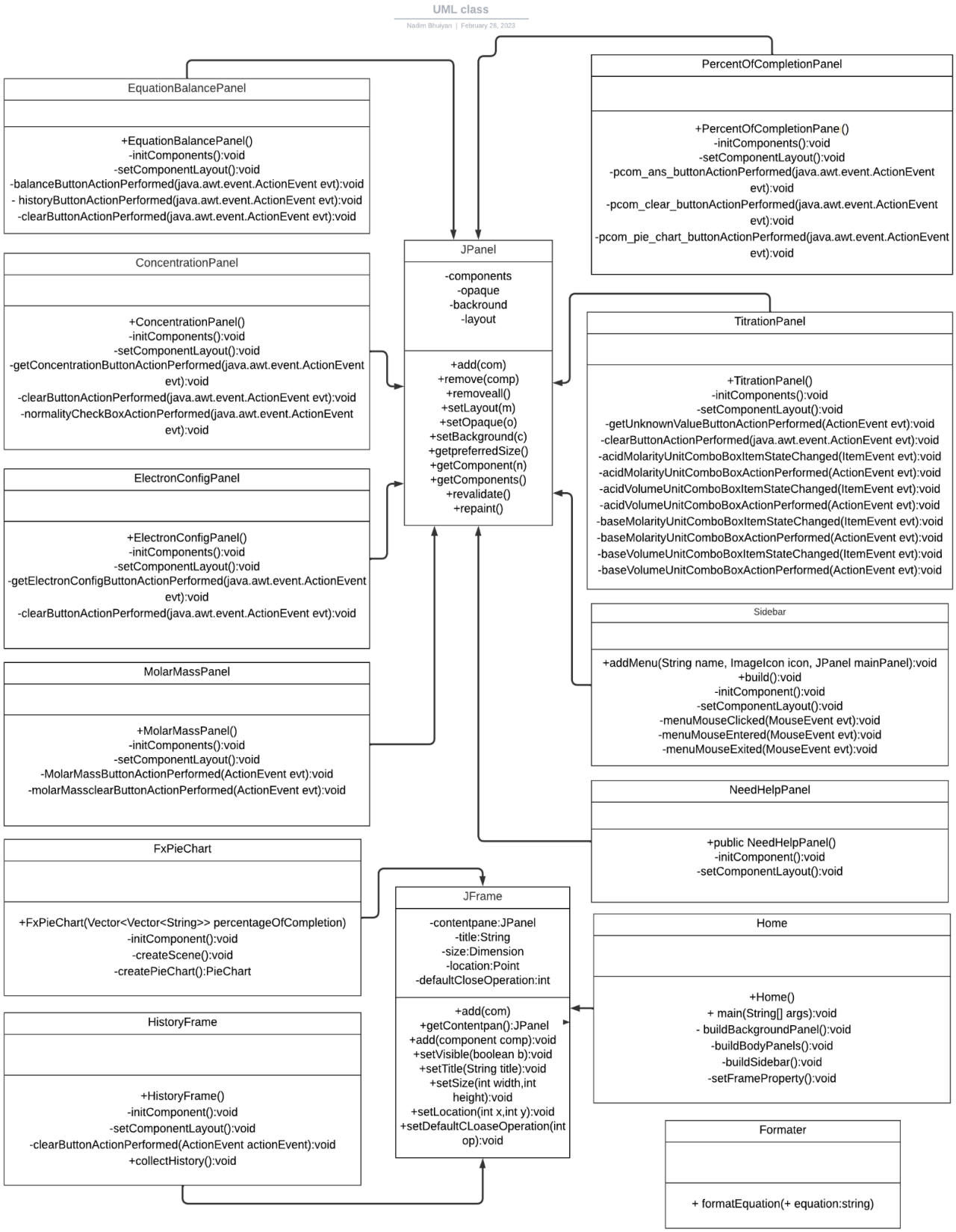


Figure: UML Class Diagram [ChemistryCalculator - Frontend]

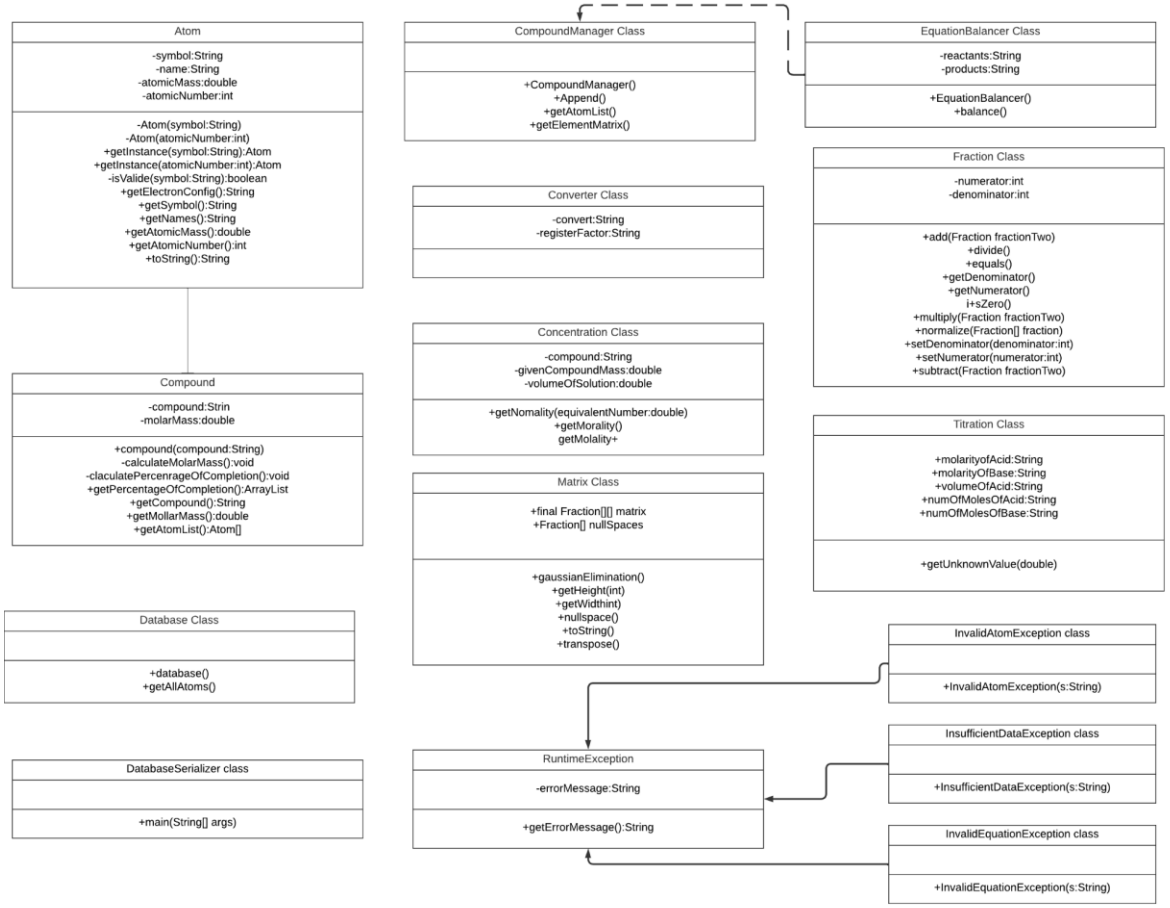


Figure: UML Class Diagram [ChemistryCalculator - Backend]

10. Prioritization of Requirements

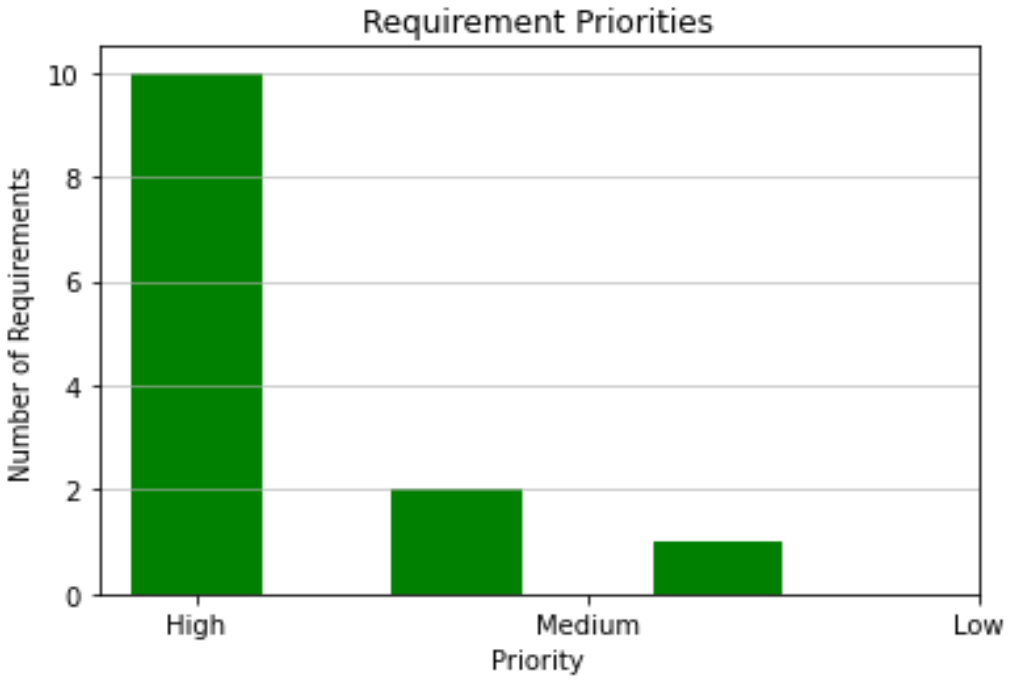
The process of determining and ranking the significance of each requirement in a project or system is known as requirement prioritization. It entails examining the project constraints, user needs, and business goals to identify which requirements should be prioritized, deferred, or completely eliminated. The project team can concentrate on the most crucial requirements and allocate resources and efforts accordingly by using prioritization.

10.1 Three Level Scale

Three level scale is an easy and efficient technique for prioritizing requirements according to their importance or urgency is the three-level scale technique. Each requirement is given a priority level of High, Medium, or Low based on how important it is to the project's success.

10.2 Priority Histogram

A requirement or feature of a system's prioritization can be represented graphically by a priority histogram. It uses a bar chart or histogram to show the distribution of requirements or features according to their priority levels.



11. Acceptance Criteria

This section describes the acceptance criteria for the software system, including the criteria for functional and non-functional requirements, system architecture, and user interface.

1. Module - Equation Balance

Index	Task	Accepted?
a	Users can write in reactants and products field	YES
b	Users can't write in reactants and products field	NO
c	'Balance' button clickable	YES
d	'History' button clickable	YES
e	Given balanced equation correct	YES
f	Output balanced equation not displaying or getting incorrect result	NO

2. Module - Concentration

Index	Task	Accepted?
a	Users can write in compound field	YES
b	Users can't write in compound field	NO
c	Users can write in compound's mass and volume of mass field and equivalent number only writable if 'Normality' is checked	YES
d	'Molarity', 'Molality' , 'Normality' can be checked and unchecked	YES
e	Given measured outputs correct	YES
f	Outputs are not displaying or getting incorrect result	NO

3. Module - Electron Config

Index	Task	Accepted?
a	Users can write in atomic number/symbol field	YES
b	Users can't write in atomic number/symbol field	NO
c	'Get Config' button clickable	YES
d	Given details of atom correct	YES
e	Given details of atom correct but electron configuration is incorrect where half/full orbital differ conventional electron configuration	NO

4. Module - Molar Mass

Index	Task	Accepted?
a	Users can write in compound field	YES
b	Users can't write in atomic compound field	NO
c	'Get Molar Mass' button clickable	YES
d	Given details of compound are correct	YES
e	Given details of compound are not correct	NO

5. Module - Percent of Completion

Index	Task	Accepted?
a	Users can write in compound field	YES
b	Users can't write in atomic compound field	NO
c	'Percent of Completion' button clickable	YES
d	Given details of compound are correct	YES
e	Given details of compound are not correct	NO
f	See pie chart button is clickable but not creates any pie chart	Partially YES

6. Module - Titration

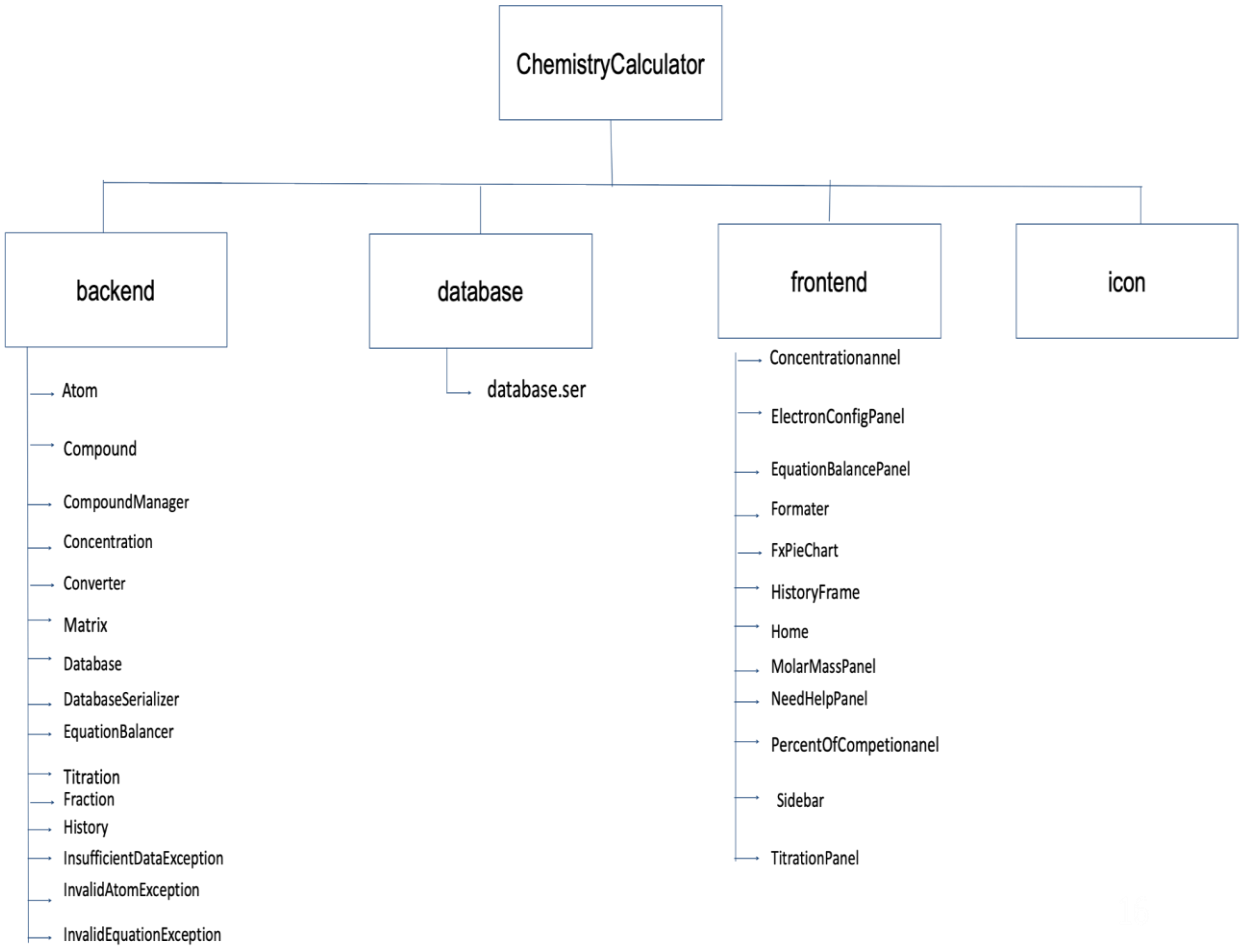
Index	Task	Accepted?
a	Users can write in Molarity of Acid, Volume of Acid, Molarity of Base, Volume of Base, Number of moles of Acid, Number of moles of Base field	YES
b	Users can't write in Molarity of Acid, Volume of Acid, Molarity of Base, Volume of Base, Number of moles of Acid, Number of moles of Base field	NO
c	'Get Unknown Value' button is clickable	YES
d	Given output is correct	YES
e	Given output is not correct	NO

7. Module - Need Help

Index	Task	Accepted?
a	Need Help shows instructions to conduct each modules	YES
b	Need Help shows nothing	NO

12. Project Source Code Structure

The arrangement of the files and directories that make up a software project is known as the project source code structure. It outlines the grouping, storing, and organization of the code within a project. The simplicity of development, maintainability, and scalability of a project can be influenced by the source code's organization.



13. Test Case

A test case is a predetermined set of circumstances or procedures used to evaluate the performance, usability, and functionality of a software program or system. Test cases are made to ensure that the software works as intended and complies with all of the requirements. Inputs, anticipated outputs, and a list of requirements that must be met for the test to be deemed successful are frequently included in test cases.

ID	Test Scenario	Test Steps	Test Data	Expected Results	Actual Results	Pass/ Fail
TC1	The scenario is to test if the equation balancer module can correctly balance the chemical equation	1.Open the equation balancer module. 2.Enter the chemical equation "H2 + O2 -> H2O". 3.Click on the "Balance" button to balance the equation.	1.Reactant: H2 + O2 2. Products: H2O	"2H2 + O2 = 2H2O"	"2H2 + O2 = 2H2O"	Pass
TC2	To test if the reactants are wrong, System will show error message	1.Open the equation balancer module. 2.Enter the chemical equation "H2 + G -> H2O". 3.Click on the "Balance" button to balance the equation.	1.Reactant: H2 + G 2. Products: H2O	G is not valid symbol	G is not valid symbol	Pass
TC3	To test if the products are wrong equation, System will show equation invalid	1.Open the equation balancer module. 2.Enter the chemical equation "H2 + 02 -> SO". 3.Click on the "Balance" button to balance the equation.	1.Reactant: H2 + o2 2. Products: SO	Equation invalid	Equation invalid	Pass
TC4	To test if the reactants & products both are null, System will show both field are required	1.Open the equation balancer module. 2.Click on the "Balance" button to balance the equation.		both field are required	both field are required	Pass
TC5	To test if the equation balancer history works	1.Open the equation balancer module. 2.Click on the "History" button.		History will be shown	History will be shown	Pass
TC6	To test if the concentration can correctly calculate the concentration.	1.Open the concentration 2.Enter the Compound Name 3.Enter the compound mass. 4.Enter the volume. 5.Click on the Get Concentration button.	1. Compound: Na 2. Compound's Mass: 1kg 3. Volume: 1L 4. Click molarity, molality, normality	Molarity:434 Molality: -48,33 Normality:434.97	Molarity:434 Molality: -48,33 Normality:434.97	Pass

TC7	To test if the concentration compound are wrong or right	1.Open the concentration 2.Enter the Compound Name 3.Click on the Get Concentration button.	1. Compound: G	System will initially show error message	System show wrong message when compound mass, volume are given	Fail
TC8	To test if the concentration compound;s mass different unit are worked	1.Open the concentration 2.Enter the Compound Name 3.Enter the compound mass unit differently. 4.Enter the volume. 5.Click on Get Concentration button	1. Compound: Na 2. Compound's Mass: 1g 3. Volume: 1dl 4. Click molarity, molality, normality	Molarity:.43.978 Molality: .43937 Normality:1.739	Molarity:.43.978 Molality: .43937 Normality:1.739	Pass
TC9	to test if the concentration module can handle the case where the volume is zero.	1.Open the concentration 2.Enter the Compound Name 3.Enter the compound mass. 4.Enter the volume. 5.Click on Get Concentration button	1. Compound: Na 2. Compound's Mass: 1g 3. Volume: 0dl 4. Click molarity, molality, normality	Infinity M	Infinity M	Pass
	To test if the concentration module can handle the case where the mass of solute is zero.	1.Open the concentration 2.Enter the Compound Name 3.Enter the compound mass. 4.Enter the volume. 5.Click on Get Concentration button	1. Compound: Na 2. Compound's Mass: 0g 3. Volume: 1dl 4. Click molarity, molality, normality	0	0	Pass
TC10	To test if the concentration module can handle the case where the volume of solute is negative.	1.Open the concentration 2.Enter the Compound Name 3.Enter the compound mass. 4.Enter the volume. 5.Click on Get Concentration button	1. Compound: Na 2. Compound's Mass: 1g 3. Volume: -1dl 4. Click molarity, molality, normality	volume of solution cannot be negative	Molarity:.-289 Molality: 37 Normality:-1.739	Fail
TC11	To test if the concentration module can handle the case where the mass of solute is negative.	1.Open the concentration 2.Enter the Compound Name 3.Enter the compound mass. 4.Enter the volume. 5.Click on Get Concentration button	1. Compound: Na 2. Compound's Mass: -1g 3. Volume: 1dl 4. Click molarity, molality, normality	mass cannot be negative	Molarity:.-289 Molality: 37 Normality:-1.739	Fail
TC12	To test if the electron config module can correctly config the electron	1.Open the electron config. 2.Enter the atomic number or symbol. 3.Click on the "Get Config" button to determine the electron	1.Atomic number of Oxygen (O): 8	Atom Name: Oxyzen Atomic symbol:O	Atom Name: Oxyzen Atomic symbol:O Mass:15	Pass

		configuration.		Mass:15 Config:$1s^2$ $2s^2$ $2p^4$	Config:$1s^2$ $2s^2$ $2p^4$	
TC13	To test if the symbol are wrong, System will show error message	1.Open the electron config. 2.Enter the atomic number or symbol. 3.Click on the "Get Config" button to determine the electron configuration.	1.Atomic symbol: g	Invalid Symbol	Invalid Symbol	Pass
TC14	To test if the number are 0, System will show error message	1.Open the electron config. 2.Enter the atomic number or symbol. 3.Click on the "Get Config" button to determine the electron configuration.	1.Atomic number: 0	Invalid	Invalid	Pass
TC15	To test if the number are 119 or higher, System will show error message	1.Open the electron config. 2.Enter the atomic number or symbol. 3.Click on the "Get Config" button to determine the electron configuration.	1.Atomic number: 120	Invalid	Invalid	Pass
TC16	To test if the molar mass module can correctly calculate the Name & atomic mass	1.Open the molar mass. 2.Enter the compound. 3 Click on the "Get Molar mass" button to determine the molar mass.	Compound: Na	Name: Sodium Atomic mass: 23	Name: Sodium Atomic mass: 23	Pass
TC17	To test if the molar mass compound symbol are incorrect	1.Open the molar mass. 2.Enter the compound. 3 Click on the "Get Molar mass" button to determine the molar mass.	Compound: G	Invalid	Invalid	Pass
TC18	To test if the molar mass compound symbol are null	1.Open the molar mass. 2 Click on the "Get Molar mass" button to determine the molar mass.		Give compound value	Give compound value	Pass
TC19	To test if the percent of completion module can correctly calculate the percentage of compound	1.Open the percent of completion 2.Enter the compound. 3 Click on the "percent of completion" button to determine the percent of completion.	Compound: NaCl	Chlorine: 60 Sodium: 35	Chlorine: 60 Sodium: 35	Pass
TC20	To test if the percent of completion	1.Open the percent of completion 2.Enter the compound.	Compound: Nal	Invalid	Invalid	Pass

	compound symbol are incorrect	3 Click on the "percent of completion" button to determine the percent of completion.				
TC21	To test if the titration module can work correctly	1.Open the titration module 2.Give values of five out of Six values 3. Click on “Get Unknown value” to find out value	Molarity of Acid:4 Volume of acid: 2 Molarity of base: 2 Volume of base :3 No. of moles of acid 2	No, of moles of base: 2.666	No, of moles of base: 2.666	Pass
TC22	To test if the titration values different unit are worked	1.Open the titration module 2.Give values of five out of Six values 3. Click on “Get Unknown value” to find out value	Molarity of Acid:4 dm Volume of acid: 2l Molarity of base: 2m Volume of base :3ml No. of moles of acid 2	No, of moles of base: 1.666	No, of moles of base: 1.666	Pass

Non-functional Requirement Test Cases

ID	Test Scenario	Test Steps	Test Data	Expected Results	Actual Results	Pass/ Fail
TC25	To Test user interface shall be user-friendly			The user interface shall be user-friendly and intuitive, with clear labels and instructions. .	As expected	Pass
TC26	To test if the The calculator shall be able to perform calculations quickly	1.Open the equation balancer module. 2.Enter the chemical equation "H2 + O2 -> H2O". 3.Click on the "Balance" button to balance the equation.	1.Reactant: H2 + O2 2. Products: H2O	User should see calculation value within 2-3 seconds	As expected	Pass
TC27	To test page loading speed is acceptable.	1.Go to chemistry calculator site		User should see that home page load within 2-3 seconds	As expected	Pass

TC28	To test calculator shall be secure			Users must not access to change atom/other criterias default values	As expected	Pass
TC29	To test calculator shall provide accurate results			User find out accurate result of calculation	As Expected	Pass

14. Requirement Traceability Matrix (RTM)

A Requirement Traceability Matrix (RTM) is a tool used in software development and project management to track and trace requirements throughout the project lifecycle. It is a document that provides a cross-reference between the project requirements and the design, development, and testing activities that are carried out to ensure that the requirements are met. The RTM is created at the beginning of a project and is continuously updated throughout the project lifecycle. It is used to ensure that all project requirements are fulfilled, and that any changes made to the project requirements are reflected in the subsequent design, development, and testing activities.

Project Name: ChemistryCalculator	**RTM**	Business Area: Education
Project Manager: Akash, Nadim		Business Analyst Lead: Emran,Priyo
QA Lead: Azad Hossain		Implementation Date: 1/03/2023

Functional

Requirements	Priority	Requirement description	Test case reference	Code module reference	Validation	Comments
FR - 01	Mandatory	The calculator shall be able to balance chemical equations entered by the user	TC1, TC2, TC3, TC4	EquationBalanceePanel.java	Verified	Covered
FR - 02	Mandatory	The calculator will store chemical equations which are recently balanced by the chemistry calculator application.	TC5	HistoryFrame.java	Verified	Covered

FR-03	Mandatory	Concentration refers to the amount of a substance that is present in a given volume or mass of a solution or mixture.	TC6 TC7 TC8 TC9 TC10 TC11	Concentration Panel.java	Verified	Covered
FR-04	Mandatory	The calculator shall be able to get details of atomic number, name and atomic mass and most rigorously electron configuration by entering only the symbol of a specific atom.	TC12 TC13 TC14 TC15	ElectronConfigPanel.java	Verified	Covered
FR-05	Mandatory	The calculator shall be able to calculate the molar mass of a compound entered by the user.	TC16 TC17 TC18	MolarMassPanel.java	Verified	Covered
FR-06	Mandatory	The calculator shall be able to calculate completion of each atom in a compound with their total atom(s) and atomic mass by entering a compound as input.	TC19 TC20	PercentOfCompletionPanel.java	Verified	Covered
FR-07	Should Have	The completion of each atom of a compound will be visual in a pie chart to clarify their contribution more aesthetically.	TC21	FxPieChart.java	Verified	Covered
FR-08	Should be better	The calculator shall be able to perform acid-base calculations, including the determination of molarity of acid, volume of acid, molarity of base, volume of base, number of acid moles	TC22 TC23	TitrationPanel.java	Verified	Covered

		and number of base moles. Here users have to input any five values from these six criterias and will get the correct value of the unknown sixth criteria.				
FR-09	Mandatory	The calculator shall provide instructions to help the users to conduct it. There each module will have distinct steps along with proper examples to input by users.	TC24	NeedHelpPanel.java	Verified	Covered
Non Functional						
NFR - 01	Mandatory	The user interface shall be user-friendly and intuitive, with clear labels and instructions.	TC25		Verified	Covered
NFR - 02	Mandatory	The calculator shall be able to perform calculations quickly and efficiently, without noticeable delay.	TC26 TC27		Verified	Covered
NFR - 03	Mandatory	The calculator shall provide accurate results, with a maximum error of 0.1%.	TC29		Verified	Covered
NFR - 04	Mandatory	The calculator shall be secure, with appropriate measures in place to protect user data and prevent unauthorised access. Users must not access to change atom/other criterias default values.	TC28		Verified	Covered