Concordia University

Deliverable 2

ETERNITY:NUMBERS

(Gaussian Integral)

Author:
Ankur Aggarwal

Supervisor:
Prof. Pankaj Kamthan

August 3, 2019

Contents

List of Figures

List of Tables

Acknowledgement

Ankur Aggarwal

August, 2019

The success and final outcome of this project required a lot of guidance and assistance from many people and I am extremely privileged to have got this all along the completion of my project. All that I have done is only due to such supervision and assistance and I would not forget to thank them.I respect and thank Prof. Pankaj Kamthan, for providing me an opportunity to do the project work and giving us all support and guidance which made me complete the project duly. I am extremely thankful to him for providing such a nice support and guidance, although he had busy schedule managing the corporate affairs.I owe my deep gratitude to our project guide Teaching Assistents , who took keen interest on our project work and guided us all along, till the completion of our project work by providing all the necessary information for developing a good system.I would not forget to remember my team members, for their encouragement and more over for their timely support and guidance till the completion of our project work. I am thankful to and fortunate enough to get constant encouragement, support and guidance from all Teaching staffs of [Department name] which helped us in successfully completing our project work. Also, I would like to extend our sincere esteems to all staff in laboratory for their timely support.

Ankur Aggarwal

Abstract

Ankur Aggarwal

July 2019

The project deals with creating the calculator which will calculate the Eternity:Number and use it in the real time application of the number .In this project the calculator will have all the basic functanality with the additional scope added to it

1 Distributed Version Control System Used

The distributed version control system used for this project is Github . I have been uploading my project various parts at various stages on github. the link for my github for this project is :-
`https://github.com/ankur27aggarwal/SOEN6481.git`

2 Criteria for the selection of the user stories for ETERNITY:NUMBERS

2.1 What are a User Stories :-

User stories are short, simple descriptions of a feature told from the perspective of the person who desires the new capability, usually a user or customer of the system. They typically follow a simple template.User stories are often written on index cards or sticky notes, stored in a shoe box, and arranged on walls or tables to facilitate planning and discussion. As such, they strongly shift the focus from writing about features to discussing them. In fact, these discussions are more important than whatever text is written.
User stories are written throughout the agile project. Usually a story-writing workshop is held near the start of the agile project. Everyone on the team participates with the goal of creating a product backlog that fully describes the functionality to be added over the course of the project or a three- to six-month release cycle within it.

2.2 User Stories for the Eternity:Number calculator :-

The user stories for the Eternity:Number calculator will be based on the persona and the use case diagram submitted in the Problem 3 and Problem 5 in delevierable 1 .The user stories will have the 6 key points : 1 :- Identifier
2 :- User story Statement
3 :- constraint
4 :- Acceptance criteria
5 :- Priority
6 :- Estimate

2.3 User Stories Estimate calculation :-

The fibonacci sequence is used for story point estimates – 1, 2, 3, 5, 8, 13, 21, and so on. Team use this sequence, rather than a linear 1 – 10 as it forces them to provide a relative estimate. Easier to ask 'is that a 5 or an 8?' than 'is that a 6 or a 7?'.
In the case of our we are taking 1 as the highest and followed by other numbers in ascending order .

2.4 User Cases from Previous delevierable:-

The different use cases used in the last delevierable are as followed ;-
1 . Calculator
2 . Eternity Number Operation
3 . Arithmetic Operation
4 . Command
5 . Interpreter
6 . Stack
7 . Calculator
8 . Accept
9 . Pixel Adjuster
10 . Signal Normalizer

User story -1

Identifier :- Gaussian integral (User story 1)

User story Statement :- As a user , I want the value of Gussian Inegral to be returned , so that I can use it to for further computations.

Acceptance criteria :-
1 Integral of the Gaussian function e^{-x^2} should be over the entire real line .
2 Value from user should be with in specified range

Acceptance Test :-
Given :- User defined the value of x in the Gaussian function e^{-x^2} over the entire real line .
When :- Value from user is taken as input
Then :- Integral of the Gaussian function is returned .(Pass)

Atomic :-
1. Before :- Ask for the power of e .
2. After :- Return its integral over the limit of $(-\infty to \infty)$

Quality Attribute :- Usability ,Maintainabilty ,Performance ,Reliability

---

Constraint :- As user must enter the power of exponential .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a polynomial expresion .

Priority :- high

Estimate :- 2

User story -2

Identifier :- storage (User story 2)

User story Statement :- As a user , I want the value of Gussian Inegral to be stored as history, so that I can use it to for appropriate approximation in computations and for future look ups .

Acceptance criteria :-
1 There should be previous values stored
2 There should be atleast 5 values

Acceptance Test :-
Given :- User asked for the previous value .
When :- To compute multiple operation (example :- Factorial)
Then :- Previous values according to the location asked is returned .(Pass)

Atomic :-
1. Before :- Value at location checked is either 0 or any variable .
2. After :- Value at location checked is changed by the user .

Quality Attribute :- Security ,Usability ,Maintainabilty ,Performance , Reliability

---

Constraint :- As user must ask for the location .

Implementable :- yes

---

validatable:- There should not be a space out of bound error.

---

verifiable :- Return the value asked at a location enterd by user .

Priority :- high

Estimate :- 3

User story -3

Identifier :- arithmetic no (User story 3)

User story Statement :- As a global constant , I want calculator to perform the basic arithmetic caalculations , so that I can use it to for computations.

Acceptance criteria :-
1 There should be basic arithmetic calculation
2 There should be (+,-,/) operations

Acceptance Test :-
Given :- User asked for the basic calculation .
When :- To compute simple operation (example :- Addition)
Then :- Return value according to the operation .(Pass)

Atomic :-
1. Before :- Ask for the two numbers .
2. After :- Return the value of operations performed on two numbers

---

Quality Attribute :- Usability ,Maintainabilty ,Performance ,Reliability

---

Constraint :- As user must enter the real numbers only .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a irrational number .

Priority :- high

Estimate :- 5

User story -4

Identifier :- decimal point (User story 4)

User story Statement :- As a user , I want the value of Gussian Inegral to be returned upto 3 digit of decimal places, so that I can use it to for appropriate approximation in computations.

Acceptance criteria :-
1 After decimal there should be atleast three number of digits

---

Acceptance Test :-
Given :- User asked for the division operation .
When :- For the division of number having denominator larger then numerator (example :- Factorial)
Then :- Value returned in float type variable .(Pass)

Atomic :-
1. Before :- Ask for the two numbers .
2. After :- Return the value of operations performed on two numbers

---

Quality Attribute :- Compatibility , Security ,Usability ,Maintainabilty ,Performance ,Portability , Reliability

---

Constraint :- As user must enter the real numbers only

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a irrational number .

Priority :- Medium

Estimate :- 8

User story -5

Identifier :- polynmomial expression (User story 5)

User story Statement :- As from other Articulation , I want the value of Gussian Inegral's exponential power in the form of polynomial expression to be solved by calculator , so that I can use it to for easy computations.

Acceptance criteria :-
1 Value that should make whole expression in the form of $(a+b)^2$
2 Value which should be taken as constant out of integral

Acceptance Test :-
Given :- User asked for the roots of quadratic equation .
When :- A polynomial expresion is given as a power of exponential function
Then :- Roots of the equation should be returned .(Pass)

Atomic :-
1. Before :- Ask for the polynomial expression .
2. After :- Return roots of the polynomial expresion .

Quality Attribute :- Compatibility ,Usability ,Maintainabilty ,Performance ,Reliability

---

Constraint :- Must be a polynomial expression .

Implementable :- yes

---

validatable:- Must have the roots to the equation .

---

verifiable :- Must be a polynomial expression .

Priority :- Very low

Estimate :- 13

User story -6

Identifier :- scititific calculation (User story 6)

User story Statement :- From polynomial extression , I want the calculator to solve problems in science, engineering, and mathematics. , so that I can use it to for extended application calculation .

Acceptance criteria :-
1 For Calculation of sin
2 For Calculation of Cosine
3 For Engineering calculations

Acceptance Test :-
Given :- User asked for the integration .
When :- To compute gaussian integral (example :- Factorial)
Then :- Return value of function after integration .(Pass)

Atomic :-
1. Before :- can ask for any number
2. After :- Return value after performing specific operation

Quality Attribute :- Usability ,Maintainabilty ,Performance ,Reliability

---

Constraint :- As user must enter the operation to perform .

Implementable :- yes

---

validatable:- Values must be in the range of operation and memory .

---

verifiable :- Must not give error of space outofbound or wrong input .

Priority :- Medium

Estimate :- 21

User story -7

Identifier :- undo operation (User story 7)

User story Statement :- As a user , I want the calculator to have undo operation, so that I can use it to reset the storage.

Acceptance criteria :-
1 Must make the latest or selected value 0 and rewrite it .

Acceptance Test :-
Given :- User asked to undo the value input .
When :- There is mistake or wrong value entered
Then :- Make the value at selected location interchanged with new value entered .(Pass)

Atomic :-
1. Before :- Location in the storage with value ”a” (a can be any value from user).
2. After :-Same location in the storage with value ”0” or ”b” (b can be any value from user).

Quality Attribute :- Security ,Usability ,Maintainabilty , Reliability .

Constraint :- As user must enter the location to check .

Implementable :- yes

---

validatable:- Must change the value at a location .

---

verifiable :- value before and after change .

Priority :- Medium

Estimate :- 34

User story -8

Identifier :- Interpreter (User story 8)

User story Statement :- As a user , I want the calculator to have interpreter , so that I can use it to access specific value in the storage.

Acceptance criteria :-
1 Must return the selected value or the location of selected value .

Acceptance Test :-
Given :- User asked for the location of the value .
When :- To update the value .
Then :- Return the location of the value .(Pass)

Atomic :-
1. Before :- Ask for the value location.
2. After :- Return the location .

Quality Attribute :- Security ,Usability ,Maintainabilty ,Performance ,Portability , Reliability

---

Constraint :- As user must enter the value that occupy location in storage .

Implementable :- yes

---

validatable:- Must ask for stored value .

---

verifiable :- Return illeagal operation if ask for not stored value.

Priority :- Medium

Estimate :- 55

User story -9

Identifier :- Pixel adjuster (User story 9)

User story Statement :- As a user , I want the calculator to normalize the given value of pixel , so that I can use it to render the object .

Acceptance criteria :-
1 There should be Average of value of pixel having value 1 for the selected region to make the edges round in image

---

Acceptance Test :-
Given :- User asked for the normaliztion of pixels in specified range .
When :- To round the sharp edged image (example :- old Mario game)
Then :- Normalized value of the region is generated .(Pass)

Atomic :-
1. Before :- Ask for the power of e .
2. After :- Return its integral over the limit of $(-\infty to \infty)$

Quality Attribute :- Usability ,Maintainabilty ,Performance , Reliability

---

Constraint :- As user must enter the power of exponential .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a polynomial expresion .

Priority :- Medium

Estimate :- 89

User story -10

Identifier :- Signal normalizer (User story 10)

User story Statement :- As a user , I want the calculator to normalize the signal distribution , so that I can use the normalized value to plot the sine and cosine graph.

Acceptance criteria :-
1 There should be Average value of signals having value (1,0,-1) for the selected range to make the sine wave form to send the signals

---

Acceptance Test :-
Given :- User asked for the normaliztion of signal bites in specified range .
When :- To send the electronic signal from one place to another (example :- sending communication signal)
Then :- Normalized value of the region is generated .(Pass)

Atomic :-
1. Before :- Ask for the power of e .
2. After :- Return its integral over the limit of $(-\infty to \infty)$

Quality Attribute :- Usability ,Maintainabilty ,Performance ,Portability , Reliability

---

Constraint :- As user must enter the power of exponential .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a polynomial expression .

Priority :- Medium

Efficiency 144

User story -11

Identifier :- mean (User story 11)

User story Statement :- From the application pixel adjuster and signal normalizer , I want the calculator to calculate mean , so that I can use it to normalize data.

Acceptance criteria :-
1 Number should be in range
2 Average of the range

Acceptance Test :-
Given :- User asked for the average over the range.
When :- To find the deviation from the average .
Then :- Generate the average of the given numbers . (Pass)

Atomic :-
1. Before :- Ask for the range of number .
2. After :- User input the series of number

Quality Attribute :- Compatibility , Security ,Usability ,Maintainabilty ,Performance ,Portability , Reliability

---

Constraint :- As user must enter the numbers with in specified range .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a polynomial expresion .

Priority :- High

Estimate :- 233

User story -12

Identifier :- Error function (User story 12)

User story Statement :- As a user , I want the calculator to calculate error function for finite limits of integral , so that I can use it for vector computations .

Acceptance criteria :-
1 There should be random variable Y that is normally distributed with mean 0 and variance 0.5

Acceptance Test :-
Given :- User asked for the probability of error with in specified range .
When :- To find the boundary conditions .
Then :- Calculate gaussian integral with the definite value of limits.(Pass)

Atomic :-
1. Before :- Ask for the value of π .
2. After :- Input Value of π from the user

Quality Attribute :- Compatibility , Security ,Usability ,Maintainabilty ,Performance ,Portability , Reliability

---

Constraint :- As user must enter the power of exponential .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a polynomial expresion .

Priority :- Medium

Estimate :- 377

User story -13

Identifier :- Integral (User story 13)

User story Statement :-From the application pixel adjuster and signal normalizer , I want the calculator to calculate integration of finite , so that I can use it to compute further data .

Acceptance criteria :-
1 There should be basic rules of Integration
2 There should be definite or indefinite integrals .

Acceptance Test :-
Given :- User asked for the Gaussian integral
When :- To find the value for error function .
Then :- Integrate over the specified limits . (Pass)

Atomic :-
1. Before :- Ask for the power of e .
2. After :- Return its integral over the limit of $(-\infty to \infty)$

Quality Attribute :- Compatibility , Security ,Usability ,Maintainabilty ,Performance ,Portability , Reliability

---

Constraint :- As user must enter the power of exponential .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a polynomial expresion .

Priority :- Medium

Estimate :- 610

User story -14

Identifier :- Variance (User story 14)

User story Statement :-From the error function use case

Acceptance criteria :-
1 There should be Square of user given mean
2 Value should be in range

Acceptance Test :-
Given :- User ask variation of variable from mean of given numbers with in range
When :- To find the probability ratio to on and off the pixel in pixel adjuster
Then :- Return the squared deviation of a variable from its mean (Pass)

Atomic :-
1. Before :- Ask for the numbers .
2. After :- Return squared deviation of a random variable from its mean.

Quality Attribute :- Compatibility , Security ,Usability ,Maintainabilty ,Performance ,Portability , Reliability

---

Constraint :- As user must enter the numbers .

Implementable :- yes

---

validatable:- Must be over the real number line .

---

verifiable :- Must not be a polynomial expression .

Priority Low

Estimate :- 1597

3 Backward traceability matrix for Gaussian Integral

3.1 What is tracebility mstrix :-

A Traceability Matrix is a document that co-relates any two-baseline documents that require a many-to-many relationship to check the completeness of the relationship. It is used to track the requirements and to check the current project requirements are met. Requirement Traceability Matrix or RTM captures all requirements proposed by the client or software development team and their traceability in a single document delivered at the conclusion of the life-cycle.
In other words, it is a document that maps and traces user requirement with test cases. The main purpose of Requirement Traceability Matrix is to see that all test cases are covered so that no functionality should miss while doing Software testing.

3.2 Types of Traceability Test Matrix:-

In Software Engineering, traceability matrix can be divided into three major component as mentioned below: **Forward traceability:**This matrix is used to check whether the project progresses in the desired direction and for the right product. It makes sure that each requirement is applied to the product and that each requirement is tested thoroughly. It maps requirements to test cases. **Backward or reverse traceability:** It is used to ensure whether the current product remains on the right track. The purpose behind this type of traceability is to verify that we are not expanding the scope of the project by adding code, design elements, test or other work that is not specified in the requirements. It maps test cases to requirements. **Bi-directional traceability (Forward+Backward):** This traceability matrix ensures that all requirements are covered by test cases. It analyzes the impact of a change in requirements affected by the Defect in a work product and vice versa.

3.3 Backward traceability matrix for Gaussian Integral and abbreviation used in it :-

Abbreviation for the Bussiness Reqirement(Identifires)

Gaussian integral :- User story 1
storage :- User story 2
arithmetic no :- User story 3
decimal point :- User story 4
polynmomial expression :- User story 5
scititific calculation :- User story 6
undo operation :- User story 7
Interpreter :- User story 8
Pixel adjuster :- User story 9
Signal normalizer :- User story 10
mean :- User story 11
Error function :- User story 12
Integral :- User story 13
variance :- User story 14

Abbreviation for the Use Cases

Calculator :- C
Eternity Number Operation :- ETN
Arithmetic Operation :- AO
Command :- CO
Interpreter :- IN
Stack :- ST
Calculator :- CA
Accept :- AC
Pixel Adjuster :- PA
Signal Normalizer :- SN

Other Abbreviation used

Business Requirement :- BR
Use Case :- UC
Persona :- PE
Survey :- SU
Global :- GL
Application :- APP
User Stories :- US
Interviewee :- IN
Articulation :- AR
Domain Model :- DO

Note:- Business Requirement include Use Case Persona Survey Global Application User Stories Interviewee Articulation

Note :- In backward traceability matrix '*' means it was deduced from that requirement .

User Story	PE	AR	SU	GL	APP	UC	US	IN	DO
User story 1	*				*	ETN		*	*
User story 2	*					ST		*	*
User story 3	*	*		*		AO		*	*
User story 4	*							*	*
User story 5		*							
User story 6		*		*					
User story 7	*					ST	User story 10,9	*	*
User story 8		*				IN			*
User story 9	*					PA		*	*
User story 10	*					SN		*	*
User story 11					*		User story 10,9		
User story 12					*		User story 10,9		
User story 13					*		User story 10,9		
User story 14					*		User story 10,9		

Table 1: Backward traceability matrix for the Guassian Integral Calculator

4 Implementation of the User Stories

4.1 Programing language used for implementation

Programing language used for implementation of the user stories is in java .Implementation includes the junit test cases and the coding of the three main user stories .
subsection User stories implemented :-
User stories implemented are as followed :-
(1) specific to the calculator's domain (arithmetic no)
(2) specific to the number assigned (Gaussian integral)
(3) specific to an application area of the number assigned (error function)

4.2 Reason for the implementation of the Error Function as the application of the gussian integral

Error fuction was the common application specified by the both interviewee and was also one of the important factor for calculating there other functions end value . also it uses the gussian integral for normalization .

Something about error function :- It is often the case that the Gaussian integral needs to be evaluated across the real line. However, many other applications, such as in diffusion and statistics, require a more general relationship. Because the Gaussian function does not have an antiderivative that can be written in terms of elementary functions, we define the error function $\operatorname{erf}(x)\operatorname{erf}(x)$as the antiderivative of the Gaussian. It is a special function conventionally defined with a normalization factor ensuring a range of$x \in (-1, 1).x \in (-1, 1)$. It has a sigmoid shape similar in form to the logistic function.

4.3 Where is code ;-

Code of the calculator is included in the package submitted and also put on the github link :-$https://github.com/ankur27aggarwal/SOEN6481.git$

5 Biblography

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