ETERNITY: NUMBERS
User Stories, Traceability Matrix and
Implementation of the User Stories

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Project repository (Git-Hub):
https://github.com/samir-anghan/SOEN-6481

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Abstract

This document is a part of project report on the problem domain model Calculator System. Domain is a calculator that computes the value of certain established irrational numbers. The purpose of the project is to carry out a number of activities, resulting in a set of inter-related artifacts for the problem domain of such a calculator.

In this document, the user stories for calculator system has been described. Each user story is associated with a priority, estimate (in story points), as well as with one or more acceptance tests. The document also describes backward traceability matrix for each user story. The document also provides information on the Java implementations of the selected representative user stories.

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Chapter 1

User stories for calculator system

1.1 Acknowledgement and Conventions

1. **User story statement:** Following structure is used to build up user story statement:

   As a **[Role]**, I would like to ... **[Goal]**, so that I can ... **[Value]**.

2. **Priority:** The prioritization of user stories is done using MoSCoW prioritization scheme [1]. Each user story is assign a category of MoSCoW considering:

   - The importance to stakeholders
   - The frequency of use
   - The order of use

3. **Estimated Story Points:** The story points of user stories are expressed in a pseudo-Fibonacci Sequence (0, 1/2, 1, 2, 3, 5, 8, 13, ... Infinity) [2].

4. **Sizing:** Sizing is done using the **hour based estimation** and considering:

   - The amount of work to do
   - The complexity of the work
   - The time need to implement

1.2 User stories for calculator system

User Story 1	
Id	US1
User Story Statement	As a mathematician, I would like to calculate the value of the silver ratio number up to given certain decimal places, so that I can see what the number is up to certain decimal places.
Acceptance Criteria	Given that I need to calculate the value of silver ratio number having 10 digits after the decimal point, When I perform an operation by providing 10 as a number of digits I want after the decimal point, I should see 2.4142135623 as an answer.
Priority	Must have
Constraint-1	The supplied **number of decimal places must be greater than zero.**
Constraint-2	The decimal expansion of an calculated irrational number **must never repeat**.
Constraint-3	All the numbers after decimal point in the calculated value of the silver ratio number **must be correct in a manner that the correct value of silver ratio up to 15 decimal places is 2.414213562373095**.
Estimated Story Points	5

User Story 2	
Id	US2
User Story Statement	As a mathematician, I would like to calculate an area of a regular octagon with given side length, so that I can see what the area is for a given side length.
Acceptance Criteria	Given that I need to calculate an area of a regular octagon with a side length of 8, When I perform an operation by providing 8 as a side length of an octagon, Then I should see 309.02 as an answer.
Priority	Must have
Constraint-1	The supplied **side length number must be greater than zero.**
Constraint-2	The expression to calculate an area of a regular octagon **must use the number 2.4142135623 as a value of the silver ratio number**, which has **exactly 10 digits after the decimal point**.
Estimated Story Points	3

User Story 3	
Id	US3
User Story Statement	As a mathematician, I would like to store a evaluated value of the expression in memory, so that I can use it later.
Acceptance Criteria	Given that I have already evaluated an expression and I want to save an intermediate result in memory for later use, When I press "M in" key, Then the value of evaluated expression should be stored in memory, And the status bar on the display should show "M" as memory indicator, And the calculator should allow me to do the next operation.
Priority	Must have
Constraint	**Only one result at a time can be stored** in memory, storing another result in memory while there is already stored value in memory, **must overwrite the previous result with new result**.
Estimated Story Points	5

User Story 4	
Id	US4
User Story Statement	As a mathematician, I would like to evaluate an irrational algebraic expression, so that I can see what the evaluated result is.
Acceptance Criteria	Given that I have $\sqrt{\delta s + 4}$ as an irrational algebraic expression, When I evaluate the expression, Then I should see the result as 2.101003.
Priority	Should have
Constraint-1	**If supplied irrational algebraic expression contains one or more arithmetic operators**, then an irrational algebraic expression **must contain at least two operands**.
Constraint-2	**If supplied irrational algebraic expression contains one or more opening parenthesis**, then an irrational algebraic expression **must contain the same number of closing parenthesis**.
Constraint-3	**If supplied irrational algebraic expression has the silver ratio as an operand**, it must use the number 2.4142135623 as a value of the silver ratio number, which has **exactly 10 digits after the decimal point**.
Estimated Story Points	5

User Story 5	
Id	US4
User Story Statement	As a mathematician, I would like to evaluate an irrational arithmetic expression, so that I can see what the evaluated result is.
Acceptance Criteria-1	Given that I have $(\delta s + 4)/100 * 3$ as an irrational arithmetic expression, When I evaluate the expression, Then I should see the result as 0.1924264068.
Acceptance Criteria-2	Given that I have two numbers 5 and the silver ratio number δs, When I perform addition on them, Then I should see the sum as 7.4142135623.
Acceptance Criteria-3	Given that I have two numbers 2 and the silver ratio number δs, When I subtract 2 from the silver ratio number δs, Then I should see the difference as 0.4142135623.
Acceptance Criteria-4	Given that I have two numbers 5 and the silver ratio number δs, When I multiply 5 with the silver ratio number δs, Then I should see the product as 12.0710678115.
Acceptance Criteria-5	Given that I have two numbers 0 and the silver ratio number δs, When I multiply 0 with the silver ratio number δs, Then I should see the product as 0.
Acceptance Criteria-6	Given that I have two numbers 1 and the silver ratio number δs, When I multiply 1 with the silver ratio number δs, Then I should see the product as 2.4142135623 which is the same as the silver ratio number δs.
Acceptance Criteria-7	Given that I have two numbers 10 and the silver ratio number δs, When I divide 10 by the silver ratio number δs, Then I should see the quotient as 4.14213562386.
Acceptance Criteria-8	Given that I have two numbers 0 and the silver ratio number δs, When I divide 0 by the silver ratio number δs, Then I should see the quotient as 0.
Acceptance Criteria-9	Given that I have two numbers the silver ratio number δs and 0, When I divide the silver ratio number δs by 0, Then I should see the quotient as infinity.
Priority	Must have
Constraint-1	**If supplied irrational arithmetic expression contains one or more arithmetic operators**, then an irrational arithmetic expression **must contain at least two operands.**
Constraint-2	**If supplied irrational arithmetic expression contains one or more opening parenthesis**, then an irrational arithmetic expression **must contain the same number of closing parenthesis.**
Constraint-3	**If an irrational arithmetic expression has the silver ratio as an operand**, it must use the number 2.4142135623 as a value of the silver ratio number, which has **exactly 10 digits after the decimal point**.
Estimated Story Points	5

User Story 6	
Id	US6
User Story Statement	As a mathematician, I would like to verify that ratio between given two numbers is the silver ratio or not, so that I can confirm that both the given numbers are consecutive numbers from the Pell number sequence or not.
Acceptance Criteria-1	Given that I have two numbers $n1 = 29$ and $n2 = 12$, When I evaluate using both the numbers $n1$ and $n2$, Then I should see the resulting message as "Pell Numbers".
Acceptance Criteria-2	Given that I have two numbers $n1 = 45$ and $n2 = 5$, When I evaluate using both the numbers $n1$ and $n2$, Then I should see the resulting message as "Not Pell Numbers".
Priority	Could have
Constraint	Let's say $n1$ and $n2$ are given two numbers where $n1 > n2$. The ratio $n1/n2$ of both the numbers is silver ratio **if and only if** it equals to the ratio of the sum of the smaller number $n1$ and twice the larger number $n2$ to the larger number $n2$. So, $n1/n2$ is the silver ratio if: $$\frac{n1}{n2} = \frac{2n1 + n2}{n1}$$
Estimated Story Points	3

Chapter 2

Backward traceability matrix for calculator system

2.1   Backward traceability matrix for calculator system

User Story Identifiers	Use case-1	Use case-2	Use case-3	Use case-4	Use case-5	Use case-7
US1		X				
US2					X	
US3						X
US4			X			
US5				X		
US6	X					

Table 2.1: Backward Traceability Matrix

Target artifacts: User stories.
Source artifacts:

    Use case-1: Evaluate Expression
    Use case-2: Evaluate Irrational Number Value
    Use case-3: Evaluate Irrational Algebraic Expression
    Use case-4: Evaluate Irrational Arithmetic Expression
    Use case-5: Evaluate Area of Regular Octagon Expression
    Use case-7: Save Value of Evaluated Expression

Chapter 3

Implementation of user stories

3.1 Implemented user stories

The following table gives information on implemented user stories:

User Story Identifiers	User Story Statement	Relevant Domain
US1	As a mathematician, I would like to calculate the value of the silver ratio number up to given certain decimal places, so that I can see what the number is up to certain decimal places.	Silver Ratio Number
US2	As a mathematician, I would like to calculate an area of a regular octagon with given side length, so that I can see what the area is for a given side length.	Silver Ratio Number Application
US3	As a mathematician, I would like to store an evaluated value of the expression in memory, so that I can use it later.	Calculator
US4	As a mathematician, I would like to evaluate an irrational arithmetic expression, so that I can see what the evaluated result is.	Calculator

Table 3.1: Implemented User Stories

3.2 Repository URL

https://github.com/samir-anghan/SOEN-6481

3.3 Repository folders structure

The following table gives information on repository folder structure:

Parent Folders	Contains
DELIVERABLE 1 (D1)	DELIVERABLE 1 Submission Package.
DELIVERABLE 2 (D2)	DELIVERABLE 2 Submission Package.
Java Code	Java code for implemented user stories along with Eclipse project file and project structure.
PROBLEM 1 to PROBLEM 9	PROBLEM 1 to 9 related files.

Table 3.2: Github Repository Folder Structure

3.4 Computation for the value of Silver Ratio

The following Java function is implemented to compute the value of Silver Ratio:

```java
// SilverRatioNumber.java
// Computes the value of Silver Ratio using recursion
private double computeSilverRatio(int n) {
  if (n == 0)
    return 1;
  return 2.0 + 1.0 / computeSilverRatio(n - 1);
}
```

Bibliography

[1] W. Foundation, "Moscow method," July 2019. [Online; accessed 27-July-2019].

[2] W. Foundation, "Fibonacci number," July 2019. [Online; accessed 27-July-2019].